

The modern method of resection of the left share of the liver**M.Soreli, I.Chanukvadze, A.Valeanu, D.Zippel, R.Shapiro, M.Papa, M.Koberidze.****(Tel Aviv, Israel –Tbilisi, Georgia)**

Prevention of blood loss in liver resection is essential for reducing postoperative morbidity and death. The main method to control bleeding during surgery of the left hemi liver is occlusion of the left portal pedicle. This may be accomplished by hilar, fissural or posterior intrahepatic techniques. In practice, majority of doctors during hemi hepatectomy prefer combination of these methods. Each of these methods has its own advantages and disadvantages. None of these methods give a guarantee to prevent such complications as: damage of large vessels, injuring trans-posed vessels or bile ducts from the right portal pedicle to the left. In 1983 year we provided backward intrahepatic approach on left portal pedicle using venous tendon as an orienteer. The purpose of this study was to describe the anatomical aspects of the posterior intrahepatic ligamentum venosum approach to the left portal pedicle.

Key words: Left portal pedicle, Hemostasis, Hepatectomy**Methods:**

Anatomical study was carried out on 215 isolated adult livers. In 57 specimens, sections of the extra and intrahepatic portions of the left portal pedicle were prepared under stereoscopic microscopy.

The ligamentum venosum is the anatomical landmark between the medial and lateral portions of the left portal vein. The convergence of the ligamentum venosum along the left portal pedicle is where the left portal sheath reaches its maximal thickness and these connections are tight. In 8–12%, the medial portion of the left portal pedicle includes a transposed right paramedian vein or right-sided bile ducts.

According to our anatomical study, we believe that it is possible to use the ligamentum venosumas, an anatomical guide to achieve a controlled approach of the left portal pedicle during left-sided hepatectomies. Moreover, ligation of the left portal pedicle at its convergence with the ligamentum venosum may prevent erroneous injury of transposed right paramedian vessels or bile ducts.

Introduction:

Prevention of intraoperative blood loss during liver resection is an essential prognostic factor for reducing postoperative morbidity and mortality. Occlusion of the left portal pedicle is an important step in achieving inflow control to the left liver parenchyma during procedures involving the left portal lobe [2, 15, and 20]. This can be accomplished by either a hilar, fissural or a posterior intrahepatic approach [4, 6, 13, 21, and 22]. In practice, most surgeons employ a combination of techniques in left hepatectomies. Each of these methods has both advantages and disadvantages. However, none of these methods guarantees avoiding complications such as injuring large vessels during formal hilar dissection or erroneously ligating transposed right paramedian vessels or bile ducts from the right portal pedicle to the left, during fissural approach [3, 5, 10].

In 1983, we proposed an original posterior intrahepatic approach to the left portal pedicle using the ligamentum venosum as a landmark [19]. The aim of this study was to describe the anatomical aspects of the posterior intrahepatic ligamentum venosum approach (PILVA) to the left portal pedicle.

Methods:

A total of 215 examinations of adult cadavers, in which there were no liver diseases, were made at the Department of Pathology, Tbilisi School of Medicine, Georgia. There were 129 men and 86 women with ages ranging from 18 to 82 years, with an average age of 52 years. The abdomen was opened through a midline incision and the anterior thoracic wall was removed to expose the intraabdominal and intrathoracic organs. The liver and duodenum with the hepatoduodenal ligament were extirpated en bloc. The trunk of the portal vein, hepatic artery and common bile duct was isolated, cannulated, and liquid latex was subsequently injected. After hardening of the latex, the entire specimen was placed in concentrated hydrochloric acid, which dissolved the liver tissue while preserving an exact latexed model of the afferent vascular and bile duct architecture. Segmentary division of the liver was based on the description of Counaud [4]. In addition, in 57 specimens, sections of the extra- and intrahepatic portions of the left portal pedicle were prepared under stereoscopic microscopy.

Results:

Surgical anatomy of the left portal pedicle.

The left portal pedicle is composed of the left branch of the portal vein, the left hepatic artery and the left bile duct. According to our measurements, the length of the left portal tract ranges between 1.3 and 5 cm (mean 3.2 ± 0.8 cm) and is dependent on the length of the left branch of the portal vein. The width of the left portal tract ranges between 1.2 and 3.5 cm (mean 2.3 ± 0.6 cm). Occasionally, the left portal pedicle includes transposed right-side vessels and bile ducts. In these cases, the portal vein trunk is divided into the right lateral vein and the common trunk of the left lobar and right paramedian veins. This type of portal vein division was observed in 8.3% of the cases (Fig. 1). The right paramedian vein was derived from the left portal vein within 0.5–1.2 cm of its origin. The confluence of right anterior (Seg. 5–8) and right lateral (Seg. 6–7) bile ducts to the left lobar ducts was observed in 5.1 and 12.1% of the cases, respectively. The left branch of the hepatic artery was located on the inferior (69.4%), anterior (17.9%) or superior surface of the left branches of the portal vein (12.7%). The left bile duct was located on the superior surface of the left branches of the portal vein in all cases. In 15.8%, in addition to the proper hepatic artery, a left accessory artery was observed. This artery was always derived from the left gastric artery (Fig. 2)



Fig.1 Transposition of the origin of the right paramedian vein from right to left (corrosion preparation of liver vessels of a 46-year-old woman visceral surface). Trunk of the portal vein (A), left branch of the portal vein (B), right lateral branch of the portal vein (C), right paramedian branch of the portal vein (D).

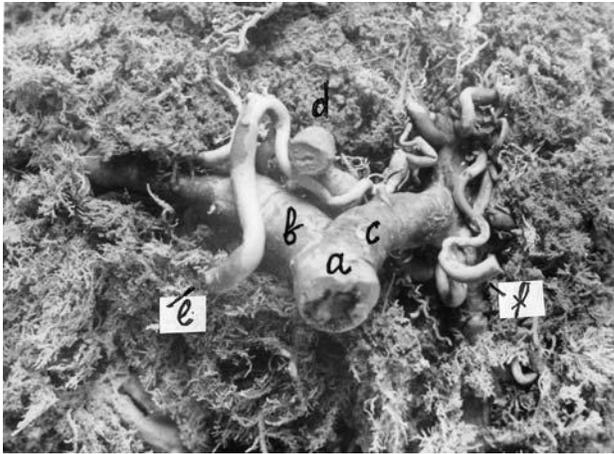


Fig.2 Blood supply of the liver by the proper hepatic artery and left accessory artery (corrosion preparation of the liver vessels of a 78-year-old woman visceral surface). Trunk of the portal vein (a), right branch of the portal vein (b), left branch of the portal vein (c), hepatic duct (d), proper hepatic artery (e), left accessory artery (f).

Morphological structure of Glisson's capsule and its left lobar sheaths.

The following data are based on the results of 57 specimens prepared under stereoscopic microscopy. The connective tissue that surrounds the elements of the left portal pedicle is an encompassing complex of fibrous and cellular structures. This tissue is formed by different components: sub-peritoneal layers, portal plates, vasculo biliary and nerve sheaths, and the interstitial tissue between them. The left portal vein and hepatic artery have a proper sheath; yet, the left bile duct is not encased in the connective sheath. The sheath of the left branch of the portal vein consists of one or two layers of connective tissue. When the sheaths are

Composed of two layers, the fibrous bundles of the internal layer are located longitudinally while the external layer runs oblique. The ligamentum venosum is the fibrous remnants of the obliterated fetal ductus venosus that shunted blood from the umbilical vein to the inferior vena cava. This ligament runs from the left branch of the portal vein to the left hepatic vein or to the common trunk of the middle and left hepatic veins. It is the anatomical landmark between the medial (transverse) and the lateral (umbilical) portions of the left portal vein (Fig.3). The convergence of the ligamentum venosum along the left portal pedicle is where the left portal sheath reaches its maximal thickness (Fig.4). The collagenous fibrous bundles that constitute the ligamentum venosum merge with the connective tissue of the left portal sheath are tightly interwoven with the fibrous bundles of the left

portal vein's sheath. These connections were too tight to separate even in manipulations under microscope.

Discussion:

Prevention of intraoperative blood loss in liver resection is an essential prognostic factor for reducing postoperative morbidity and mortality. In order to control bleeding during surgery of the left hemiliver, the main method is occlusion of the left portal pedicle. The approach to the left portal tract maybe done by formal dissection of the hepatic hilus on the visceral surface of the liver [1, 4, 20]. The left portal pedicle lays superficially below the visceral surface and is

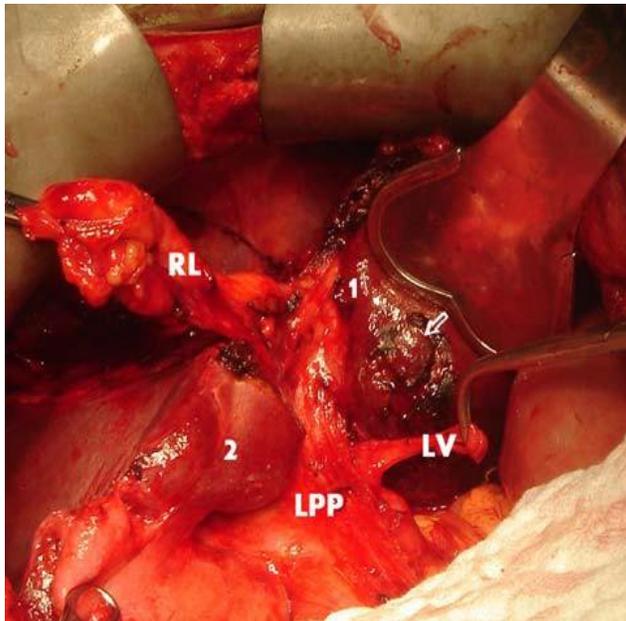


Fig.3. Utilization of ligamentum venosumas a landmark for identification of the left portal pedicle. LPP left portal pedicle, LV ligamentum venosum, RL round ligament, 1 left lateral segment, 2 quadrate lobe, the arrow indicates the left hepatic tumor.

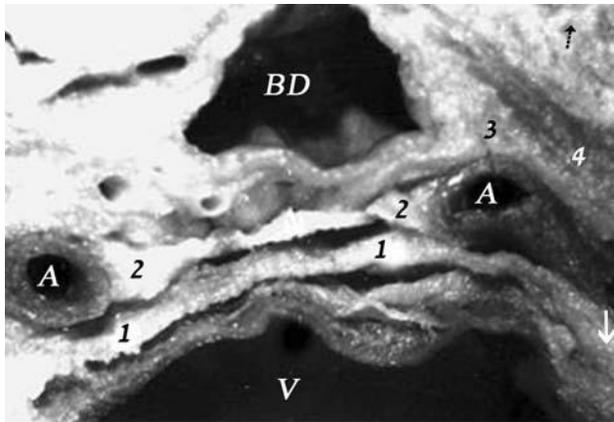


Fig.4. Ligamentum venosum and the left portal tract of a 73-year-old woman prepared under the microscope (98). The white arrow indicates the precise spot where the ligamentumvenosum joins with the left portal tract. The black arrow indicates the liver parenchyma. V portal vein, A hepatic artery, BD bile duct. 1 fibrous sheath of the portal vein, 2 periarterial connective tissue and

its lateral processes forming intermediate fibrous sheaths between the portal vein and the bile duct, 3 peribiliary connective tissue, 4 perivascular fibrous capsule

usually no deeper than 1.5 cm and the large hepatic veins are well above the portal tract [4, 10]. Formal hilar dissection can occasionally cause injury to large afferent vessels with profuse hemorrhage [3, 11].

Alternatively, the left portal tract may be secured within the liver by primary opening of the median portal fissure either by finger fractures [6, 21] or by crushing the liver parenchyma with clamps [22]. The fissural approach from the diaphragmatic surface of the liver is considered to be relatively more difficult because of the lack of external marking of the median fissure, which complicates the planning of the operation. It is well recognized that the left portal tract lies deep below the diaphragmatic surface of the liver at 2.5–5 cm [4, 10]. Therefore, this approach can be complicated by the injury of the hepatic vein branches lying superior to the left portal tract, or due to parenchymal bleeding during the primary opening of the median portal fissure [18].

In 1992, Launois and Jaimeson [13] described a posterior intrahepatic axis to the left portal sheath. Here, the left omentum is divided and a posterior incision is made behind the ligamentum venosum on the caudate lobe. Circular incision around the hilum exposes the entire Glissonian sheath [12, 14].

In general, the left portal pedicle is composed of the vascular and biliary ducts of the left portal lobe. Sometimes, it includes afferent vessels or bile ducts which belong to the right portal lobe. These cases may occur when the right paramedian vein exits from the left branch of the portal vein, or when the bile duct of the right paramedian or lateral sectors enters the left bile duct [4, 8]. In contrast, the right portal pedicle rarely includes the vessels or bile ducts of the left portal lobe [7, 9].

According to our anatomical investigation, transposition of the right paramedian vein was observed in 8.3%. Transposed right paramedian vein exited at 0.5–1.2 cm from the bifurcation of the portal vein. These variants of the portal vein distributions must be taken under consideration during inflow control to the left portal lobe. Ligation of the left portal vein near the bifurcation of portal vein can cause circulatory disorders in right paramedian sector. Therefore, we firmly believe that during left hepatectomy, a ligation of the left portal vein should be performed as distal as possible from the bifurcation which is close to the confluence of the ligamentum venosum and the left portal sheath. Utilization of ligamentum venosum as a landmark discloses the posterior surface of the left portal sheath and facilitates controlled posterior intrahepatic approach to the left portal pedicle [19]. The ligamentum venosum is always situated within the fossa between the caudate lobe and left lateral segment of the liver. We have shown that the precise spot where the ligamentum venosum joins with the left portal pedicle is where the left portal sheath reaches its maximal thickness. The collagenous fibrous bundles that constitute the ligamentum venosum merges with the connective tissue of the left portal pedicle and are tightly interwoven with the fibrous bundles of the sheath of the left portal veins. We suggest using this connection between the ligamentum venosum and the sheaths of the left portal pedicle to mobilize and retract the left portal pedicle from the liver parenchyma. Mobilization of the portal pedicle may be performed superiorly to the caudate lobe within an avascular plane. The retracted left portal pedicle can be ligated or banded with a vessel loop and tightened until achieving complete occlusion of the afferent vessels of the left portal lobe.

We have found in the literature that several authors who have used the ligamentum venosum principally to expose the medial and left hepatic veins [16, 17]. In 2005, Machado et al. [15] described “Arantius ligament” approach to the left pedicle. It was stated that the division of the “Arantius ligament” is a useful step to obtain quick access to the left portal sheath. The authors have proven the predominance of the approach by obtaining excellent results through the utilization of this method in 26 patients. We recommend that further clinical studies will be conducted to test the applicability of this technique in clinical practice.

Conclusion:

1. The ligamentum venosum is the anatomical landmark between the medial and the lateral portions of left portal vein. In 8–12%, the left portal pedicle includes transposed right paramedian portal vein or right-sided bile ducts. This transposition occurs at 0.5–1.2 cm distal to the portal bifurcation and is always found within the medial portion of the left portal pedicle. Due to those

variations, during left hepatectomy, ligation of the left portal tract within 1.5 cm beyond the bifurcation can cause circulatory disorders in the remaining right lobe.

2. The closely connected bridge between the ligamentum venosum and the left portal sheath provides ample conditions for using the ligamentum venosum to achieve controlled posterior intrahepatic approach to the left portal pedicle.

ღვიძლის მარცხენა წილის ანატომიური რეზექციის მოდერნიზებული მეთოდი მსარელი, ი.ჭანუყვაძე, ა.ვალეანუ, დ.ზიპპელ, რ.შაპირო, მ.პაპა, გ.კობერიძე. (თელავი, ისრაელი – თბილისი, საქართველო)

ღვიძლის რეზექციის დროს სისხლის დაკარგვის პრევენცია პოსტოპერაციული ავადობისა და სიკვდილიანობის შემცირების მნიშვნელოვანი პროგნოზული ფაქტორია. მარცხენა პორტალური ფეხის ოკლუზია წარმოადგენს მნიშვნელოვან ეტაპს ღვიძლის მარცხენა წილზე ქირურგიული ქმედების დროს პარენქიმაში შემავალი სისხლის ნაკადის კონტროლის მისაღწევად. ეს მიიღწევა პორტალური კარის, ნაპრალოვანი ან ღვიძლის შიდა უკანა მიდგომით. პრაქტიკაში, ქირურგთა უმრავლესობა უპირატესობას ანიჭებს ამ მეთოდების კომბინაციას, მარცხენა მხრივი ჰემიჰეპატექტომიის დროს. თითოეულ ამ მეთოდს აქვს თავისი უპირატესობა და ნაკლი, თუმცა არცერთი მათგანი არ იძლევა ისეთი გართულებების თავიდანაცილების გარანტიას, როგორცაა: მსხვილი სისხლძარღვების დაზიანება, ტრანსსპოზიციური მარჯვენა პარამედიანური სისხლძარღვების ან მარჯვენა ფეხიდან მარცხნისაკენ მიმართული ნაღვლის სადინრების შეცდომითი გადაკვანძვა. ჩვენს მიერ 1983წ. მოწოდებული იქნა ვენური იოგის ორიენტირად გამოყენებით მარცხენა პორტალურ ფეხზე უკანა ინტრაჰეპატიკური მიდგომა. ამ კვლევის მიზანი მეთოდის ანატომიური ასპექტების განხილვაა.

გასაღები სიტყვები: მარცხენა პორტალური ფეხი, ჰემოსტაზი, ჰეპატექტომია.