서 울 의 대 잡 지 제4권 제3호
The Seoul Journal of Medicine
Vol. 4, No. 3, September, 1963

Surgical Anatomy of Liver Pertaining to Major Hepatic Resection
A Summary of Clinical Experience

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Introduction

Massive resection of the liver has increased in frequency and magnitude during recent years. Recently, in 1962, Quattlebaum[1] has said that an active abdominal surgeon will encounter a number of hepatic conditions favorable for resection, some of which will be discovered unexpectedly during the course of an abdominal exploration.

According to Galluzzi et al,[2] primary hepatic cancer is seen in Europe in 0.13 percent of all autopsies and comprises 1.1 percent of all carcinoma; in America, it is seen in 0.25 percent of all autopsies and comprises 2.1 percent of all carcinoma; while in the Orient, it is seen in 0.85 percent of all autopsies and comprises 14.1 percent of all carcinoma.

Since the authors have encountered carcinoma of the liver at surgery on many occasions in Korea, they are convinced that resection of the liver is a necessary form of therapy. During the past five years, the authors have attempted to clarify the surgical anatomy of the liver, pertaining to major hepatic resection, in the hope that resection may become a safe and practical proce dure. The following report is a result of these investigations along with a summary of clinical experiences with hepatic resection.

Standard Form in Liver Anatomy

One of us(Dr. S.Y. Ryu) dissected 140 Korean infant cadavers. Using Vinylite-acetate corrosion casts, he injected the portal vein (117 cases), the hepatic arteries (41 cases), the bile ducts (61 cases), and the hepatic veins(60 cases). On the basis of these dissections, we tried to formulate a "standard form" which might be of clinical application. The following results were obtained:

I. Portal Vein—In the majority of cases, a bifurcation of the portal vein occurred extrahepatically. It was intrahepatic in only 20% of cases. In 2 cases of our 117, a duplication of the portal vein system was observed.

A. Mode of branching of the main portal vein.

1. "Standard Form"(Type I)—In 71.8%, the portal vein divided into two branches, the right and the left portal veins(Figure 1).

2. Variations(Type II)—In 16.2%, the portal vein going to the anterior segment of the right lobe originated from the side of the left portal vein (Figure 2).

3. Variations(Type III)—In 10.3%, instead of the usual bifurcation, an immediate trifurcation occurred. In these cases, the segmental branches to the right anterior and right posterior segments sprang directly from the main portal vein trunk without forming a proper right portal vein(Figure 3).

4. Variations (Type IV)—In these variations, 1.7 %, the left portal vein was found as usual. On the right, however, the anterior segmental branch, the posterior superior and the posterior inferior subsegmental branches took off directly from the main portal vein, thus giving the picture of a main portal vein suddenly dividing into four branches(Figure 4).

Of our seven clinical cases of right hepatic lobectomies, six belong to Type I and the remaining case belonged to Type IV.

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B. Mode of branching of the right and left portal veins.

1. As in Figure 5, the left portal vein runs transversely and then turns anteriorly to form the umbilical portion. In this portion, four branches were observed, as shown in the picture. This was the "standard form"(88.9%). There were a few variations in which the transformation of the transverse part into the umbilical part was not as clear cut as in the standard form(4.4%) (Figure 5 & B).

2. The right portal vein bifurcated into the right anterior and the right posterior segmental branches. The right anterior segmental branch further divided into the right anterior superior and the right anterior inferior subsegmental branches, while the right posterior segmental branch bifurcated into the right posterior superior and the right posterior inferior subsegmental branches. This was the standard form, representing 50.4%(Figure 6).

3. Variations—In 20.5% of cases, instead of bifurcating into the right anterior and posterior segmental branches, the right main portal vein trifurcated into the right anterior segmental, right posterior superior and the right posterior inferior subsegmental branches(Figure 7).

II. Hepatic Artery—The main hepatic artery divided into the right and left hepatic arteries at the *porta hepatis*.

A. The right hepatic artery followed the right hepatic ducts on its posterior-inferior aspect and divided into the right anterior and right posterior segmental branches. This was seen in 84.4%. In 87.5% of these cases, the right anterior segmental branch further divided into the right anterior superior and right anterior inferior subsegmental branches. These were the standard forms.

B. The left hepatic artery ran medially and superiorly, and then divided into the medial and lateral segmental branches. The medial segmental artery followed the umbilical portion of the portal vein on its medial side, and then further divided into the medial superior, medial inferior, lateral superior and lateral inferior subsegmental arteries. This occurred in 51.6%(Figure 8A).

Variations: The medial segmental artery originated from the lateral inferior subsegmental branch in 31.3%. In these cases, the possibility of occluding the arterial blood flow in the lateral inferior subsegmental branch when ligating the artery at the umbilical portion should be kept in mind(Figure 8B).

C. The middle hepatic artery was seen in 36% of the specimens. In ten instances, it originated from the left hepatic artery, and in the remaining five cases, it originated from the main hepatic arterial trunk(15 out of 41 cases).

D. Aberrant and accessory hepatic arteries: a left aberrant and accessory hepatic artery originated from the left gastric artery coursed along the left segmental fissure, divided into the lateral superior and lateral inferior subsegmental arteries, and perfused the lateral segment of the left lobe(7.3%). A right aberrant and accessory hepatic artery originated from the superior mesenteric artery, ran along the right segmental fissure, entered the liver substance and divided into the right anterior and right posterior sub segmental arteries(3.1%).

Intrahepatic collateral circulation between the hepatic arteries was seen in 21.9%.

III. Bile Ducts

A. The right hepatic duct divided into the anterior and posterior segmental ducts. The right anterior segmental duct further divided into the right anterior superior and right anterior inferior subsegmental ducts. Meanwhile, the right posterior segmental duct split into the right posterior superior and right posterior inferior subsegmental ducts. This was the standard form and was seen in 85.2%(Figure 9A) There were many variations of this, as are seen in Figure 9B and 9C.

B. The left hepatic duct bifurcated into the medial and lateral segmental ducts at the point anterior to the junction of the transverse and umbilical portions of the left portal vein. The lateral segmental duct further divided into lateral superior and lateral inferior subsegmental ducts. The medial segmental duct divided into the medial superior and medial inferior subsegmental ducts. This occurred in 47.5%(Figure 10A).

C. Variations: The left hepatic duct divided into the lateral superior and lateral inferior

subsegmental ducts, and then the medial segmental branch originated from this lateral inferior subsegmental branch(27.9%)(Figure 10B).

IV. Hepatic Veins

A. The right hepatic vein collects blood from the posterior segment and the anterior superior subsegment, travels along the boundary of the anterior and posterior segments, and then empties into the inferior vena cava on its right side in 87.7%(Figure 11).

B. The right inferior hepatic vein, consisting of one to three branches, collects blood from the posterior inferior subsegment and empties into the inferior vena cava where the latter is adherent to the posterior surface of the right lobe of the liver. This was observed in 88.3% (Figure 12).

C. The middle hepatic vein drains the anterior segment of the right lobe and the medial inferior segment of the left lobe, follows the interlobar plane and joins the left hepatic vein before emptying into the inferior vena cava (63.4%).

D. The left hepatic vein drains blood from the lateral segment and the medial superior subsegment of the left lobe and empties into the medial superior aspect of the inferior vena cava (86.7%).

V. Caudate Lobe—The right half of the caudate lobe receives blood from the right portal vein and the right hepatic artery, and drains bile into the right hepatic duct. The left half receives blood from the left portal vein and the left hepatic artery, and drains bile into the left hepatic duct. Venous blood drains directly into the inferior vena cava rather than joining any other major venous branch.

With the above observations in mind, we wish to divide the liver into the following areas:

A. Classification of the Lobes

1. Left Lobe
2. Right Lobe

B. Classification of the Segments

1. Anterior segment of the right lobe.
2. Posterior segment of the right lobe.
3. Lateral segment of the left lobe.
4. Medial segment of the left lobe.
5. Medioposterior segment, or, the Caudate Lobe, as in the classic anatomical usage.

C. Classification of the Subsegments

1. Anterior superior subsegment of the Anterior segment.
2. Anterior inferior subsegment of the Anterior segment.
3. Posterior superior subsegment of the Posterior segment.
4. Posterior inferior subsegment of the Posterior segment.
5. Latero-superior subsegment of the Lateral segment.
6. Latero-inferior subsegment of the Lateral segment.
7. Medio-superior subsegment of the Medial segment.
8. Medio-inferior subsegment of the Medial segment.
9. Right medio-posterior subsegment of the Medioposterior segment.
10. Left medio-posterior subsegment of the Medioposterior segment(Figures 15 & 16).

Clinical Experience

During the past five years, ending December 1961, we have performed five right lobectomies and 6 left lobectomies on clinical cases(Table 1). In performing the right lobectomies, we followed the technique of Quattlebaum, using the control method. To do the left lobectomies, we utilized the Guillotine type of technique applying massive mattress sutures to the left of the falciform ligament before amputating the liver substance.

More recently, in 1962, we have done massive hepatic resections, utilizing what we consider as a more reasonable and anatomical approach. This will be brought out in the following brief resume of four cases.

Case I

Performed by Dr. T.Y. Paik in April, 1962.

Dignosis: Primary Hepatoma, Left Lobe.

Operation: On exploration, the tumor occupied the entire left lobe. The right lobe was normal. However, the tumor in the left lobe was such that the entire mass could included in the resection if one were to perform a classical left lobectomy. Accordingly, the surgeon decided to perform the

Table I. Left Hepatic Lobectomy Cases

No	Name	Age	Sex	Postoperative diag.	Postoperative course	Results
1	Kim Soon	56	M	Hepatocellular ca. of the left lobe	Uneventful, discharged 11 days after operation	
2	Chun Im	59	F	〃	Infection, discharged 19 days after operation	Lived for 2 months
3	Kim Ai	49	M	cholangioma	Uneventful discharged 12 days after operation	Lived for 1 year
4	Kim Choog	52	M	Metastatic ca. from stomach ca.	Infection, discharged 41 days after operation	Lived for 2 months
5	Yoon Sool	44	M	Metastatic ca. from cardia ca	Uneventful, discharged 14 days after operation	
6	Lee Siok	44	M	contiguity spread from stomach ca.	Uneventful, discharged 12 days after operation	Lived for 1 year

Table II. Right Hepatic Lobectomy Cases

No	Name	Age	Sex	Postoperative diagnosis	Postoperative course	Results
1	Choi Ai	52	F	Cholangioma of the right lobe	Bile leakage, hepatorenal syndrome, coma.	Died 9 days after operation
2	Ha Oon	49	M	Hepatoma with liver cirrhosis	Bile leakage, jaundice and ascites increased	Lived for 3 months
3	Moon Hae	28	F	Contiguity spread of malignant lymphom from right colon.	Infection, discharged 29 days after operation	Living Well over 2 years
4	Lee Sool	60	F	Hepatoma	Bile leakage, bile peritonitis	Died 13 days postoperative
5	Kim Shick	52	M	Hepatoma of the right lobe of the liver	Uneventful, discharged 14 days after operation	Living well over 4 months

left total lobectomy, including the lateral half of the medial segment, using the control method. The left triangular and coronary ligaments were divided and the posterior-superior surface of the left lobe, especially the left hepatocaval angle region, was well exposed. At the same time, the falciform ligament was cut along the line of the hepatic insertion up to the round ligament insertion.

A few stay sutures were established by means of mattress suture near the anterior margin of the medial segment, about 2cm. to the right of the falciform ligament. These stay sutures help greatly to expose the *porta hepatis*. The left portal vein and left hepatic artery were extrahepatically individually identified, divided, and ligated respectively. The left hepatic vein was exposed and divided and ligated. A line of demarcation appeared rather sharply along the Cantlie line, 2 to 3cm. to the right of the falciform ligament. From this point on, following the left para-lobar plane (preserving the middle hepatic vein), the entire left lobe, including the lateral half of the medial segment, was removed along the line 2 cm. to the right of the falciform ligament.

Individual ligation of the vessels and bile ducts presenting on the cut surface was carefully performed. Bleeding from the cut surface was moderate, but the entire operation required only three pints of whole blood. The resected specimen weighed 1300gm.

The cut surface was covered with the remaining portion of the falciform ligament to prevent adhesions. A penrose drain was inserted to this space but a T-tube was not inserted.

The postoperative course was uneventful and there was only minimal discharge about the

penrose drain. The patient was discharged on the 21st postoperative day. Liver functions studies were normal at the time of discharge, as were those done on the 61st postoperative day. There was no jaundice. The patient, a 57-year-old male, is now in vigorous health(Figure 17 Photographs 1 and 2).

Comments: Left lobectomy with the lateral half of the medial segment, utilizing the control method individual ligation of vessels and ducts at the *porta hepatis* was first performed by Shakleford in 1956. However, he amputated the liver at a line to the left of the falciform ligament and, accordingly, in the strict sense, this represents lateral segmentectomy of the left lobe rather than total left hepatic lobectomy. The case presented is the first case reported, so far as the authors are aware, where the entire left lobe, includng the lateral half of the medial segment, or quadrate lobe, was resected *en masse*, utilizing the control method.

Case II.

Performed by Dr. P.C. Min in April, 1962.

Diagnosis: Primary Hepatoma, originating in the gall bladder bed.

Operation: On exploration, the tumor appeared to originated in the anterior segment of the right lobe, as well as extending and occupying the entire left lobe. Preoperative needle biopsies had shown the posterior segment to be free of disease. The resection of the left lobe and the anterior segment of the right lobe was decided upon and performed as follows:

At the *porta hepatis*, the dissection and ligation of the left portal vein, left hepatic artery, and left hepatic duct were first carried out. In order to control the pedicles to the anterior segment of the right lobe, dissection was carried along the right portal vein, right hepatic artery and the right hepatic duct. Rather profuse bleeding was encountered during this dissection, but it was completed and the structures to the anterior segment of the right lobe were ligated and divided. A line of demarcation appeared which seemed to outline the entire left lobe and the anterior segment of the right lobe, but the anterior segmental boundary was not as clear cut as that between the lobes.

Following mobilization of the liver, the left hepatic and middle hepatic veins were ligated extrahepatically, and amputation of the liver substance was carried out along the intersegmental plane (between the anterior and posterior segments) and the interlobar plane(3cm. to the right of the falciform ligament). Individual ligations of structures on the cut surface were done. Included in the specimen were the entire left lobe and the anterior segment of the right lobe, as well as the caudate lobe. A T-tube was inserted and the abdomen drained.

Postoperatively, there was very minimal bile drainage from the T-tube, while much bile drained along the penrose abdominal drain placed at the cut surface. The patient's general condition was fair and he had begun to take oral nourishment, but signs of liver coma appeared on the 7th postoperative day, and, the patient expired on the 9th postoperative day. Autopsy was refused(Figure 18, Photographs 3 and 4).

Comments: To our knowledge, this case represents the first attempt at resection of a segment of the liver, utilizing the control method. It appears that when bleeding was encountered during the dissection of the right anterior segmental branches of the structure, hasty ligation of these bleeding points may inadvertently have occluded the bile duct from the remaining posterior segment of the right lobe, thus contributing to the cause of death. However, the feasibility of this type of resection is amply proved. Photographs 3 and 4 show the resected specimen, resecting the entire left lobe and the anterior segment of the right lobe, which containd the tumor.

Case III

Performed by Dr. K.R. Chang in May, 1962.

Diagnosis: Primary hepatoma, right lobe.

Operation: Tumor was found to be localized in the anterior segment of the right lobe and the medial segment of the left lobe. The lateral segment of the left lobe was unaffected. Preoperative needle biopsies had shown minimal cirrhotic changes in the remaining liver. At the *porta hepatis*, the right hepatic artery, right portal vein and right hepatic duct were ligated. Then, along

the left trunk of these structures, dissection was carried out until the transverse and umbilical portions of the portal vein were freed. These steps were performed with relative ease. The portal vein, hepatic artery and bile ducts to and from the medial segment of the left lobe were then identified, freed, ligated and divided. At this point, a line of demarcation clearly appeared along a line 0.5cm. to the right of the falciform ligament.

The liver was further mobilized by severing the ligamentous and diaphragmatic attachments. The right hepatic and middle hepatic veins were isolated and divided extrahepatically, During this manuever, the inferior vena cava was lacerated and profuse bleeding occurred momentarily, requiring partial occlusion of the vena cava and suturing of the laceration. The liver was then resected along the line 0.5 cm. to the right of the falciform ligament, including a major portion of the medial half of the left lobe attached to the right lobe of the liver. T-tube insertion and drainage were instituted and the abdomen closed.

The postoperative course was rather uneventful except that the bile drainage via the T-tube was in the vicinity of 50 cc. daily. Mild jaundice appeared on the 5th day. The patient was able to take oral nourishment and his general condition improved, allowing him to sit up alone on the 7th postoperative day. However, on the 7th postoperative day, the abdominal wound disrupted shortly after removal of the sutures and this may have been due to poor choice of suture material at the time of abdominal wound closure. Prompt re-suture was done.

Following the second operation, the jaundice rapidly deepened, urinary output decreased with hyponatremia(120 mEq/L) and a rise in serum am monia to 240 $\gamma=\gamma$ and the patient went into coma on 3rd postoperative day(10 PO day after the lst operation). He expired 24 hours later.

Comments: The area of the liver resected in this case has many precedents. However, the method was rather unique, for, in addition to the structures of the right lobe, the duct, artery, and portal vein to the medial segment of the left lobe were individually ligated before resecting the liver. Thus, bleeding from the cut surface of the liver was kept to a minimum, requiring no hemostatic mattress sutures(Figure 19, Photographs 5 and 6).

Case IV.

Performed by Dr. K.R. Chang on july 26, 1962.

Diagnosis: Primary hepatoma.

Operation: As shown in Figure 20, the mass was in the anterior segment of the right lobe and in the medial segment of the left lobe. The rest of the liver was moderately cirrhotic.

Following division of the cystic artery and cystic duct, the common bile duct was opened and the left and right hepatic ducts were cannulated with fine catheters. As the tumor was well-defined and expansive, blunt dissection between the tumor and the remaining liver tissue was rather easily done. Structures to the medial segment were treated on the left side of the tumor and the anterior segmental branches were likewise clamped and divided from the right side of the mass. Thus, in this case, the resected tumor together with surrounding liver tissue, approximated 50% of the liver, being equivalent to the medial and anterior segments. Hemostasis was obtained by means of gauze tamponades. The common duct was drained.

Postoperative Course: Jaundice appeared on the 3rd postoperative day, which gradually deepened. On the 8th postoperative day, the gauze tamponades were removed, followed by bleeding from the cut surface of the liver. In spite of five pints of whole blood, the patient died on the 9th postoperative day.

Comments: This case represents a massive form of primary hepatoma confined to the medial and anterior segments of the liver. The tumor was so massive and expansive that all small structures had been replaced by tumor. The only structures which required individual ligation were the anterior segmental branches and the middle hepatic vein. A small nodule, probably tumor, in the posterior superior subsegment was also well-defined and was treated by wedge resection.

Ordinarily, if it had not been for the moderate cirrhosis present, a wider resection would have been performed about the tumor. This case shows clearly that a patient with 50% cirrhotic liver

cannot survive such a massive operation(Figure 20).

Discussion

On the basis of study by Rex,[3] McIndoe and Counseller,[4], Hjortsjo[5], Healey and Schroy,[6], and Elias and Petty,[7] intrahepatic distribution of vessels and ducts have largely been clarified, and, it is now established that the liver divides into two lobes. The fundamental division between the right and left lobes is along a line which passes through the long axis of the fossae for the gall bladder toward the middle of the inferior vena cava, as it lies in contact with the liver posteriorly. The right lobe shows two distinct segments; anterior and posterior segments, which are divided by the intersegmental plane. In the left lobe, the medial and lateral segments are divided by the left segmental(sagittal) fissure. Each of the four segments has been further divided so that a total of eight subsegments can be recognized. However, the caudate lobe, as it is called in classic anatomical terminology, has an unique arrangement. It receives a portal tributary directly from the portal vein trunk and its hepatic veins empty directly into the inferior vena cava. Because of these rather independent vascular connections, it seems more appropriate to define this portion as the medioposterior segment. Furthermore, the area where portal venous blood is from the right portal vein is called the right medioposterior subsegment, while the area receiving blood from the left portal vein is called the left medioposterior subsegment.

Lortat-Jacob and Robert[8], and Quattlebaum[9] were among the first to report the removal of a large segment of the liver by truly anatomical techniques, in which ligation of the important vessels was achieved at an early point in the operation. Since these two reports, their results have been duplicated by others: Pack[10], Brunschwig[11], Fineberg, et al[12], and Clay and Finney[13].

However, all of these operative procedures were lobar resections, wherein dissection at the *porta hepatis* ended when structures to one lobe were severed. There is no mention of individual ligation of segmental structures. In our report, there were such individual ligations and divisions of the segmental structures, which were done prior to the segmental resecitons. This has been shown to be anatomically feasible by Goldsmith and Woodburne[14], as in Figure 21, and by this present anatomical study the procedure has been shown to be a reasonable one for performing hepatic lobectomy(Figure 21).

Conclusions

We have presented morphological observations on the anatomy of the liver pertaining to major hepatic resection on the basis of cadaver dissections and clinical experience. We have added four unusual case reports in which a more thorough anatomical approach was applied in resecting major portions of the liver. The controlled technic at the *porta hepatis* is applicable to any resection for any amount of liver tissue and there is not excessive hemorrhage.

國 文 抄 錄

肝葉切除術과 關聯된 肝臟의 外科的 解剖學 우리들의 臨床經驗

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Galluzzi et al.에 依하면 原發的 肝癌이 歐羅巴에 있어서는 全解剖例의 0.13%, 全癌例의 1.1%이고, 美國에 있어서는 全解剖例의 0.25%, 全癌 例의 2.1%이며, 東洋에 있어서는 全解剖例의 0.85%, 全癌例의 14.1%라고 하였다.

著者들은 韓國에 있어서는 肝癌이 자조 遭遇되며, 그 治療法으로 肝葉切除術을 應用할 境遇가 있을 것으로 믿어, 過去 5年間에 韓人小兒屍體 140具를 使用하여 肝臟의 膽管과 血管構造를 觀察하고 그 標準型과 異型들을 分類하였다.

I. 門靜脈의 分枝型

1. 標準型(第1型) 門靜脈이 肝門部에서 右門靜脈과 左門靜脈으로 分岐되는 것인데 71.8%에서 觀察되었다. 그中 80%는 肝門外에서 分岐되었고, 20%는 肝門內에서 分岐되였다.

2. 異型(第2型) 右葉의 前區域門脈枝가 左門靜脈枝

로부터 分岐되는 것인데 16.2%에서 觀察되였다.

3. 異型(第3型): 右門靜脈의 長이 너머 짧어서 右葉의 前區域門脈枝와 後區域門脈枝가 直接 左門靜脈枝에서 分岐되어 三叉型을 나타내고 있는 것인데 10.3%에서 觀察되였다.

4. 異型(第4型): 右葉의 前區域門脈枝와 後上 및 後下亞區域門脈枝가 左門靜脈로부터 分岐되여 四叉型을 나타내는 것이어서 1.7%에서 觀察되였다.

우리들에 依하여 實施된 肝右葉切除術 7例中 6例는 第1型(標準型)에 該當하였으며 他1例는 第4型에 屬하는 것이었다.

II. 肝動脈: 主肝動脈은 肝門에서 右肝動脈과 左肝動脈으로 分岐된다.

1. 右肝動脈은 右肝膽管의 後下方을 走行하다가 (右) 前區域動脈枝와 後區域動脈枝로 分岐한다(84.4%). 그리고 前區域動脈枝는 前上 및 前下亞區域動脈枝로 分岐되고 後區域動脈枝는 後上 및 後下亞區域動脈枝로 分岐된다(87.5%) 即 이들이 右肝動脈의 分岐의 標準型이다.

2. 左肝動脈은 主肝動脈으로 分岐되여 內上方으로 走行하다가 左門靜脈臍部의 內側에서 內區域動脈枝와 外區域動脈枝로 分岐되고, 이것들은 다시 各各 內上 및 內下亞區域動脈枝들과 外上 및 外下亞區域動脈枝들로 分岐되는 것이 51.6%이어서 標準型에 屬하였다.

3. 異型: 內區域動脈枝가 外下亞區域動脈枝에서 分岐되는 것인데 31.0%에 該當하였다. 即 이들은 左肝動脈이 먼저 外上亞區域動脈枝와 外下亞區域動枝로 分岐된 後에 內區域枝가 外下亞區域枝로 發出된 것으로서, 左門靜脈部에서 區域枝를 結紮할 때에 外下亞區域動脈枝를 內區域枝로 誤認하기 쉬운 故로 留意할 것이다.

4. 中肝動脈: 41例中 15例(36%)에서 觀察되였는데 그中 10例는 左肝動脈으로 부터 남어지 5例는 主肝動脈幹으로부터 分岐되였다.

5. 副肝動脈枝: 左胃動脈으로부터 左副動脈枝가 分岐되여 肝臟의 外區域에 分布되는 것이 7.3%이었다. 또 右副肝動脈枝가 上腸間膜動脈으로부터 分岐되여 右區域間隔內로 들어가 前 및 後區域枝로 分岐되는 것이 3.1%이었다. 그리고 肝臟內에서 左, 右動脈이 吻合되여 있는 것이 21.9%에서 觀察되였다.

III. 膽管, 總肝膽管은 肝門에서 右肝膽管과 左肝膽管으로 分岐된다.

1. 右肝膽管은 前區域枝와 後區域岐로 分岐되고, 前區域枝는 前上 및 前下亞區域枝로, 後區域枝는 後上 및 後下亞區域枝로 再次分岐되는 것이 標準型이어서 85.2%에 該當하였다(그림 9A).

2. 左肝膽管은 左門靜脈의 臍部의 始發部附近에서 外區域枝와 內區域枝로 分岐되고, 外區域枝는 外上 및 外下亞區域枝들로, 內區域枝는 內上 및 內下亞區域枝들로 分岐되여 있는 것이 標準型이어서 47.5%를 占領하고 있었다(그림 10A).

3. 異 型 左肝膽管이 먼저 外上亞區域枝와 外下亞區域枝로 分岐된 後에 內區域枝가 外下亞區域枝로부터 分岐된 것으로 27.9%에서 觀察되였다(그림 10B) 이것은 左肝動脈의 異型과 一致되는 것으로 留意를 要한다.

IV. 肝靜脈

1. 右肝靜脈은 肝右葉의 後區域 및 前上亞區域枝들을 모아 前後區域間을 走行하다가 右後上方에서 下空靜脈內로 開口된다. 이것이 標準型이어서 87.7%에서 觀察되었다(그림 11)

2. 右下肝靜脈은 主로 右後下亞區域으로부터 集合된 靜脈으로서 肝臟의 右後下方에서 1 或은 2 乃至 3個의 靜脈으로 되여 下空靜脈에 開口되는 것이 88.3%이었다(그림 12).

3. 中肝靜脈은 右葉의 前區域과 左葉의 內下 亞區域枝들을 集合하여 左右兩葉間面을 走行하다가 左肝靜脈과 合하여 下空靜脈에 開口되는 것이 標準型이어서 63.4%이었다.

4. 左肝靜脈은 左葉의 外區域과 內上亞區域枝들을 集合하여 左後上方에서 下空靜脈에 開口한다(86.7%).

V. 尾狀葉은 右半은 右門靜脈과 右肝動脈의 分枝를 받고 膽管은 右(肝)胆管에로, 靜脈枝들은 直接 下空靜脈에로 開口하고, 左半은 左門靜脈과 左肝動脈의 分枝를 받고 膽管들은 左肝膽管에로 靜脈들은 直接 下空靜脈內로 開口되여 있는 故로 獨立的 區域으로 看做하고 內後區域이라고 命名하고 이것은 右內後亞區域과 左內後亞區域으로 再分할 것을 提議하였다.

다음에 著者들은 1958年에서 1961年까지에서 肝右葉切除術 5例 肝左葉切除術 6例를 表示하였으며, 1962年에 實施된 4例(區域切除術의 範疇에 屬하는 것)를 追加報告하였다.

REFERENCES

1) Quattlebaum, J.K.: *Hepatic lobectomy for benign and malignant lesions, The Surgical Clinics of North America, 42:507, 1962.*

2) Galluzzi, N.J., Wingarten, W., Regan, F.D., and Doerner, A.A.: *Evaluation of hepatic tests and clinical findings in primary hepatic cancer, J. Am. Med. Ass., 152:15, 1953.*

3) Rex, H.: *Beitrage Zur morphologie der Saeuger leber, Morph. Jahrb., 14:517, 1888. cit. to N. A.Goldsmith and R.T. Woodburne.*

4) McIndoe, A.H.and Counseller, V.S.: *A report on the bilaterality of the liver. Arch. Surg., 15:589,*

1927.

5) Hjortsjo, C.H.: *The Topography of the intrahepatic duct systems, Acta. anat., 2 (Suppl 14 15):599, 1950–1951.*

6) Healey, J.E.,Jr., and Schroy, P.C.: *Anatomy of the biliary ducts within the human liver. Arch. Surg., 66:599, 1953.*

7) Elias, H. and Petty, D.: *Gross anatomy of the blood vessels and ducts within the human liver. Am. J. Anat., 90:59, 1952.*

8) Lortat-Jacob, J. L., and Robert, H. G.: *Hepatectomie droite reglee, Presse Mid. 60:549, 1952.*

9) Quattlebaum, J. K.: *Massive Resection of the liver. Ann. Surg.,137:787, 1952.*

10) Pack, G.T., Miller, T. R., and Brasfield, R.D.: *Total right hepatic lobectomy for carcinoma of the gallbladder, Ann. Surg., 141:1, 1955.*

11) Brunschwig, A.: *Hepatic lobectomy. Am. J. Surg., 97:148, 1959.*

12) Fineberg, C., Goldburgh, W.P. and Templeton, J.Y.: *Right Hepatic lobectomy for primary carcinoma of the liver, Ann. Surg.,144:881, 1956.*

13) Clay, R.C. and Finney, G.G.: *Lobectomy of the liver for benign conditions, Ann. Surg., 147:827, 1958.*

14) Goldsmith, N.A. and Woodburne, R.T., *Surgical Anatomy pertaining to liver resection, Surg., Gyn., and Obst., 105:310, 1957.*

15) Shackelford, B.J. and Marbury, W.B., Jr.: *Left hepatic lobectomy for extrabiliary fistula. Ann. Surg., 144:245, 1956.*

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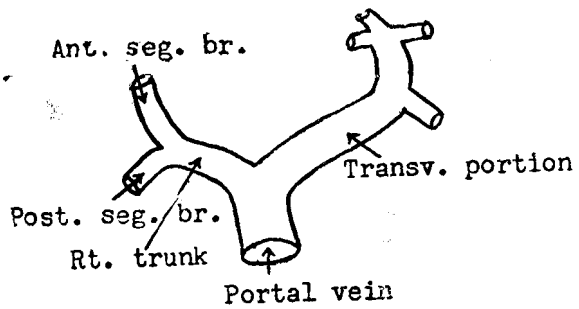

Fig. 1 Sketch showing the distribution of the anterior segmental portal branch(Type I). "Standart form" Portal vein bifurcate extrahepatically into right and left trunk.
Frequency. 71.8%

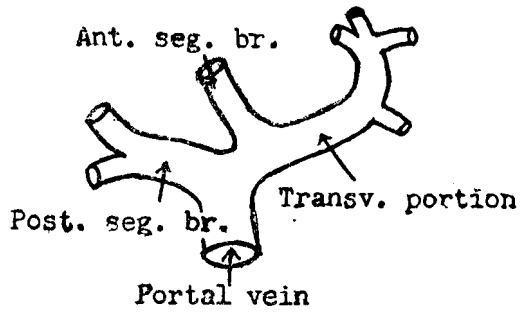

Fig. 2 Sketch showing the anterior segmental portal branch originate from the transverse portion of the left portal trunk(Type II).
Frequency. 16%.

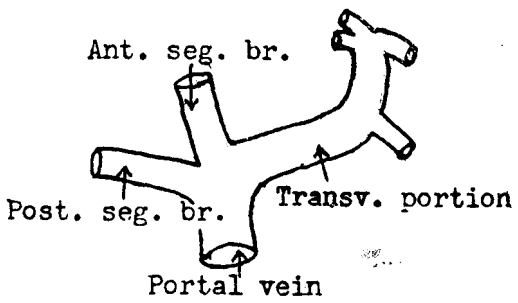

Fig. 3 Sketch showing an immedia te trifurcation of the right anterior segmental and posterior segmental branch from the main portal vein trunk without forming a proper right portal vein(Type III).
Frequency. 10.3%.

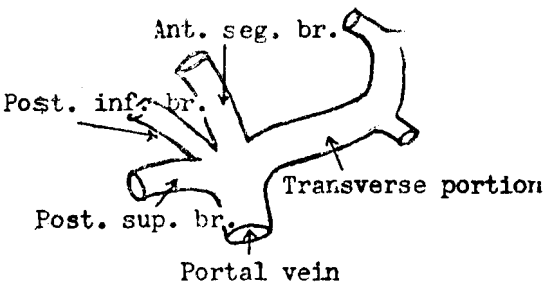

Fig. 4 Sketch showing the anterior segmental, posterior superior and posterior inferior subsegmental branches take off directly from the main portal vein. (Type IV).
Frequency. 1.7%.

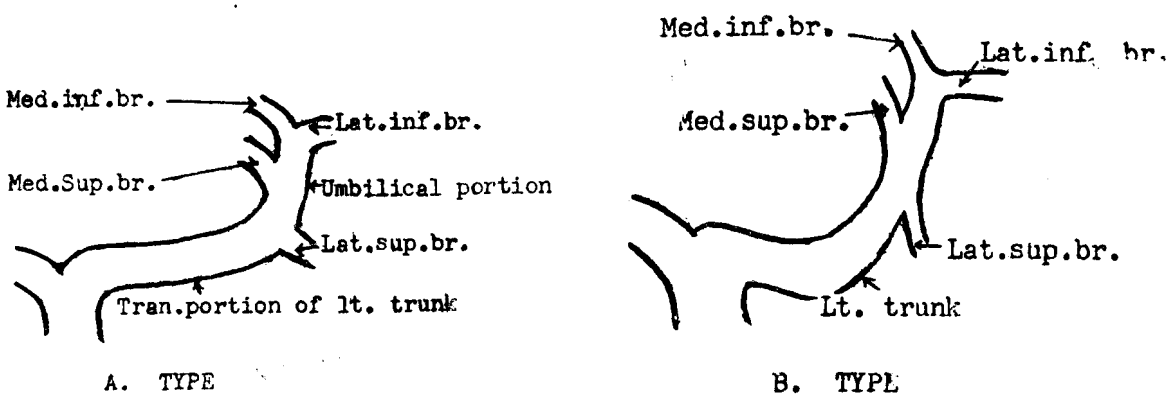

Fig. 5 Sketch(A. & B.) showing a variety of the left trunk of the portal vein. Frequency. A Type 88.9%, B Type 4.4%.

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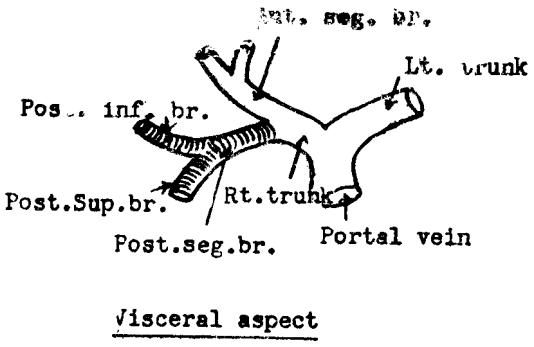

Fig. 6 Sketch showing presence of both the right anterior segmental branch and the posterior segemental branch. The right portal trunk divide into the anterior segmental and posterior segmental branch.
Frequency. 50.4%.

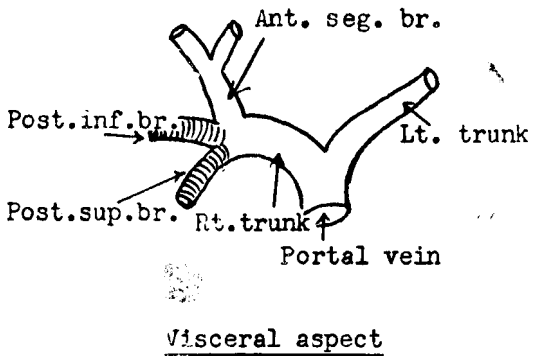

Fig. 7 Sketch showing trifurcation of the posterior segmental portal branch, anterior segmental portal branch and posterior superior portal branch from the right portal trunk. Without right posterior segmental branch.(Type I).
Frequency. 20.5%.

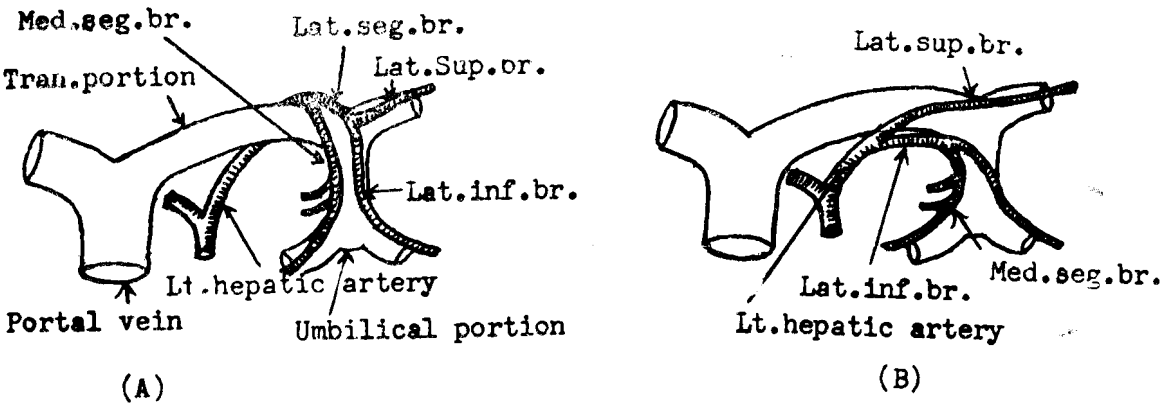

Fig. 8 Sketch(A & B) showing the distribution of the lateral superior branch and the lateral inferior branch of the left hapatic artery at the umbilical portion of the left portal trunk.
Frequency. A type 51.6%. B type 31.3%

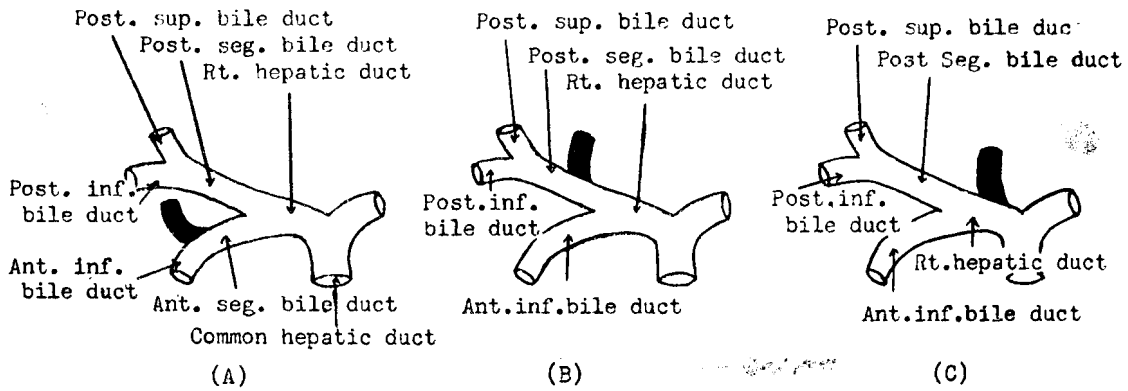

Fig. 9 Sketch(A.B.& C.) showing the mode of confluency of the anterior superior bible duct. Frequency. A Type 85.2%, B Type 13.1, C Type 1.6%, respectively.

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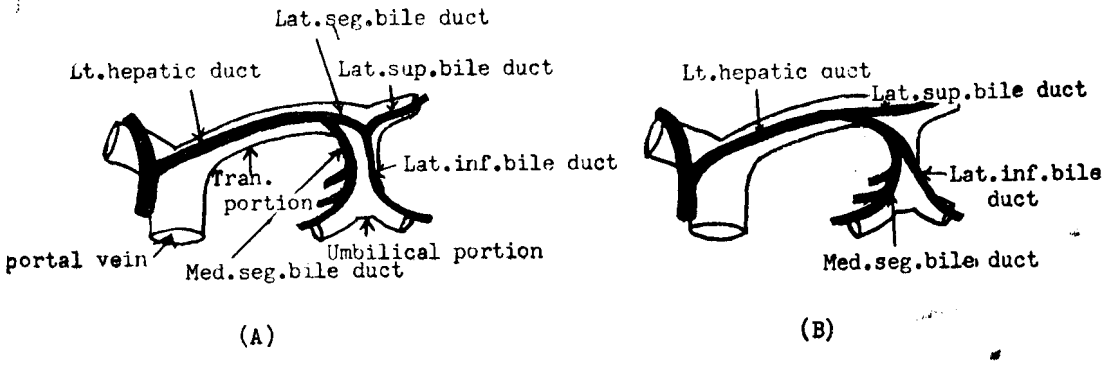

Fig. 10 Sketch(A & B) showing the distribution of the lateral superior and lateral inferior bible duct at the umbilical portion of the left portal trunk. Frequency. A type 47.5%, B type 27.9%, respectively.

Fig. 11 3 main hepatic veins.

Fig. 12 Right inferior hepatic vein(Visceral aspect).

Fig. 13 Interlobar plane(Visceral aspect).

Fig. 14 Interlobar plane(Diaphragmatic aspect).

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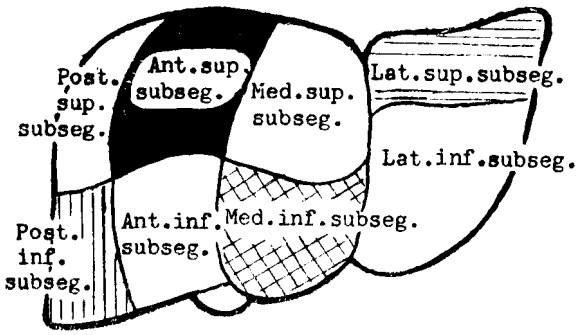


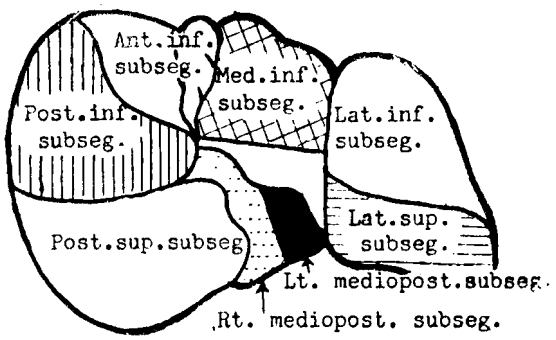
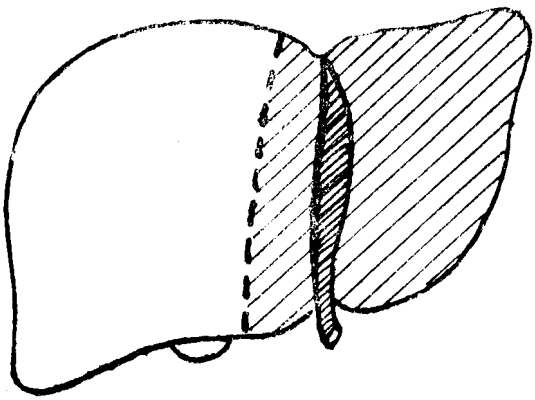
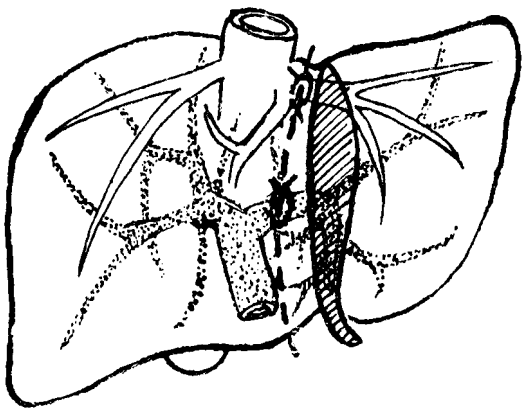


Fig. 15 Segmental anatomy(Diaphragmatic aspect). **Fig. 16** Segmental anatomy(Visceral aspect).





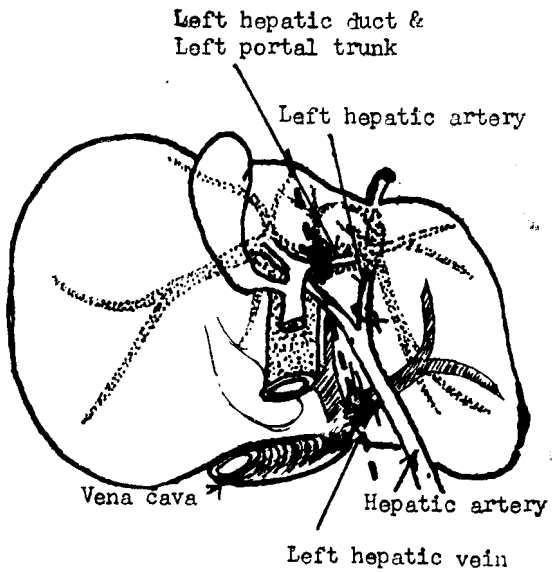


Fig. 17 Sketch showing left hepatic lobectomy.

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Fig. 18 Photograph 1 showing the division surface of the case 1

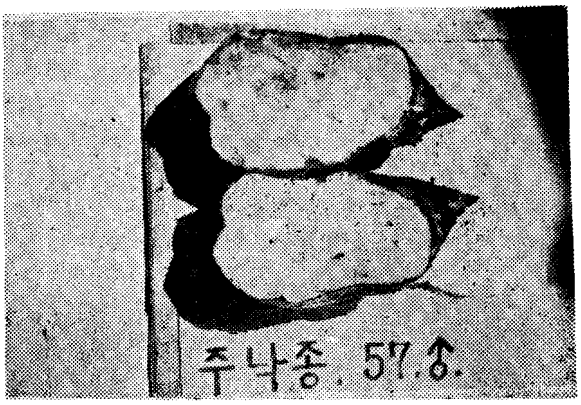

Fig. 18 Photograph 2 showing the cut surface of the case 1.

Fig. 20 Photograph 4 showing the diaphragmatic surface of the case 2.

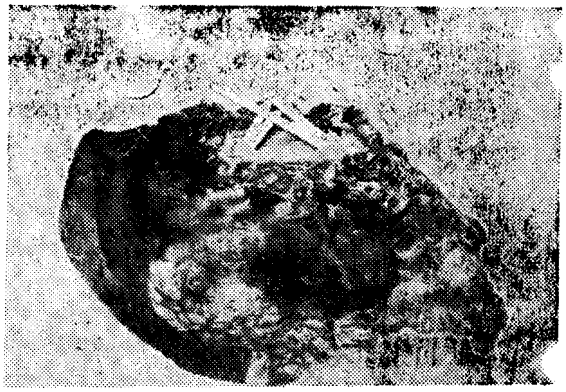

Fig. 20 Photograph 3 showing the visceral surface of the case 2.

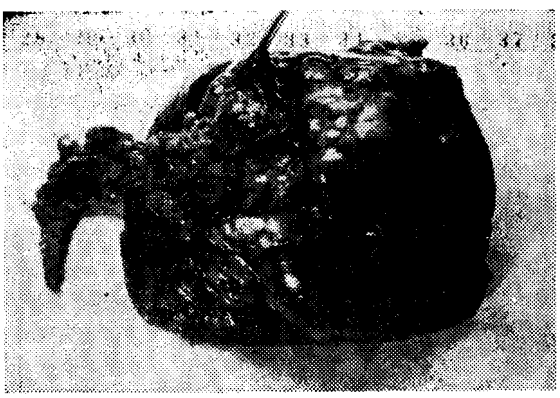

Fig. 22 Photograph 5 showing the diaphragmatic surface of the case 3.
The grasped portion with forcep, was invaded to diaphragm that was removed togather.

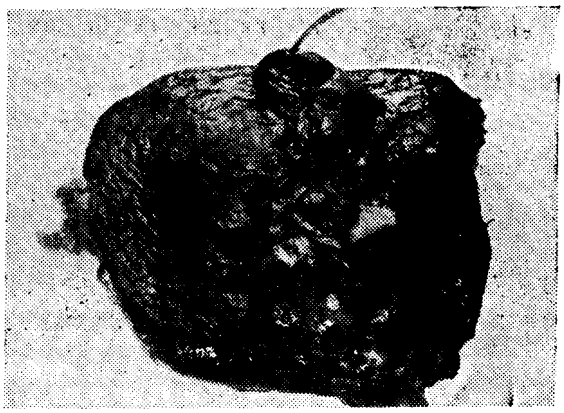

Fig. 22 Photograph 6 showing showing the visceral surface of the case 3

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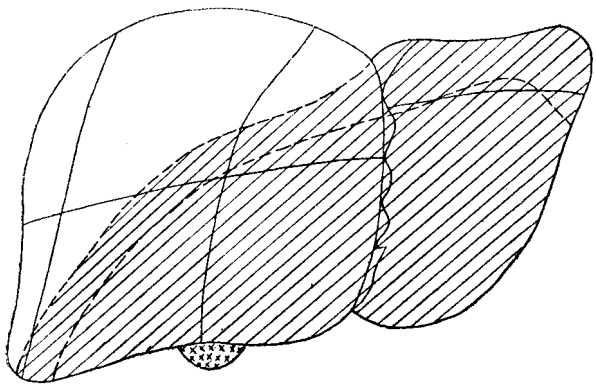

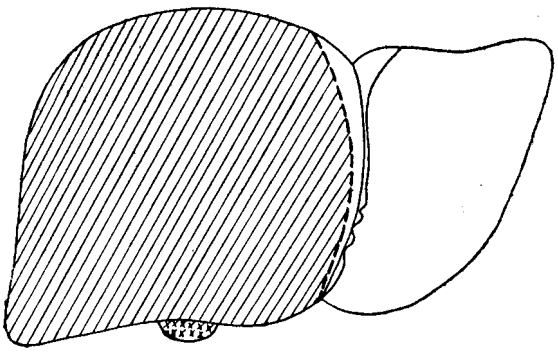

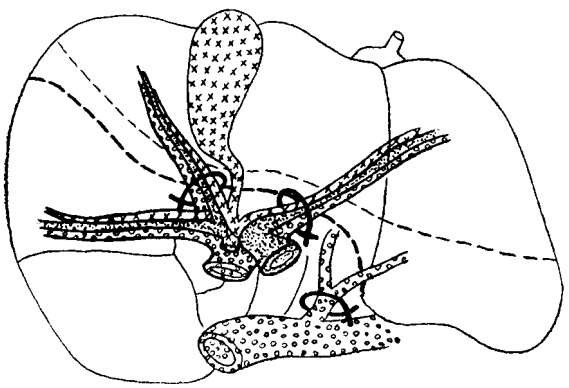

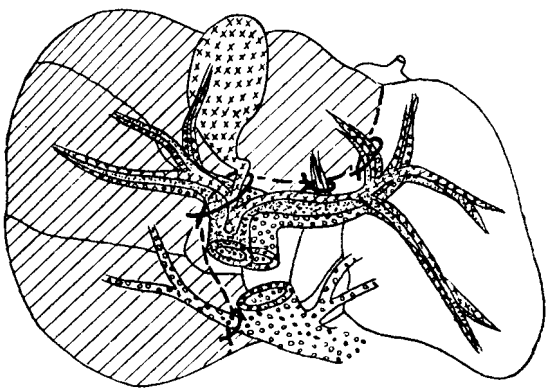

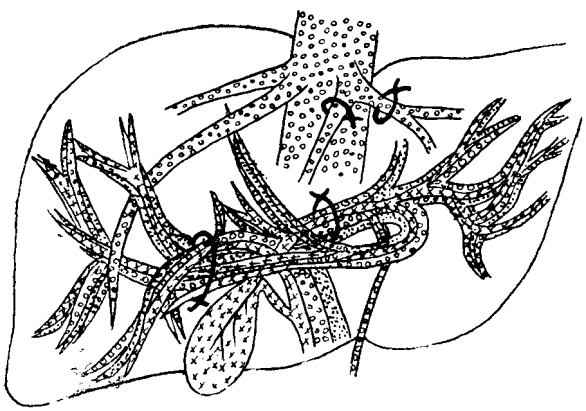

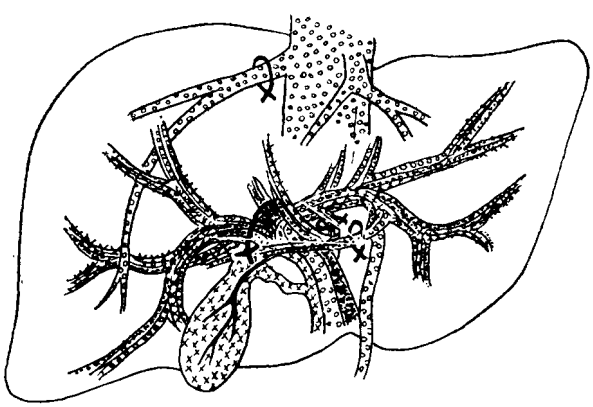

Fig. 19 Sketch showing of the schematic presentation of the case 2 (Left subtotal hepatectomy).

Fig. 21 Sketch showing of the schematic presentation of the case 3 (Right subtotal hepatectomy).

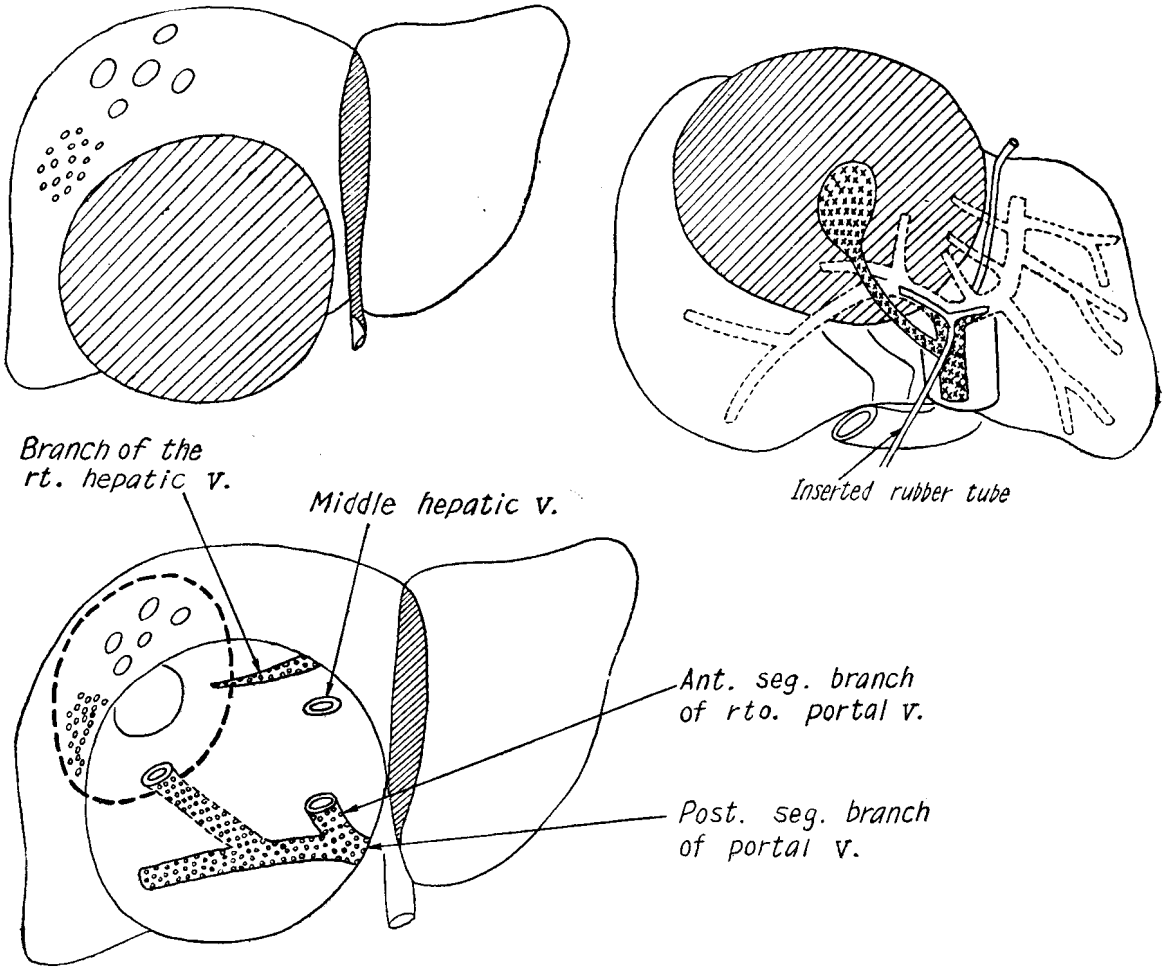

Fig. 23 Sketch showing the schematic presentation of the case 4 (Segmental resection).

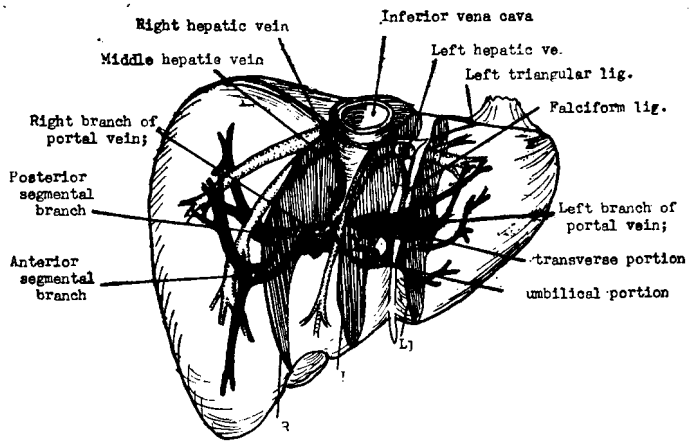

Fig. 24 Sketch showing the recommended surgical planes of the liver in relation to the portal and hepatic veins. R, indicatse the plane of preference for a right lobectomy; L_1 for a left lobectomy; L for a left lateral segmental resection.