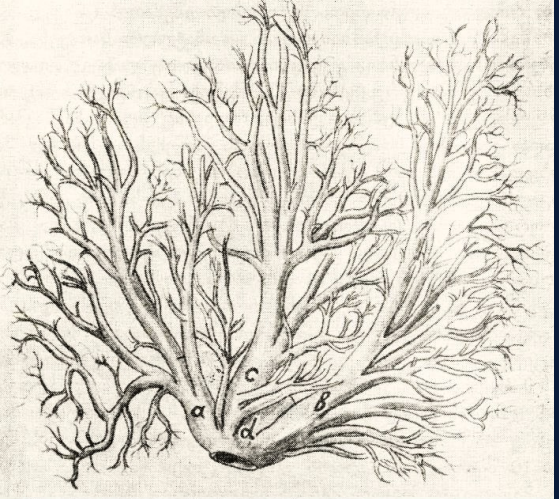
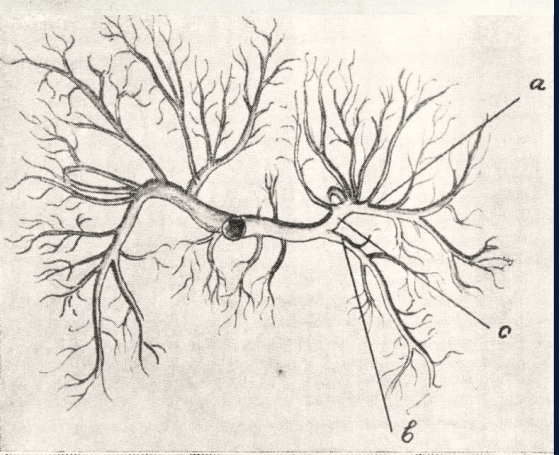
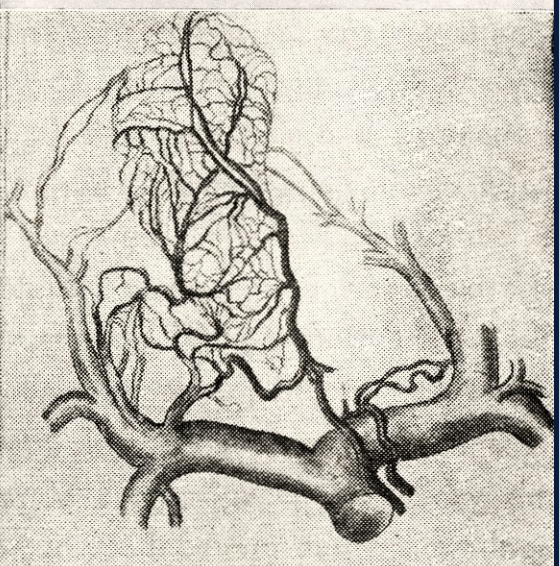






შამშე ქევანიშვილი

ღვიძლის სისხლძარღვების ქირურგიული ანატომია

ინგლისურ ენაზე თარგმანის ავტორი:
გიგი გორგაძე

თარგმანის რედაქტორი:
მედიცინის აკადემიური დოქტორი
თამარ თურმანიძე

SHAMSHE KEVANISHVILI

SURGICAL ANATOMY OF LIVER VESSELS

ENGLISH TRANSLATION BY
GIGI GORGADZE

შამშე ქევანიშვილი

ღვიძლის სისხლძარღვების ქირურგიული ანატომია

გამომცემლობა
„საბჭოთა საქართველო“
თბილისი – 1969

საქართველოს მეცნიერებათა ეროვნული
აკადემიის გამომცემლობა
თბილისი – 2024

ღვიძლის სისხლძარღვების ქირურგიული ანატომია
თარგმანი ინგლისურ ენაზე

ნაშრომი ხაზს უსვამს ღვიძლისა და ნაღვლის ბუშტის ფორმისა და პოზიციის ვარიაბელობას, ასევე, დატოტიანების თავისებურებებსა და კარისა და ღვიძლის ვენების ურთიერთგანლაგებას ინტრაორგანული ძარღვების დატოტიანების მიხედვით, ღვიძლი დაყოფილია სეგმენტებად.

ნაშრომში მოწოდებულია ორიგინალური განაკვეთები ღვიძლზე, შემუშავებული სისხლდენის პრევენციისა და ღვიძლში სისხლის ნორმალური მიმოქცევის შესანარჩუნებლად.

ნაშრომი საინტერესოა როგორც მორფოლოგების, ასევე ქირურგებისათვის. მოიცავს 44 ილუსტრაციასა და 9 ცხრილს.

თარგმანის ავტორი:

თბილისის სახელმწიფო სამედიცინო უნივერსიტეტის
მედიცინის ფაკულტეტის სტუდენტი
გიგი გორგაძე

თარგმანის რედაქტორი:

მედიცინის აკადემიური დოქტორი, თბილისის სახელმწიფო სამედიცინო უნივერსიტეტის კლინიკური ანატომიისა და ოპერაციული ქირურგიის დეპარტამენტის ასოცირებული პროფესორი
თამარ თურმანიძე

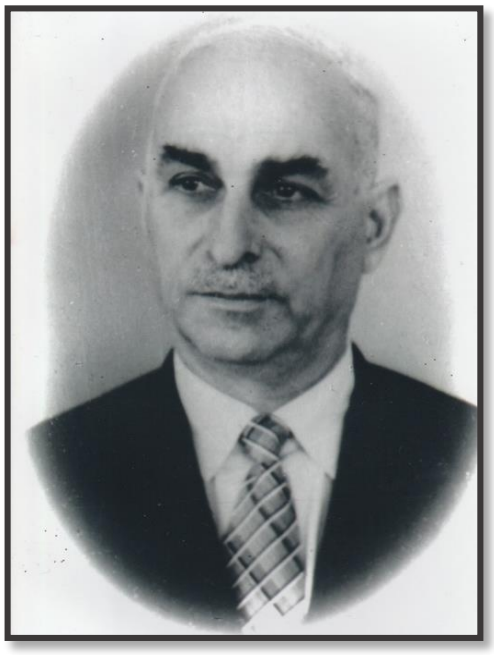
თარგმანის რეცენზენტები:

მედიცინის მეცნიერებათა დოქტორი, პროფესორი
მერაბ სარელი (იზრაელაშვილი)

მედიცინის მეცნიერებათა დოქტორი, პროფესორი
დიმიტრი კორძაია

ISBN 978-9941-8-7323-2

პროფესორი შამშე ქევანიშვილი
1907–1986



ქართული სამედიცინო ინტელიგენციის თვალსაჩინო წარმომადგენელი, პროფესორი შამშე ქევანიშვილი დაიბადა 1907 წლის 9 მაისს ღარიბი გლეხის ოჯახში, ამბროლაურის რაიონის სოფელ თლუღში. 1926 წელს დაამთავრა საშუალო სკოლა ქ. ქუთაისში. სკოლის დამთავრების შემდეგ ერთი წელი ქ. ჭიათურაში მუშაობდა მუშად.

1933 წელს დაამთავრა თბილისის სახელმწიფო სამედიცინო ინსტიტუტის სამკურნალო ფაკულტეტი. ინსტიტუტის დამთავრებისთანავე აყვანილ იქნა უფროს ლაბორანტად ოპერაციული ქირურგიისა და ტოპოგრაფიული ანატომიის კათედრაზე. 1934 წელს, საკვალიფიკაციო კომისიის გავლის შემდგომ, დაინიშნა ამავე კათედრის ასისტენტის თანამდებობაზე. პარალელურად მუშაობდა ორდინატორ-ქირურგად სასწრაფო დახმარების საავადმყოფოს ქირურგიულ განყოფილებაში.

1941 წლის 23 ივნისს მობილიზებულ იქნა საბჭოთა არმიაში, სადაც ცხენოსანთა მე-17 დივიზიის სამედიცინო ესკადრონში მუშობდა ექიმად. იმავე წლის სექტემბერში დანიშნულ იქნა 224-ე დივიზიის 44-ე სამედიცინო სანიტარული ბატალიონის წამყვან ქირურგად. 1941 წლის 26 დეკემბერს ყირიმის საზღვაო სადესანტო ოპერაციის დროს ჩავარდა ტყვედ და 1942 წლის 5 იანვრიდან იმყოფებოდა ტყვეთა საკონცენტრაციო ბანაკებში, ჯერ საბჭოთა კავშირისა და შემდგომ გერმანიის ტერიტორიებზე. 1945 წლის 3 აპრილს კაიზერშტაინბრუხის საკონცენტრაციო ბანაკის ევაკუაციისას მოახერხა გაქცევა და 4 აპრილს შეუერთდა საბჭოთა არმიის ერთ-ერთ ნაწილს. სათანადო შემოწმების შემდეგ აღდგენილ იქნა საბჭოთა არმიის რიგებში. 1945 წლის 4 ნოემბერს იქნა დემობილიზებული. 1946 წელს დაბრუნდა მშობლიურ კათედრაზე, სადაც სიცოცხლის ბოლომდე ეწეოდა ნაყოფიერ პედაგოგიურ და სამეცნიერო მუშაობას.

შამშე ქევანიშვილმა 1948 წელს წარმატებით დაიცვა საკანდიდატო დისერტაცია თემაზე: „ახალშობილის ღვიძლის ცვალებადობის უკიდურესი ფორმები“. 1958 წელს არჩეულ იქნა კათედრის დოცენტად. 1962 წელს დაიცვა სადოქტორო დისერტაცია თემაზე: „ღვიძლის სისხლძარღვების ქირურგიული ანატომია“, ხოლო 1966 წელს არჩეულ იქნა კათედრის პროფესორის თანამდებობაზე.

ბატონი შამშე,როგორც კათედრის გამგის მოადგილე სასწავლო დარგში, მრავალი წელი ხელმძღვანელობდა სასწავლო პროცესს და ახალგაზრდა თანამშრომელთა დახელოვნებას. მას დიდი წვლილი აქვს შეტანილი კათედრის კლასიკური ანატომიური მუზეუმის შექმნაში. მის მიერ დამზადებულია მრავალი სველი და კოროზიული პრეპარატი, რომლებიც დღემდე ამშვენებს კათედრის მუზეუმს.

პროფესორი შამშე ქევანიშვილი 70-ზე მეტი სამეცნიერო ნაშრომის ავტორია, მათ შორის ორი მონოგრაფიისა: „ღვიძლის სისხლძარღვთა ქირურგიული ანატომია“ (1969წ.) და „კარის ვენის გამოთიშვის შედეგები ექსპერიმენტში“ (1974წ). ამ ნაშრომებში მას მოწოდებული აქვს ღვიძლზე ორიგინალური განაკვეთები, ასევე დასაბუთებული აქვს კარის ვენის ღვიძლშიდა ტოტებს შორის ანასტომოზების განვითარების შესაძლებლობა, ერთი ან რამოდენიმე ტოტის ოკლუზიის დროს. დღეს, როდესაც ჰეპატოლოგიის დარგის მკვლევარების შრომები ფართოდ ხელმისაწვდომი გახდა, შეიძლება დადასტურებულად ითქვას, რომ პროფესორ შამშე ქევანიშვილის აღნიშნულ მიგნებას ანალოგი არ გააჩნია.

ბატონი შამშე გამორჩეული პედაგოგიური ტალანტით იყო დაჯილდოვებული. მის ლექცია-პრაქტიკულებს სტუდენტები განსაკუთრებული ინტერესით და ხალისით ესწრებოდნენ. რამდენიმეჯერ აქვს მოპოვებული სამედიცინო ინსტიტუტის საუკეთესო პედაგოგის წოდება.

მასთან ერთად და მის შემდეგ ოპერაციული ქირურგიისა და ტოპოგრაფიული ანატომიის კათედრაზე (დღეს-დეპარტამენტში) მოღვაწე ყველა პიროვნება დიდად არის დავალებული შამშე ქევანიშვილისაგან, რომელიც უშურველად უზიარებდა მათ თავის ცოდნასა და გამოცდილებას, პედაგოგიკის საიდუმლოებებს, პრეპარაციის ტექნიკას.

პროფესორი შამშე ქევანიშვილი სამეცნიერო-პედაგოგიურ მუშაობასთან ერთად აქტიურად იყო ჩართული საზოგადოებრივ მუშაობაში, იგი 1930-34 წლებში თბილისის საქალაქო საბჭოს დეპუტატი იყო. 1963-65 წლებში მედიცინის მუშაკთა კავშირის რესპუბლიკური კომიტეტის პრეზიდიუმის წევრი.

პროფესორი შამშე ქევანიშვილი საფუძვლიანად ითვლება საქართველოში ღვიძლის ქირურგიული მორფოლოგიისა და ექსპერიმენტული ქირურგიის ფუძემდებლად. მან გასული საუკუნის 50-იან წლებში მსოფლიოში ცნობილ ფრანგ მკვლევართან, კლოდ კუინოსთან თანადროულად და მისგან სავსებით დამოუკიდებლად შეასრულა ფუნდამენტური კვლევა ღვიძლის გარეგნული ფორმისა და ორგანოსშიგა მოწყობილობის შესწავლის მიზნით.

აღნიშნული კვლევის შედეგებმა თავისი განზომილება ჰპოვა ნაშრომში „ღვიძლის სისხლძარღვთა ქირურგიული ანატომია“, რომელიც გამომცემლობა „საბჭოთა საქართველომ“ 1969 წელს ქართულ ენაზე გამოსცა მონოგრაფიის სახით.

ბუნებრივია, ჩემს მიზანს არ წარმოადგენს აღნიშნული ნაშრომის რეცენზირება - ეს გაკეთდა დიდი ხნის წინ და დიდი წარმატებითაც. მე მსურს, გამოვეხმაურო ინიციატივას, რომლის მეშვეობითაც აღნიშნული ნაშრომი (მონოგრაფია) ითარგმნა მაღალი ხარისხის ინგლისურ ენაზე და ამით მას მეორე სიცოცხლე მიენიჭა.

მაინც რა არის საშური ამ წამოწყებაში:

- ნაშრომის ინგლისური ვერსია უწევს პოპულარიზაციას ქართველი მეცნიერის ნააზრევსა და ნამოღვაწარს;
- იგი გვაბრუნებს გასული საუკუნის 50-იან წლებში და უცხოელი მეცნიერებისათვის ნათელს ხდის იმ სამეცნიერო-კვლევით მოძრაობას, რომელსაც ადგილი ჰქონდა საქართველოს ანატომიური თეატრის სივრცეში იმხანად;
- უცხოელი მკვლევარებისათვის ნათელჰყოფს კვლევის იმ მდიდარ მეთოდურ შესაძლებლობებს (ანატომიური პრეპარირება, კოროზიული პრეპარატების მომზადება, რენტგენო-ვაზოგრაფია, ბინოკულარული მიკროსკოპის ქვეშ პრეპარირება და სხვ.), რომლითაც უკვე მაშინ იყვნენ შეიარაღებულნი ქართველი მორფოლოგები;
- დაბოლოს, შ.ქევანიშვილის მონოგრაფია „ღვიძლის სისხლძარღვების ქირურგიული ანატომია“ თითქმის უკვე საუკუნეა, დამხმარე სახელმძღვანელოს როლს ასრულებს ქართველი მედიკოსი სტუდენტებისათვის. დარწმუნებული ვარ, მისი ინგლისური ვარიანტი ასევე დიდ სამსახურს გაუწევს უცხოელ სტუდენტებსა და ახალგაზრდა ექიმებს მედიცინის იმ დარგის ათვისებაში, რომელსაც ღვიძლის ქირურგიული ანატომია და ანატომიური ქირურგია ჰქვია.

ამასთან დაკავშირებით, მინდა გავიხსენო იაპონელთა ხალხური გამონათქვამი: „თუ გინდა ერთი წლით გაგიხსენონ, დათესე პურის თავთავი, თუ გინდა ათეულობით წლები ახსოვდეთ, დარგე ხე, თუ გინდა სამარადისო ხსოვნა დაიმკვიდრო - დაწერე სახელმძღვანელო, რომელზეც თაობები გაიზრდებიან.“

რა საშურ მინიშნებასთან გვაქვს საქმე...

მედიცინის მეცნიერებათა დოქტორი, პროფესორი
მერაბ სარელი (იზრაელაშვილი)
ისრაელის ხ. შიბას სამედიცინო ცენტრის წამყვანი სპეციალისტი
საქართველოს მეცნიერებათა ეროვნული აკადემიის უცხოელი წევრი
საპატიო თბილისელი
საქართველოს ებრაელთა მსოფლიო კონგრესის თავმჯომარე

ახალგაზრადა მკვლევარმა, გიგი გორგაძემ რომელიც ჯერ კიდევ სწავლობს დიპლომირებული მედიკოსის ერთსაფეხურიან საგანმანათლებლო პროგრამაზე, წარმოადგინა 1969 წელს „საბჭოთა საქართველოს“ მიერ გამოცემული პროფესორ შამშე ქევანიშვილის მონოგრაფიის „ღვიძლის სისხლძარღვების ქირურგიული ანატომია“ ინგლისურენოვანი თარგმანი.

პირველ რიგში, მინდა შევეხო ამ არჩევანს: გიგი გორგაძე პროფესორ შალვა თოიძის სახელობის სტეპენდიის სტიპედიატია. პროფესორი შალვა თოიძე კი თითქმის ნახევარი საუკუნე ხელმძღვანელობდა იმ კათედრას, რომელზეც პროფესორმა შამშე ქევანიშვილმა აღნიშნული მონოგრაფია დაწერა. ეს ის კათედრაა, რომელმაც პროფესორების შ. თოიძის და შ. ქევანიშვილის ხელმძღვანელობით სათავე დაუდო საქართველოში ღვიძლის კლინიკური და ექსპერიმენტული ანატომიის კვლევას და საფუძველი ჩაუყარა ღვიძლის ქირურგიის განვითარებას ჩვენს ქვეყანაში. პროფესორ შალვა თოიძის სტეპენდია კი მისი ერთ-ერთი გამორჩეული მოწაფის - პროფესორ ილია ჭანუყვაძის დაარსებული და დაფინანსებულია.

ყოველივე ზემოთქმული ადასტურებს, რომ ახალგაზრდა მკვლევარის და წარჩინებული სტუდენტის მიერ არჩევნის შეჩერება პროფესორ შამშე ქევანიშვილის ზემოაღნიშნული მონოგრაფიის თარგმანზე, დასახელებულ კათედრაზე დამკვიდრებულ თაობათა ურთიერთობის და მასწავლებელთა დაფასების გამორჩეული ტრადიციის გაგრძელებაა და ეს მოწონებას ომსახურებს. აქვე, ამ ტრადიციის შენარჩუნებისათვის მადლობას ვუხდი პროფესორებს: ელგუჯა ყიფიანსა და ლიანა კიკალიშვილს, რომლებიც

კათედრას პროფესორ შ. თოიძის შემდეგ ხელმძღვანელობენ. ეს საკითხის ე.წ. „ემოციური მხარის“ თაობაზე.

რაც შეეხება შ. ქევანიშვილის ნაშრომის სამეცნიერო მნიშვნელობას: დღეს მსოფლიოში ასე წარმატებულად მიმდინარე ღვიძლის ქირურგია იმ გამოკვლევებს ეფუძნება, რომლებიც ძირითადად გასული საუკუნის 20-50 -იან წლებში შეიქმნა და რომლის საფუძველზეც შესაძლებელი გახდა ღვიძლის რეზექციის (ნაწილის მოკვეთის) უსისხლოდ (ან სისხლის მინიმალური რაოდენობის დაკარგვით) ჩატარება.

ამ ტიპის კვლევების ავტორათა შორის უდავო ლიდერად გვევლინება ფრანგი ანატომი და ქირურგი კლოდ კუინო (Claude Couinaud), რომლის კვლევათა შედეგები სახელმძღვანელოდ არის აღიარებული ღვიძლის ქირურგიაში. ამ ტიპის კვლევების შედეგებს უნდა უმადლოდეს დღეს ცოცხალი დონორიდან ღვიძლის ნახევრის ტრანსპლანტაციის დამკვიდრება, რაც წარმოუდგენელი იქნებოდა ღვიძლის და მისი წილების (და სეგმენტების) ე.წ. „ანატომიური რეზექციის“ უხიფათო მეთოდის შემუშავების და სტანდარტიზაციის გარეშე. პროფესორ შამშე ქევანიშვილის კვლევები კუინოს კვლევებთან დროში თანხვდენილია. ამასთანავე, პროფესორ შ. ქევანიშვილს მოწოდებული აქვს ღვიძლის სისხლძარღვთა ზოგიერთი ისეთი ანატომიური თავისებურება, რაც Couinaud-თან არ გვხვდება. რომ არა საბჭოთა ეპოქისათვის დამახასიათებელი ბარიერები, მათ შორის ნაშრომთა უცხო ენაზე გამოქვეყნების დიდი სირთულე (თუ არ ვიტყვით „შეუძლებლობა“), უნდა ვივარაუდოთ, რომ პროფესორ შამშე ქევანიშვილის სახელიც პოპულარული იქნებოდა მსოფლიოს ქირურგ-ჰეპატოლოგთა შორის.

და მაინც, რამდენად აქტუალურად შეიძლება ჩაითვალოს ახალგაზრდა მკვლევარის არჩევანი, პროფესორ შამშე ქევანიშვილის მონოგრაფიის „ღვიძლის სისხლძარღვების ქირურგიული ანატომიის“ დღეს თარგმნა ინგლისურ ენაზე?

საქმე იმაშია, რომ ღვიძლის სისხლძარღვების შემსწავლელ კვლევებში ძირითადი აქცენტი გაკეთებულია ოპერაციის დროს სისხლდენის პრევენციის შესაძლებლობაზე, ან მისი შეჩერების ტექნიკის ანატომიურ საფუძვლებზე. პროფესორი შ. ქევანიშვილი კი გახლავთ მკვლევართა იმ მცირერიცხოვანი ჯგუფის წარმომადგენელი, რომლისთვისაც თანაბრად მნიშვნელოვანია როგორც სისხლდენის პრევენცია ღვიძლის გაკვეთის (ნაწილის ამოკვეთის) დროს, ასევე ღვიძლის რეზექციის შემდგომ დარჩენილ ნაწილში სისხლის სრულყოფილი მომარაგების შენარჩუნება.

სწორედ აღნიშნულის გათვალიწინებით, პროფესორ შ. ქევანიშვილს მოწოდებული აქვს ორიგინალური განაკვეთები, რომელთა ნაწილიც განსაკუთრებით მნიშვნელოვანია ღვიძლის ე.წ. „ატიპიური რეზექციების“ წარმოებისას. ამ მხრივ, წარმოდგენილ მონოგრაფიას მნიშვნელობა არ დაუკარგავს და სრულად ინარჩუნებს აქტუალურობას. ამ მოსაზრებას ადასტურებს უკანასკნელ წლებში გამოქვეყნებული ნაშრომები, სადაც „CUSA-ს“ სკალპელით (ან მისი ანალოგებით) შეიარაღებული ქირურგები, რომლებისთვისაც ღვიძლზე განაკვეთი სისხლდენის განვითარების თვალსაზრისით არავითარ პრობლემას აღარ ქმნის, მიუთითებენ ღვიძლის ორგანოსშიდა სისხლძარღვთა ანატომიის დეტალური შეფასების აუცილებლობაზე, რათა ღვიძლის „უსისხლოდ“ მოკვეთამ ოპერაციის შემდგომ პერიოდში არ შექმნას ღვიძლის დარჩენილი ნაწილის სისხლით ადექვატური მომარაგების პრობლემები.

აღნიშნულის გარდა, პროფესორ შ. ქევანიშვილის მიერ აღწერილი დამატებითი კარის ვენები და კარის ვენის კოლატერალური გზები დღემდე უნდა მივიჩნიოთ ღვიძლის სისხლძარღვების აღწერაში შეტანილ ორიგინალურ წვლილად. ასევე, ძალიან მნიშვნელოვანია მონოგრაფიაში დადასურებული ფაქტი, რომ ნაღვლის ბუშტის ვენები კავშირს ამყარებს კარის ვენის მარცხენა და მარჯვენა ტოტებს შორის და ასეთმა ანატომიურმა თავისებურებამ შეიძლება ხელი შეუწყოს სიმსივნის მეტასტაზირებას ღვიძლის ერთი წილიდან მეორე წილში. ამ აღმოჩენას დაეფუძნა პროფესორების: შ. თოიძისა და შ. ქევანიშვილის ერთ-ერთი სახელოვანი მოწაფის, პროფესორ მერაბ სარელის (იზრაელაშვილის) მიერ მოწოდებული ღვიძლის რეზექციის წესი (ორგანოს სიმსივნური დაზიანების დროს), რომელიც ნაღვლის ბუშტის პროფილაქტიკურ ამოკვეთას გულისხმობს მეტასტაზების გავრცელების პრევენციის მიზნით.

ყოველივე ზემოთქმულის გათვალისწინებით, გიგი გორგაძის მიერ პროფესორ შ. ქევანიშვილის აღნიშნული მონოგრაფიის თარგმნა და მისი საერთაშორისო მიმოქცევაში ჩართვის ხელშეწყობა ფრიად მოსაწონი გადაწყვეტილებაა.

თარგმანი შესრულებულია კარგი ინგლისურით, ანატომიური და ქირურგიული ტერმინების ადექვატური გამოყენებით. ის ასევე ინარჩუნებს დედნის ერთ გამორჩეულ თვისებასაც - კარგად იკითხება.

პროფესორი **დიმიტრი კორძაია**
თსუ ალექსანდრე ნათიშვილის მორფოლოგიის ინსტიტუტის დირექტორი

SHAMSHE KEVANISHVILI

SURGICAL ANATOMY OF LIVER VESSELS

Publishing House
"Soviet Georgia"
Tbilisi – 1969

Publishing House of Georgian
National Academy of Sciences
Tbilisi – 2024

Surgical Anatomy of Liver Vessels

Translation into English Language

The work highlights the variability of the shape and position of the liver and gallbladder, as well as the features of branching and the relationship between the portal and hepatic veins. Depending on the branching of the intraorganic vessels, the liver is divided into segments.

On the basis of our own proposals, the work suggests original incisions of the liver, designed in terms of preventing bleeding, as well as maintaining normal blood circulation in the liver.

The work is of interest to both morphologists and surgeons.

The work contains 44 figures and 9 tables.

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Prof. Shamshe Kevanishvili 1907-1986

A prominent representative of the Georgian medical society, Professor Shamshe Kevanishvili was born on May 9, 1907, into a poor peasant family, in the village of Tlughi, Ambrolauri district. In 1926, he graduated from high school in Kutaisi. After graduating from school, he worked as a laborer in Chiatura for a year.

In 1933, he graduated from the Medical Faculty of the Tbilisi State Medical Institute. Immediately after graduating from the institute, he was hired as a senior laboratory assistant at the Department of Operative Surgery and Topographic Anatomy. In 1934, after passing the qualification commission, he was appointed to the position of assistant at the same department. At the same time, he worked as a resident surgeon in the surgical department of the emergency hospital.

On June 23, 1941, he was mobilized into the Soviet Army, where he worked as a doctor in the medical squadron of the 17th Cavalry Division. In September of the same year, he was appointed leading surgeon of the 44th Medical Sanitary Battalion of the 224th Division. On December 26, 1941, he was captured during the Crimean naval landing operation and from January 5, 1942, he was in prisoner of war concentration camps, first in the Soviet Union and then in Germany. On April 3, 1945, during the evacuation of the Kaisersteinbruch concentration camp, he managed to escape and on April 4 joined one of the units of the Soviet Army. After a proper examination, he was reinstated in the ranks of the Soviet Army. He was demobilized on November 4, 1945. In 1946, he returned to the department, where he was engaged in fruitful pedagogical and scientific work until the end of his life.

In 1948, Shamshe Kevanishvili successfully defended his candidate's thesis on the topic: "Extreme forms of liver changes in newborns". In 1958, he was elected as a docent of the department. In 1962, he defended his doctoral thesis on the topic: "Surgical anatomy of the blood vessels of the liver", and in 1966, he was elected as a professor of the department.

Mr. Kevanishvili, as the deputy head of the department, led the educational process and the training of young employees for many years. He made a great contribution to the creation of the classical anatomical museum of the department.

He made many wet and corrosive dissections, which still adorn the department's museum.

Professor Shamshe Kevanishvili is the author of more than 70 scientific works, including two monographs: “Surgical Anatomy of Liver Vessels” (1969) and “Results of Portal Vein Occlusion in Experiments” (1974). In these works, he provided original measurements of the liver, and also substantiated the possibility of developing anastomoses between the intrahepatic branches of the portal vein during occlusion of one or several branches. Today, when the works of researchers in the field of hepatology have become widely available, it can be confidently stated that Professor Shamshe Kevanishvili’s aforementioned discovery has no analogues.

Mr. Kevanishvili was endowed with an outstanding pedagogical talent. Students attended his lectures and practicals with special interest and enthusiasm. He has been awarded the title of the best teacher of the medical institute several times.

With him and after him, all the people working at the Department of Clinical Anatomy and Operative Surgery are greatly indebted to Shamshe Kevanishvili, who freely shared with them his knowledge and experience, the secrets of pedagogy, and the technique of dissecting.

Professor Shamshe Kevanishvili, along with his scientific and pedagogical work, was actively involved in public work; he was a member of the Tbilisi City Council in 1930-34. In 1963-65, he was a member of the Presidium of the Republican Committee of the Union of Medical Workers.

Sitting: Professor Shalva Toidze and Professor Shamshe kevanishviili
Standing: Professor Manana Ramishvili, Professor Leila Jandieri, Ilia Kutchava and Professor Liana Kikalishvili

Prof. Shamshe Kevanishvili is widely considered the founder of surgical morphology and experimental surgery of the liver in Georgia. In the 1950s, at the sametime with the world-famous French researcher Claude Quinaud and completely independently of him, he carried out fundamental research to study the external shape and internal structure of the liver. The results of this research are summarized the work “Surgical Anatomy of Liver Vessels”, which was published in Georgian language as a monograph by the publishing house “Soviet Georgia” in 1969.

It can be said that this work made a major contribution to the formation of a modern-profile theoretical school, and on the other hand, it created the foundations for the development of clinical surgery in Georgia.

Naturally, my goal is not to review the work in detail - this was done a long time ago, with great success. I would like to respond to the initiative through which the aforementioned work (monograph) was translated into professional English and thus gave it a second life.

- The English version of the work popularizes the ideas and work of the Georgian scientist;
- It takes us back to the 50s of the last Century and makes clear to foreign scientists the scientific-research progress that took place in Georgian anatomical theater at that time;
- It makes clear to foreign researchers the rich methodological possibilities of research (anatomical dissection, preparation of corrosive specimen, X-ray vasography, dissection under a binocular microscope, etc.) which were actively implemented and used by Georgian morphologists at that time;
- Finally, Kevanishvili's monograph “Surgical Anatomy of Liver Vessels” has been an auxiliary textbook for Georgian medical students (and not only) for almost a century. I am sure that its English version will also be of great service to foreign students and young doctors in mastering the field of medicine called surgical anatomy of the liver and anatomical surgery.

In this regard, I would like to recall the Japanese folk saying: *"For a year's remembrance, sow seeds; for a decade's remembrance, plant a tree; for eternal remembrance, write a book people will learn from" (一年の記憶には種を蒔き、十年の記憶には木を植え、永遠の記憶には人々が学ぶ本を書く).*

Professor Merab Sareli (Izraelashvili) MD, PhD
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Honorary Citizen of Tbilisi City
Chairman of the World Jewish Congress of Georgia

A young researcher, Gigi Gorgadze, who is still studying at the One-Cycle Educational Program for Medical Doctor, presented an English translation of Professor Shamshe Kevanishvili's monograph "Surgical Anatomy of Liver Vessels", published by "Soviet Georgia" in 1969.

First, I would like to touch on this selection: Gigi Gorgadze is a fellow of the Scholarship named after Professor Shalva Toidze. Professor Toidze headed for almost half a century the department where Professor Shamshe Kevanishvili conducted the aforementioned monograph. This is the department that initiated the research of clinical and experimental anatomy of the liver in Georgia under the leadership of Professors Sh. Toidze and Sh. Kevanishvili and laid the foundation for the development of liver surgery in our country. The aforementioned scholarship is established and funded by one of his distinguished students, professor Ilia Tchanukvadze.

All of the above confirms that the suspension of the election of a young researcher and an excellent student for the translation of the aforementioned monograph by Professor Shamshe Kevanishvili is a continuation of the distinguished tradition of intergenerational relations and appreciation of teachers established at the named department, and this is commendable. Here, I would like to thank Professors Elguja Kipiani and Liana Kikalishvili, who have been heading the department after Professor Sh. Toidze. This as the "emotional side" of the issue.

As for the scientific significance of Kevanishvili's work: Liver surgery, which is so successful in the world today, is based on research that was mainly developed in the 1920s-1950s, and on the basis of which it became possible to perform bloodless (or with minimal blood loss) liver resection (partial resection). The undisputed leader among the authors of this type of research is the French anatomist and surgeon Claude Couinaud, whose research results are recognized as a guideline in liver surgery. The results of this type of research are responsible for the establishment of split liver transplantation from a living donor today, which would have been unthinkable without the development and standardization of the safe method of so-called "anatomical resection" of the liver and its lobes (and segments). Professor Shamshe Kevanishvili's research coincides in time with Couinaud's research. In addition, Professor Sh. Kevanishvili has provided some anatomical features of the hepatic vasculature that are not found in Couinaud. If it were not for the barriers characteristic of the Soviet era, including the great difficulty (if not to say "impossibility") of publishing works in a foreign language, we must assume that the name of Professor Shamshe Kevanishvili would also be popular among the world's surgeon-hepatologists.

And yet, how relevant can the choice of a young researcher to translate Professor Shamshe Kevanishvili's monograph "Surgical Anatomy of the Liver Vasculature" into English today be considered?

The point is that in studies of the hepatic vasculature, the main emphasis is placed on the possibility of preventing bleeding during surgery, or on the anatomical foundations of the technique for stopping it. Professor Sh. Kevanishvili is a representative of that small group of researchers for whom it is equally important to prevent bleeding during liver resection (partial excision), as well as to maintain a complete blood supply to the remaining part of the liver after resection. With this in mind, Professor Sh. Kevanishvili has provided original incisions, some of which are especially important when performing so-called "atypical resections" of the liver. In this regard, the presented monograph has not lost its importance and fully retains its relevance. This opinion is confirmed by the works published in recent years, where surgeons armed with the "CUSA" scalpel (or its analogues), for whom the liver incision no longer poses any problems in terms of the development of bleeding, point to the need for a detailed assessment of the intra-organ vascular anatomy of the liver, so that "bloodless" resection of the liver does not create problems with adequate blood supply to the remaining part of the liver in the postoperative period.

In addition to the above, the additional portal veins and collateral pathways of the portal vein described by Professor Sh. Kevanishvili should still be considered an original contribution to the description of the hepatic vasculature. Also very important is the fact noted in the monograph that the gallbladder veins establish a connection between the left and right branches of the portal vein, and such an anatomical feature may contribute to tumor metastasis from one lobe of the liver to another. This discovery was based on the liver resection rule (in case of tumor damage to the organ) provided by Professor Merab Sareli (Izraelashvili), one of the famous students of Professors Sh. Toidze and Sh. Kevanishvili, which involves prophylactic excision of the gallbladder to prevent the spread of metastases.

Considering all of the above, Gigi Gorgadze's translation of the aforementioned monograph by Professor Sh. Kevanishvili and his support for its inclusion in international circulation is a very welcome decision.

The translation is done in good English, with adequate use of anatomical and surgical terms. It also retains one of the outstanding features of the original - it is well readable.

Professor Dimitri Kordzaia MD, PhD
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I N T R O D U C T I O N

Liver surgery is one of the most difficult and relatively less treated areas of abdominal surgery. The main reason for this is considered to be the fact that the anatomical basis of liver incisions has not yet been adequately studied.

The liver is characterized by a special multiplicity of blood vessels. Blood circulation in it is carried out by three systems of blood vessels (portal vein, hepatic artery and hepatic veins), the topographic relationship of the branches of which in the organ is very complicated.

It should be noted that the intra-organ blood vessels of the liver are not located in one direction. The locations of the branches of the hepatic artery and portal vein are the same, but the location of the hepatic veins is completely different, and their branches flow in different directions to the branches of the first two blood vessels (hepatic artery and portal vein), which makes it difficult to develop rational incisions of the liver.

A number of authors divide the liver into segments and sub-segments based on internal architecture, which has a certain practical significance. Such a division is mainly based on the branching of the portal vein, and the location of the liver veins is not always taken into account, which reduces the cost of such a division. The direction of the incisions of the liver much depends on the location and distribution of all intra-organ blood vessels, as the sparing incisions of one system are sometimes dangerous for the other system and vice versa.

It is worth noting that the incisions provided for liver resection mainly aim dealing with bleeding, and the possibility of disruption of intra-organ blood circulation and the development of pathological changes in this regard is not properly taken into account.

It has been determined that as a result of disconnection of a separate branch of the portal vein or hepatic artery, deep pathomorphological

changes develop in the matching lobe of the liver, which indicates that both the risk of bleeding and the possibility of developing secondary changes due to disruption of blood circulation in the remaining part of the liver should be taken into account when carrying out incisions on the liver.

A. Melnikov (1924) provided a rule of resection of the left lobe of the liver, according to which the main trunks of blood vessels included in this lobe are first clamped and then the inicision is carried out along the left edge of the left sagittal groove. The rule is quite acceptable from the point of view of prevention of bleeding, but it does not take into account the danger of disruption of blood circulation in the remaining part of the liver as a result of ligated blood vessels.

Due to K. Kremer and H. Hilke (1959), for the resection of the lobe of liver, after ligation of the portal vein and the left branches of the hepatic artery, the liver is moved to the right of the left transverse groove so that the quadrate lobe is cut in the middle. Even in this case, the preserved part of the quadrate lobe remains disconnected from the blood circulation.

The view of K. Popescu (1958) is interesting, according to which typical resections represent technical progress in the development of liver surgery, but at the same time, atypical resections are also needed in appropriate indications. He provides incisions that are based on the principle of maintaining normal vascularization in the remaining part of the liver, but little consideration is given to the danger of cutting the main vascular branches and the danger of bleeding that develops on this ground.

Thus, at the current stage of development of liver surgery, such incisions have not yet been developed that fully ensure both the safety of bleeding and the maintenance of normal blood circulation in the organ during operations on the liver.

The progress of liver surgery is particularly hindered by the fear of bleeding, although such important methods as hemostatic suture (M. Kuznetsov and Pensky, 1894), action of hot air and steam on the incision of the liver (F. Abramovich, 1900), temporary ligation of vessels in porta hepatis (N. Burdenko, 1909; Z. Dukhinova, 1922), use of an electricity (A. Lushko, 1948), tissue plastic (A. Velikoretsky and T. Kasyakina, 1955) and others have been provided to deal with bleeding, but all of them have defect and it is dangerous to perform operations based only on these methods, if the peculiarities of vascular branches and their arrangement in the body are not taken into account.

Therefore, it is indisputable that the knowledge of the morphology of the liver vessels is of crucial importance during surgical intervention on this organ. This circumstance in itself indicates the necessity of a detailed study of the mentioned blood vessels.

The intra-organ blood vessels of the liver were first studied by Glisson (1654), and later by Rex (1885). Later - A. Melnikov (1924), A. Naduin and M. Kriemholtz (1925), b. Ognev and A. Sizganoev (1927), A. Akilova (1936), G. Elias and D. Peti (1952), N. Javakhishvili-Komakhidze (1953), V. Parfenteva (1954) and others.

Nevertheless, some aspects of this vascular structure are still not adequately covered in the literature. This especially applies to the venous system of the liver.

Based on the above, we aimed:

1. To specify the branching forms of portal vein and hepatic veins;

2. To study their collateral ways;

3. To prove the superiority of some incisions of the liver based on anatomical data.

L I T E R A T U R E R E V I E W

The internal apparatus of the liver is complex and still obscure. If the shape and location of this organ are relatively well studied, the same cannot be said about its internal structure.

The liver is characterized by a special multiplicity of blood vessels. From this follows the fact that bleeding associated with surgical intervention on this organ is considered one of the serious complications, and not infrequently the doctor becomes powerless in the face of this bleeding. It is true that the surgical anatomy of the liver has been sufficiently studied and appropriate literature has been accumulated in this regard, but the issue of rational incisions and stopping of bleeding on the liver still remains problematic. In addition, there is the issue of portal hypertension, the etiopathogenesis of which is undoubtedly of great importance for a detailed study of the hepatic venous system.

It is known that all venous systems in the human body are characterized by an abundant anastomotic network. In addition, one trunk artery is often followed by two trunk veins. So, the sum of venous vascular lumens is several times more than that of arteries, if we do not take into account that the capacity of arterial and venous beds in a small circle is almost equal.

It should be noted that all the veins in the body are not of the same importance in terms of pathological process and restoration of collateral pathways. This includes the location of acceptable veins, caliber, collateral ways, functional load, relationship with related organs, etc.

Three networks of venous vessels are chosen according to their location: superficial, i.e. subcutaneous network, deep, which follows the arteries, and hepatolienal system veins, which are part of the portal

vein system. It should be noted, that superficial veins anastomose with both deep veins and hepatolienal system. Because of this, in cases of damage to veins, restoration of blood circulation through collaterals is much easier than in case of damage to arteries. An exception at this point is the portal vein, which is connected to both superficial and deep veins through collaterals, but nevertheless, in case of knotting it, the existing collaterals become functionally insufficient.

The portal vein is a special blood vessel. Some authors compare its structure with an artery, because it is characterized by great resistance, equal dichotomous branching, division into capillaries and the absence of valves (A. Nadein and M. Kriemholtz, 1926).

I. Hirtle (1869) compares the portal venous system to a tree whose roots are scattered in the stomach, pancreas and spleen. The branches are embedded in the liver parenchyma, and the main trunk is located in the hepatoduodenal ligament.

It is well known that the portal vein collects blood from the abdominal organs except the genitourinary system. By connecting the small veins, three relatively large veins are finally formed: the superior messenteric vein, the inferior messenteric vein, and the splenic vein, which join at the level of the second lumbar vertebra (behind the head of the pancreas) to form the portal vein.

After that, the portal vein, as the main collector, goes upward and passes through the hepatoduodenal ligament, enters in central part of the porta hepatis.

Such is the schematic description of the extrahepatic part of the portal vein system, but as it turns out from the special literature, this description is not always true.

The roots of the portal vein and their initial sources have been extensively covered by F. Marikzov (1950), N. Bisenkov (1955), G. Rusanov (1955), A. Tsagareishvili (1955), E. Diskin (1955) and others.

As it turns out from the literature, the description of this part of the veins is less controversial, but the same cannot be said about the level of the formation of the portal vein and its location.

F. Walker (1920) describes four options for creating the portal vein:

1. The vein formed by the connection of the inferior and superior mesenteric veins joins to the splenic vein and forms the portal vein (29%);
2. The superior messenteric vein joins to the trunk created by the connection of the inferior mesenteric and splenic veins and forms the portal vein (42%);
3. The superior mesenteric vein joins the splenic vein and the inferior mesenteric vein joins the corner of this connection;
4. The portal vein is formed by the connection of the superior mesenteric vein, inferior mesenteric vein, splenic vein and upper coronary vein of the stomach (22%).

According to the observations of A. Kuliabko (1940), the second option described by F. Valker is typical for humans, that is, the portal vein is formed by the connection of the inferior mesenteric vein and the splenic vein, and the superior mesenteric vein joins to the common trunk created by them.

As can be seen, the number of roots forming the portal vein and the characterization of their connection are variable. According to literature sources, the level of connection of these roots, that is, the creation of the portal vein, is also variable.

According to the observations of F. Valker and A. Kuliabko, the level of creation of the portal vein varies within the I-III lumbar vertebrae. However, they do not deny that, this level can also refer to the XII thoracic vertebra.

The main trunk of the portal vein from its formation to the transverse fissure of the liver (porta hepatis) is a sufficiently large blood vessel and

is located in the hepatoduodenal ligament. It is in close relationship with the elements of the mentioned ligament, e.g. with the hepatic artery and the common bile duct. It should be noted that its length and the diameter of the lumen are very unequal.

According to A. Nadein and M. Krimholz (1925), the length of the portal vein varies from 5 to 12 centimeters, and the diameter varies from 5 to 18 mm.

According to A. Kuliabko, the length of the portal vein varies from 2.8 to 7.3 cm. According to his observation, the average amount of the diameter of the portal vein is greater in men than in women. In addition, the caliber of the portal vein is closely related to the size of the liver, thus, the larger the volume of the liver, the wider the lumen of the portal vein and vice versa.

According to F. Valker (1920), the length of the portal vein is equal to 6-8 centimeters, and the diameter is 15-18 mm.

According to E. Gudkova (1948), the diameter of the portal vein ranges from 12 to 20 mm. In addition, the diameter of the portal vein in men is larger than in women. The author does not agree with A. Kuliabko that the size of the lumen of the portal vein depends on the volume of the liver.

According to G. Mikhailov (1959), the diameter of the portal vein ranges from 16-22 mm.

Thus, it is clear from the sources of the literature that the extra-organic part of the portal vein is highly variable depending on the number of roots and the characterization of their connection, as well as the level of formation of the main trunk, length and diameter. Most authors describe this variation as a separate variant.

In the liver itself, the intra-organ branches of the portal vein are in a close relationship with the branches of the hepatic artery and the bile ducts,

therefore, by studying the intra-organ part of the portal vein, we get a clear view of the main branches of the mentioned two systems.
In general, the blood vessels and bile ducts of the liver are divided into two groups:

- In the first group are placed the portal vein, hepatic artery and bile ducts, because they have one direction, are located next to each other and are placed in one common - Glisson's - capsule.
- In the second group, hepatic veins are placed, which have a different location and direction.

Almost all authors point out that the portal vein divides into two branches in the porta hepatis, of which the right branch enters the right lobe of the liver, and the left branch enters the left lobe of the liver.

According to A. Tarenetsky (1883), the portal vein is usually divided into 2 branches, but sometimes there is a third branch. In this case, the latter follows the left hepatic artery.

According to Lalob (1910), the division of the portal vein into two branches occurs in 88% of cases. 12% have double branches entering the right and left lobes of the liver.

E. Gudkova's observation was performed on 6 dissections*, in one of which the portal vein was divided into three branches in the porta hepatis of the liver, and in the other five - into two branches.

V. Parfentieva (1951, 1954) describes three options for dividing the main trunk of the portal vein:

1. The main trunk of the portal vein is divided into the right and left branches of the first row with equal or almost equal diameter;
2. The main trunk of the portal vein goes to the right lobe, where it divides into two adjacent branches of the first row. In addition to this, one branch of the first row comes out from the main trunk.

***Dissection**- *1. The act or an instance of dissecting.*

***2. Something that has been dissected, such as a tissue specimen under study**.*

3. The main trunk of the portal vein enters the left lobe, where it divides into two branches of the first row, one of which remains in the left lobe, and the other enters the right. In addition, the right lobe also contains one first-row branch, which branches off from the main trunk of the portal vein before it divides.

B. Kuznetsov (1957) singled out the following three main variants of branching of the portal vein:

1. **Dichotochemical** (77.4%), when the portal vein is divided into right and left branches under an angle of 90°-180°.
2. **Embryonic** (8.9%), when the portal vein immediately after entering the porta hepatis gives the lower right branch, and then finally divides into the right and left branches.
3. **Diffuse** (13.7%), when the portal vein is divided into right lower, right upper and left branches.

Thus, according to the majority of authors, the main trunk of the portal vein usually divides into two branches of the first row, and by further branching of these branches, all lobes of the liver are supplied with portal vein. In some cases, the portal vein may divide into three branches.

The length, caliber and exit angle of the branches of the first row of the portal vein can be equal or unequal. Along with all this, it is also interesting how the branches of the first, second and next row of the portal vein are distributed according to the separate lobes and zones of the liver.

Representing the issue in this way (if other blood vessels of the liver are also taken into account), in addition to theoretical interest, has a great practical value, because it allows us to discuss what incisions would be more rational during operations on the liver, from the point of view of minimizing bleeding.

According to the research of A. Melnikov (1920, 1924), the left branch of the portal vein forms a slightly pronounced arc from the beginning and goes transversely or obliquely. Reaching the left sagittal groove, it changes its direction to the front and ends blindly in the form of an umbilical recess, from which various branches emerge. The umbilical recess sometimes divides in one place into branches of the next row.

The right branch of the portal vein wraps around, goes from below to above, runs transversely, and at the level of the right sagittal groove divides into two or four large branches, which, in turn, form typical arcs.

According to A. Nadein and M. Krimholtz, the right branch of the portal vein enters the parenchyma of the liver, is divided into anterior and posterior branches, which, in addition to the right lobe, feed the caudate and quadrate lobes. The left branch is divided into several transverse branches, which, together with the left lobe, supply blood to a small area of the central lobe.

According to A. Gudkova (1948), the right branch of the portal vein can be divided into two *(anterior and posterior)*, three *(anterior, posterior and superior)* or four *(two anterior, posterior and superior)* branches. The left branch can also give us two *(anterior and posterior)*, three *(two anterior and one posterior)*, or four *(one anterior and three posterior)* branches.

According to V. Parfentieva (1954), each branch of the first row of the portal vein is divided in different ways, but it is characteristic that the external form of the branches is repeated on all the divisions of the next row of a certain branch. According to this, the author distinguishes two main forms of branches - Trunk and Diffuse:

- In the case of the trunk form, the branch of the first row of the portal vein is dichotomously divided into the branches of the next row. At the same time, the diameter of the branches gradually decreases. From the main branch, the branches of the second row come out

under a right angle, which are relatively straight. Their number ranges from 8 to 10.

- In the case of diffuse form, the branch of the first row of the portal vein is usually short and divides into two branches of the second row, from which 2-3-4 relatively large branches emerge under the angle of 60°-70°. In this case, these branches are not straight, they are more bent and, what is typical, the division of the next row is produced in the same order.

According to the research of P. Morozova (1956), branching of the portal vein is characterized by significant fluctuations of individual signs. The blood vessels of the left lobe of the liver bear relatively constant signs. In addition, there is a certain dependence between the shape of a separate lobe of the liver and the nature of the vascular branches in it, which is especially well manifested in the right and left lobes. For example, when the transverse size of the left lobe is large, then its posterior arcuate vein is long. Also, if the anterior-posterior size of the right lobe is increased, in its lower part, normally, not one, but two or three blood vessels are located.

The variability of the branches of the second and subsequent rows of the portal vein is particularly well described by A. Melnikov. According to his observations, two typical arcuate veins emerge from the left branch of the portal vein — anterior and posterior. Sometimes, in addition to the mentioned two veins, a third one comes out of the left branch - the upper arcuate vein. Anterior and posterior veins are largely equal, and in some cases the posterior vein is a relatively more important blood vessel and is a direct continuation of the left branch of the portal vein, which gives off typical branches with a narrower lumen along its entire length on both sides (trunk form—70%). The anterior vein can give us exactly the same picture, with the difference that here the branches come out mostly from the outer periphery and are longer.

In the case of good development, the posterior vein sometimes divides into two large branches of almost equal development (diffuse form—30%).

According to the author, sometimes the anterior and posterior arcuate veins surround the oval-shaped area in the left lobe of the liver. In such a case, the upper part of the left lobe is supplied with blood by the superior arcuate vein. The latter is noted in 55% of cases. It usually starts from the umbilical recess or the lateral surface of the anterior vein. The superior arcuate vein is well developed in 20% of cases and is no less important in its size than the anterior vein. In 35% of cases it can come directly from the anterior vein as a visible branch, and in 45% it is not present at all. In this case, it is replaced by several small blood vessels that come from the anterior or posterior vein, or both.

According to Melnikov's observations, the right branch of the portal vein and its further branches are characterized by a more complex architectonics. Usually, it divides at the level of the right sagittal groove into two large branches - the inferior arcuate vein and the ascending vein. The first of them goes down and a little externally, then changes direction to backwards and ends in the thick part of the back of the liver. So, this vein is initially located frontally, then sagittally, and finally vertically. The branches coming out of it are non-permanent, the number of which is five on average. They are located near the lower surface of the right lobe of the liver, 1.5 to 2.5 cm deep. An ascending vein has a tendency to maintain an upward direction. Its branches are scattered in the thickness of the right lobe of the liver, near the upper surface.

Apparently, the division of the anterior arcuate vein is much more diverse. The author distinguishes two main types of his branches. In the first case, this vein is uniaxial, and the branches of the next row are continuations of each other (trunk form), and in the second case, it is biaxial, and the inferior vein, in turn, is divided into anterior, posterior, and middle arcuate veins. So, the blood vessel mainly contains branches

of the second row (diffuse form). Sometimes the right branch of the portal vein is initially divided into four equal branches: Ascending, anterior, posterior and middle arcuate veins, which in turn divide into branches of different numbers and directions.

According to the observations of H. Elias and D. Petty (1952), the division of the right branch of the portal vein is so variable that it is not possible to distinguish its variants. There were not any alike dissections found.

According to the dissections of L. Nechunaev (1958) (60 cadavers), the right branch of the portal vein is divided into two branches (trunk form) in 56%, in three branches (diffuse form) in 21%, and in four branches (well expressed diffuse type), and in the remaining 18% transitional forms are noted.

Thus, the nature of the branching of the internal part of the portal vein is quite complex and variable. In this regard, the right branch of the portal vein and its subsequent branches are especially variable. The portal branches in the left lobe of the liver are relatively more stable. Such data should be considered completely normal, because the right lobe of the liver is much more massive and obviously, it should be characterized by the abundance of vascular branches and more complex architecture.

As stated above, a certain branch of the portal vein enters the same named lobe of the liver, but the blood vessels from these branches also enter the quadrate and caudate lobes. It should be noted that these veins are relatively small in diameter, but highly variable depending on the number of branches and initial sources.

According to A. Melnikov (1924), the quadrate lobe and often the caudate lobe are supplied with blood vessels by the left branch of the portal vein. In particular, the quadrate lobe is supplied by blood vessels coming from the umbilical recess, except for the rare case when these veins start directly from the left branch of the portal vein. The number

of these veins ranges from 2 to 5. The author divides it into a variable number of upper and lower row branches. He encountered one lower branch in 20% of cases, two in 60%, and three lower branches in 20%.

The number of branches of the portal vein in the caudate lobe is even more non-constant, the reason for which the author considers the variable size of this lobe. These blood vessels start from the right or left branch of the portal vein, or both. One vein is noted in 10%, two in 60%, and three in 30%, if we do not take into account the small branches that do not always, but often enter the caudate lobe together with the mentioned veins.

According to P. Morozova, the blood vessels of the quadrate lobe together with the right branch of the portal vein, are characterized by significant variability of individual signs. The blood vessels of the caudate lobe are characterized by even more non-constancy of these signs. Blood vessels enter the quadrate and caudate lobes from the right lobe of the liver.

The opinion of both A. Melnikov and P. Morozova that the vessels of the caudate and quadrate lobe are highly variable should be considered completely acceptable, but we cannot agree with P. Morozova that the portal vessels enter the quadrate and caudate lobe only from the right lobe of the liver.

More convincing is the data of A. Melnikov and E. Gudkova, according to which blood vessels should enter the both mentioned lobes from the right or left branch of the portal vein, or from both together.

According to observation of the majority ot the authors, some characteristic signs of the internal part of the portal vein and the number of branches change visibly with age. I.Witkind (1936) made observations in this regard, according to which, the younger the child, the smaller the difference in caliber between the main trunk of the portal vein and its branches. Newborns and infants have abundant branches that are still undifferentiated. As the child grows, the veins differentiate, the

main branches grow intensively, while the small branches, on the contrary, lag behind in growth. This process gradually deepens with age.

Like I. Vitkind, V. Parfentieva (1954) notes age changes in the branching of the internal part of the portal vein. According to his observations, blood vessels in children are more abundant, but thin, and in the elderly, the venous network is thick and the number of branches is small. This is especially noted in the peripheral areas of the organ.

Similar age changes are noted by P. Morozova, who adds that with increasing age, the anterior branch of the anterior arcuate vein gradually shortens, and the number of veins of the quadrate lobe visibly decreases.

Thus, as can be seen from literary sources, the branching of the intra-organ part of the portal vein and the number of branches changes depending on age, which should be related to the age-related changes of the liver itself. It is quite natural that along with changes in the shape and location of the liver, the vascular architecture in its thickness should also change to some extent.

Along with the above, the issue of portal vein collaterals should be considered, because they have a special practical importance.

The collateral ways of the portal vein were described by F. Sapey (1883) and called them additional portal veins (vienes portes accesorius).

These veins are very thin in diameter. They are mainly located in the hepatoduodenal ligament, in the thickness of the suspensory ligament, on the lower surface of the gallbladder, along the round ligament of the liver, and others.

According to the prevailing classification to date, the collateral system of the portal vein is divided into two main groups: parietal and visceral.

According to F. Valker (1919), such a classification is not correct from a clinical point of view. He considers it appropriate to distinguish:

1. A group of collaterals that can at least partially replace the portal vein (hepatopetal collaterals);
2. A group of collaterals that bring blood from the portal vein without the liver to the inferior vena cava (hepatofugal collaterals).

On the author's dissections, which included 160 cadavers, hepatopetal anastomoses were noted in 8 cases:

- In case of 6 dissections of these 8 times, these veins exited from the main trunk of the portal vein itself at the level of the involvement of the superior vein in the stomach, or higher, and entered the liver tissue. The diameter of the mentioned veins varied from 0.25 to 1 mm, and the length - from 1 to 2.5 cm;
- On one dissection, a branch from the superior gastric coronary vein entered the right lobe of the liver;
- In one case the superior gastric coronary vein entered completely into the right lobe.

The author called these veins particular additional portal veins (v.v. portae accesorie), which are quite different from the veins described by F. Sapey, both in diameter and in location and direction.

The veins described by T. Valker are of the hepatopetal type, have a visible diameter and play a much more important role in pathology than the veins described by F. Sapei.

According to A. Lurie (1935, 1937), macroscopically visible hepatopetal collaterals are of two types:

- One type of collateral branches exits the portal vein at the level of its beginning or higher, runs parallel to the main trunk of the portal vein and enters the liver parenchyma;
- The second type of venous collaterals comes from the veins of the lesser curvature of the stomach or the area of the pylorus and the

beginning of the duodenum. These branches also run parallel to the portal vein and enter the liver parenchyma, sometimes joining the main trunk of the portal vein or one of its branches.

Out of 194 cadavers, the author encountered hepatopetal collaterals of the first type 13 times: in 9 cases the branches exited from the left surface of the portal vein and entered the caudate lobe, and in 4 cases they exited from the right surface and entered the right lobe of the liver. Second type hepatopetal collaterals were noted 21 times (10.8%). In this case, the venous branches exited from the veins of the lesser curvature of the stomach or the upper part of the duodenum and entered the parenchyma of the liver, or one of the branches of the portal vein. It should be noted that in 9 cases the diameter of the collaterals reached from 0.33 to 2 mm.

Thus, as can be seen from the researches of F. Valker and A. Lurie, in addition to the thin venous collaterals described by Sapey in the portal vein, in a certain percentage there are also sufficiently large hepatopetal collaterals, which are of great importance in some portal vein pathologies (thrombosis, stenoses, etc.).

In the portal vein system, there are other types of (hepatofogal) collaterals that connect the portal vein with the superior and inferior vena cava. These connections are known as porta-caval anastomoses and are much more abundantly developed than hepatopetal anastomoses.

Porta-caval anastomoses were studied by A. Petrov (1901), F. Valker (1919), M. Torkacheva (1924), A. Nadein and M. Krimholtz (1925), A. Maksimenkov (1937, 1949), A. Dolgosaburov (1946, 1953), by H. Feitelberg (1947), I. Petrovsky (1956) and others.

According to the literature, there are three main groups of porta-caval anastomoses:

- The first group is placed in the cardiac area of the stomach and the abdominal part of the esophagus, which is formed by the junction of the branches of the left gastric vein and the veins of the

esophagus. These veins attach to the venous plexus of the esophagus in the upper part and finally connect to the internal jugular vein. Therefore, in this way, the portal vein is connected to the superior vena cava.

- The second group of anastomoses is represented in the form of a venous plexus, which is placed in the wall of the rectum. This plexus connects the inferior messenteric vein with the middle and inferior rectal veins. In this way, the portal vein is connected to the inferior vena cava.
- The third group of anastomoses is represented by the veins near the umbilicus (v. v. paraumbilicales), which connect the portal system with the caval system. These connections are established as follows: the smallest venous branches in the anterior part of the suspensory ligament of the liver anastomose with the veins located along the round ligament, and these veins are connected with the portal vein at one end, and with the veins near the umbilicus and abdominal muscles with the other. In this way, the portal vein is connected to the superior and inferior vena cava.

Porta-caval anastomoses of the three described groups almost always exist and are well known, but according to a number of studies there are other anastomoses that connect the vena cava system with the portal system. These anastomoses are highly variable in structure and localization, but are noticeable in most cases. For example, according to M. Toracheva (1924), anastomoses between the right Colic vein and the right internal testicular vein, as well as between the left Colic vein and the left renal vein occur in 75-80%.

According to P. Feitelberg's observations, porta-caval anastomoses in the area of the right iliac fossa is observed in 48.5%; There are similar anastomoses in the area of the left iliac fossa in 57.4% of cases.

According to A. Maksimenkov, porta-caval anastomoses exist in the cardiac area of the the stomach, between spleen, stomach, left kidney

and adrenal gland veins, between descending Colon veins and the veins of the caval system in the retroperitoneal space, the upper, middle and lower hemorrhoidal veins, the cecal veins and between the internal testicular veins and etc.

Based on the above, it can be concluded that the porta-caval anastomoses are presented in the form of a rather wide venous network, but, as A. Maksimenkov's observation (1937) shows, the anastomoses are not always developed in the same way. This is related to the reduction process of primary veins. In the case when the reduction of the posterior cardinal veins lags behind or is weakly expressed (embryonic type), then the derivative of their development - the hemiazigos vein - is well expressed and the porta-caval anastomoses are also abundantly developed, and vice versa, if there is a complete reduction of the posterior cardinal veins (differentiated type), then the Hemiazigos vein is weakly expressed or absent at all, and in this case, the porta-caval anastomoses are also weakly or insignificantly developed. Based on these data, according to the author, liver cirrhosis without ascites can be explained by the presence of abundant porta-caval anastomoses and their sufficient functioning, while persistent (severe form) ascites can be explained by weak development or complete absence of porta-caval anastomoses.

O U R R E S E A R C H

M A T E R I A L S

We mainly aimed to study intra-organ part of portal vein and liver veins, but since these venous systems are closely related to other elements of the liver, simultaneous observation was made of the hepatic artery and bile ducts (the materials for the study of the hepatic veins will be discussed in the corresponding chapter).

We examined 130 livers of people of different ages and sex.

According to age, the dissections were distributed as follows:

From 1 to 6 months – 11
From 5 to 10 years – 3
From 20 to 30 years – 10
From 31 to 40 years – 23
From 41 to 50 years – 23
From 51 to 60 years – 31
From 61 to 70 years – 18
From 71 to 80 years – 8
Above 80 years – 3

Distribution of dissections according to sex is shown in table 1:

	Gender	Quantity	%
Child	Male	9	6,9
	Female	5	3,9
Adult	Male	67	51,5
	Female	49	37,7
Total	Male	76	58,5
	Female	54	41,5

Table 1

As the Table 1 shows, the research is mainly based on adults (cadavers). We used children's dissections only in few cases.

From the mentioned material, liver pathology occurred in four cases: cancer metastases were observed twice, echinococcal disease once, and cirrhosis once. In all other cases, the liver was of normal development and no macroscopic pathology was observed.

We removed the liver from the cadaver with due care, because it often bursts, tears and becomes unusable for injection during the cutting of ligaments.

After opening the abdominal cavity, the hepatoduodenal ligament was cut first.

Cutting the portal elements close to the porta hepatis makes injection difficult and, more importantly, makes it almost impossible to identify additional vessels, so we tried to cut the hepatoduodenal ligament as low as possible near the duodenum.

After cutting the hepatoduodenal ligament, we cut the right and left triangular ligaments and finally removed the liver completely, taking with it the part of the diaphragm, which is directly connected to it, and the hepatic section of the inferior vena cava.

RESEARCH METHODS

As it is known, various examination methods (preparation, radiography, radioscopy, limpidity, etc.) are provided for the study of blood vessels, which, despite being widespread, are still characterized by several drawbacks. The selection of the research method is of particular importance in the study of liver vessels, since they are characterized by special complexity in terms of branching and topographic relationships.

It should be said that preparation is one of the old and basic methods of vascular study. Although it is widespread enough today, it is almost impossible to use it in all cases. For example, it is very difficult to study the intra-organ blood vessels of parenchymal organs with this method, because the complex vascular network rich of thin branches is easily damaged during preparation, especially if we study not one single system, but a complex of systems.

At one time, the limpidity method of Spalteholtz and Krause was widely used for the study of blood vessels, but nowadays it is rarely used. The main drawback of this method is that it is not used to study relatively mature preparations.

The use of X-ray (radioscopy, radiography) played a big role in the study of blood vessels. This method of research is highly preferred, because in this case subjectivity is excluded and the image obtained in the picture will be related to reality. At the same time, it should be noted that the X-ray method gives good results only when the observation is made on one system, but when studying the vascularization of an organ in which there are several vascular systems (liver, lung), the shadows of the complex structure of these systems are obtained on the X-ray, which are different to be distincted from each other. This method is more useful for examining organs whose blood vessels are mostly in one plane. Therefore, for the study of intra-organ blood vessels, such a method of

study should be considered the best, by which both individual systems and their complex are studied. This requirement is relatively better met by the corrosion method.

In recent times, the corrosion method has developed rapidly and various modifications have been proposed. It is worth noting that among the methods of vascular research, it took one of the prominent places.

Celluloid is still widely used for the production of corrosive preparations. The main disadvantage of this substance is that the corrosive preparations are inelastic, that's why it is often impossible to view branches located in depth. Preparations break easily and, most importantly, can not be kept for a long. Because of all this, the use of latex (liquid synthetic rubber) has an undeniable advantage over celluloidin and other non-elastic materials for the production of corrosive preparations.

In order to make vascular corrosive preparations, natural latex was used for the first time by François Frank, and synthetic latex by V. Stefanova (1949, 1953), who studied placenta blood vessels with this substance.

For the last 12-15 years, the method of injection of synthetic latex for vascular study has been successfully used by the Department of Operative Surgery and Topographic Anatomy of Tbilisi State Medical Institute, and a number of examinations have been performed with this method.

The conducted work showed us that corrosion using latex is one of the important methods of studying the vascular system, which has certain advantages compared to other similar methods. Because of this, we chose the corrosion method using artificial latex as the main method of vascular anatomical examination of the liver.

Latex is a milky liquid in which the concentration of dissolved rubber reaches 50%. The volume of its particles (rubber balls) is so small that this liquid passes freely even through the smallest blood vessels. The

injection technique is simple and can be performed without any preliminary preparation. Under the influence of acids and alkalis, the latex curdles, hardens and gives an initiated vascular imprint.

We preliminarily measured some liver measurements according to specially designed questionnaires (liver weight, lobe length, width and thickness, gallbladder dimensions, blood vessel diameters, etc.). Registration of the shape of the organ as a whole was done by drawing its superior and inferior surfaces on frosted glass and then transferring it to paper. After that, we washed out the blood vessels with normal (tap) water and 2-3 hours after washing out we started the injection. During this time, the organ loses a certain amount of fluid, which is necessary for the proper injection. The freer the blood vessels are from fluid and blood, the better the quality of corrosive preparations.

After such preparation, a blunt needle of the "Record"[1] syringe was inserted into the lumen of the blood vessel, which was fixed with a ligature. As a rule, the syringe was filled with some oil (preferably sunflower oil). After that, it was filled with an injection mass, which was injected into the lumen of the blood vessel with uniform pressure. We used both 5 and 10, and 20 gram "Record" syringes.

The injection was carried out in two moments, but always under the same pressure. For the first time, a mass diluted with distilled water (1:1) was injected into the blood vessels under a relatively low pressure (up to 90-100 mm of water column[2], after 6-8 hours, a repeated injection was made under relatively high pressure (up to 120-130 mm of water column), As a result, blood vessels were filled as much as possible.

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1. *Reusable collapsible syringe with glass body, silicone ring and metal fittings.*

2. *It may be defined as the pressure exerted by a column of water of 1 cm in height at 4 °C (temperature of maximum density) at the standard acceleration of gravity. 1 centimeter of water gauge equals 98.0665 pascals.*

Injections were made on an isolated (resected) liver. According to some authors (A. Melnikov, 1922), we cannot get a complete idea of the topography of intra-organ blood vessels by observing the isolated liver, because it is deformed after excision. According to our observation, blood vessels can be studied on the isolated liver as well as in situ, if we create equal pressure conditions around the organ during the injection. The conditions under which the injection is made are of great importance. The hard and soft consistency of the liver easily changes shape on the injection table, which affects the distribution of the mass injected into the blood vessels and the form of the received material.

In order to avoid the mentioned negative circumstance, we placed the liver prepared for injection in water, thus creating equal pressure conditions around it and no deformation of the organ was observed. After the injection, we transferred the material to an 80% solution of technical hydrochloric acid, as a result of which the conditions of equal pressure around the liver remained unchanged. After disintegration of the liver tissue (which takes 8-10 days), we washed the material with running (tap) water.

Corrosive preparations made in this way give an accurate representation of the system of blood vessels (Fig.1,2), they are characterized by appropriate flexibility and strength. In addition, they are kept for a long time. In the case of the simultaneous study of different vascular systems by the method of corrosion, the different ratio of the injection mass is an important issue.

This issue is particularly noteworthy because most commonly used dyes are either insoluble in latex or discolored by hydrochloric acid. To obtain the red color, we used methyl orange or red scarlet, of which the latter turned out to be better. When the latex is dyed with scarlet, the preparation acquires a bright red color and, most importantly, is much cooler and more flexible than a corrosive preparation made of latex colored with other dyes or completely undyed. To get a bright red color, we added 2-3 grams of scarlet for every 500 grams of latex.

Fig. 1

Intra-organ branching of the portal vein (corrosive dissection)

Red scarlet in latex does not dissolve quickly, it takes 10-12 days to dissolve. We reduce the time required for coloring by boiling the injection mixture. It should be noted that boiling latex does not change its ability to coagulate.

In the early days, we mixed non-freeze-resistant (alcohol-free) mascara in the injection mass to make black preparations. Later, it was found that nigrosin (in powder form) is better for this purpose. The latter dissolves easily in latex and gives a completely black specimen. 2-3 grams of nigrosin are needed for coloring 400 grams of latex.

Fig. 2

Intra-organ branching of the portal vein (corrosive dissection)

For latex coloring, we also used bile, the pigments of which were sufficiently resistant to hydrochloric acid. Bile was mixed with the injection mass immediately before the injection, as a result of which a yellowish-green color was obtained.

Thus, in the case when we intended to make corrosive preparations of four different systems, we introduced a red mass (stained with red scarlet) into one system, a black mass (stained with nigrosin) into the second, a yellowish green mass (stained with bile) into the third, and a white mass into the fourth (colorless) system.

Corrosive preparations made of latex are stored for a long time. Currently, we have at our disposal vascular corrosive preparations of various systems, which have not been completely changed for 12-15 years. Preparations are stored both wet and dry. For wet storage, the preparations are placed in a 2-3% formalin solution, and for dry storage - in a hermetically sealed container. Without it, as a result of excessive drying, the material becomes wrinkled, loses elasticity and changes its color to some extent.

In order to clarify the topographic relationship of the main blood vessels in the separate lobes of the liver, we made preparations along with corrosion (corrosion by preparation), which is manifested in the fact that after the injection, the liver is placed in concentrated hydrochloric acid for 3-4 days. This time is quite enough for the transformation of the latex into rubber, while the liver tissues are still dissolved and the organ retains its shape. After that, the preparation is produced in the usual way, but much easier, because the sufficiently dense, elastic rubber is less damaged and it can be separated from the liver tissue relatively easily. The preparation is carried out from porta hepatis to the depth of the organ, to the branching of blood vessels of the III row (Fig. 3), and produces their detailed registration. After that, the material is placed again in the hydrochloric acid solution until its complete corrosion.

In five cases, blood vessels (hepatic veins) were also examined by X-Ray. In this case, we used a lead syringe dissolved in turpentine as a contrast agent.

Thus, for the study of intra-organ blood vessels and bile ducts of the liver, we used both the corrosion and corrosion-preparation and X-Ray methods, and in this way separate and complex specimens of systems were made from 130 isolated livers, the number of which according to systems is shown in table 2.

Fig. 3
Branches of the first, second and next row of the portal vein (specimen)

Number of preparations made								
Portal Vein	Hepatic Artery	Hepatic Veins	Biliary ducts	All 4 systems	Portal and Hepatic Veins	Portal Vein and Hepatic arteries	Portal Vein, Hepatic artery, Biliary ducts	Portal Vein, Biliary ducts
50	3	12	13	23	6	11	6	6

Summary by Systems			
Portal Vein	Hepatic artery	Hepatic veins	Biliary ducts
102	43	41	48

Table 2

LIVER SHAPE

The aim of one part of our research is to study the liver, because the internal architectonics of this organ also changes due to the change in shape (A. Melnikov, 1924).

Liver is one of the important organs of the digestive system, which is sharply distinguished from other organs of the abdominal cavity both in terms of function and size. Its weight varies between 1400-2000 grams according to different authors (L. K. Cruvelier, F. Sapei, L. Testiu).

When we compare the absolute weight of the liver with the total weight of the body, it is especially acceptable to take into account the age, because it is known that in the embryonic period the liver is a massive organ and it occupies the largest part of the abdominal cavity. During the period of fetal and extrauterine development, the relative volume of the liver gradually decreases. According to this, the ratio of liver and total body weight also changes.

According to V. Chernov (1909), the weight of the liver of newborns is equal to 4.33% of the whole body weight, according to Gogitidze (1927) it is 4.4%; According to F. Heiderich (1934) — 4.57-5.47%. According to the same V. Chernov and S. Gogitidze, the ratio in adults is 2.65%. The observations of F. Kovalski, N. Gundovin and others speak in favor of these data, according to which the liver of the fetus has a relatively large volume, but after birth it gradually lags behind the overall growth of the body, and this should explain the relative difference that exists between the weight of the liver and the total body weight.

Thus, along with human growth and development, the relative size of the liver changes visibly, but it should also be noted that the size of the liver is not always the same even in people of the same age. In this case, the variation of the amount of the liver is related to the forms of its individual development.

According to our material, the weight of the liver varies from 800 to 2000 g (on average it is equal to 1420 g). The difference by gender is small. The average weight of the liver in men is 1423 grams, and in women - 1417 grams.

From these data, it is clear that there is a wide range of variation in the size of the liver, which cannot have a certain importance for the formation of its shape.

The formation of the peculiar shape of the liver is associated with various factors, for example: age (F. Kowalski, 1905), the influence of the bordering organs (N. Burole, 1911), the location of the diaphragm and the influence of its compression (V. Vorobiov, 1933), the influence of gender (L. Hirtle), etc.

Undoubtedly, all the above-mentioned aspects have a certain importance, but as it was found out in recent times, the constitutional factor plays a greater role in the formation of the shape and location of the liver, which includes both internal (embryonic) and external parameters, which is manifested in the form of individual variation.

Different authors describe the shape of the liver in different ways. The difference in the description of the shape of the liver follows from the variation in the individual development of its lobes, and the overall shape of the liver is determined by the same. Therefore, studying the shape of the liver without considering its separate lobes, namely, the right and left lobes, would lead to inaccurate conclusions. We do not mean to study them in isolation, but as a whole in relation to each other.

Right Lobe

The fact that the liver mainly consists of the right and left lobes does not cause controversy in the literature, but the issue of the existence of a border between them causes a difference of opinion.

According to some authors (Kentley)[1] the boundary between the right and left lobes should be considered the gallbladder, since the latter is located in the middle part of the organ at the beginning of its development.
According to Bradley[2], the border between the right and left lobes of the liver is the line connecting the fossa of the gallbladder to the place where the hepatic veins join the inferior vena cava.
The majority of authors do not share this opinion, since the location and direction of the gallbladder is highly variable. In addition, as a result of such a division, the quadrate and Spiegel lobes belong to the left lobe.

The majority of authors consider the suspensory ligament to be the boundary between the right and left lobes of the liver, the line of which is attached to the liver is the location of the left longitudinal groove on the inferor surface.

As the length of the lobe, we took the distance from its lateral edge to the left (sagittal) groove, as the width - the largest anterior-posterior dimension of the lobe, and as thickness - the maximum vertical dimension.

According to our material, the length of the right lobe of the liver varies from 11.5 to 22 cm (average - 15.8 cm), width - from 9 to 22 cm (average - 17.5 cm), and thickness - 4 from to 9 cm (on average - 6.5 cm).

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1. *citation according to N. Buerle*

2. *citation according to F. Levis*

According to these data, the maximum of the range of variation of the length and width of the right lobe of the liver is the same, but according to the amplitude and average value of the variation, the width indicators are higher than the length. In some specific cases, sometimes the length is greater than the width, or vice versa, or their indicators are almost equal.

To express these ratios in percentages, Sh. Toidze (1949) provided an index that shows what the comparison of the width of the right lobe with its length is equal to in percentage:

$$\frac{\text{Width of the right lobe} * 100}{\text{Length of the right lobe}}$$

The author processed his material in this manner. It was found that the index of the relative width of the right lobe ranges from 70 to 128, that is, in one case, the width lags behind the length and is 70% of it, in the other case, the width exceeds the length by 28%. Relatively often, the length and width of the right lobe are almost equal.

It should be noted that Sh. Toidze established a certain regularity between the relative width index of the right lobe and the variability of the overall shape of this lobe. According to his observations, in the case when the width of the right lobe exceeds the length, the edges of the lobe are separated from each other by corners (quadrangular shape), and vice versa, when the width is less than the length, then the free edges of the lobe are directly connected to each other, that is, the corners are not expressed (hemispherical shape).

In addition, the right lobe of the quadrangular shape is wide and thin, the superior surface is flattened, and the inferior surface is flat. The hemispherical-shaped right lobe is thicker. Its superior surface is sharply bulging, but on the inferior surface is noted irregularity (traces of organs).

To determine the ratio of the length and width of the right lobe of the liver, we also used a simple ratio:

$$\frac{\text{Length of the right lobe} * 100}{\text{Width of the right lobe}}$$

It was found that the index of relative length of the right lobe ranges from 63 to 133. This means that on our material in one case the length is less than the width and is 63% of it, in the other case the length exceeds the width by 33%, and in more frequent cases the length and width of the right lobe are almost equal or completely equal. Along with the change in the mentioned proportions, the general outline and shape of the right lobe also changes visibly. In this regard, the right lobe of the liver is more quadrangular in one case, hemispherical in the second case, and in the third case it is almost trapezoidal in shape, with a narrow part facing down and gradually thinning from top to bottom like a wedge.

Left Lobe

The left lobe of the liver is highly variable in terms of its shape and size, which is mainly due to the reduction process of this lobe.

It is known that in the early period of embryonic development, the right and left lobes of the liver are of equally developed (L. Testiu, O. Hertwig, A. Panshi and others), then the left lobe gradually begins to lag behind in growth or, as some authors note, to reduce. The left lobe of the liver is significantly smaller in adults. According to A. Rauber, it is only 1/5 of the right lobe.

As it turns out, reduction processes do not spread equally in the left lobe. Sometimes it will be more clearly manifested as a decrease in length, and in other cases, on the contrary, in the form of a decrease in width. According to this, the indicators of the ratio of the length and width of

the left lobe and its overall shape change visibly. Therefore, we mainly studied the variability of the left lobe according to the relationship between its length and width. Taking proper measures was produced on the bottom surface. The length was measured from the middle level of the left longitudinal (sagittal) groove to the left edge of this lobe (maximum size), the width - in the anterior-posterior direction in the widest part, which is more often located near the suspensory ligament. The thickness was determined in the thickest part of the lobe.

The analysis of the material showed that the length of the left lobe of the liver varies from 6 to 19 cm (average is equal to 9.5 cm), the width is from 10 to 19 cm (average - 13.9 cm), and the thickness is 2.5 to 8 cm (average - 4.4 cm). According to these data, the length of the left lobe varies in a relatively wider range than its width.

To determine the ratio of the length and width of the left lobe of the liver, we used the same index as we used to determine the relative length of the right lobe:

$$\frac{\text{Length of the left lobe} * 100}{\text{Width of the left lobe}}$$

It was found that the relative length index of the left lobe ranges from 42 to 150, that is, in one extreme case, the length of the left lobe is much less than the width and is 42% of it, and in the other extreme case, the length is 3.5 times greater than the width. More often, the length is significantly less than the width. This fact indicates that reduction processes in the left lobe are more intensive in the length direction than in the width direction, that is, the shortening of this lobe occurs from the left edge in the direction of the middle line.

The relationship and variability of the length and width of the left lobe mainly determines the overall shape of this lobe. According to the research of Sh. Toidze (1956), in the formation of the shape of the left lobe, in addition to the above, the expression of the corners and edges of

this lobe and their variability are of some importance. According to this, three different forms of the left lobe are distinguished:

- In the case of form I, both the anterior and posterior corners are clearly defined and the lobe is quadrangular in shape.
- In form II, only the posterior corner is expressed and the shape of the lobe is triangular.
- In form III, the corners are not marked and the shape of the lobe is approximately semilunar shaped.

According to our material, three main forms of the left lobe of the liver were identified:

1. Both anterior and posterior corners are expressed and the lobe is approximately quadrangular in shape (13.7%);
2. Only the posterior corner (42.2%) or only the anterior corner (10.8%) is well defined, but in both cases the overall shape of the lobe is triangular (53%);
3. The corners are not completely marked and the lobe has a semilunar shape (33.3%).

Therefore, the results of our observation coincide with Sh. Toidze's data, with the difference that in the case of a triangular shape, sometimes the posterior corner is more clearly expressed, thus the apex of the triangle is turned posteriorly and superiorly. Sometimes the anterior corner is more clearly defined. This time the apex of the triangle is turned anteriorly and inferiorly. In fact, in both cases, the left lobe is triangular in outline.

Thus, the left lobe of the liver standing on the path of reduction is much more variable than the right lobe. It should be noted that the reduction process is more pronounced in its anterior lateral edges, and this should explain why the triangular shape with the angle turned posteriorly is more common among the named forms.

Here, it should be noted that the reduction process in the left lobe of the liver is quite visible, but it is not always expressed with the same intensity. In some cases, the left lobe is almost equal to the right lobe, and sometimes it even exceeds it in newborns. However, there are cases when the left lobe is very small and is almost an appendage of the right lobe. Such an unequal interdependence of liver lobes is of great importance in determining their general form. Therefore, we studied the relationship between the length indicators of the left and right lobes:

$$\frac{\text{Length of left lobe X 100}}{\text{Length of the right lobe}}$$

The obtained index was mainly determined by the ratio of the length of the left lobe to the length of the right lobe (Table 3).

relative length index of left lobe	Number of cases	%
30-40	**5**	**4,9**
41-50	**20**	**19,6**
51-60	**31**	**30,4**
61-70	**29**	**28,4**
71-80	**11**	**10,8**
81-90	**3**	**2,9**
91-100	**1**	**1**
101-110	**2**	**2**
Total	102	100

Table 3

The ratio of the lengths of the left and right lobes of the liver

As can be seen from Table 3, the length of the extremely short left lobe is equal to 30 - 40% of the length of the right lobe, the length of the extremely long left lobe exceeds the length of the right lobe, but such cases are relatively rare (2%). More often, the length of the left lobe is

equal to 60-70% of the length of the right lobe, that is, usually the length of these lobes is related to each other as 0,6:1 or 0,7:1.

Thus, the length of the left lobe of the liver is more variable compared to the right lobe, which, along with other indicators, mainly determines the overall shape of the liver. It should be noted that increased length mostly characterizes the left lobe of triangular and quadrangular shape, while relatively short length characterizes the left lobe of semilunar shape. However, the long left lobe is more pronounced in the case of the quadrangular right lobe, and the short left lobe in the case of the hemispherical right lobe.

Quadrate Lobe

The quadrate lobe is relatively small in area and is located between the left longitudinal (sagittal) groove, the gallbladder and the porta hepatis. The variation in its shape is highly individual, which is mainly related to the overall development of the liver and gallbladder.

According to Genesis data, separation of the quadrate lobe begins from the third month of embryonic development, as the gallbladder does not take its final location until this time. In this regard, the change in its shape mostly depends on the shape and localization of the gallbladder.

According to N. Burle's observations, the quadrate lobe does not justify its name, because he did not see such a shape either in embryos or in human-like monkeys. The author mostly encountered the wedge-like shape of the quadrate lobe, but, nevertheless, he considers it more appropriate to use the term adopted by G. Ruge - the anterior lobe of the porta hepatis.

Sh. Toidze (1956) described the triangular, trapezoidal and rectangular (most common) forms of the quadrate lobe.

In newborns, oval (most frequent) and wedge-like forms of the quadrate lobe was identified by us (1947).

It should be noted that the age factor, along with other factors, is of great importance in the formation of the Quadrate lobe, because significant changes in the formation of its boundaries are also noted in this regard.

It is known that newborns and early-aged children are characterized by a deep location of the gallbladder, the fundus of which often does not reach the anterior edge of the liver. In this regard, the right border of the quadrate lobe in the form of a right longitudinal (sagittal) groove is not always expressed along its entire length and continues in the right lobe. Due to age, the gallbladder takes a superficial position and its fundus approaches or even exceeds the anterior edge of the liver. At the same time, it visibly widens in the area of the body and especially in the fundus, and the direction of its axis also changes to some extent. All this leads to a change in the right border of the quadrate lobe, which, in turn, affects the overall outline of the lobe. Along with the right longitudinal (sagittal) groove, the left longitudinal groove also undergoes changes in that its edges gradually grow together with age, which is also important in forming the overall shape of the quadrate lobe.

It is worth noting that the development of the gallbladder and the left longitudinal groove will be manifested in different ways even in adults. According to this, the Quadrate lobe is very variable even in adults. According to the main features, it has three types of shape: quadrangular, trapezoidal and oval (Table 4).

Quadrate Lobe Shapes	Number of cases	%
Quadrangular	**39**	**38,2**
Trapezoidal	**21**	**20,6**
Oval	**30**	**29**
Uncertain form	**12**	**11,8**
Total	102	100

Table 4

As shown on Table 4, the quadrangular shape is the most frequently observed among the quadrate lobe shapes, and the trapezoidal shape is relatively rare. In 11.8%, the shape of the lobe is completely unclear and does not resemble any geometric shape.

It should be noted that the four-cornered quadrate lobe is more often found in the case of good development of the two (right and left) lobes of the liver, and the trapezoidal quadrate lobe - in the case of weak development of the left lobe of the liver.

Caudate Lobe

The caudate lobe is located behind the porta hepatis. Its left border is the posterior part of the left longitudinal (sagittal) groove, and its right border is the groove of the inferior vena cava. This latter vein is less noticeable in newborns and early-aged children, because the inferior vena cava is located deep in the liver parenchyma and only a canal is created for it. In adults the mentioned groove is well expressed, the width of which, according to Sh. Toidze (1949), ranges from 2.5 to 4 cm at the upper end, and from 2.0 to 3.7 cm at the lower end. Therefore, in this case, the caudate lobe is sharply separated from the right lobe of the liver.

According to the literature, the recognition of the caudate lobe as a separate part is controversial. Some authors attribute it to the right lobe

(I. Leden), while others consider it an independent part, which is formed as a result of local cell proliferation and is secondarily connected to the right lobe. According to its location, it is called the retroportal, dorsal lobe (G. Ruge, 1911).

According to the phylogenic and ontogenic development, the caudate lobe should be considered a separate part, which begins to develop at the end of the third month of embryonic life. (Brashe)[1]
Two processes are formed on the wide end of the mentioned formation, of which the left one is relatively short and blunt, conical, and the right one is long and flatter. The degree of development of the above-mentioned processes and the length-width relationship of the caudate lobe itself mainly create the individual development forms of this lobe.

The following forms of the caudate lobe have been described: quadrangular (N. Lisenkov), triangular (Golstein), saddle-like (Sh. Kevanishvili, 1947) and others.

According to Sh. Toidze, there is a wide caudate lobe with well-developed processes and a narrow caudate lobe with weakly developed processes.

According to our material, the length of the caudate lobe varies from 4 to 9 cm (average equal to 5.7 cm), and the width - from 2 to 6 cm (average 3.2 cm). As can be seen from these data, the maximum length caudate lobe is about twice as long as the minimum length caudate lobe, and the maximum width caudate lobe is three times as wide as the minimum width caudate lobe. Therefore, the width of the caudate lobe varies more than the length. In addition, its length is always greater than its width.

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1 - citation according to O. Hertwig

During the analysis of the material, we took into account the main distinguishing features of the caudate lobe: the length-width ratio, the development of the mastoid and caudate processes, and hence its overall outline.

Considering these signs on our material, the following forms of the caudate lobe were identified:

1. Wide, quadrangular caudate lobe (34.3%), on which both processes are moderately pronounced, and there is a notch between them;

2. Narrow, oval-shaped caudate lobe (27%), on which no processes development is noted;

3. Caudate lobe with a good development of mastoid process (25%). In this case, this process is evenly rounded, and the caudate process is completely imperceptible;

4. Caudate lobe with good development of caudate process (13.7%). This time, the mastoid process is completely underdeveloped, and the caudate process is a direct continuation of this lobe, which, in turn, is located between the porta hepatis and the inferior vena cava in the form of the colon-renal crest (crista colicorenalis).

It should be noted that the quadrangular, wide caudate lobe is mostly characteristic of a flat liver, and the oval, narrow caudate lobe is characteristic of a thick, compact liver. The other two forms should be considered as transitional options. They are marked in different ways in this or that form of the liver.

SHAPE AND LOCATION OF GALLBLADDER

The shape, location, and especially the relation of fundus of gallbladder to the anterior edge of the liver is highly variable, which should be explained by the age changes of this organ and the individual characteristics of its development.

It is known that in the early period of embryonic development and three months after birth the gallbladder is located deep in the liver tissue. At this time, it is relatively narrow, has a small volume, and its base does not reach the anterior edge of the liver, and in the later period of its development, it gradually expands, occupies a superficial position, and its fundus also moves to the anterior edge of the liver. It should be noted that such a process continues even after birth with increasing age. This can be seen from the observation of I. Vitkind (1936) and us (1956) that the gallbladder in newborns is narrow, has a finger-like structure, and its fundus most often does not protrude from the anterior edge of the liver. In adults, according to A. Lurie, C. Parture and Dilesenger, the gallbladder is wide and its fundus more often protrudes from the anterior edge of the liver.

Changes in the shape and location of the gallbladder cannot be explained by the influence of age alone, because it varies within a wide enough range even at the same age.

According to Sh. Toidze, in some cases, the fossa of the gallbladder is deeper and the bladder is almost completely buried in the liver parenchyma. In this form, the fundus of the gallbladder does not reach the anterior edge of the liver. In some cases, the fossa depth is relatively small, the gallbladder is located superficially, and its fundus more often reaches or exceeds the anterior edge of the liver.

According to our data, the length of the gallbladder varies from 5 to 13 cm (mean 8.3 cm) and the width from 2 to 6 cm (mean 3.9 cm). These numbers speak for themselves about the variation in the length and width

of this organ within a wide enough range, which also greatly affects the outline of its general shape. That is why different authors describe different forms of gallbladder.

According to P. Tio, the gallbladder is pear-shaped. According to L. Testius, it can also be cylindrical and ovoid.

All three named forms of gallbladder were observed on our material, but with different frequencies, which is shown in Table 5.

Gallbladder Shapes	Total Number of cases	%
Pear-like Cylinder-like Ovoid	**43** **39** **15**	**44,3** **40,2** **15,5**
Total	97	100

Table 5

As table 5 shows, the pear-shaped form of the gallbladder is the most common, and the ovoid form is the least common.

The fundus and anterior part of the pear-shaped gallbladder is particularly wide, which gradually narrows towards the porta hepatis and passes into the part of the neck. Cylindrical gallbladder is somewhat curved, borders the quadrate lobe along its entire length on the right side, and often gives a recess-like bulge on the right side of the neck. The ovoid gallbladder fully justifies to its name. Its general outline really resembles an egg, the wider end of which is more often directed towards the anterior edge of the liver.

Our attention was also drawn to the location of the gallbladder. It was found that sometimes it is located relatively deep in the liver tissue and is immobile, and sometimes, on the contrary, it is located superficially

and is more mobile. This fact, apart from the theoretical interest, is also important from a practical point of view, in particular, in diagnostics and also in conducting surgical manipulations on the gallbladder.

On our material, in two cases, the gallbladder had its own messentery. It is clear that in both cases the gallbladder was characterized by a wide range of movement.

The location of the gallbladder is interesting and important in that sometimes its fundus does not reach or reaches only the anterior edge of the liver, and sometimes, on the contrary, it is beyond its anterior edge (Table 6).

The location of the fundus of the gallbladder in relation to the edge of the liver	Number of cases	%
The fundus of the gallbladder is beyond the anterior edge of the liver	**71**	**73,2**
The fundus of the gallbladder reaches the anterior edge of the liver	**15**	**15,5**
The fundus of the gallbladder does not reach the anterior edge of the liver	**11**	**11,3**
Total	97	100

Table 6

As can be seen from Table 6, the base of the gallbladder in most cases is beyond the anterior edge of the liver. In addition, it should be noted that the deeper the gallbladder is located in the liver tissue, the more its fundus reaches the anterior edge of the liver, and conversely, the more superficially the gallbladder is located, the more its fundus reaches or exceeds the anterior edge of the liver.

It should be noted that a deep, relatively narrow gallbladder is more characteristic of a flat liver, the left lobe of which is well developed, and a wide gallbladder, located superficially, is characteristic of a thick liver, the left lobe of which is relatively small.

There was no significant difference in the variability of the gallbladder according to gender.

Thus, the changing forms of the liver are formed against the common background of the signs of the individual characteristics of its separate lobes, and the fluctuation of the shape of the liver is also related to the variation of individual signs. It should be noted that in the fluctuation of the individual features of the individual shares, there is a definite interdependence, but this regularity is not absolute. Sometimes a single indicator does not completely cover this or that form of the organ, but based on the relationship of the majority of the main signs, the following forms that are sharply different from each other can be distinguished:

1. Flat, quadrangular liver with good development of the left lobe;
2. Thick, hemispherical liver with weak development of the left lobe.

In the first case, the liver is flattened with its entire mass, the left lobe is well developed. It is almost equal to the right lobe and their general outline resembles a roundangular square, the superior surface of the liver is relatively flat. Traces of organs are less marked on the inferior surface, the grooves and fissures between the lobes are well defined. The quadrate lobe is quadrangular in shape. The processes of the caudate lobe are well defined, short and broad. The gallbladder is narrow, located deep in the liver tissue, and its fundus does not reach the anterior edge of the liver.

In the second case, the liver is thick and massive. The left lobe is weakly developed compared to the right. Their general outline reminds of a hemispherical formation. The superior surface of the liver is convex, and the inferior surface is somewhat concave, especially on the left lobe. The grooves between the lobes are weakly expressed, this is especially true for the left longitudinal (sagittal) groove. The quadrate lobe is trapezoidal, while the caudate lobe is narrow and oval. The gallbladder in this case is wide, located relatively superficially, and its fundus protrudes quite far from the anterior edge of the liver.

The described forms differ sharply from each other and literally determine the variability of variation. Transitional forms are placed between them, which are characterized by the following main indicators: the left lobe of the liver is of medium development (its length is equal to 51-70% of the length of the right lobe). The posterior lateral corner of this lobe is particularly well defined and is directed posteriorly and superiorly (not infrequently ending in a fibrous appendage). The superior surface of the liver is not sharply convex. The grooves between the lobes are weakly expressed. The edges of the left longitudinal (sagittal) groove are mostly ingrown with each other by means of "bridges". The quadrate lobe is oval in shape. The caudate lobe is narrow, its caudate process is well developed. Generally, this lobe is narrow and long. The gallbladder is largely cylindrical in shape and its fundus protrudes slightly from the anterior edge of the liver.

In our material, flat, quadrangular liver with good development of the left lobe was detected in 17 cases (16.7%), thick, hemispherical liver with weak development of the left lobe - in 25 cases (24.5%), and transitional forms - in 60 cases (58.8%).

PORTAL VEIN

The level of development of liver surgery is at such a stage that there is a question not only about the resection of its separate lobes, but also about the excision of separate segments and sub-segments. However, it can be noted that the immediate and distant results of these operations are mainly based on accurate knowledge of the nature of intrahepatic blood vessel branches, their location and interrelationships.

According to the topographic relationship, intra-organ blood vessels and bile ducts of the liver are divided into two groups. The portal vein, hepatic artery and bile ducts are placed in the first group, and the hepatic veins are placed in the second group.

The intra-organ part of the portal vein system is really closely related to the intra-organ part of the hepatic artery and bile ducts. That is why the study of the portal vein gives us a complete clear view of the location of the branches of the hepatic artery and bile ducts.

Such a relationship affects both the main trunks and branches of the second and next row of these systems, and in the relationship of the first row branches this parallelism is not always preserved. There are cases when the portal vein is divided into two branches of the first row, and the hepatic artery into three or four branches. Also, the hepatic duct is formed by joining two (right and left) or three (two right and one left) ducts. Thus, the numerical indicators of the branches of these three systems in the area of porta hepatis are fluctuating, while the course of their next branches is always coincident and parallel.

The portal vein is a blood vessel of a special property. It collects blood from all organs of the abdominal cavity (stomach, duodenum, small and large intestines, pancreas, spleen and gallbladder) and enters the liver.

According to some authors, there are two blood flows in the main trunk of the portal vein.

According to Serzhe, one stream of blood flows from the superior messenteric vein, the other from the splenic vein. Moreover, the author

notes that blood from the superior messenteric vein passes into the right branch of the portal vein, and from the splenic vein into the left branch.

A. Krasuskaya's experiments (1924), which was done on dogs and rabbits, did not agree with claims by Serzhe. The mascara injected by her into the spleen was distributed to all areas of the liver.

In recent years, this issue was raised again by N. Khashimov (1959, 1960), according to which blood from the superior messenteric vein (in dogs) flows mainly to the right half of the liver, and from the inferior messenteric vein— to both the right and left halves (more to the left half).

Thus, the presence of two blood streams in the portal vein has not been conclusively proven, but it is undoubtedly important to determine some issues of pathology. We can name many more such issues, which are essentially related to the peculiarity of the anatomical system of the portal vein itself. Undoubtedly, a detailed study of its structure will greatly help the researcher to clarify the pathological events related to this blood vessel.

It is known that the main trunk of the portal vein is formed at the level of the second lumbar vertebra by the junction of the superior messenteric, inferior messenteric and splenic veins. From here it goes superiorly and to the right and enters porta hepatis. The largest part of the portal vein is usually located to the right from the midline. In addition, the inclination of its trunk is variable. Sometimes this inclination is clearly expressed, in most cases the location of the trunk is close to vertical. The main collector of the portal vein is a relatively large blood vessel, that is why its wall can be sutured in case of damage. In addition, it should be noted that the wide lumen of the portal vein allows the creation of an artificial porta caval anastomosis.

We measured the diameter of the portal vein both before injection and after corrosion. It was found that its diameter was almost 1.5 mm less on the corrosive preparation. Apparently, this is due to the fact that during the coagulation of the latex, it is dehydrated and the diameter of the lumen is somewhat reduced on this soil. Nevertheless, we measured the diameter of the lumen of both the main trunk and its branches on

corrosive specimens, because it is very difficult to measure the lumens of the intrahepatic branches of the portal vein before corrosion.

It was found that the lumen diameter of the main collector of the portal vein varies from 1 to 2 cm (mean equal to 1.4 cm).

According to F. Walker, A. Nadein and M. Kriemholz, the diameter of the lumen of the portal vein varies from 15 to 18 mm. According to E. Gudkova, it ranges from 12 to 20 mm.

According to A. Kuliabko's research, the average value of the diameter of the portal vein in men is greater than in women. In addition, the size of the diameter of this blood vessel is in a certain relationship with the size of the liver, i.e. the larger the volume of the liver, the wider the lumen of the portal vein.

Thus, the results of our observation are generally close to the data of other authors, with the difference that, according to our material, the diameter of the lumen of the portal vein does not depend on the size of the liver. Sometimes the liver is large in volume, but the diameter of the portal vein is smaller, and vice versa.

The portal vein usually divides into an unequal right and left branch in the region of porta hepatis. The left branch is narrower than the right one, but much longer (Fig. 4).

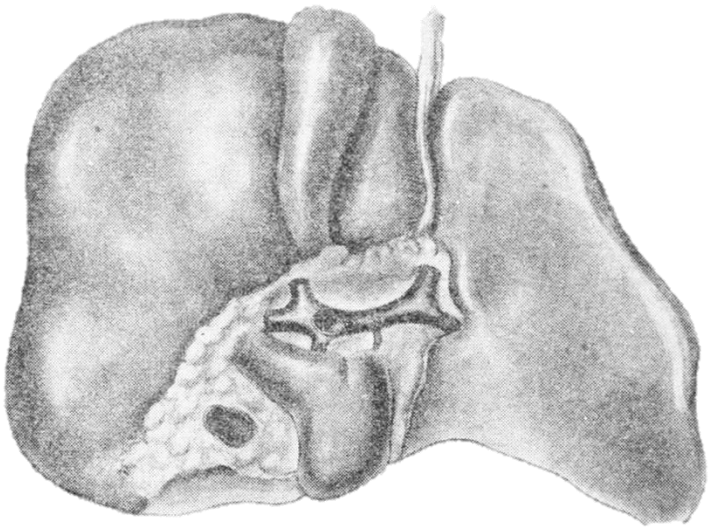

Fig. 4. Branches of the first and second row of the portal vein (preparation)

Immediately after the division, the two branches of the vein take the opposite direction to each other. Both the right and left branches, reaching the sagittal groove of the same name, are further divided into different number of branches of the second row. Branches of the first row are placed in the region of porta hepatis and are wrapped in the fibrous connective tissue. These branches are most often located superficially, so that it is quite possible to separate them without damaging the liver parenchyma. Rarely, they first dive deep into the liver tissue.

The portal vein is divided into branches of the first row under different angles: either nothing is said about it in the literature sources, or very little information is found. According to our material, the angle mentioned in adults ranges from 70° to 170° (mean equal to 120.9°).

Branches of the first row emerge from the portal vein at different angles. On adult material, the angle of separation of the left branch varies from 60° to 170° (mean 93.2°). The angle of exit of the right branch on the same material ranges from 10° to 100° (mean 37.5°). From these data, it is clear that the angle of exit of the left branch varies in a particularly wide range and is mostly blunt.

Thus, in adults the right branch of the portal vein more often emerges under a small angle and in its direction seems to be a direct continuation of the main trunk, while the left branch, on the contrary, mostly emerges under a blunt angle, i.e. it has a somewhat opposite direction to the main trunk of the portal vein (Fig. 5, 6, 7). Due to such a system of blood vessels, in the right lobe of the liver there are much better hemodynamic conditions for portal circulation than in the left lobe.

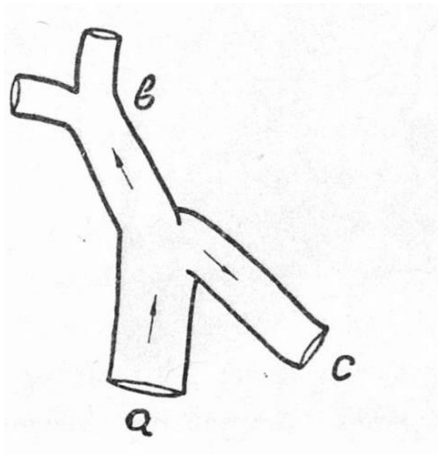

Fig. 5
a - The main trunk of the portal vein;
b - Right branch of the portal vein;
c-left branch of the portal vein (scheme)

We must mean that during the development period, the growth retardation of the left lobe of the liver should also be caused by the obstruction of portal blood circulation in this lobe.

Such is the peculiarity of separation of the permanent branches of the first row of the portal vein and the variation of their separation angle, which, in addition to theoretical significance, also has a certain practical significance.

It should be noted that our material revealed cases when the portal vein was divided not into two, but into three branches of the first row — right, left and middle branches.

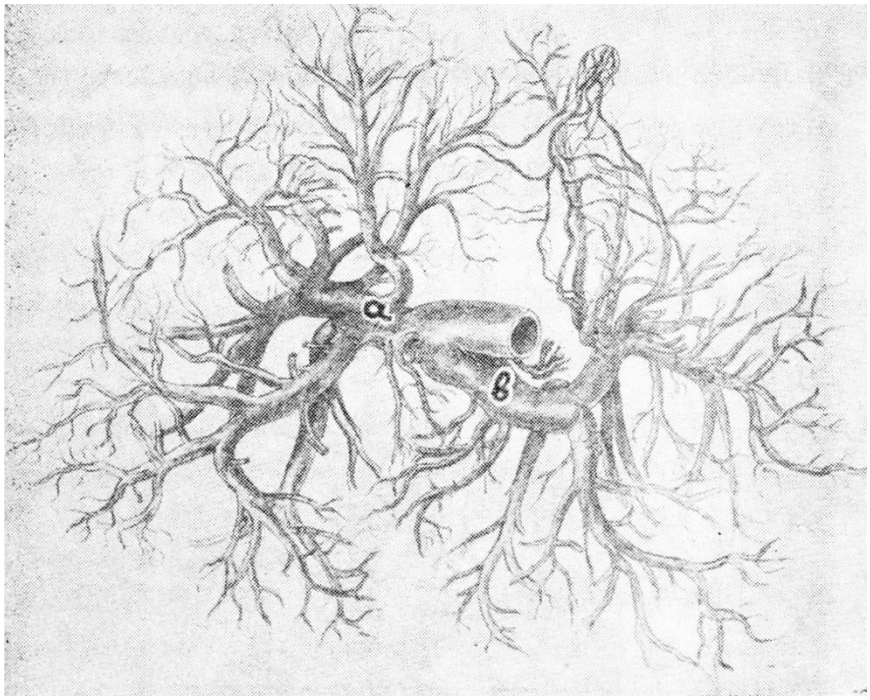

Fig. 6. - Right branch of the portal vein (a) comes out under an acute angle, left branch (b) under a blunt angle.

In its direction and distribution, the middle branch actually represents the ascending vein. It comes out more often from the right branch, relatively rarely - from the left branch, and sometimes from the portal vein itself. The diameter of the ascending vein is larger when it exits directly from the portal vein. It is largely equal to the right and left branches. Sometimes it even exceeds them. Since it is located between the right and left branches, it can be called the middle branch, or the ascending branch.

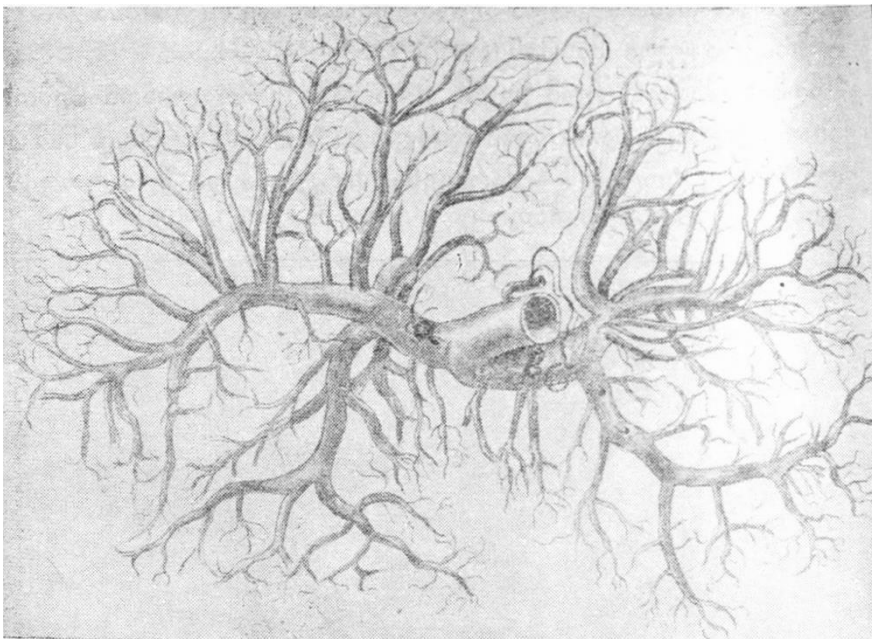

Fig. 7

Left branch of the portal vein (a) emerges under an acute angle,

Right branch (b) under a blunt angle

Depending on the location of the middle, same ascending, branch, three main forms of division of the portal vein were identified on our material (Fig. 8):

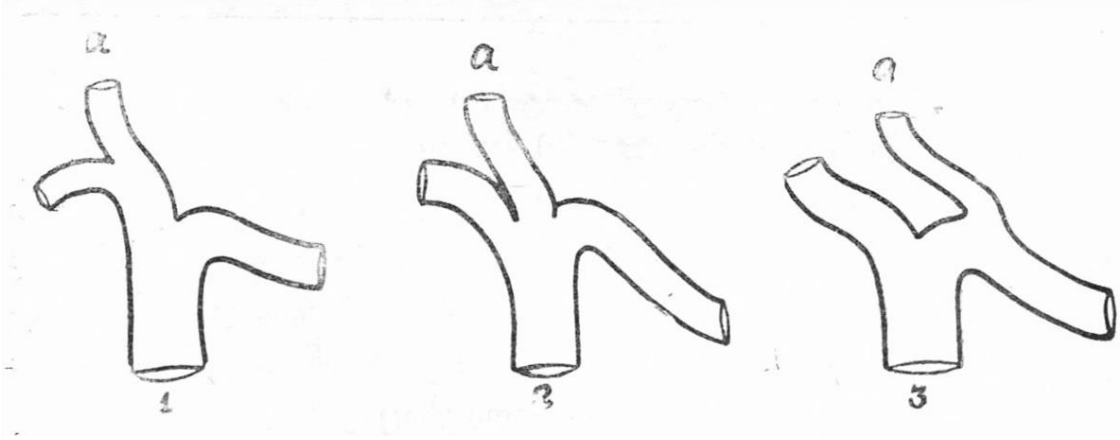

Fig. 8

1 — the main trunk of the portal vein is divided into two branches, ascending vein (a) comes out of the right branch;
2 — the portal vein is divided into three branches, ascending vein (a— the middle branch) comes out of the main trunk;
3. The main trunk of the portal vein is divided into two branches, ascending vein (a) emerges from the left branch (scheme).

1. The portal vein is divided into right and left branches of equal or almost equal diameter. The left branch is longer than the right. From the right branch, the ascending vein comes out and enters the central part of the liver (80.2%);

2. The portal vein is divided into three equal or almost equal diameter right, left and middle (i.e. ascending) branches, the first two branches enter the same named lobes of the liver, and the third one enters the central part of the right lobe (11.9%);

3. The portal vein divides into unequal right and left branches. The length and diameter of the left branch is greater than the right one. From it (the left branch) the ascending vein comes out and enters the central part of the right lobe (7.9%).

Thus, the middle, i.e. ascending branch arises from different sources, but in all cases it enters the right lobe of the liver and finally branches in its thickness, under the surface of the diaphragm (superficially).

The possibility of dividing the portal vein into three branches is not widely known. The vast majority of authors describe two branches of the first row, while some authors note the presence of three branches of the first row.

- For example, According to A. Tarenetsky, the portal vein usually divides into two branches. But sometimes a third branch can be separated from it.
- A. Akilova recognizes the division of the portal vein into three branches, although his material was relatively small.
- On K. Gudkova's material (6 preparations), in one case, the portal vein was divided into three branches of the first row.
- Couinaud has come across several cases of trifurcation of portal vein.
- B. Kuznetsov describes cases where the portal vein was divided into right inferior, right superior and left main branches.

Thus, as it is clear from our material, the presence of three branches of the portal vein is not a random event and it represents one of the options for dividing its main trunk.

Left branch of portal vein

The left branch of the portal vein is described schematically in almost all works. It is usually noted that the left branch is longer than the right, and the lumen diameter of the right branch is greater than that of the left. These data are generally correct, but to better clarify the issue, it is necessary to analyze them in more detail.

The left branch of the portal vein is a peculiar blood vessel that undergoes significant functional and morphological changes during its development. It is known that during intrauterine development, maternal blood flows to the fetus through the umbilical vein, which passes through the left (sagittal) groove of the liver and connects directly to the inferior vena cava in the form of the Arantius' duct (ductus venosus). At the left end of the transverse groove, it anastomoses with the left branch of the portal vein. Therefore, one part of the blood from the umbilical vein is directly transferred to the inferior vena cava through the Arantius' duct, and the other part - after passing through the left branch of the portal vein and liver tissue.

After the birth of the fetus, the umbilical vein undergoes obliteration, and the venous duct of Aranzi transforms into a venous ligament. In this regard, the direction of blood flow changes in the system of the left branch of the portal vein, which in itself leads to a complete transformation of the system of this blood vessel. After such changes, a part of the portal vein and the umbilical vein are distinguished in the left branch. The first of them starts from the main trunk of the portal vein and continues to the left longitudinal (sagittal) groove of the liver, and the second is its direct continuation and is located in the anterior part of the left longitudinal groove, which more often ends in the form of a blind sac.

Thus, the left branch takes an anterior direction immediately after separating from the main trunk of the portal vein. At the place of transition of its first part to the second part, a posterior convex arc is formed, from which in most cases the posterior arcuate vein emerges, e. i. the main trunk of the left branch also literally extends so far. Its next continuation is the remnant of the umbilical vein, which is called the umbilical recess (recessus umbilicalis) by A. Melnikov.

The length of the left branch of the portal vein is variable. According to our material, it ranges from 2 to 4.9 cm (mean 3.5 cm). Also, the diameter of its lumen is also variable. The diameter of this branch on adult material varies from 0.6 to 1.5 cm (mean 1 cm).

The left branch does not represent a blood vessel of the straight direction. It is bent in any plane and sometimes turns spirally, it is worth noting that this irregularity increases with age.

Two main blood vessels emerge from the left branch — anterior and posterior arcuate veins (v.arcuata anterior et v.arcuata posterior). Sometimes the third one also separates - superior arcuate vein (v. arcuata superior). The first two veins are the main branches of the left branch, and the third is either completely absent or weakly developed.

The anterior and posterior arcuate veins have almost the same development (Fig. 9), but there are cases when one of them is relatively well developed (Fig. 10). According to our observation, this phenomenon largely depends on the individual characteristics of the forms of the left lobe itself. In the case when the left lobe of the liver is triangular in shape, the posterior arcuate vein is better developed in terms of diameter, length and abundance of branches. In the case of the quadrangular-shaped left lobe, on the contrary, the anterior arcuate vein is well developed. In the semilunar shape, the anterior and posterior arcuate veins are almost equal, and it can be said that both heads are behind in development.

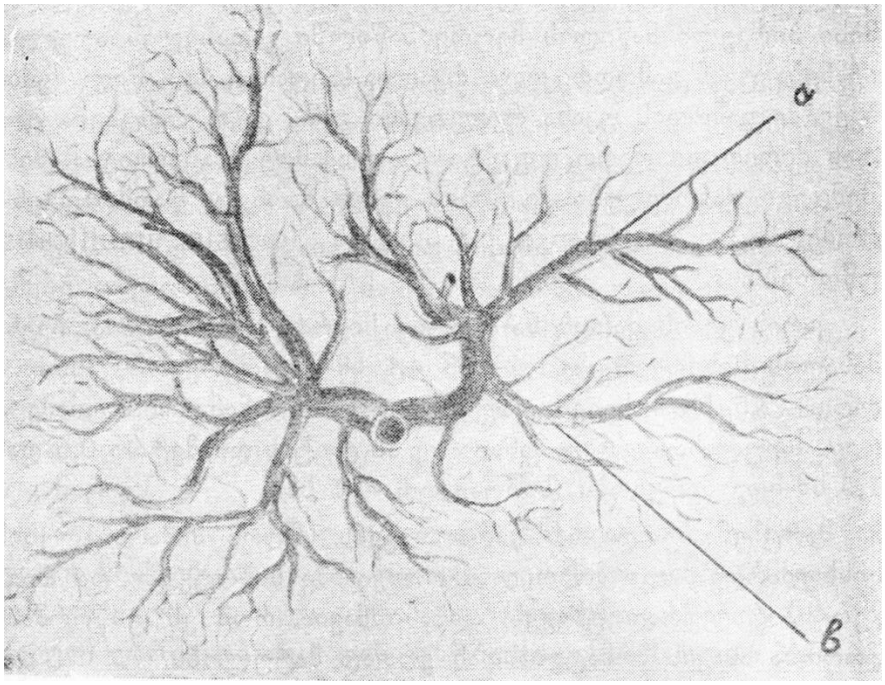

Fig. 9

left anterior (a) and left posterior (b) arcuate veins are almost equally developed

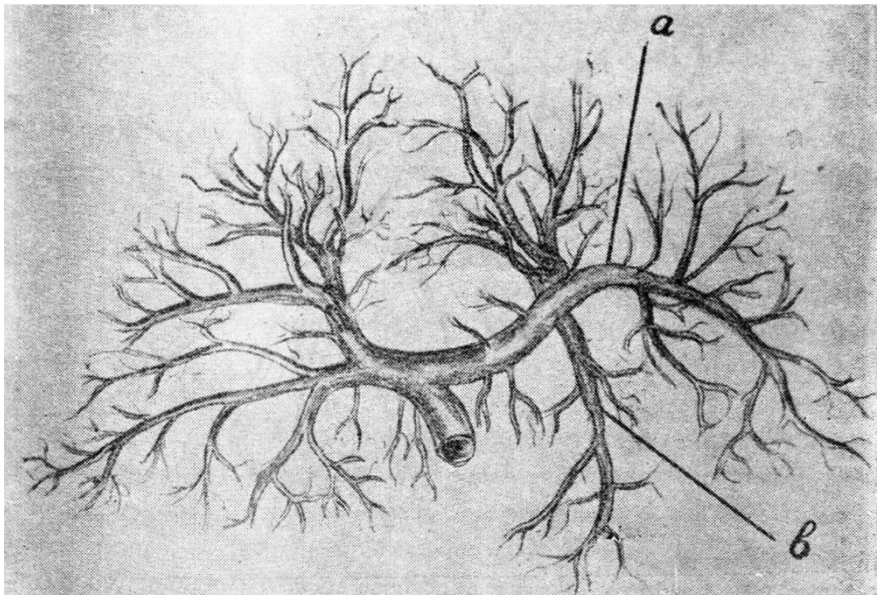

Fig.10

left anterior arcuate vein (a) is well developed, while the posterior arcuate vein (b) is lagging behind in development.

The posterior arcuate vein exits directly from the left branch, and the anterior one from the umbilical recess (Fig. 11). The posterior arcuate vein is separated at the place where the anterior part of the left branch passes into the sagittal part, e. i. At the level of intersection of the transverse groove and the left longitudinal (sagittal) groove. Its exit angle is different. Sometimes it is a direct continuation of the left branch, and sometimes it comes out under a sufficiently large angle. Further, its course is determined by the shape of the left lobe itself. More often it goes to the left, posteriorly and somewhat cranially.

According to our material, the angle of separation of the posterior arcuate vein ranges from 0° to 140° (mean 75.8°). Therefore, this angle in some cases does not exist at all or its magnitude is insignificant. Therefore, it is clear that the portal blood from the left branch passes without any obstacles to the posterior arcuate vein, i.e. in this case, in the appropriate area of the liver, the hemodynamic conditions are good enough for portal blood circulation. We find the opposite phenomenon in cases where the posterior arcuate vein exits the left branch under a relatively large angle. In this case, the hemodynamic conditions of the portal circulation in the appropriate area of the left lobe are relatively unfavorable in relation to the change in the direction of the blood flow. In general, it should be said that the exit angle of the posterior arcuate vein varies in a very wide range, and we can think that the blood circulation conditions of the portal vein in the posterior part of the left lobe should be similarly variable.

As for the diameter of this blood vessel, it ranges from 0.3 to 0.8 cm (mean 0.5 cm) on adult material. Therefore, the posterior arcuate vein is a sufficiently large blood vessel that supplies portal blood to the largest part of the left lobe of the liver. According to our observation, its length depends on the shape of this lobe. The more elongated is the left lobe, the longer this vein is and vice versa.

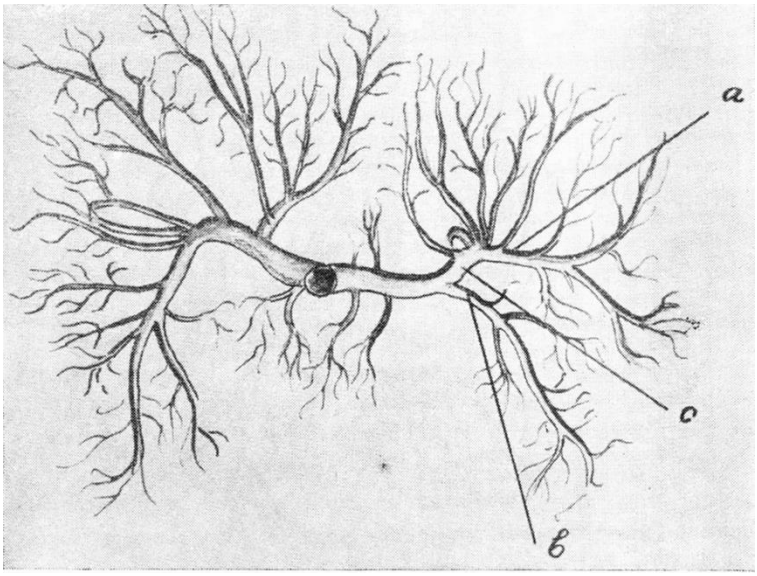

Fig. 11

left anterior arcuate vein (a) leaves the umbilical recess (c), posterior arcuate vein (b) leaves the left branch.

The posterior arcuate vein is located along the posterior edge of the left lobe of the liver, 2-3 centimeters away from it. The direction of this vein is in a certain relationship with the individual development forms of the left lobe. In the case of an elongated lobe, this blood vessel bends gradually to the left and posteriorly and forms an anterior convex arc, while when the left lobe is equally rounded, the posterior arcuate vein also tends anteriorly and thus will be a weakly expressed posterior convex arc. Therefore, the protrusion of the posterior arcuate vein is turned anteriorly in one case, and posteriorly in the other case.

The posterior arcuate vein is located relatively superficially, closer to the inferior surface. Along the way, it gives off a different number of branches of the next row, the number of which varies from 3 to 10. Branches almost always come out at a sharp angle and spread like a fan in all directions. It should be noted that the branching of the posterior arcuate vein is mainly trunk-form, i.e. there is only one main trunk from which relatively small branches of the second row arise, but sometimes the posterior arcuate vein initially divides into two or three branches (in 9%), which in turn further divide into branches of the next row. It is clear that in this case we are dealing with a bush-like (diffuse) form.

Thus, the posterior arcuate vein is mainly of the trunk structure, but in a certain percentage the diffuse form of its branches is also noted.

The left anterior arcuate vein usually originates from the left edge of the umbilical recess and also travels to the left and posteriorly in a convex arc. Its diameter is approximately equal to the diameter of the left posterior arcuate vein. It ranges from 0.3 to 0.7 cm (mean 0.5 cm). It seems that the range of variation of the diameter of the left anterior arcuate vein is somewhat less than the range of variation of the diameter of the posterior arcuate vein. The size of the exit angle of this vein also varies within relatively small limits. It varies from 10° to 90° (mean 52.3°) on our material.

There are cases when the umbilical recess is completely reduced and literally does not present. In this case, the left branch directly divides into anterior and posterior arcuate veins (16%). Therefore, the anterior arcuate vein in one case directly exits from the main trunk of the left branch, and in the other - from the umbilical recess (Fig. 12). In the latter case, it is a direct continuation of the umbilical recess or is separated far from it.

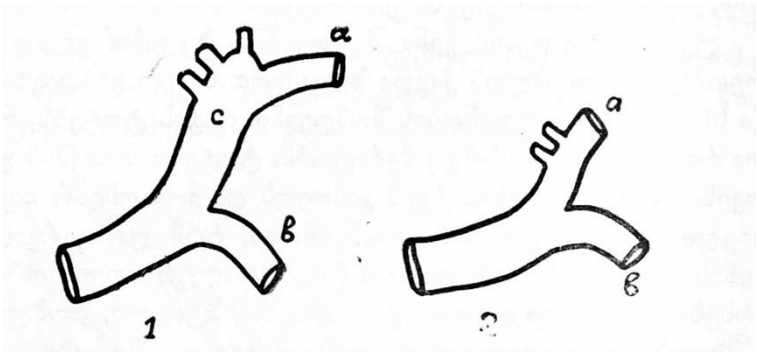

Fig. 12 (scheme)
1- anterior arcuate vein (a) comes out of the umbilical recess (c), the posterior arcuate vein (b) - from the left branch;
2- anterior (a) and posterior (b) arcuate veins emerge from the left branch.

The anterior arcuate vein is more often directed along the left anterior edge of the liver, 3-4 centimeters away from it. Relatively rarely, it takes a direction from the anterior end of the left longitudinal (sagittal) groove to the left and posteriorly. In length, it is almost always behind the posterior arcuate vein, which is explained by the reduction processes that take place in the anterior lateral part of the left lobe of the liver.

A different number (3-13) of branches of the next row is separated from the anterior arcuate vein under an acute angle, which spread out in almost every direction. The anterior branches are relatively shorter than the posterior ones. In addition, the branches of the first row are longer and larger, and the subsequent branches gradually become insignificant in size. In general, the anterior arcuate vein is characterized by trunk branching like the posterior arcuate vein, although bush-like (diffuse) forms are also observed in a sufficiently significant percentage.

The described forms of anterior and posterior arcuate veins are the main variants, but there are also cases where there is only one arcuate vein (in 4%), or the anterior arcuate vein is double (4%).

As for the superior arcuate vein, according to our material, it is completely absent in 52.9% of cases, and in the remaining cases, it is sometimes very slightly developed. This vein is primarily noted when the left lobe of the liver is well developed. The development of the superior arcuate vein lags behind the anterior and posterior arcuate veins. Its diameter, according to our material, ranges from 0.2 to 0.7 cm (mean 0.4 cm). Branching is almost always trunk-form (gives 3-7 branches). The direction of the vein is initially ascending, but then significantly changes direction and gradually bends posteriorly, finally branching under the diaphragmatic surface of the left lobe.

Thus, the left lobe of the liver is supplied with portal blood mainly by the anterior and posterior arcuate veins separated from the left branch of the portal vein, but in a certain percentage (47.1%) by the superior arcuate vein as well.

In addition to the mentioned veins, other thinner and relatively shorter branches emerge from the left branch, which together with the arcuate veins participate in the vascularization of the left lobe. In addition, it should be noted that the left branch of the portal vein also supplies the quadrate lobe (whole) and most part of the caudate lobe with portal blood.

A. Melnikov (1924) divides quadrate lobe veins into two (superior and inferior) groups. According to his observations, the total number of these

veins ranges from two to five. The inferior branches (numbered 1 to 3) start from the umbilical recess. However, one inferior vein is noted in 20%, two in 60%, and three in 20%.

According to our material, the number of veins of the quadrate lobe range from 3 to 8. Of these, three veins are noted in 15.2%, four in 19.2%, five in 35.4%, six in 17.21%, seven in 7%, and eight veins in 6%. Therefore, the quadrate lobe most often includes 5 veins, rarely - 8.

It was also found that the number of both inferior and superior branches varies from 1 to 4. In addition, one inferior branch is noted in 5%, two - in 43.4%, three - in 35.4%, and four branches in 16.2%. Thus, 2 branches are observed most often, 1 is the least common. As for superior branches, one branch is observed in 23.2%, two in 36.4%, three in 27.3%, and four branches in 13.1%. in %. i.e., two superior branches are more often observed, and rarely - four.

The veins of the quadrate lobe begin from the trunk of the left branch of the portal vein or (more often) from its umbilical part. The inferior branches are usually located near the inferior surface of the quadrate lobe (superficially). They go to the right and slightly anteriorly and reach the area of the gallbladder fossa. The superior branches also go in the same direction and disperse under the diaphragmatic surface of the quadrate lobe. Quantitative indicators of the veins of the quadrate lobe have a certain relationship with the size of this lobe itself. In the case when the quadrate lobe is well developed, the number of afferent veins in it is more and vice versa. In addition, the remnant of the umbilical vein, i.e. the size of the part of the umbilical recess is of great importance. When it is well expressed, the number of lobular veins is more and is characterized by diffuse branches, and in the case of complete reduction of the umbilical vein, the number of quadrate lobe veins is less and the number of their branches is also fewer.

Along with the veins of the quadrate lobe, in some cases (33%), there also emerges a recurrent branch (v. recurrentens), which first goes vertically, and then sharply bends from anterior posteriorly and usually reaches the level of junction of the left hepatic vein in the inferior vena

cava. The trunk form of the branching is characteristic of this venous branch. It is located deep enough in the liver tissue.

In A. Melnikov's material, as well as in our material, this vein sometimes started not from the umbilical recess, but directly from the left branch of the portal vein, from one of the branches of its next row, or from the ascending vein. Its distribution and nature of branching are the same in all cases.

Thus, the scope of distribution of the left branch of the portal vein is not limited to the left lobe alone. It supplies portal blood to both the quadrate lobe and most of the caudate lobe, which will be discussed below.

Right branch of portal vein

The right branch of the portal vein has a simple structure compared to the left, but its subsequent branching is much more complex and variable.

It was noted that the exit angle of the right branch of the portal vein is 2.5 times smaller (on average) than that of the left branch. In most cases, it is separated from the portal vein at an acute angle, and because of this, an impression is created as if this branch is a direct continuation of the main trunk of the portal vein.

The analysis of the material showed us that after separating from the main trunk of the portal vein, the right branch in one case creates an anterior convexed arc, which gradually bends posteriorly and inferiorly in the peripheral direction, in the second case it gives off a superior arc and then gradually takes anterior direction, and in the third case it goes anteriorly from the beginning. No matter what forms of location we are dealing with, the length of the right branch and the diameter of the lumen vary as well as the left branch, with the difference that in this case the amplitude of fluctuation is much greater.

According to our material, the length of the right branch varies from 0.5 to 4 cm (mean 1.9 cm), and the diameter of its lumen - from 0.6 to 1.7 cm (mean 1.1 cm).

Thus, the average value of the length of the left branch is almost twice more than of the right branch, and the average value of the diameter, on the contrary, of the right branch is greater than that of the left.

The right branch, reaching the place of connection of right longitudinal (sagittal) groove to the porta hepatis, divides into two, three or four branches of the second row, and these branches, in turn, further divide into different numbers of branches of the third row.

Our attention was drawn to the variation in the number of veins separated from the right branch, the degree of their development and the nature of their distribution. According to all this, four forms of branching of the right branch of the portal vein were detected on our material (Fig. 13):

1. Four branches of the following row are separated from the right branch of the portal vein: anterior arcuate, posterior arcuate, middle arcuate and ascending veins (14.9%);

2. The right branch of the portal vein gives off three main branches of the following row: anterior arcuate, posterior arcuate and ascending vein (18.8%);

3. Two branches of the following row emerge from the right branch of the portal vein: superior ascending and inferior arcuate veins. The latter, in turn, is further divided into anterior and posterior arcuate veins (46.5%);

4. The right branch of the portal vein divides into anterior and posterior arcuate veins. The ascending vein comes out directly from the main trunk of the portal vein (11.9%) or from its left branch (7.9%).

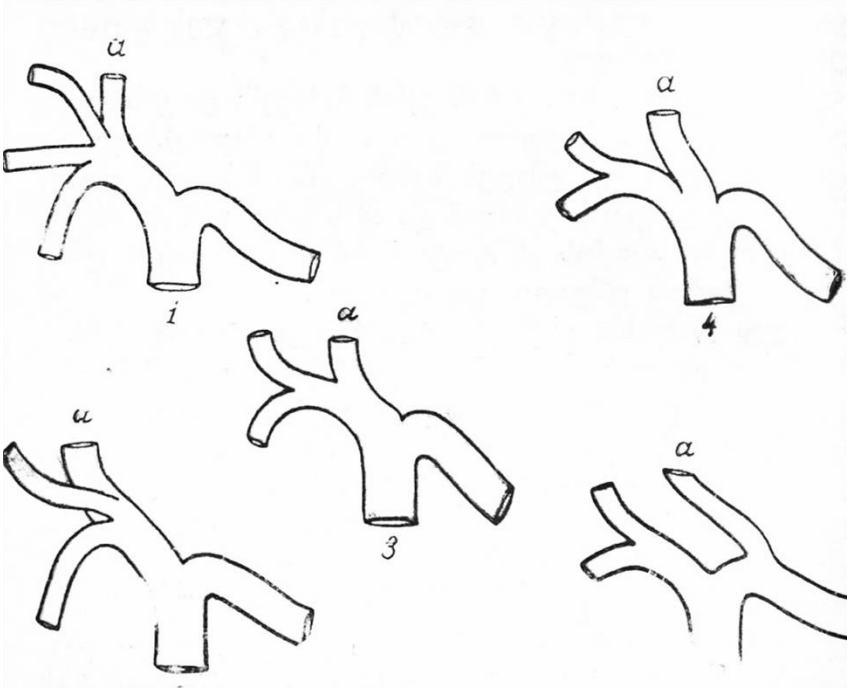

Fig. 13 Branch options of right branch of the portal vein (scheme)

The first of the four named forms is characterized by an abundance of branches, and, most importantly, all the branches of the next four rows are separated from the right branch of the portal vein in almost the same place. It should be noted that these branches, in turn, undergo branching of the next row in approximately the same way. According to our observation, this form of branching of the right branch is more characteristic of a thick, massive liver, the right lobe of which is well developed.

The second form of branching is also characterized by the abundance of branches. Similar to the first form, the right branch has all branches of the next three rows separated at almost the same point. Especially of good development is distinguished the ascending vein.

Thus, the first two forms of the division of the right branch, despite the fact that in one of them the blood vessel is divided into four branches, and in the other - into three, are similar to each other. In both cases, the main trunk is short, and the branches are long and abundant. Therefore, they belong to the bush-like (diffuse) form of branching.

In the third case, the right branch of the portal vein divides near its beginning into superior and inferior veins of almost equal diameter. The

superior, or ascending, vein runs from the inferior superiorly, almost vertically, and the inferior vein, in turn, is divided into the anterior and posterior arcuate veins of the next row. In this case, the right branch of the portal vein and its branches are characterized by a dichotomous division.

The fourth form of branching differs from the first three forms in that in this case the right branch is relatively long and directly divides into anterior and posterior arcuate veins, and the ascending vein emerges directly from the main trunk of the portal vein or its left branch. It should be noted that in the case of the latter variant, the trunk form of the branches is mostly noted. It is characteristic of a flat liver, the right lobe of which is relatively weakly developed.

Thus, the first two variants of the branching of the right branch of the portal vein belong to the bush-like (diffuse) form (observed in 33.7%), the last variant - trunk (19.8%), and the third, the most frequent variant (46.5%), carries the signs of both one and the other, that is why it should be identified as a mixed (transitional) form.

As mentioned above, the right branch divides in 46.5% into the superior ascending and inferior arcuate veins, and the latter in the vast majority of cases gives off the anterior and posterior arcuate veins (rarely the inferior vein continues directly into the anterior or posterior arcuate vein). In all other cases, the right branch directly divides into the anterior and posterior arcuate veins, or divides into the anterior arcuate, posterior arcuate, and ascending veins, or the middle arcuate vein is added to the latter. Therefore, the anterior arcuate vein is separated directly from the right branch of the portal vein (53.5%), or one of its branches, namely the inferior vein (46.5%).

The anterior arcuate vein (v. arcuafa anterior) is almost always present, but in different cases it has different development and shape. A. Melnikov (1924) calls this vein differently v. obliqua angularis. Sometimes, indeed, it faces the anterior lateral corner of the right lobe. Usually, it creates an anteriorly convexed arc and branches in the ventral part of the right lobe of the liver.

The anterior arcuate vein is a fairly visible blood vessel. Its diameter ranges from 0.3 to 1.2 cm (mean 0.6 cm). In six specimens, the anterior arcuate vein was well developed (caliber - 1.1-1.2 cm) so that it actually represented a direct continuation of the right branch, while the posterior arcuate vein was very weakly developed. According to our material, the magnitude of the exit angle of the anterior arcuate vein varied from 0° to 100° (mean 41.6°). This means that the anterior arcuate vein is sometimes a direct continuation of the right branch or its next row division (inferior vein), and in some cases it exits at an blunt angle. Accordingly, its direction changes somewhat. Usually it goes frontally and slightly anteriorly, rarely in an oblique or sagittal direction.

The anterior arcuate vein gives off a different number (from 3 to 12) of branches that emerge under an acute angle and are arranged near the visceral surface of the right lobe of the liver (superficially). It should be noted that the anterior branches - directed towards the periphery - are much longer than the branches directed posteriorly. The distance between the origins of the branches ranges from 0.1 cm to 3 cm. According to branching, the anterior arcuate vein is usually trunk-form, although we also find diffuse branching forms. In our material, two anterior arcuate veins were noted in one case, and both branched in a diffuse manner. In general, the forms of the branches of this vein coincide with the forms of the branches of the right branch of the portal vein itself. Thus, the anterior arcuate vein is a sufficiently large blood vessel that varies widely in shape and location. Its branches are located in the anterior half of the right lobe of the liver and reach the level of the gallbladder.

The second, relatively large vein, which is almost equal to the anterior arcuate vein, is the posterior arcuate vein (v. arcuata posterior), which also comes directly from the right branch (53.5%) or inferior vein (46.5%).

Posterior arcuate vein changes direction at its origin, according to how bordering veins are developed. Usually, it branches under the posterior surface of the right lobe of the liver, i.e. in its thickest area, but in the

case of good development of the ascending vein, it moves to the inferior surface, and here its branches are placed relatively superficially.

The angle of exit of this vein ranges from 10° to 110° (mean 54°). Therefore, the range of variation of the magnitude of the angle is approximately the same as that of the anterior arcuate vein, with the difference that the minimum and maximum of the magnitude of the exit angle of the posterior arcuate vein is 10° greater than that of the anterior arcuate vein.

Thus, the posterior arcuate vein is never a continuation of the right branch, since it always exits at a certain angle.

As for the diameter of the lumen of this vein, it varies from 0.4 to 1 cm (mean 0.7 cm). Therefore, the range of variation of the diameter of the posterior arcuate vein, compared to the anterior arcuate vein, is less, but the average indicator of its size, on the contrary, is higher.

From 3 to 11 branches emerge from the posterior arcuate vein, the distance between the origins of which is determined by 0.1 - 3.5 cm. The first (proximal) emerging veins are relatively long, and the next (peripheral) emerging veins will gradually shorten and, in connection with this, their diameter will also decrease. It should be noted that the forms of the branches of the posterior arcuate vein are in a certain relationship with the vertical size of the right lobe of the liver itself. When this lobe is relatively thick in the posterior part, the form of the branching of the posterior arcuate vein is diffuse and vice versa. In general, diffuse forms of posterior arcuate vein are more common.

The posterior arcuate vein is also a blood vessel with a sufficiently wide lumen, the branches of which are located in the posterior half of the right lobe of the liver, mostly near the inferior surface (superficially). Its branches reach the level of canal of the inferior vena cava.

Thus, anterior and posterior arcuate veins supply portal blood mainly to the inferior (visceral) part of the right lobe of the liver.

The middle arcuate vein also participates in the portal blood supply of the right lobe of the liver.

The middle arcuate vein (v. arcuata media) is not constant. On our material, it was observed only in 36.4%. In 14.9% of them, it came out directly from the right branch of the portal vein, and in the remaining 21.5% from the anterior or posterior arcuate vein. It should be noted here that we recorded the middle arcuate veins in the case when they were well expressed. The middle arcuate vein is more unequally developed. According to our material, the diameter of its lumen varies from 0.3 to 1 cm (mean 0.5 cm).

Its exit angle is also different. As mentioned above, this vein sometimes arises from the right branch of the portal vein itself. In this case, it is actually a direct continuation of the right branch. Its exit angle is also very small, or equal to 0°. Sometimes it separates from the anterior or posterior arcuate vein, and in this case the angle of its exit is relatively large. Generally, the exit angle of the middle arcuate vein on our material ranges from 0° to 90° (mean 25°), but it is worth noting that more often its exit angle is equal to 0°. These data indicate that there are much better hemodynamic conditions for blood circulation in the vein than in any other arcuate vein.

The middle arcuate vein is located mostly anteriorly and its branches are located in the anterior and middle area of the right lobe of the liver. The number of branches coming out of this vein varies from 2 to 7 (mean 4), and the distance between the branches is determined by 0.1 to 7 cm. Thus, the middle arcuate vein, depending on its diameter and exit angle, is variable. Sometimes this vein is completely insignificant in its development. Rarely, it is much more developed than the anterior and posterior arcuate veins.

The ascending vein also supplies blood to the right lobe of the liver, but it is much more visible and well developed compared to other veins coming out of the right branch of the portal vein. The right branch of the portal vein is usually considered to be the origin of this vein. Indeed, more often it comes from the right branch, but it turned out that it can also come from another branch. Analysis of our material showed that the ascending vein originates from the right branch in 80.2%, from the left branch - in 7.9%, and directly from the main trunk of the portal vein - in

11.9%. From the right branch it can come out together with the inferior vein (46.5%), or together with the anterior, posterior and sometimes with the middle arcuate vein (33.7%).

It should be noted that if the ascending vein emerges from the left branch, or from the main trunk of the portal vein, then it is particularly distinguished by its good development, and in this respect it does not differ from the rest of the branches of the first row of the portal vein. Generally, its diameter is large enough. According to our material, it ranges from 0.3 cm to 1.3 cm (mean 0.8 cm).

The ascending vein fully justifies the name. Immediately after its exit, it goes upward and divides into 2-3 branches in the central part of the right lobe of the liver, which in turn finally branch under diaphragmatic surface of the liver (superficially). These branches are rarely two, and more often three or four (Fig. 14). It is worth noting that the ascending vein can start from different sources, but their final branching is almost always produced in the same area.

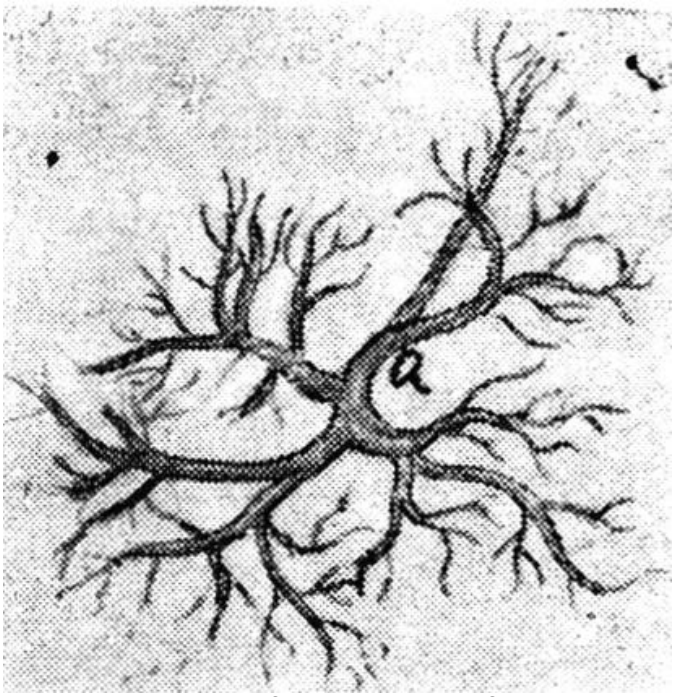

Fig. 14

a-terminal branches of the ascending vein

Thus, the right branch of the portal vein is characterized by an abundance of branches of the next row, and these venous branches are much more variable than the venous branches arising from the left branch. From the right branch, up to five branches of the next row emerge, but all five are never found at the same time. Usually there are two to three, rarely four branches.

Veins of the caudate lobe

The branches of the first row coming out of the portal vein directly enter the corresponding right and left lobes of the liver, where they are branching finally. Thin branches are coming out from them. The thin veins coming out of the left branch enter the quadrate lobe, and from the two branches together - into the caudate lobe. Therefore, the caudate lobe is supplied with portal blood from both the left and right branches of the portal vein, and in rare cases, even from the main trunk itself.

The number of veins in the caudate lobe is as variable as the shape and size of this lobe.

According to A. Melnikov (1920, 1924), one venous branch is observed in 10%, two branches - in 60%, and three - in 30%. It should be added here that the author did not include the relatively thin venous branches in the caudate lobe in these accounting.

According to P. Morozova, the number of efferent veins in the caudate lobe ranges from 3 to 5.

On our material, their number varies from 2 to 6, and three veins are more often observed.

The ratio of the veins allocated to the caudate lobe from the branches of the first row of the portal vein revealed a complete asymmetry. The analysis of the material showed us that a certain number of veins for the caudate lobe always comes out of the left branch, but their number is highly individual. For example, one venous branch is separated from the left branch for the caudate lobe in 12.2%, two branches in 41.4%, three in 37.4%, four in 8%, and five branches in 1%. In 23.7% of cases, the right branch does not give a branch to the caudate lobe. Of the remaining cases, one branch is observed in 66.2%, two - in 28.4%, three - in 4.2%, and four branches in 1.2%.

Thus, in 23.7%, the venous branches entering the caudate lobe originate only from the left branch of the portal vein, and in the remaining 76.3% - from both branches. However, the left branch gives the caudate lobe more often two or three veins, and the right branch - one vein.

It should be noted that the veins of the caudate lobe are relatively short (3-5 cm), have the straight direction and are mainly characterized by trunk structure. Rarely, they branch out in a diffuse form immediately after coming out. In this case, their number is few (one or two veins).

In addition to the named, non-permanent venous branches included in the caudate lobe are also noted, which sometimes emerge from the main trunk of the portal vein near its bifurcation. In one case, they enter the caudate lobe, and in another case - in porta hepatis itself, so they will be described together with additional portal veins and anastomotic connections.

Thus, the veins of the caudate lobe, both in terms of initiation, numerical indicators and distribution, are highly non-constant. In addition, in the blood supply of the caudate lobe, the right branch of the portal vein is significantly lags behind the left one. In addition, sometimes the portal blood supply of this lobe is produced only at the expense of the left branch.

GALLBLADDER VEINS

The study of the gallbladder veins and their collateral pathways has a particular clinical importance. Nevertheless, these veins are still not sufficiently studied. The reports that exist about their morphology are schematic and can not meet today's requirements of the clinic.

According to F. Sapei and L. Testiu, the main trunks of the gallbladder veins join the portal vein or its right branch. In addition, part of the thin veins from the superior surface of the gallbladder enter the liver parenchyma.

According to K. Suslov (1907), the gallbladder veins are connected to the branches of the superior mesenteric vein by thin venous anastomoses, and its main trunk attaches to the right branch of the portal vein.

V. Vorobiov and F. Walker (1919) noted that the gallbladder veins open into the main trunk of the portal vein or its right branch.

Petren Thirl (1933) divides the gallbladder veins into two groups. The first group includes thin and large branches located in layers, and the second group includes the efferent veins, which are located on both the fixed and free surface of the gallbladder (subserosally). The branches of the veins of both groups in most cases enter the liver parenchyma and finally turn into capillaries. According to the author's observation, the veins entering the liver parenchyma from the gallbladder wall are not connected to the intra-organ branches of the portal vein.

According to N. Fedorov (1934), the veins of the gallbladder originate from the superior and inferior surface of the gallbladder and are attached to both the portal vein and thin branches of the hepatic veins.

According to A. Akilova (1936), the main venous trunk follows the right cystic artery of the gallbladder and attaches to the right branch of the portal vein.

According to B. Letichevsky (1939), the veins of the gallbladder consist of venous plexus and efferent venous trunks. The latter are placed on the right, left and superior surface of the gallbladder. The efferent veins are connected to the intraorgan part of the both branches of the portal vein.

According to the data of E. Pikieva (1955), part of the veins of the bladder is attached to the portal vein or its right branch, and part directly enters the liver parenchyma. However, their main trunks sometimes anastomose with the gastric and duodenal veins.

Thus, it is clear from the review of the literature that there is no consensus on the architecture of the gallbladder veins and their distribution, and many issues require further clarification.

On our material, it was found that the veins of the gallbladder form a particularly complex system and a rich venous network, which is divided into deep and superficial plexuses in the thickness of the organ wall. The deep plexus consists of numerous thin branches and is presented in the form of a thin looped complex network that completely repeats the shape of the gallbladder. Superficial venous plexus is placed subserosally on the inferior surface of the organ, and between the wall of the liver and the gallbladder on the superior surface. A different number (up to 2-12) of relatively large trunks are formed from the superficial plexus in the form of efferent veins.

The location of the efferent veins is not constant. They are mainly located along the axis of the gallbladder. However, their direction varies not only for different materials, but even for the same material. It is possible that on one surface the main veins are located along the axis of the gallbladder, and on the other surface - transversely or obliquely. They join the main trunk of the portal vein, any of its branches or their further branches and additional portal veins.

Thus, our data on the distribution of the gallbladder veins do not correspond to the schematic description given in the textbooks. Also, the

idea that the veins of the gallbladder connect only to the portal vein or the portal vein and its right branch was not justified.

According to our material, the veins of the gallbladder are connected by a sufficiently wide collateral network to the branches of the second and next row of the portal vein, as well as to the portal vein itself or its branches of the first row, due to which the connections between the right and left branches of the portal vein are actually established by means of the veins of the gallbladder.

As can be seen from the references above, considerable variability is observed in the system of gallbladder veins, but nevertheless, according to the similarity of the main signs, trunk, diffuse (bush-like) and mixed (transitional) forms of their structure can be distinguished.

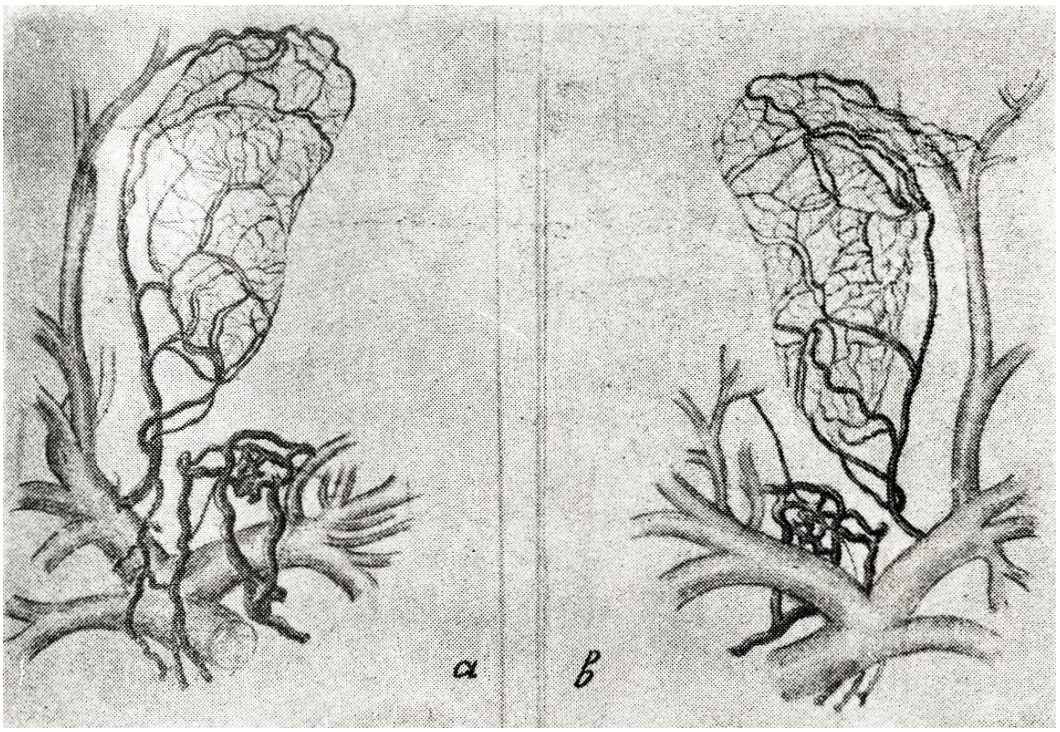

Fig. 15. Trunk form of branching of gallbladder veins
a - view of the material from below;
b – view of the material from above.

The following features are characteristic of trunk forms: deep plexus is presented in the form of a network of relatively simple structure, the branches of which are in different directions. Superficial veins are closely connected with deep veins. They are located in pairs, like tortous path of the vessels, and connect to the main venous trunk of the gallbladder, which is located along the axis of the gallbladder (subserosally) (Fig. 15). The latter connects to the portal vein or one of its branches. The trunk form of branching of gallbladder veins was observed in 25.9% of our material.

In the case of the diffuse form, the deep veins form a dense network of relatively more complex structure, in the elements of which transverse branches predominate. Superficial veins are presented in different direction stems, which are placed on both the free (inferior) and fixed (superior) surface of the gallbladder. This form is characterized by the fact that there is no main venous trunk, and secondary branches are abundantly developed (Fig. 16). The efferent veins are not represented as one or two trunks, but in the form of 7-10 branches that join the branches of the first and next row of the portal vein. The direction of the veins in this case is different, but they still have transverse and oblique branches.

The diffuse form of gallbladder veins was observed in 29.4% of our material.

Thus, the diffuse form of branching of the gallbladder veins is markedly different from the trunk form both in the abundance of the deep venous plexus and superficial branches and in the nature of their distribution.

The mixed form is characterized by the same arrangement of the deep venous network of the gallbladder as for the trunk form, with the difference that the diameter of the deep veins is unequal and the structure of the superficial plexus is also mixed, that is, it has both trunk and diffuse features (Fig. 17).

This form of vein branching is characterized by the variable structure of the excretory veins: along the left edge of the gallbladder, the main form of veins predominates, and along its right edge - diffuse, that is, on the wall of the gallbladder, there are both a longitudinal main vein and abundant transverse branches, which are connected to the first, second and next row branches of portal vein.

This form of branching of veins was observed in 44.7% of our material.

Thus, the veins of the gallbladder are presented in the form of deep and superficial plexuses. The deep plexus is formed from thin branches and is placed in the thickness of the organ wall. The superficial plexus consists of relatively large veins (main arteries) located on the surface of the gallbladder wall. The individual features of the relationship between the deep and superficial plexus determine the branching forms of the gallbladder veins.

It is worth noting that a certain interdependence was revealed in the individual variability of the gallbladder shape and the system of its veins. In the case of a narrow and deeply located gallbladder, the trunk form of venous branching is mostly noted, and in the case of a wide, superficially located gallbladder, the diffuse form of venous branching is observed.

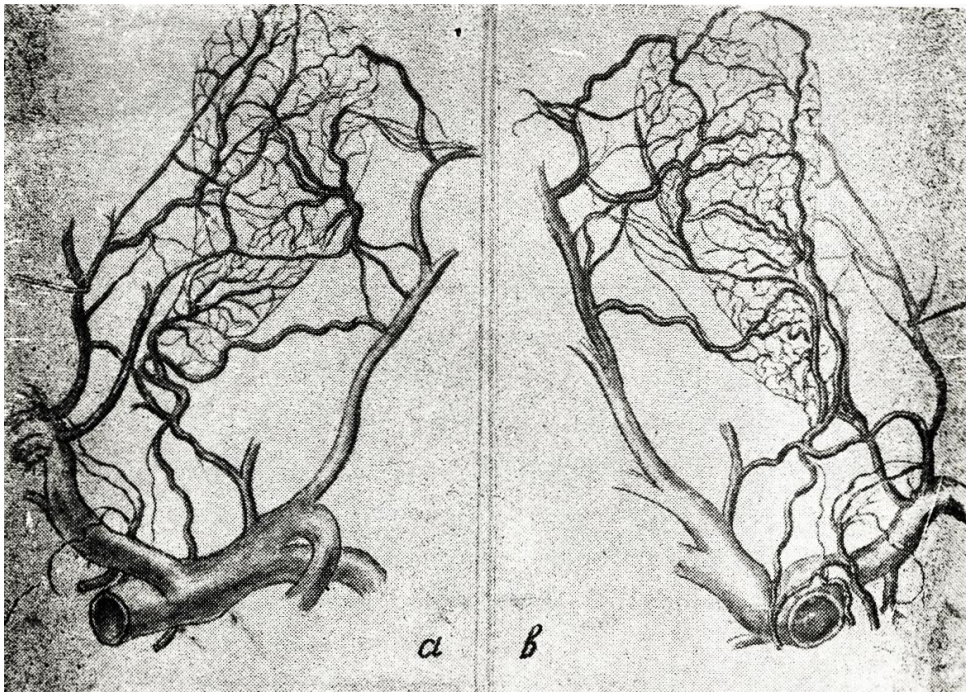

Fig. 16. Diffuse form of branching of gallbladder veins.
a - view of the material from above;
b – view of the material from below.

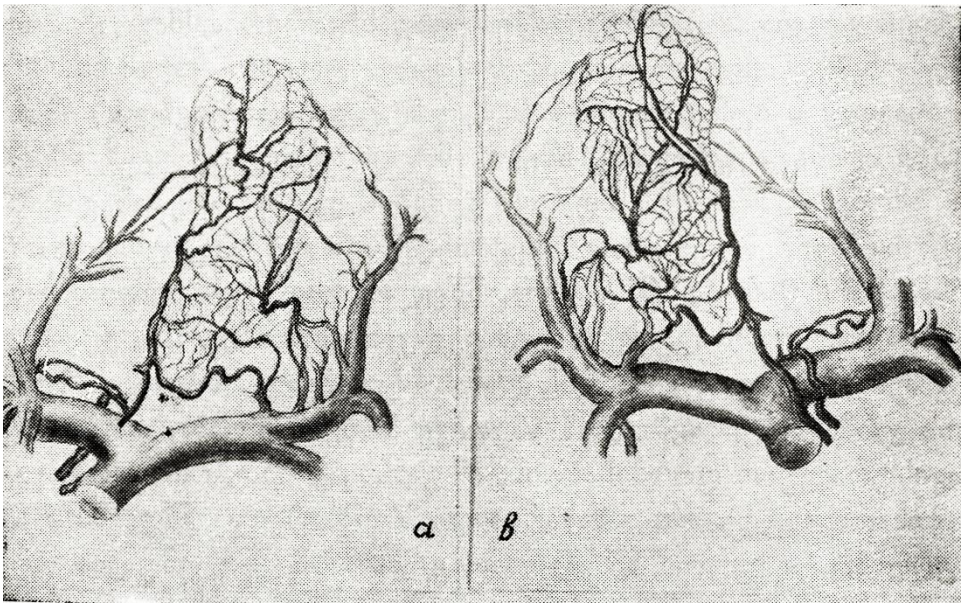

Fig. 17 Mixed (transitional) form of branching of gallbladder veins.
a - view of the material from above;
b – view of the material from below.

ADDITIONAL PORTAL VEINS AND PORTAL VEIN COLLATERALS

The study of collaterals of the portal vein is especially interesting from a practical point of view, because it is known that in the presence of an obstruction in the main trunk (thrombosis, stenosis, obliteration), portal blood circulation can be carried out only through collaterals.

According to literature sources, the collaterals related to the portal vein system can be combined into two main groups:

- The first group includes all those thin venous branches that eventually enter the liver tissue and at least partially replace the portal vein (hepatopetal collaterals);
- The second group includes all the other branches that blood from the portal vein is delivered without the liver to the superior and inferior vena cava (hepatofugal collaterals). This last group of collaterals is known as porta-caval anastomoses and has been sufficiently studied (B. Ognev and A. Syzganov, 1927; B. Dolgo-Saburov, 1946; H. Feitelberg, 1947; A. Maksimenkov, 1949; I. Petrovsky, 1956).

Collaterals entering the porta hepatis have not been properly studied yet.

Hepatofugal (porta-caval) anastomoses are mainly observed in the cardiac part of the stomach and the lower third of the esophagus, in the region of the rectum, around the umbilicus, in the retroperitoneal space and in other places. Therefore, these anastomoses exist both inside and outside the abdominal cavity (pelvic cavity, thoracic cavity, anterior abdominal wall). The hepatopetal (entering porta hepatis) anastomoses are placed only in the area of the epigastrium (glandular floor).

According to F. Walker (1919) and A. Lurie (1935), there are two types of hepatopetal collaterals visible to the naked eye. One bundle emerges from the main trunk of the portal vein at the level of its beginning or superiorly, runs parallel to this main trunk and enters the portal vein, and

the other bundle of collaterals originates from the veins in the region of the lesser curvature of the stomach or the beginning of the pylorus and duodenum, runs parallel to the portal vein, enters parenchyma of the liver and joins the main trunk of the portal vein or one of its branches.

Those venous collaterals that run parallel to the portal vein, then enter the liver parenchyma and at least partially substitute for the portal vein, are known as additional portal veins.

In our material, additional portal veins were observed in 61.7% of cases. In 8.8% of them, they came out of the main trunk of the portal vein itself (1-2 cm away from the bifurcation) and entered the porta hepatis (collaterals of the first type), and in 52.9% they started from the veins of one or another organ of the glandular floor and after passing parallel to the portal vein, they entered porta hepatis or joined the porta hepatis itself (collaterals of the second type).

On 160 cadavers, F. Valker encountered hepatopetal collaterals of the first type 6 times, and of the second type - 2 times.

On A. Lurie's material (194 cadavers), collaterals of the first type were noted 13 times (in 6.7%), and of the second type - 21 times (10.8%).

The data of F. Valker and A. Lurie concern macroscopically visible collaterals, that is, additional portal veins, the diameter of which reaches 2 mm on some materials.

On the material of E. Gudkova (50 cadavers), additional veins of this nature were observed 2 times, and on the material of V. Parfentieva (98 cadavers) - 6 times. Their diameter reached from 1.5 to 4 mm.

Thus, according to literature data, additional portal veins are noted in a single cases. The largest percentage of their presence is given by A. Lurie (17.5%).

According to our data, additional portal veins are observed much more often, than was known until now, which should be explained by the perfection of the research methodology.

The origins of the additional portal veins are known in one way or another, but the question of how these veins extend after entering the porta hepatis is less certain. Depending on the unit of labor, they join the portal vein or enter directly into the liver parenchyma. We did not find more detailed data on this issue in the available literature.

The analysis of our material showed us that additional portal veins are attached to:

- The main trunk of the portal vein (1-2 centimeters away from the bifurcation) – in 23.8%;
- The left branch of the portal vein — in 27%;
- Tranching of the next row of the left branch — in 11.1%;
- The right branch of the portal vein — in 4.8%;
- Teins of the caudate lobe — in 12.7%;
- Gallbladder veins—in 20.6%.

It should be noted that in all cases of the presence of additional portal veins of the second type, i.e. in 52.9%, from these veins in the region of the porta hepatis, a thin looped venous network of complex structure is formed, which wraps around in the form of a paravenous plexus and follows the branches of the first and next row of the portal vein. Also, it should be noted that this network is much more developed along the left branch of the portal vein than along the right branch.

Thus, additional portal veins are more often opened in the left branch of the portal vein and its next-row divisions. In addition, the paravenous plexus is more abundantly developed around the left branch than around the right branch. Therefore, the anastomotic network is asymmetrically developed. Collaterals are much more abundant in the left lobe of the liver than in the right lobe, which

should be due to the fact that the conditions of portal circulation in the left lobe of the liver are relatively less favorable (anatomical feature of the exit of the left branch).

The number of additional portal veins is variable. On our material, one additional vein was noted in 50.8%, two — in 33.3%, three — in 11.1%, four — in 3.2%, and five — in 1.6%. Therefore, one or two additional portal veins are most common, four or five veins are relatively rare.

It should be noted that the additional portal veins are of a sufficiently significant caliber. On our material, their diameter varied from 1 to 3 mm, and in four cases it was equal to 4 mm. These veins are tortious and lie mostly in front and to the left of the portal vein in the hepatoduodenal ligament. Additional portal veins often connect to the gallbladder veins and thus create an extensive collateral network between the right and left branches of the portal vein.

Rarely, in addition to the named anastomoses, there are intra-organ direct anastomoses between separate branches of the portal vein. On our material, thin anastomoses between the divisions of the next row of the right branch were observed only in three cases and between the right and left branches in four cases. Therefore, total intra-organ direct anastomoses were observed in 7 cases, while anastomoses formed by additional portal veins are much more frequent.

Thus, additional portal veins and, in general, hepatopetal anastomoses are observed much more often than previously known. However, if we take into account the hepatofugal (porta-caval) anastomoses, we can say with certainty that there are almost always collaterals in the portal vein system. Under conditions of pathology, they begin to develop especially quickly and are better manifested. It should also be noted that their development is uneven. When the collaterals of the first group (hepatopetal) are well developed, then the collaterals of the second group (hepatofugal) lag behind in development and vice versa. Rarely, the anastomoses of the two-headed group begin to develop evenly and

intensively and become very visible. It is clear that during congestive events in the portal vein system, the collaterals of both groups begin to function, with the difference that porta-caval anastomoses contribute to the mechanical unloading of the portal system. And hepatopetal (into porta hepatis) anastomoses, in addition to mechanical unloading, at least partially "take over" the function of the portal vein. Therefore, the additional portal veins have some importance in the regulation of portal blood flow.

HEPATIC VEINS

The location of the hepatic veins and the features of their attachment to the inferior vena cava, as well as their collaterals, were studied by us on 73 dissections. In 36 cases, the entire corrosive dissection of the liver veins was studied, in 32 cases, the diameter and numerical indicators of their lumens (from the side of the inferior vena cava), and in 5 cases, the radiograph of these veins was studied.

Despite the fact that a sufficient number of works have been devoted to the study of liver blood vessels (A. Melnikov, 1924; A. Akilova, 1936; K. Delitsyeva, 1940; V. Parfentieva, 1951; H. Elias and D. Petty, 1952; H. Gans, 1955; A. Borosov and P. Stepanov, 1956; Sh. Sherlock, 1958; Chen Hao-de, 1959) some issues of the structure of the liver veins are still not adequately covered in the literature. At the modern stage of development of liver surgery, the detailed study of the morphology of these blood vessels is of particular importance.

It is known that blood vessels of parenchymal organs consist of two parts - extra-organ and intra-organ. Hepatic veins are an exception in this respect. They are located completely intra-organically, they do not have a common trunk, and they open directly into the inferior vein as several veins of different calibers. Such an anatomical feature somewhat complicates the study of their structure.

According to A. Melnikov, K. Delitsyeva and Chen Khao-de, the number of main veins of liver varies from 2 to 5.

A. Akilova admits the existence of three main veins of the liver, on the basis of which she claims that the liver consists of three lobes.

The existence of three main veins of the liver is also recognized by H. Elias and D. Pat, H. Gans and Sh. Sherlock. According to their observations, the left vein belongs to the left lobe of the liver, and the right and middle veins belong to the right lobe. These veins open into the inferior vena cava below the diaphragm. A. Melnikov and H. Gans call the place where these veins join "the second porta hepatis".

A. Borisov and P. Stepanov do not deny the quantitative variation of liver veins. According to their observations, the two main hepatic veins should be considered as constant, one of which collects blood from the left, quadrate and caudate lobes of the liver, and the other - from the right and partially from quadrate lobe.

According to the material of V. Parfentieva, the number of main veins of the liver ranges from 2 to 7.

Thus, the number of the main veins of the liver is given differently by different authors, which, in our opinion, should be explained by the difference in research material and research methodology.

As for the small veins of the liver, almost all authors about them note that their number is highly variable, and they invariably open into the inferior vena cava, below the junction of the main veins. Sh. Sherlock calls these small venous branches additional branches of liver veins.

According to the material we examined, the number of main hepatic veins varies from 2 to 5. When we talk about main veins, we are referring to veins that are larger than 6 mm in diameter and that open into the inferior vena cava, under the diaphragm. Such veins are observed with different frequencies (Table 7).

Number of Main Hepatic Veins	Number of Cases	%
2 Veins	23	31,5
3 Veins	39	53,4
4 Veins	8	11
5 Veins	3	4,1
Total	73	100

Table 7

When we mention two (right and left) hepatic veins, it is meant that they open separately into the inferior vena cava (23 cases). In addition, the middle vein is also sometimes expressed, but the latter is attached to the left hepatic vein before it enters the inferior vena cava (19 cases — 26%). The presence of only two veins, without a middle vein, is relatively rare (4 cases - 5.5%). It is clear that in all cases when the middle vein is

attached to the left vein, ligating the latter, there is no doubt that the middle vein will also be blocked, i. e. there will be a disruption of venous circulation in the middle vein area as well.

The results of our study in determining the numerical indicators of the main veins of liver are generally close to the data of other authors. For example, according to A. Melnikov (1924), three hepatic veins open independently into the inferior vena cava in 65%, and two veins in 30%. But in 25% of the latter cases, the middle vein, which attaches to the left vein, is also expressed.

According to K. Delitsyeva's material, two hepatic veins are noted in 5%, three in 78%, four in 12%, five veins in 5%. However, in 48% of the cases of presence of three veins, these veins open independently into the inferior vena cava, and in 30%, the middle vein joins the left vein and they join the inferior vena cava with one common lumen.

Thus, according to literature data and our own observations, three veins (right, left and middle) are most often observed among the main veins of the liver. The most rare - five. However, when there are two veins (right and left), the left vein is most often joined by the middle vein, and they open with one common lumen into the inferior vena cava (Fig. 18).

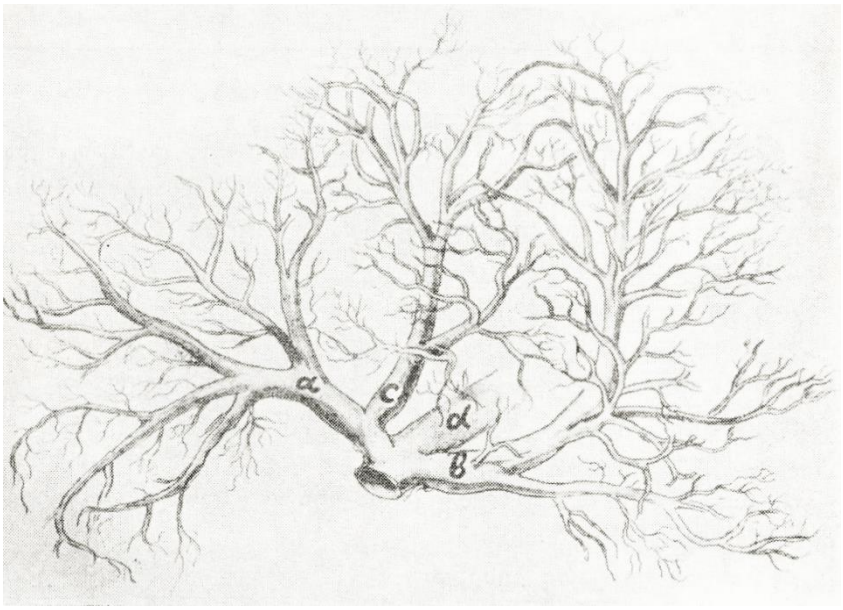

Fig. 18. a – Left Hepatic Vein; b-Right Hepatic Vein; c – Middle Hepatic Vein; d – Inferior Vena Cava.

Figure 18 shows the most common (typical) form of two hepatic veins. As this picture shows, the hepatic veins open into the inferior vena cava with two lumens as the left and right veins. The main trunk of the left vein is short and in turn is formed by the left and right branches. The latter in its development is almost equal to the left branch and actually replaces the middle vein. The right branch of the left vein (in this case, the middle vein) is sometimes weakly developed or absent. Only one left venous trunk is marked from beginning to end, i.e. the liver contains two independent right and left veins. As we mentioned, such cases are relatively rare (5.5%).

In the presence of three veins, the right, left and middle veins are expressed. These veins open independently (directly) into the inferior vena cava (39 cases), but if we add to this the cases when the middle vein is sufficiently expressed, is attached to the left vein (19 cases), then the number of cases of the presence of three veins increases significantly and reaches 79.4%. A typical example of three veins is shown in Figure 19, where the main trunk of the left vein is relatively short and is formed by the joining of three branches (left, right and middle). Each of these branches is formed by two or three relatively thin branches of the next row. The middle vein is much longer than the left one and is formed by joining two branches.

The right vein is presented in the form of one long arcuate vein, the convex side of which is directed to the right, from the same side, 8-10 relatively thin venous branches open into it under an acute angle.

The fourth and fifth veins usually join the right and left veins. They are of small caliber compared to the first three veins and are mostly observed in cases where the right lobe of the liver is especially thick in its posterior part.

In the presence of three veins, the left vein is located in the thickness of the left lobe, more in its dorsal part, and its tributary branches are diffused throughout the left lobe like a fan. These branches originate both from the region of the lateral edge of the left lobe, and from the ventral parts of this lobe, which initially move from left to right, then gradually

bend dorsally and open at an angle close to a straight angle into the inferior vena cava.

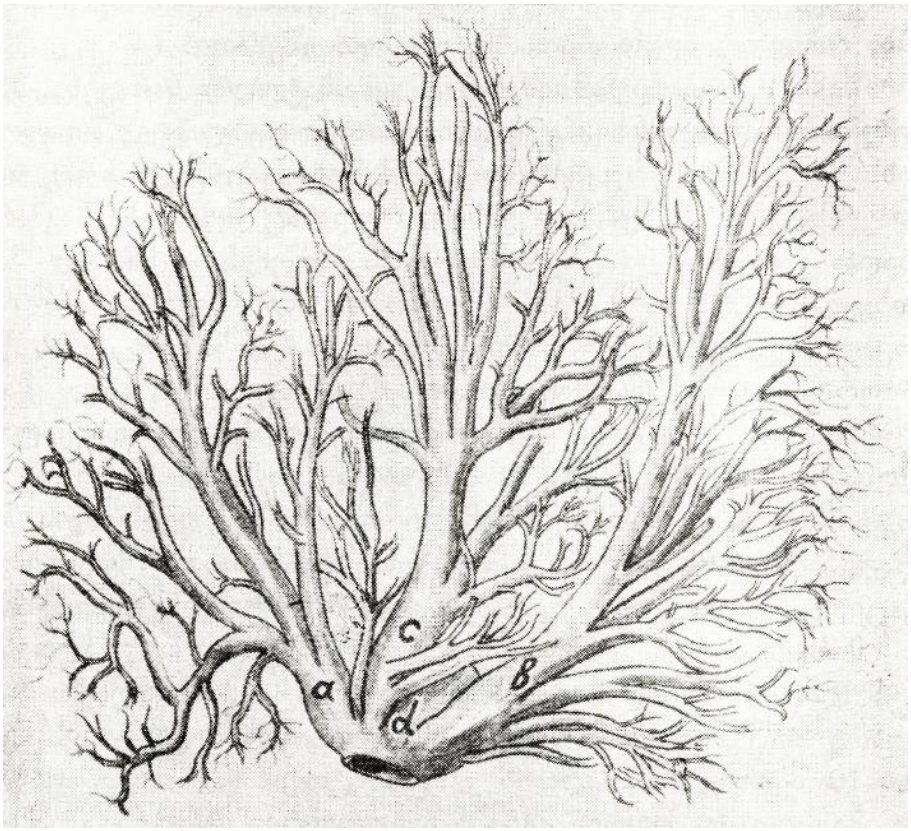

Fig. 19

a – Left Hepatic Vein; b - Right Hepatic Vein; c - Middle Hepatic Vein; d - Inferior Vena Cava

The middle vein begins with thin branches in the area of the quadrate lobe. Two or three larger branches of this vein are located in the superior part of the mentioned lobe near the diaphragm (superficially) and collect blood from the distribution area of the ascending branch of the portal vein. The main trunk of this vein is located slightly to the right of the middle hepatic fissure. To the left of this fissure are placed several branches into it. The middle vein more often opens independently into the inferior vena cava, and sometimes, as mentioned above, joins the left vein. In the absence of the middle vein, it is replaced by the medial branch of the left vein.

The right vein also begins in the region of the anterior edge of the right lobe of the liver, to the right of the gallbladder. It is characterized by a long main trunk that runs to the right, superiorly and posteriorly, creating a well-defined arc. This vein collects blood from both the lateral and

medial parts of the right lobe of the liver, as well as from the superior part of the central area of the liver. The right vein opens into the inferior vena cava at a much more acute angle than the other main veins.

Thus, the main veins of the liver are characterized by an arcuate shape and a radial arrangement. They are located deeply in the thickness of the liver, relatively closer to the superior surface, and the branches of the portal vein are located under them. In this regard, our data confirmed Glisson's view that the relationship of the hepatic venous system is like the fingers of two hands, which are arranged crosswise. In this case, the location of the hepatic veins will be referred to the upper hand, and the location of the branches of the portal vein - the lower hand.

As for the small-caliber veins of the liver (with a diameter of 6 mm and less), they collect blood from the caudate lobe and from the liver tissue closely adjacent to the inferior vena cava. These veins have a relatively straight direction, never cross each other (do not crossover) and open separately into the inferior vena cava, along the entire length of the latter liver lobe. Their number, according to our material, ranges from 2 to 7. Of these, a relatively significant caliber vein (5-6 mm) is sometimes noted, which comes out from the lateral side of the right lobe and opens into the inferior vena cava 4-5 cm below the place of junction of the main veins. This vein is located near the inferior surface of the liver (superficially) and is more common in thick, massive livers. In the case of five dissections on our material, two such veins were noted. According to Melnikov (1924), the number of veins can be three.

Thus, the hepatic veins can be divided into two groups: the first group includes the main veins (2-5), which are relatively permanent collectors and open into the inferior vena cava in the area of the posterior surface of the liver - under the diaphragm. The second group includes small-caliber veins, whose numerical indicators are highly variable. They open into the inferior vena cava below the junction of the main hepatic veins. The total number of veins of both groups sometimes reaches a significant number (Table 8).

Differet Caliber Hepatic Veins together	Number of Cases	%
4 Veins	5	6,8
5 Veins	9	12,3
6 Veins	19	26
7 Veins	18	24,7
8 Veins	10	13,7
9 Veins	8	11
10 Veins	4	5,5
Total	73	100

Table 8

As Table 8 shows, 6-7 veins are most often observed, and rarely 4 or 10 veins. The results of our study on the number of hepatic veins generally coincide with the data of the majority of authors, and if there is a slight difference in the numerical indicators of some authors, it should be attributed to the method of examination.

The number of hepatic veins is in a certain relationship with the variation of their diameter. In particular, the greater the number of main veins, the smaller their diameter and vice versa. In addition, the diameter of the right vein is always greater than the diameter of the left vein. The diameter of the right vein varies from 0.9 to 2 centimeters, while the diameter of the left vein varies from 0.8 to 1.5 cm. The diameter of the middle vein is even smaller. On our material, it reached 1.3 cm only in three cases, in the remaining cases it was less than 1cm. As for the fourth and fifth veins, their diameter, as mentioned above, reaches 6.8 mm. These veins are relatively rare.

The main hepatic veins join the inferior vena cava at various angles.

The right vein joins the inferior vena cava at a sharper angle than the other veins. The angle of its attachment to the inferior vena cava ranges from 10 to 30°(mean 18.4°). The inclination of the left vein is relatively less, it ranges from 20 to 90° (average is 46°). As for the middle vein, it occupies an average place in this regard - its angle of inclination varies from 20 to 70° (on average equal to 32.6°).

Thus, the right hepatic vein is the most inclined to the inferior vena cava, and the left hepatic vein is the least inclined. Therefore, the hemodynamic conditions in the right lobe are much better than in the left lobe. A similar difference between liver lobes was also noted in terms of portal blood circulation.

According to A. Melnikov and K. Delitsyeva, the variation of the angle of junction of the main veins of the liver in the inferior vena cava depends on the type of location of the liver itself. In the case of the ventropetal location of the liver, the veins join the inferior vena cava at a sharper angle, while in the case of the dorsopetal location, the mentioned angle is relatively larger. This point of view cannot be denied, but along with it, the inclination of the right and left lobes to different degrees is undoubtedly important. The fact is that no matter what form of the location of the liver we are dealing with, the right lobe is more inclined than the left, and in this connection the right vein is attached to the inferior vena cava at a sharper angle. Because the left lobe of the liver is characterized by a relatively lesser inclination, the left hepatic vein also enters the inferior vena cava at a greater angle. Its magnitude often approaches a straight angle.

As for the character of the branching of the hepatic veins, the same variability as is generally known in the structure of blood vessels is revealed.

As it is known, there are two main forms of vascular branching - trunk and diffuse. In the first case, the blood vessel is characterized by a long trunk, few branches and rare anastomotic connections, and in the second case - by a short trunk, an abundance of branches and frequent anastomotic connections. They also choose the third, mixed (transitional) form, which is characterized by the signs of both the first and second forms.

We examined our material from this point of view, and it was found that there is a certain peculiarity in the structure of the veins of the liver. Sometimes, on the same dissection, one vein of the liver bears signs of the trunk form, while the other vein is bush-like (diffuse), or the main

trunk of the main vein belongs to one form by its structure, and its branches to another. Such a peculiarity somehow makes it difficult to separate the forms of individual variation. According to K. Delitsiev (1948), all veins of one type in the liver are observed only in 17%.

Such a peculiarity of liver veins forced us to distinguish separate forms not according to the whole dissection, but according to individual veins (Table 9). It was found that the right vein in most cases are a trunk form (60.9%), the left one is a bush-like (diffuse) form (65.9%), and the middle vein mostly has signs of a mixed form (63.4%). As for the fourth and fifth veins, their forms more often resemble the forms of the veins with which they are directly connected.

Hepatic Veins	Trunk Form	Bush-like Form	Mixed Form
Right	25	12	4
Middle	8	7	26
Left	5	27	9

Table 9

The branching forms of the hepatic veins are also related to their length. The main trunk of the bush-like form vein is short, and the trunk-form vein is long. In general, it should be noted that the length of the hepatic veins varies widely. For example, the length of the right vein varies from 3 to 12 cm, the left vein from 3 to 6.5 cm, and the middle vein from 4 to 9 cm. Therefore, the right vein is longer than the middle vein, and the latter is longer than the left vein. In addition, the left vein is formed by joining the branches of the 6-7 row, and the left vein - by the joining of the branches of the 4-5 row.

One of the important issues in the study of hepatic veins is the determination of collaterals between these veins. Anatomy textbooks completely deny the existence of anastomoses between hepatic veins. Also, in a number of special works, nothing is said about this issue, or the answer is negative. For example, K. Delitsyeva, A. Borisov and P. Stepanov do not mention anything about anastomoses of hepatic veins in their study, while A. Akilova (1936) categorically denies the existence of anastomoses between hepatic veins. In this regard, E. Parfentieva

(1954) and Chen Khao-de have relatively important studies, according to whose data anastomoses exist between separate veins of the liver. Unfortunately, no author covers the issue of how common these anastomoses are.

On our material, anastomoses were observed in 63.8% of cases. Not only the main veins, but also short veins of relatively small caliber were connected with each other by anastomoses. These anastomoses were characterized by special abundance in 5 cases. Their caliber reached 2-3 mm.

It should be noted that the anastomoses are mostly located superficially, more often near the place where the main hepatic veins join the inferior vena cava (Fig. 20).

Fig. 20
a - Left Hepatic Vein; b - Right Hepatic Vein; c - Middle Hepatic Vein; d - Inferior Vena Cava. Anastomoses are noted between the right and inferior veins.

According to our observations, the frequency of anastomoses and the degree of their development are mainly related to the forms of branching of the hepatic veins. In the case of bush-like (diffuse) form, abundant anastomoses are observed relatively often.

Thus, anastomoses in the hepatic venous system are much more common than previously known.

The issue of porta-hepatic anastomoses is completely different.

A. Melnikov (1924) saw an anastomosis between the portal vein and the hepatic veins in only one case out of 115 dissections, at the place of junction in the inferior vena cava (at the left side). The author considers it possible that this anastomosis was a remnant of the ductus venosus of Orange (the result of its incomplete obliteration).

V. Krasuskaya (1924) completely denies the existence of intra-organ porta-caval anastomoses.

Intra-organ porta-caval anastomoses were noted 7 times on the material of V. Parfentiea (110 specimens). In 5 of these cases, these anastomoses were the result of incomplete obliteration of the ductus venosus. In all five cases, the anastomoses connected the left branch of the portal vein with the left or middle hepatic vein.

In our material, porta-heptic anastomosis was seen only in one case. An anastomosis was expressed between the left branch of the portal vein and the left hepatic vein, the diameter of which was equal to 2 mm.

On the material of H. Elias and D. Petty (100 objects), direct anastomoses between the branches of the portal vein and hepatic veins were not detected in any case. Sh. Sherlock also denies the existence of the mentioned anastomoses.

According to H. Elias, D. Petty and Sh. Sherlock, branches of the portal vein and hepatic veins are connected to each other by means of sinusoids, and if anastomoses exist, they actually represent a widening of these sinusoids, which never occurs in a normal liver, such anastomoses are expected to be detected in pathologically changed, namely in cirrhotic liver.

Thus, some authors completely deny porta-hepatic anastomoses, and according to others, such anastomoses are noted only in single cases. We agree with the point of view that microscopically visible such anastomoses really do not exist and we must mean that such anastomoses found in a single case are certainly not permanent and must be related to liver pathology.

ANATOMICAL JUSTIFICATION OF RATIONAL INCISIONS ON THE LIVER

Despite the fact that the liver and its intra-organ blood vessels have been sufficiently studied, the issue of carrying out rational incisions on it still remains problematic.

The liver is characterized by a special excess of intra-organ blood vessels, that is why sometimes even a small operation is complicated by extremely dangerous bleeding. In connection with this, liver surgery lagged far behind the general surgery of the abdominal cavity, and it is no coincidence that the issue of liver resection became the subject of discussion at the World Congress of Surgeons (1955, Copenhagen).

Liver resection does not have a long history. It was introduced in the 90s of the 19th century. This operation was performed for the first time in cystic disease in 1886 by Lins[1]. The first liver resection in Russia was performed in 1890 by N. Salifasovsky [2]. As we can see, this operation was developing at a slow pace from the beginning and the unit was compensated by the liquidation, which is also evident from the fact that M. Kuznetsov and I. Pensky in 1894, i. e. 8 years after the first operation, only 25 cases of liver resection were collected in the literature.

Liver resection became relatively more possible when special hermetic sutures were introduced for the prevention of bleeding (M. Kuznetsov and I. Pensky, 1894), the plasticity of omentum and the possibility of its use during liver bleeding were clarified (S. Girgolav, 1907, N. Boliarsky, 1910).

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1. *Citation According to A. Melnikov.*

2. *Citation According to A. Velikoretskyi and T. Kasaikina.*

Most importantly, the detailed study of blood vessels and bile ducts of this organ contributed to the production of resections (G. Volintsev, 1902; A. Melnikov, 1920; F. Valker, 1920; E. Rabinovich, 1927; B. Ognev and A. Syzganov, 1927; A. Akilova, 1936; H. Serebrov, 1941; N. Javakhishvili, 1953; V. Parfentieva, 1953, G. Agarkov, 1953; B. Shkolnikov, 1956; E. Yakubovskaya, 1956; M. Novikov, 1957; B. Kuznetsov, 1958; I. Sosnovik, 1959; A. Tymoshenko, 1960; N. Mamforia, 1961, etc.).

According to literature data, liver resection has become more frequent in the last 20 years compared to previous years, and with good results.

A. Velikoretskyi and T. Kasaikina collected 218 cases of liver resection in the literature in 1955, 17 of which were their own.

A. Melnikov, together with E. Seleznyakov in 1956, collected 592 cases of liver resection in the national literature.

In addition to the summarized material, the literature also contains both a single case and works based on extensive materials, which describe the course and outcome of the operation (liver resection) (N. Terebinsky, 1929; V. Balinsky, 1930; I. Athanasov. 1934; A. Lobok, 1936; I. Danilov, 1939; Sh. Murlaga, 1951; T. Kasaikina, 1953; V. Semyonov, 1954; A. Dikhno, 1955; I. Bregadze, 1957; I. Shishkin, 1957; E. Gorbunov, 1957; P. Mironov, 1957; G. Feldman, 1957; D. Valery, 1959; G. Belitsky, 1959; I. Kartsi, 1959; A. Zon and K. Feifer, 1959; S. Yaritsyn, 1959; V. Shapkin, 1959; B. Alperovich, 1960; B. Agaev, 1961; S. Borovkov; 1962, etc.).

N. Melnikov (1956) distinguished 39 of his own cases of liver resection. Of these, he performed extended (massive) resection of the right lobe twice, the author notes that the results of the operation mainly depend on the amount of the resected part of the liver and the function of the remaining part.

According to experimental works, liver tissue has a great ability to regenerate and compensate.

According to V. Kiknadze (1957), the volumetric growth of liver tissue is so intensive that during the first 10-15 days its weight is almost close to normal. However, a moderate resection of the liver (up to 50% of its tissue) in the experiment (dogs) is a less dangerous surgical act, which is quickly compensated by the body and, most importantly, the rest of the liver maintains a normal appearance.

According to A. Lokhotuk (1957), excision of 55% of the liver in later periods does not cause significant changes in the nature and quantity of bile secretion. What's more, the remaining lobe of the liver provides the body with the ability to compensate for liver function even when 70% of the liver is excised. Despite all this, liver resection is still not widely implemented in the clinic. The reason of this is the difficulty of the operation and the fear of severe bleeding.

The Kuznetsov-Pensky suture is still considered the best way to stop bleeding from the liver, which since the publication of this rule is widely used both for prophylactic purposes and during bleeding caused by damage to this organ, although this suture is not flawless. In this regard, many observations have been made, but almost all of them were limited by experiments and could not be widely implemented in the clinic.

F. Abramovich (1900) in the case of resection of the liver operated on the cut site with hot air or steam (in the experiment). According to the author's data, blood clots develop in blood vessels due to necrosis in the superficial layer of liver tissue and that’s the reason why bleeding stops.

N. Burdenko (1909) and then Z. Dukhinova (1922) temporarily ligated the blood vessels passing through the hepatoduodenal ligament in order to stop bleeding from the liver (in an experiment), but it was possible to ligate the portal vein without complications for only 10-15 minutes.

Lipau-Hua, Lilly-Hsien and Hsien-Tung (1960) repeated the same experiments on dogs under hypothermic conditions and came to the conclusion that the portal vein can be occluded for up to one hour without significant complications. They tested this method in the clinic (two cases of liver resection) with good results.

Thus, hypothermia to some extent helps to prolong the time of clotting of the portal vein, but anyways, in this case there is a strong coagulation of venous blood in the portal system and, knowing what its further complications are, this method cannot be considered flawless. Because of all this, prophylactic-hemostatic sutures are preferred.

A. Galushko (1948, 1949) as a result of observing 135 test animals (dogs) came to the conclusion that during resection of a large part of the liver, hemostatic suture only is not enough. Such a suture gives a good result in the case when it is supplemented with plastic mesh or a sheet of peritoneum. The author prefers resection with an electric surgical knife, subsequent ligation of blood vessels and tamponade of an uninsulated omentum.

A. Velikoretsky and T. Kasaikina deny the use of an electric surgical knife for this purpose, because although it reduces the bleeding, it cannot stop it completely. According to their experience, a hemostatic suture with non-insulated omentum is better. In this way, they performed 13 operations (resections) with fairly good results.

Thus, many methods have been proposed to stop bleeding from the liver: hemostatic sutures, use of an electric surgical knife, tissue plastic surgery, temporary ligation of blood vessels passing through the hepatoduodenal ligament, ligation of blood vessels in the wound, exposure to the liver incision site with hot air and steam, etc., but all of them have certain drawbacks. So, performing a liver resection based on these rules only is dangerous if the location of intra-organ blood vessels is not taken into account.

A. Melnikov (1920, 1924), based on the study of the architectonics of the intra-organ blood vessels of the liver, provided us with a number of incisions for the liver. According to him, in the case of massive resection, it is necessary to ligate the main blood vessels of the lobe to be cut in advance and then carry out the rest of the manipulations.

It should be noted that the incisions provided for typical liver resection mainly serve the interests of dealing with bleeding, and the danger of

disruption of intra-organ blood circulation and related secondary changes are not properly taken into account.

It is known that as a result of disconnection of separate branches of liver blood vessels (hepatic artery, portal vein or hepatic veins), deep pathomorphological changes develop in the appropriate area. An example of this is a number of experimental and clinical observations.

Gibe and Hescherschmidt[1] performed resection of the quadrate lobe in a case of hepatic echinococcus. In this regard, they ligated the left branch of the portal vein (along with the artery), which resulted in total necrosis of the left lobe and the patient died. It is clear that in this case, the consequences of disruption of the vascularization of the left lobe of the liver were not taken into account.

According to our experiments (1954, 1958), as a result of partial or total disconnection of the portal vein, sclerosis and changes characteristic of cirrhosis develop in the proper lobe of the liver. Therefore, according to experimental and clinical data, during resections, preference should be given to such incisions, which are based on the location of intra-organ blood vessels. Therefore, accurate knowledge of the blood supply of a separate lobe of the liver is of a great importance. So, the boundaries between separate lobes should be represented not only by their external shape, but also by taking into account the distribution of blood vessels and their blood supply.

During the development of rational incisions for the liver, some authors are not satisfied with the division of this organ into parts, and according to the arrangement of blood vessels, separate parts are further divided into segments and sub-segments.

A. Zone and Cl. Pfeiffer (1959) provided two schematic images of Hiortzio in their work, according to which the right lobe is divided into three (ventrocranial, intermedial and dorsocaudal) segments, and the left lobe into two (ventrolateral and dorsolateral) segments.

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1. *Citation According to A. Melnikov.*

In addition, there are two fissures on the liver. First, the main border fissure passes at the level of the right longitudinal groove of the liver, second, an “additional fissure” is at the level of the left longitudinal groove. According to A. Zone and Cl. Feifer, the mentioned scheme is of great importance during surgical intervention on the liver.

Indeed, Hiortzio's scheme is simple and easy to imagine. The division of the liver into segments is based on the location of the main branches of the portal vein, hepatic artery and bile ducts. This is undoubtedly important, but, unfortunately, the relationship of the quadrate and caudate lobes with the segments of the left lobe is not properly taken into account. In general, according to this scheme, resection of the intermedial and dorsocaudal segments of the right lobe is extremely dangerous due to the possibility of disruption of the porta-hepatic circulation.

H. Elias and D. Pett divide the liver into two – right and left parts depending on the branching of the portal vein and the location of its branches. According to their observations, the right lobe is further divided into two small and three large areas. Accordingly, they divide the right lobe into segments and sub-segments. Such a division of the liver is interesting, but it has a more theoretical character, and in practice it is very difficult to use this scheme to excise a separate segment and sub-segment. In this regard, the data of those authors who take into account the placement of other blood vessels (hepatic veins) in addition to the portal vein during incisions on the liver, even though these systems are not located in the same direction, are more important.

Taking into account the location of the main branches of the liver vessels and relatively less vascular areas, A. Melnikov (1956) provided us with incisions that still hold a certain place in liver surgery. The author provides an original rule for a typical resection of the left lobe, which is performed in four consecutive moments:

1. At the level of the left longitudinal (sagittal) groove (in the area of porta hepatis), the left branch of the portal vein is ligated together with corresponding artery and bile ducts;

2. After cutting the left triangular ligament, the left hepatic vein is ligated at the posterior edge of the liver;
3. The incisions of the liver is carried out along the left edge of the left sagittal groove;
4. The cut surface is covered (wrapped) with a suspensory ligament freed from the diaphragm.

Such a rule of resection of the left lobe of the liver is completely justified in the sense that significant bleeding is not expected during and after the surgery, but by ligating the left branch of the portal vein (along with the artery), we create a kind of danger to the quadrate lobe in terms of disruption of feeding.

K. Kremer and H. Hilke (1959), like A. Melnikov, pre-ligate the left branch of the portal vein together with the corresponding artery and bile ducts during a typical resection of the left lobe of the liver, but, unlike other authors, they carry out the liver incision between the right and longitudinal grooves, i. e. on the midline of the quadrate lobe.

If we approach the issue critically, this rule of resection of the left lobe of the liver cannot be considered perfect, because, although bleeding during the operation should not take place in this case, but because the blood supply of the quadrate lobe (along with the left lobe) is produced by the left portal vein and the left hepatic artery branches, ligating the latter, the remaining part of the quadrate lobe will be deprived of any blood supply. In addition, it is acceptable to take into account that in 7.9% the left branch also participates in blood supply of the right lobe of the liver.

According to H. Gans, during the resection of the right lobe of the liver, the incision should pass along the right edge of porta hepatis, and during the resection of the left lobe, along the left edge of porta hepatis, i. e. along the left sagittal groove. Finally, the author leaves the issue of the entire extirpation of the right lobe unanswered.

Thus, the rules provided for resection of the left lobe of the liver (A. Melnikov, K. Kremer and H. Hilke, H. Gans) can be considered rational from the point of view of avoiding the danger of bleeding, but the danger

of disrupting the vascularization of the remaining part of the liver is not taken into account in these rules.

In this regard, the work of K.Popescu (1958) is important. It contains indications and contraindications for typical and atypical liver resections. The author rightly points out that typical resections represent technical progress in the development of liver surgery, but sometimes atypical resections are necessary to save liver tissue. In typical resections, the blood vessels corresponding to the resected lobe or segment are more often ligated in advance and then resected. The author considers such wide resections appropriate in the case of widespread tumors, but in the case of small tumors, he considers it best to excision of the tumor itself, from the point of view of not damaging the main feeding vessels of the remaining liver tissue, and this becomes possible based on the study of the topography of intra-organ vessels.

For atypical resection of the liver K. Popescu provides incisions that are based on the principle of maintaining normal vascularization of the remaining liver tissue, but the risk of bleeding is less taken into account, that is why even these incisions do not meet the current requirements of liver surgery.

Thus, the issue of carrying out rational incisions on the liver can be considered as a solution only when the provided rule includes both the prevention of bleeding and the maintenance of normal vascularization of the remaining part of the liver.

From the above, it can be concluded that the issue of carrying out rational incisions on the liver has not been finally clarified yet and requires further observation.

In this regard, we aimed to identify dangerous and less dangerous zones for incisions based on the study of the topography of the main intra-organ vascular branches of the liver.

As mentioned, we studied the portal vein on 102 dissections, and the hepatic veins - on 41 dissections.

The study of the branches of the portal vein gives us a complete view of the location of the branches of the hepatic artery and bile ducts, because the corresponding branches of all three mentioned systems are in one common capsule. On the basis of the mentioned material, we had every right to discuss the positive and negative sides of this or that incision, but in order to discuss the issue in more detail, we additionally conducted a special observation on twenty dissections. In this case, latex dyed in different colors was injected into the intra-organ blood vessels and bile ducts of the liver. Dissections were placed in 10% formalin solution for five to six days for hardening. After the mentioned time, we carried out sutures on the organ in the direction of the estimated incisions (Figs. 21, 22) in such a way that all the main and thin branches of the blood vessels on this line were caught in the loops of the mentioned suture.

Fig. 21.
The liver is sutured according to the estimated incisions

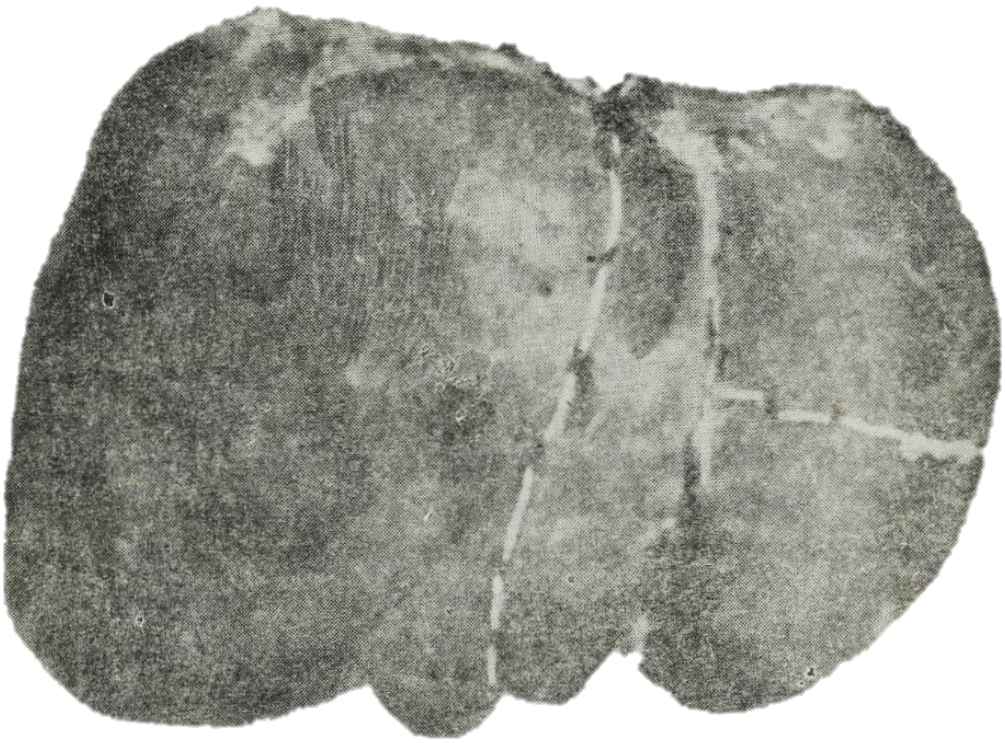


Fig. 22

The liver is sutured according to the estimated incisions

A thin copper wire with an acid-resistant plastic sheath was used as a suturing material. After proper drawing and photography, the dissection was placed in an 80% solution of technical hydrochloric acid (12-15 days). After corrosion, the dissections were washed under running water and studied.

Special attention was paid to the registration of the vascular branches that were included in the suture loops. According to this material, we have every right to judge the positive and negative sides of this or that incision, namely, during which incision, which blood vessels are cut, whether any area of the liver is left without blood supply, or how severe bleeding is expected.

The intra-organ blood vessels of the liver are characterized by the abundance of branches, and because of this, it is rare to find even such a small area, which does not cause bleeding when punctured or incised. There is no "Avascular zone" on the liver, therefore, no matter what

rational incision is performed on it, it still gives bleeding. But there is a question as to how dangerous this bleeding is for the patient.

In advance, it can be assumed that if the main branches of the portal vein (meaning the artery too) and the hepatic veins are cut, catastrophic bleeding is expected, but the issue is completely different when the incision goes beyond the main branches, i. e. when thin branches are cut. In this case, heavy bleeding should not occur. According to this, the following zones are distinguished on the liver:

- Mainvascular — relatively more dangerous for incisions;
- Thinvascular - less dangerous for incisions.

The dangerous zone includes porta hepatis, in which the main trunks of the portal vein, hepatic artery and bile duct, as well as their first-row branches, are placed. Cutting these formations is extremely dangerous from the point of view of both blood and bile flow. It is also dangerous to ligate them, because this procedure ends with the death of the patient. The dangerous zone also includes “second porta hepatis”, located on the posterior surface of the liver, where the hepatic veins meet and open into the inferior vena cava.

Taking into account the location of the elements of porta hepatis and the level of junction of the hepatic veins into the inferior vena cava, we united these two main vascular zones, which form a quadrate-shaped area on the liver (Fig. 23). In addition to the elements of porta hepatis, their first-row branches, as well as the hepatic part of the inferior vena cava and the tributary of hepatic veins are placed in this quadrant. The mentioned quadrant actually includes a relatively more dangerous area for incisions. Carrying out incisions in other areas is not so dangerous, but the arrangement of the main branches of the intra-organ blood vessels should be taken into account so that no part of the liver must be left without feeding due to the cutting of the blood vessels.

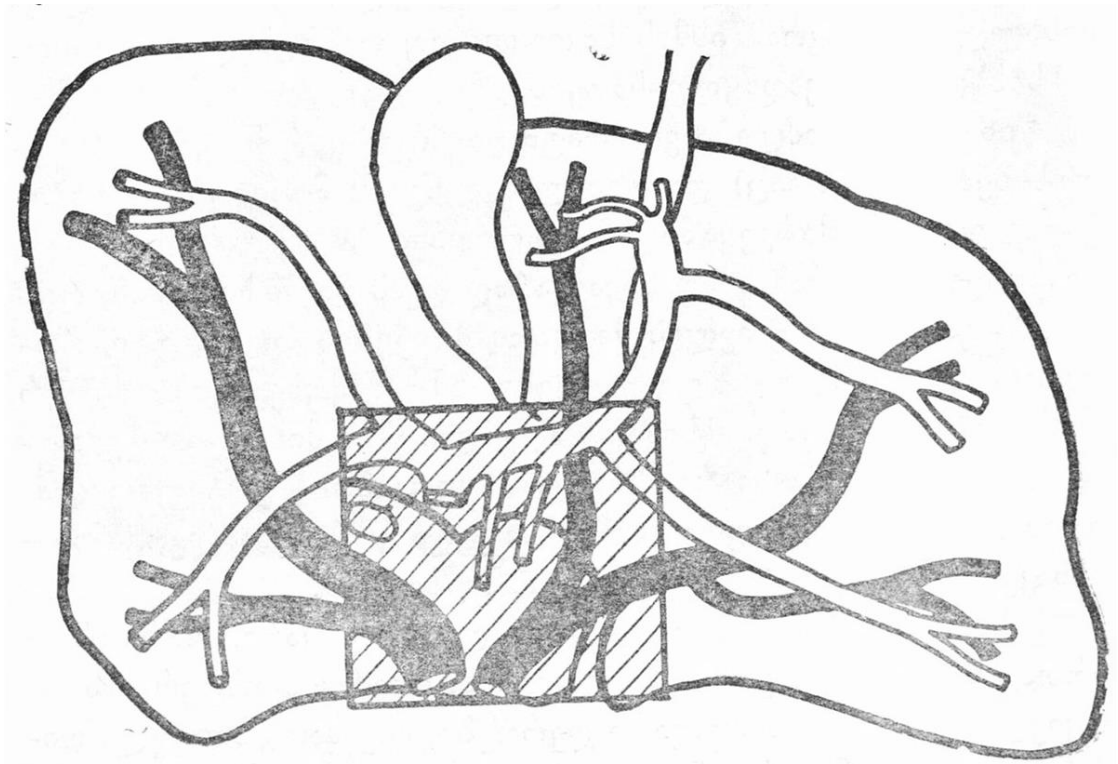
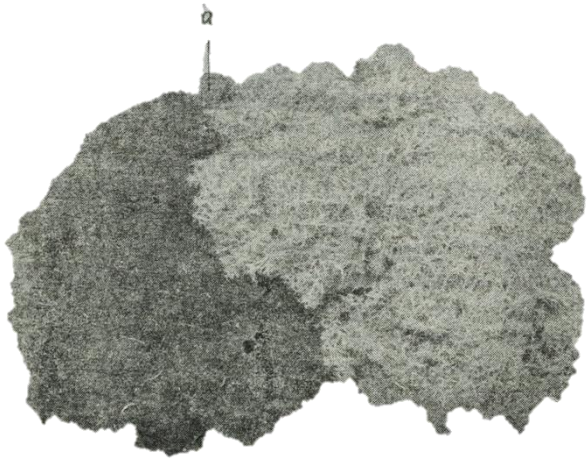


Fig. 23.
The quadrate-shaped area shows the relatively more dangerous area for the incision (scheme).
Branches of the portal vein are shown in white;
In black - hepatic veins

The left branch of the portal vein supplies portal blood to the left lobe of the liver, most of the quadrate and caudate lobes (often the whole). Apart from that, in 7.9%, it gives off a relatively large caliber ascending vein which participates in the vascularization of the central area of the right lobe. The right branch and the ascending, middle branch emerging from the portal vein (present in 11.9%) supply only the right lobe with portal blood, although sometimes it participates in feeding the caudate lobe with its few branches.

1



2

Fig. 24.
The distribution zones of the right and the left branches of the portal vein (corrosive dissection).
a black mass is injected into the left branch, and white into the right branch
1 — inferior surface of the liver,
2 — superior surface of the liver,
a — gallbladder veins

Thus, depending on the branching of the portal vein (as well as the hepatic artery and bile ducts), the right and left halves of the liver are separated (Fig. 24) and the following 6 segments are important from a surgical point of view (Fig. 25):

- Left ventral (1),
- Left dorsal (2),
- Middle ventral (3),
- Middle dorsal (4),
- Right ventral (5),
- Right dorsal (6).

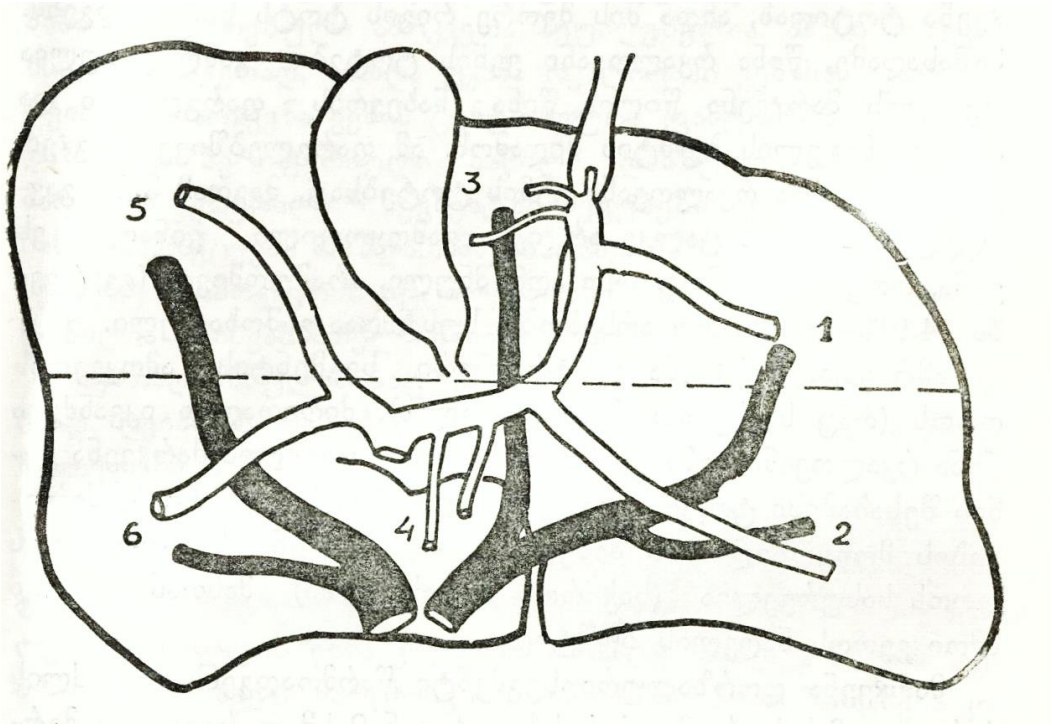


Fig. 25.
Division of the liver into segments according to intra-organ blood vessels (scheme):

1 — left ventral segment;	***4 — middle dorsal segment;***
2 — left dorsal segment;	***5 – right ventral segment;***
3 — middle ventral segment;	***6 — right dorsal segment.***

The border between the right and left parts on the inferior surface of the liver corresponds to the right longitudinal groove, and on the superior surface to the curved line directed to the left, which starts at the fundus of the gallbladder and continues to the place where the hepatic veins enter the inferior vena cava. If we make the incision on the mentioned boundary line, it is clear that catastrophic bleeding is not expected and, moreover, no part of the liver tissue will be left without blood supply.

As for the segments of the liver, the left ventral segment is completely related to the distribution of the anterior arcuate vein, the left dorsal segment - to the distribution of the posterior arcuate vein.

Depending on the location of blood vessels, isolated excision of the left ventral segment is quite possible. In connection with the resection of the segment, the anterior arcuate vein, corresponding artery and bile duct, as well as the proper branch of the left hepatic vein are ligated. It should be noted that in this case, the vascularization in the remaining part of the liver is not completely disturbed.

Isolated resection of the left dorsal segment is dangerous, because along with this segment, the central section of the left hepatic vein is excised (its peripheral part remains), as a result of which in the left anterior segment will develop clotting of blood and general disruption of blood circulation, which usually ends in cirrhosis. Therefore, in case of necessity of excision of the left dorsal segment, it becomes necessary the left anterior (ventral) segment to be excised along with it, i. e. total left lobe resection is conducted.

The mid-ventral segment mainly refers to the quadrate lobe, which is supplied with portal blood by branches from the left branch of the portal vein. It is not advisable to dissect this segment in isolation, because the branches of the portal vein, which extend into the left anterior segment, will partially pass within it. Therefore, together with the quadrate lobe, the left anterior segment should be excised. Otherwise, necrosis of the latter is expected.

The mid-dorsal segment is actually a caudate lobe, bordered on almost all sides by grooves. For conventional resection of other segments, the liver tissue is cut through the entire thickness, from one surface to another surface. Since the posterior middle segment (caudate lobe) is placed in a relatively dangerous area for incisions (hepatic veins are located deep under it), therefore, during any manipulations on it, the action should be performed superficially, at a depth of 2-3 centimeters, i. e. only within the caudate lobe. In this case, the veins of the caudate lobe should be ligated, which will not affect the blood circulation in the rest of the liver, nor is dangerous bleeding expected.

The right ventral and dorsal segments are the largest and cover the extent of the branches of the anterior and posterior arcuate veins arising from the right branch of the portal vein.

The right ventral segment is located to the right of the gallbladder. The right anterior arcuate vein is mainly branched in it, which either comes directly from the right branch, or is a branch of its second row. Therefore, the branches of the anterior arcuate vein are located within the anterior half of the right lobe of the liver and reach the region of the gallbladder. Within these limits, we sometimes find branches of the middle arcuate vein, but its distribution zone was not separated, since this vein, as mentioned above, is not constant (found in 14.9%) and if it is present, it is weakly expressed.

Thus, during resection of the right ventral segment (which is quite possible), the anterior arcuate vein and the corresponding branch of the right hepatic vein are generally ligated. It should be noted here that according to the system of the blood vessels, during the excision of this segment, it is preferable (if necessary) to excise the gallbladder together with it.

The right dorsal segment is the main mass of the liver, the thickness of which ranges from 4cm to 9 cm. It is turned posteriorly and to the right, and it is located relatively deep (under the dome of the diaphragm), that is why the operative approach to it is somewhat difficult. Among the blood vessels, this segment mainly contains the right posterior arcuate vein (together with the artery), which is always well developed and characterized by abundant branches. Along with it, here, near the middle line of the liver, there is an ascending vein, which goes almost vertically and finally branches superficially on the side of the diaphragm, so that in the right dorsal segment the portal vessels are located in two layers: in the inferior layer, the branches of the posterior arcuate vein are mainly diffused, and in the superior layer - branches of the ascending vein. Therefore, the portal blood supply of this segment is mainly produced by means of two main veins, which complicates surgical intervention on it.

The same can be said about the resection of this segment as about the left dorsal segment, i. e. it is impossible to isolate it. The reason for this is that this time, in addition to the posterior arcuate vein, the central (efferent) section of the right hepatic vein is also ligated, and its peripheral part remains blocked, which will cause blood circulation disruption due to congestion in the right ventral segment. Therefore, in the case of the necessity of excision of the right dorsal segment, it is appropriate the question of resection of the entire lobe to be arised.

Based on the above, according to our data, the following incisions are considered the most rational during liver resection (Fig. 26):

- For resection of the left ventral segment — angular incision: (abc), which follows the left edge of the left longitudinal (sagittal) groove (with a distance of 1 cm) from the anterior edge of the liver to porta hepatis, then turns to the left with a straight angle and reaches the left edge of the liver;
- For total resection of the left lobe — sagittal incision (III) from the anterior edge of the liver to the posterior edge, which will pass 1 cm to the left of the left longitudinal groove;
- For the resection of the right ventral segment, an angular incision (a'b'c'), which follows the right edge of the gallbladder from the anterior edge of the liver to porta hepatis, then turns to the right under a straight angle and reaches the right edge of the liver;
- For total resection of the right lobe — sagittal incision (I) from the anterior edge of the liver to the posterior edge, which follows the right edge of the gallbladder and continues to the right edge of the inferior vena cava;
- For simultaneous resection of the quadrate lobe and the left ventral segment — an angular incision that follows the left edge of the gallbladder from the anterior edge of the liver to porta hepatis, then turns to the left and reaches the left edge of the liver;
- For total resection of the left half of the liver — sagittal incision (II), which follows the left edge of the gallbladder and cuts the caudate lobe in half.

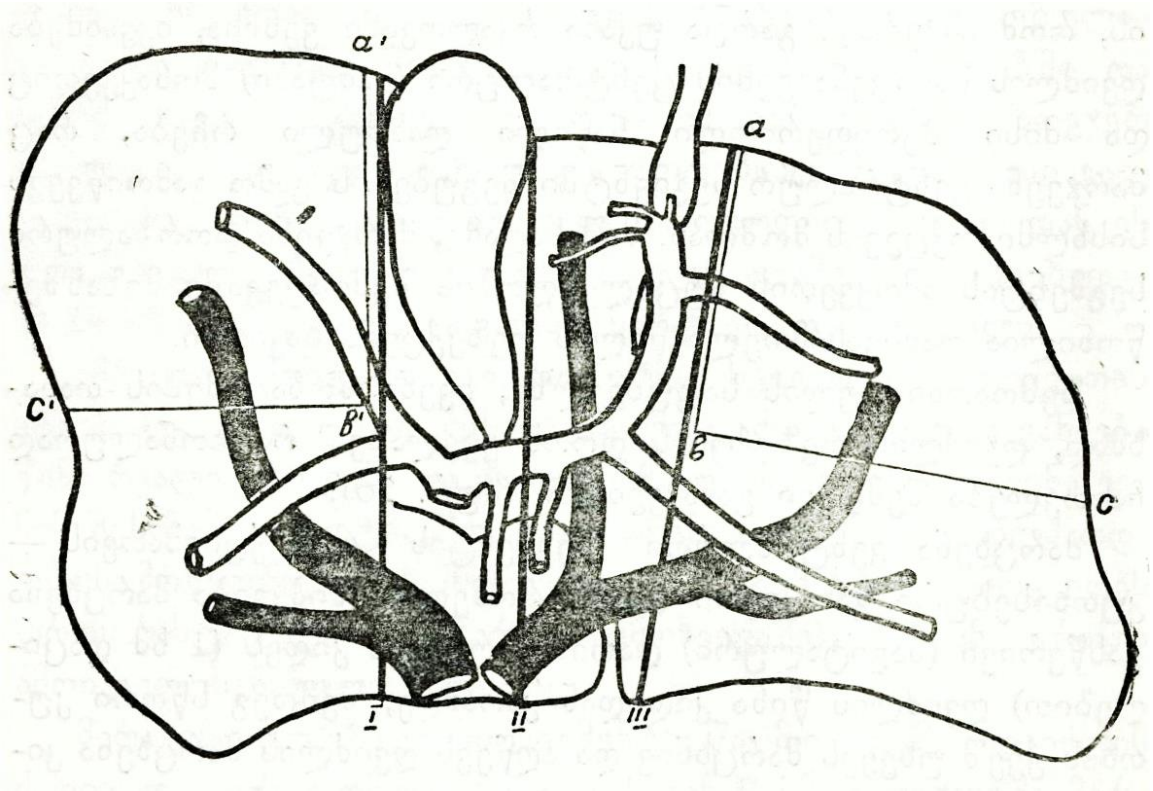


Fig. 26.
Inicisions for the liver (scheme):
abc - angular incision for resection of the left ventral segment;
a'b'c' - angular incision for resection of the right ventral segment;
I - sagittal incision for resection of the right lobe;
II - sagittal incision for resection of the left half of the liver;
III- sagittal incision for resection of the left lobe.

These incisions are provided based on the study of the vascular and bile ducts of the liver. They are provided both to deal with bleeding and also to maintain normal vascularization of the liver.

C O N C L U S I O N S

1. The portal vein in the porta hepatis can be divided into:

I. Right and left branches with almost equal diameter (80.2%). The right branch is relatively shorter and gives off a ascending vein;

II. Right, left and middle branches with almost equal diameter (11.9%). The latter is a direct continuation of the main trunk of the portal vein in its direction;

III. Right and left branches with different lengths and diameters (7.9%). The length and diameter of the left branch is larger than the right. It separates the ascending vein, which enters the central part of the right lobe of the liver.

2. Branches of the first row of the portal vein emerge from the main trunk at different angles. The right branch more often emerges under an acute angle (on average 20-30°), and the left branch - under a blunt angle (on average 110°). Because of this, the right branch is almost a direct continuation of the main trunk of the portal vein in its direction, and the left branch has an almost opposite direction to the axis of the portal vein.

Due to such peculiarities of exit of the branches of the first row of the portal vein, the hemodynamic conditions should be much better in the right lobe of the liver than in the left. This can also explain the lag in the growth of the left lobe of the liver during development.

3. The left branch of the portal vein is characterized by curvature, which increases with age. The anterior and posterior arcuate veins are separated from it, sometimes the superior arcuate vein as well. The first two veins are the main branches of the left branch, and the third is either completely absent (52.9%) or weakly developed.

The anterior arcuate vein separated from the left branch is located parallel to the anterior edge of the left lobe of the liver, 3-4 cm distanced

from it, and the posterior arcuate vein is parallel to the posterior edge of the same lobe, 2-3 cm distanced from it. These veins are divided into a variable number (4-13) of anterior and posterior branches under an acute angle, which are located superficially (relative to the inferior surface of the liver).

4. The left branch of the portal vein together with the left lobe of the liver supplies the quadrate lobe and most part of the caudate lobe.

The number of branches allocated to a quadrate lobe varies from 3 to 8.

In 23.6% of cases, venous branches entering the caudate lobe originate only from the left branch of the portal vein, and in the remaining 76.3% - from both branches of the portal vein. In addition, the left branch supplies the caudate lobe mostly with two or three veins, and the right branch with one vein.

5. The right branch of the portal vein is divided into 2, 3 or 4 branches of the next row. According to this, four main types of its branching are noted:

I. Four branches are separated from the right branch of the portal vein: anterior arcuate, posterior arcuate, middle arcuate and ascending vein (14.9%);

II. Three branches are separated from the right branch of the portal vein. anterior arcuate, posterior arcuate and ascending vein (18.8%);

III. Two branches are separated from the right branch of the portal vein: superior ascending and inferior arcuate vein. The latter, in turn, is further divided into anterior and posterior arcuate veins (46.5%);

IV. The right branch of the portal vein is divided into anterior and posterior arcuate veins, and the ascending vein comes out directly from the main trunk of the portal vein (11.9%) or from its left branch (7.9%).

By its structure, the first and second types belong to the bush-like (diffuse) form of the division of the right branch (33.7%), the fourth type – trunk form (19.8%), and the third (the most frequent type) - mixed (transitional) form (46.5 %).

6. The right and left branches of the portal vein are connected to each other by means of the gallbladder veins. In addition, direct anastomoses are observed in their branching, which is relatively rare (6.9%).

7. Gallbladder veins form deep and superficial plexuses. The deep plexus is formed by thin branches and is placed in the thickness of the organ wall. The superficial plexus is connected to the deep plexus and is formed by relatively large veins.

In the branching of the veins of the gallbladder, three main forms are noted: trunk, bush-like (diffuse) and mixed.

In the case of the trunk form, the deep venous plexus is represented as a large looped network, and the superficial one is in the form of paired and tortious blood vessels that connect to the main venous trunk of the gallbladder, and the latter is attached to one of its branches of the portal vein (25.9%).

In the case of a bush-like form, the deep venous plexus is represented as a thin looped network of complex structure, and the superficial plexus connected to the deep plexus consists of 7-10 branches that join the branches of the portal vein (29.4%).

In the case of mixed form, signs of both trunk and bush-like (diffuse) form are noted in the system of deep and superficial systems. The efferent veins of the gallbladder join the branches of the portal vein in this case too (44.7%).

8. Additional portal veins are noted in 61.7% of cases. In 8.7% of them, they start from the main trunk of the portal vein, and in 52.9% - from the veins of one or another organ of the glandular floor and join the main trunk of the portal vein (23.8%), its left branch (27%), branches of the

left branch (11.1%), right branch (4.8%), veins of the caudate lobe (12.7%) or gallbladder veins (20.6%). The number of additional portal veins varies from 1 to 5. More often, 1 or 2 veins are noted.

9. Hepatic veins can be divided into two groups: the first group includes the main veins (from 2 to 5), which are relatively permanent collectors and open into the inferior vena cava under the diaphragm. The second group includes small-caliber veins (from 3 to 10), which open separately into the inferior vena cava along the entire length of the liver area.

10. The main veins of the liver join the inferior vena cava at different angles. The angle of junction of the right vein varies from 10° to 30°, of the left vein — from 20° to 90°, and the angle of junction of the middle vein — from 20° to 70°. Moreover, more often the right vein is trunk-form (60.9%), the left - bush-like form (diffuse) (65.9%), and the middle vein – mixed form (64.9%).

In most cases, anastomoses are observed between the main hepatic veins, which are mainly located superficially, near the place where the main hepatic veins join the inferior vena cava.

11. Three ventral (left, right and middle) and three dorsal (left, right and middle) segments are distinguished in the liver according to the branching of the liver vessels and bile ducts.

Left and right ventral segments can be resected separately. Excision of the left and right dorsal segments in isolation cannot be considered rational, because venous congestion will develop in the corresponding ventral segments (due to ligation of the proper vein of the liver).

Therefore, in the case of the necessity of excision of the left or right dorsal segment, the question of total excision of the appropriate lobe may be raised.

A P P E N D I X

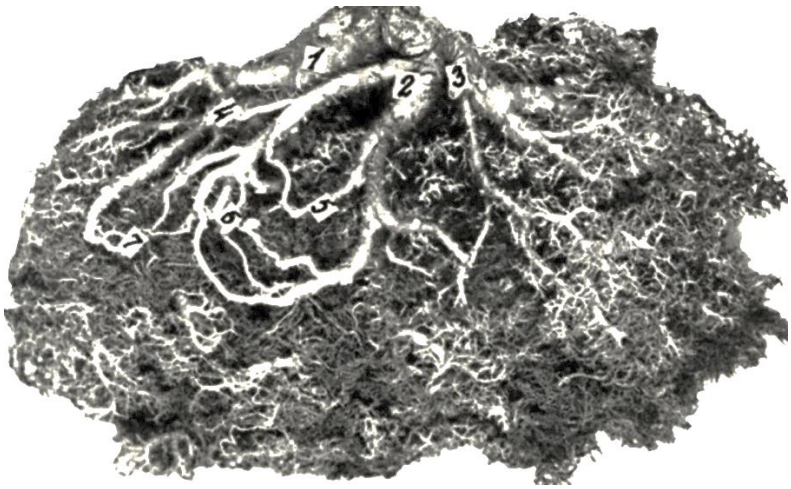


Fig. 1

Intraorgan branching of hepatic veins (corrosive preparation)

1-right hepatic vein; 2-middle hepatic vein; 3-left hepatic vein; 4,5,6,7 – anastomoses between branches of the hepatic veins.

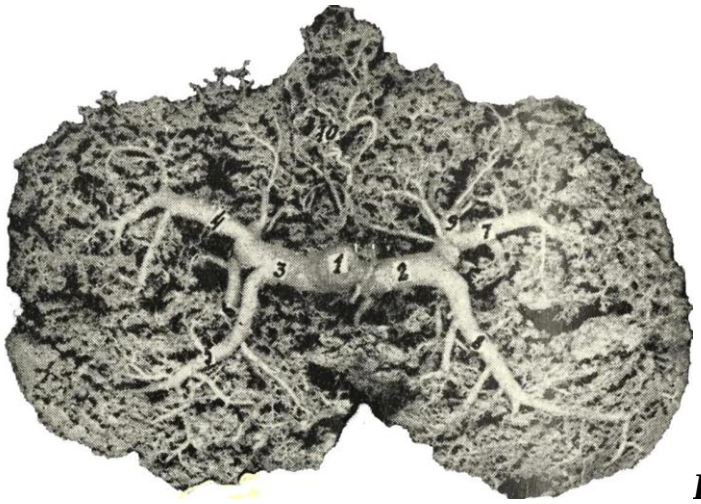


Fig. 2

Intraorgan branching of the portal vein (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-right middle arcuate vein; 7-left anterior arcuate vein; 8-left posterior arcuate vein; 9-umbilical recess; 10-gallbladder veins.

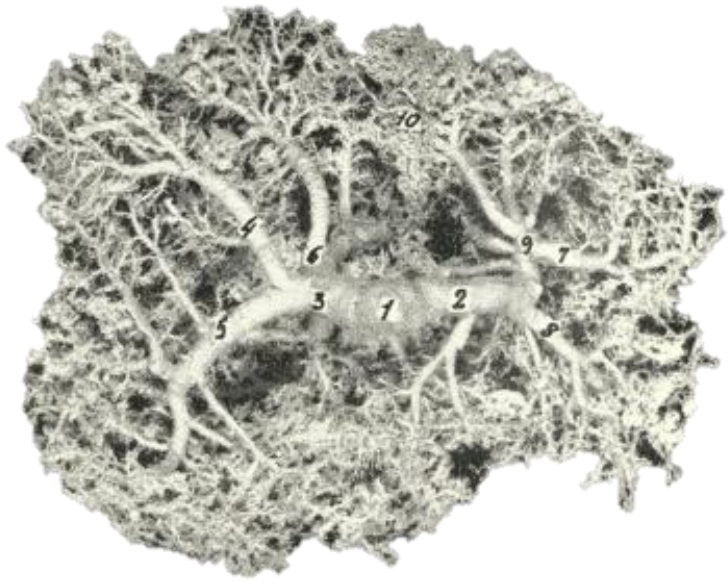


Fig. 3

Intraorgan branching of the portal vein (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-ascending vein; 7-left anterior arcuate vein; 8-left posterior arcuate vein; 9-umbilical recess; 10-gallbladder veins.

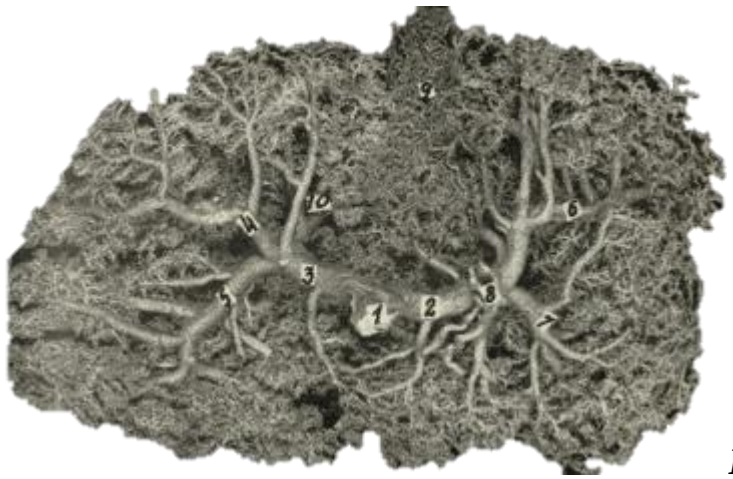


Fig. 4

Intraorgan branching of the portal vein (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-accessory portal veins (connect to the veins of caudate lobe); 9-gallbladder veins; 10-ascending vein.

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Fig. 5

Intraorgan branching of the portal vein and bile ducts (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-hepatic duct; 9-10-bile ducts.

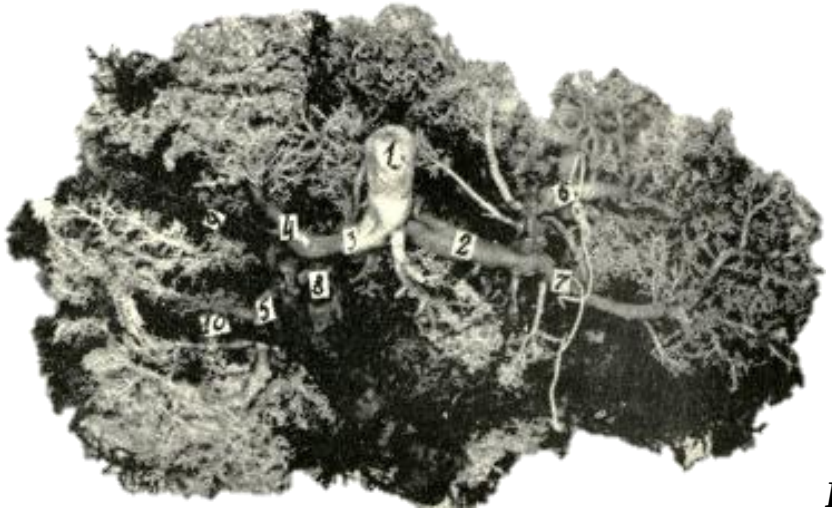

Fig. 6

Intraorgan branching of the portal vein and hepatic veins (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-inferior vena cava; 9-10-right inferior hepatic veins.

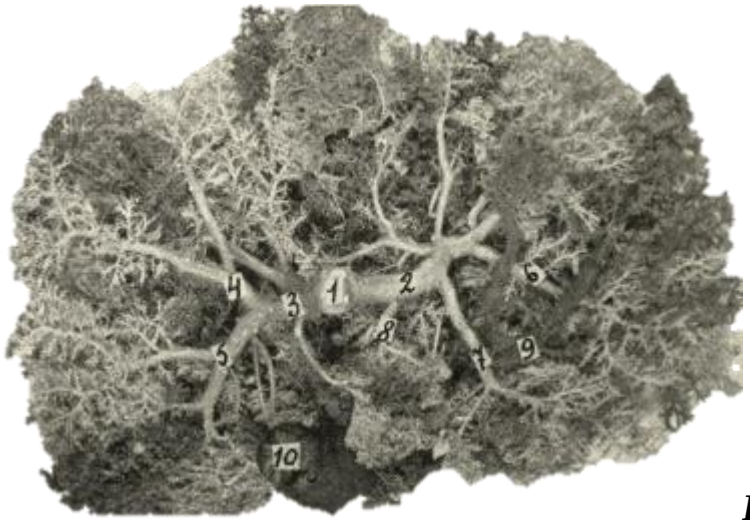

Fig. 7

Intraorgan branching of the portal vein and hepatic veins (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-caudate lobe vein; 9-left hepatic vein; 10-inferior vena cava.

Fig. 8

Corrosive preparation of intraorgan hepatic vessels (view from inferior surface)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-accessory portal vein; 9-hepatic artery; 10-inferior vena cava.

Fig. 9

Intraorgan hepatic vessels (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-hepatic artery; 9-quadrate lobe veins; 10-inferior vena cava.

Fig. 10

Intraorgan hepatic vessels and bile ducts (corrosive preparation)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-common bile duct; 9-hepatic artery; 10-inferior vena cava.

Fig. 11

Corrosive preparation of intraorgan hepatic vessels and bile ducts (view from superior surface)

1-right hepatic vein; 2-middle hepatic vein; 3-left hepatic vein.

Fig. 12

Corrosive preparation of intraorgan hepatic vessels and bile ducts (view from inferior surface)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-left middle arcuate vein; 9-hepatic artery and common bile duct; 10-inferior vena cava.

Fig. 13

Corrosive preparation of intraorgan hepatic vessels and bile ducts (view from superior surface)

1,2,3,4,5-hepatic veins

Fig. 14

Corrosive preparation of intraorgan hepatic vessels and bile ducts (view from inferior surface)

1-main trunk of the portal vein; 2-left branch of the portal vein; 3-right branch of the portal vein; 4-right anterior arcuate vein; 5-right posterior arcuate vein; 6-left anterior arcuate vein; 7-left posterior arcuate vein; 8-hepatic artery; 9- common bile duct; 10-inferior vena cava.

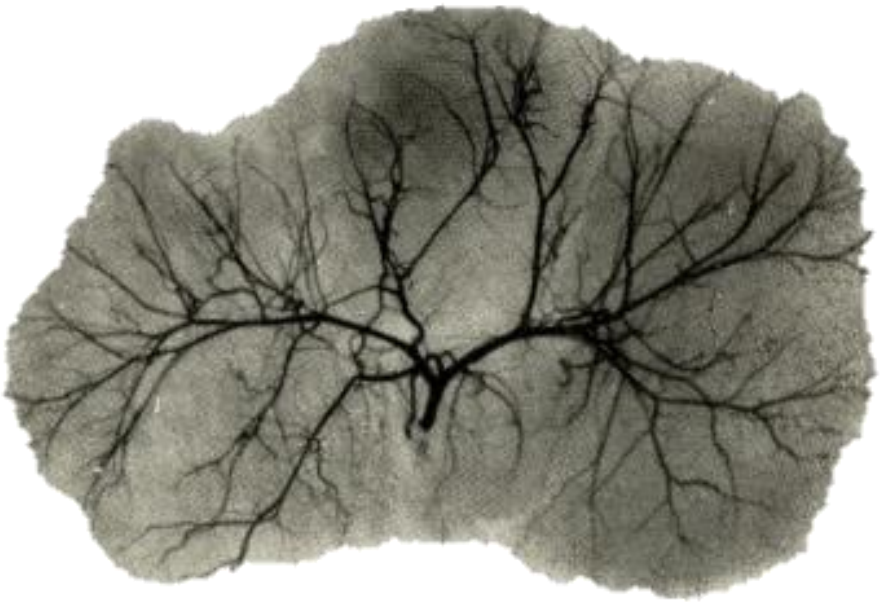

Fig. 15

Branching of the hepatic artery of a newborn (X-ray)

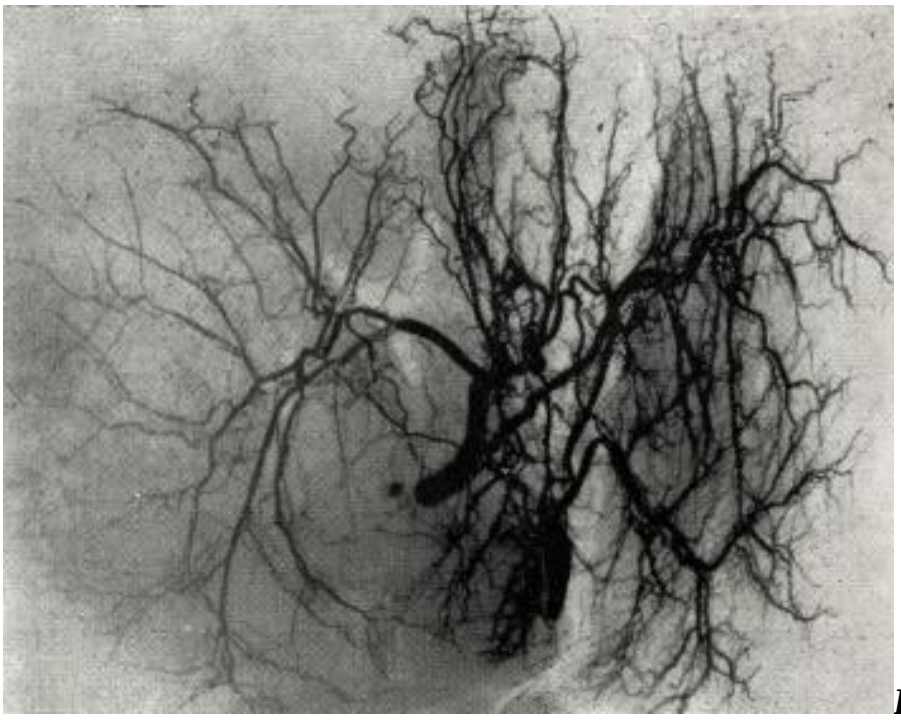

Fig. 16

Branching of the hepatic artery of an adult (X-ray)

Fig. 17

Branching of the hepatic veins of a 1-year old baby (X-ray)

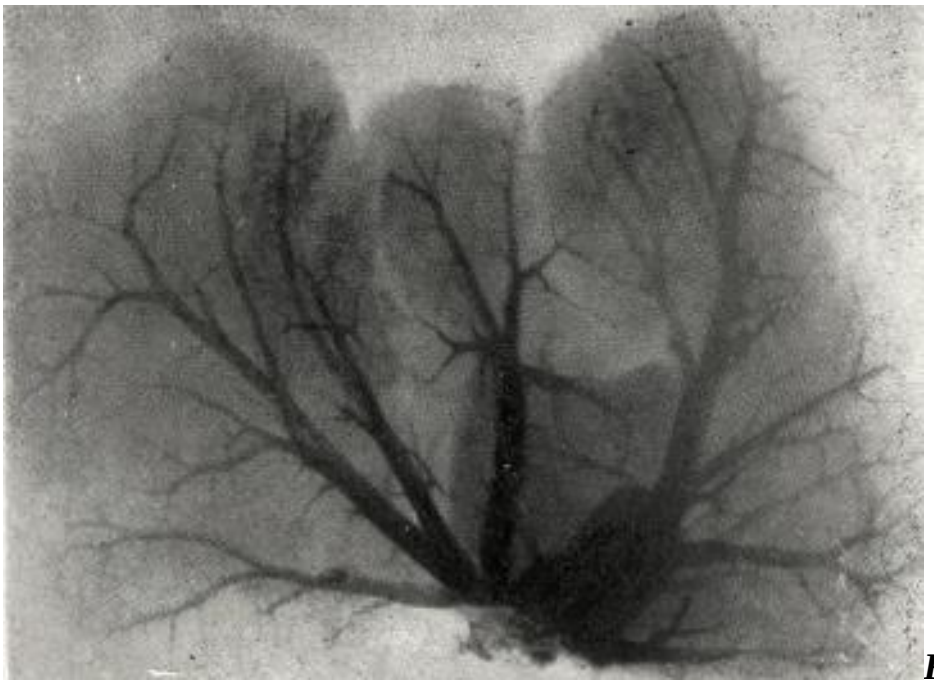

Fig. 18

Branching of the hepatic veins of an adult (X-ray)

R E F E R E N C E S

თოიძე შ. თბილ სახ. სამედ. ინსტ. ოპერატიული ქირურგიისა და ტოპოგრაფიული ანატომიის კათედრის შრომები, 1956, I. 89-103.

იოსელიანი დ. თანამედროვე მედიცინა, 1930, II, თბილისი.

კიკნაძე ვ. ღვიძლის ვრცელი რეზექციის გავლენა სისხლწარმოქმნაზე. დის. მედ. მეცნ. დოქტორის ხარისხის მოსაპოვებლად. თბილისი, 1957.

ქევანიშვილი შ. თბილ. სახ. სამედ. ინ-ტის შრომები. ტ. XVIII, 1958, 41-49.

ჯავახიშვილი-კომახიძე ნ. საქ. სსრ მეცნ. აკადემიის ექსპერიმენტული მორფოლოგიის ინსტიტუტის შრომები. ტ. IV, 1953, 65-147.

Акилова А. Т. Труды и материалы Донецкого мединститута, 1936, 1, 20-28.

Альперович Б. И. Вестник хирургии им. И. И. Грекова, 1960, 85, 11, 127-128.

Брегадзе И. Л. Хирургия, № 3, 1957, 26-31.

Бурденко Н. Н. Материалы к вопросу о последствиях перевязки V. Portae. Дисс. Юрьев, 1909.

Валькер Ф. И. К хирургической анатомии системы воротной воны. Дисс. науч. степ. докт. мед. наук, Л., 1920.

Великорецкий А. Н. Хирургия, 1955, 5, 44-54.

Виткинд Ю. Э. Анатомические особенности печени и ее сосудов у детей. Дисс. нз канд. мед. наук, 1936.

Галушко А. Я. Резекция печени в эксперименте и клинике. Дисс. на уч. степ, доктора мед. наук, 1948.

Гудкова Е. С. К анатомин воротной вены. Дисс. на соиск. уч. степ. канд. мед. наук. Горький, 1948.

Делициева К. Н. К типовой печеночных вен. Дисс, на степ. канд. мед. наук. Саратов, 1948.

Делициева К. Н. Труды кафедры нормальной анатомии. Саратов, 1955. 1. 239-243.

Долго-Сабуров Б. А. Об окольном кровотоке в системе воротной вены. Очерки функциональной анатомии кровеносных сосудов. Л., 1961, 148-166.

Золотухин А. Рентгено-ангиология, 1934.

Иоселиани Д. Г. Типовая анатомия брюшной полости новорожденных (в кн. сбори, груд, посвящ. 40 летно научи и учебн. дент. проф. В. Н. Шевкуненко, Л., 1937).

Иоселиани Г. Д. К вопросу патогенеза и лечения симптомокомплекса. Пика. Дисс. на соиск. уч. степ, доктора мед. наук, Тбилиси, 1958.

Касайкина Т. Н. Хирургия, 1953, 7, 62-65.

Ковальский Ф. Ю. О печени у детей. Дисс. СПб, 1900.

Комахидзе М. Э. Тр. ин-та экспе. и клин. хир. и гематологии АН Груз. ССР, т. VII, 1957, 353-372.

Красуская А. А. Двойной ток воротной вены. Известия научного института им. П. Ф. Лесгафта, т. X, 1924.

Крылова Н. 11. Казанский медицинский журнал, 1960, 4, 63-65.

Кузнецов Б. Г. Ученые записки Горьковского мед. института, 1957, 121-135.

Кулябко Б. В. Изменения в строении в воротной системы печени при нарушениях кровообращения. Л., 1940.

Кунцевич В. В. Труды Военно-мед. Акад. им. С. М. Кирова, том 38, 1947.

Летичевский Б. И. Архив анатомии, гистологии и эмбрио- логин, г. XX, 1939.

Лурье А. Вестник хирургии им. И. И. Грекова, 1935, 37, 106 и 107, 187-189.

Максименков А. Н. Крайние типы изменчивости системы нижней полой вены и их прикладное значение. Дис. на уч. степ. докт. мед. наук, Л., 1937.

Мампория Н. М. Микроваскуляризация печени в норме и в эксперименте. Труды Института экспер, морфологии Акад. наук Груз. ССР, т. IX, 1961, 95-103.

Мельников А. В. О резекции печени, Хирургия, 1, 1956, 38-17.

Михайлов Г. А. Внутриорганная топография сосудов печени, Ученые записки, т. 111, 1959, 202-209.

Морозова Т. Д. Тезисы докладов II Украинской конференции морфологов, Харьков, 1956.

Надеин А. П. и Крымгольц М. Л. Труды 1 съезда хирургов Закавказья, Баку, 1925.

Надеин А. П. и Крымгольц М. Л. Теорет. и практич.мед.,1926,1,5-6.

Нечунаев Л. М. Казанский медицинский журнал, 1958, 8, 44-51.

Огнев Б. В. и Сызганов А. Н. К хирургической апатомии печени человека, XVIII съезд Российских хирургов, 1927.

Павлов И. П. Экковский свищ вен нижней полой и воротной и его последствия для организма. Собрание сочинений, М.-Л., 1951, 2, 210-238.

Парфентьева В. Ф. Архитектоника кровеносных сосудовпечени. Кишинев, 1960.

Степанова В. Н. Тр. в/мед. Акад. им. С. М. Кирова, 1953,50,563-579.

Тихомиров М. А. Варианты артерий и вен человеческого тела, Киев, 1899.

Тонков В. Н. Вестник рентгенологии и радиологии, т. XXVI, 5-6, 1947.

Торкачева М. И. Монография, 1924.

Фейтельберг П. И. Анатомия анастомозов между воротной и нижней полой веной в подвздошных областях и по ходу вос ходящего и внсходящего отделов толстых кишок, Дисс. на степ докт. мед. наук, 1947.

Фишман Л. Г. и Кревер А. Н. Вестник рентгенологии и радиалогии, VIII, вып. 1. 1930.

Хашимов Н. Х. Архив анатомии, гистологии и эмбриологии, I 1959, 55-62.

Шевкуненко В. Н. и Максименков А. Н. Новый хир. архив, т. 36, кн. 3-4, 1930.

Шепелев М. В. Вестник хирургии им. И. И. Грекова, 1956, 4, 14-22.

Экк Н. В. Военно-медицинский журнал, 1877, XXX, 32.

Burlet H. M. Morph. Jahrb, 1911. 42, 1-71.

Couinaud C. Presse méd., 1954, 62, 33, 709-712.

Gans H. Introduction to Hepatic Surgery. 1955.

Glisson F. Anatomia Hepatis. London, 1954.

Hocssetter F. Morph. Jahrb., 1893. 20, 543-648.

Keibel F. U. Mall F. P. Handbuch der Entwicklungsgeschichte des Menschen. Leipzig, 1911, 2.

Kremer K. u. Hilke H. Zentralblatt für Chirurgie, 1959, 31, 1225-1232.

Lalanbie. Contribution à Pétude de la circulation intrahè patique. Paris, 1910.

Lewis F. T. Handbuch der Entwicklungsgeschichte des Menchen. Herausg von Keibel F. und Mall F. P., 1, 911.

Lurie A. Ann. Surg., 1937, 105, 161-168. Referate-Zorg. f. Chir., 83, 144-145.

Melnikoffa. Zeitschrift für Anatomie und Entwicklungsgeschichte, 1294, 70.

Naboer I. F. Frankf. Zeit. Pathol., 1931, 41, 454-11; Refepate-Anat Ber., 25, 462-463.

Perren Tierl. Die Venen der Gallenblase und der extrahepatischen Gallenwege beim Menschen und Wirbeltieren. Stockholm 1933.

Popescu C. Zeitschrift fâr Arztliche Fortbildung, 1958, 16, 672-676.

Reifferscheid M. Chirurgie der Leber. Klinik und Technik. Stuttgart. 1957.

Ruge G. Leber mit abgespaltenem, rechtem Seitenlappen. Gegenbaurs morphologisches Jahrbuch. 1913, 46, 293.

Sherlock Sc Diseases of the Liver and Biliary System 1958.

Spigel A. Dh humani corporis fabrica 1627.

On the Cover: *Fig. 11 from Bonnel F, Duparc F. Historical anatomy of hepatic segmentation: about 250 livers corrosions by Rapp (1953) and Couinaud (1953) in the Conservatory of Anatomy in Montpellier. Surg Radiol Anat. 2020 Dec;42(12):1407-1420. doi: 10.1007/s00276-020-02596-3. Epub 2020 Oct 17. PMID: 33070211.*