Where to incise and/or divide the cystic duct

D. Ignjatovic, B Djurić, V Zivanović,
Department of Surgery, KBC "Dr Dragiša Mišović"
University Hospital, Belgrade.

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The study concern was to establish the position of cystic duct incision/division in circumstances of laparoscopic cholecystectomy. Seventy consecutive human cadavers were dissected. Corrosion casting (50) and post-mortem cholangiography (20) were employed. Cystic duct length was 34.6 mm, and in 88.6 % cases its length was 1-5 cm. Mean cystic duct diameters next to the gallbladder neck, within the valve and 5 mm proximal to the junction with the common hepatic duct were 1.95, 0.42 and 1.85 mm, respectively. Lateral cysto-hepatic junction was identified in 78.6%, spiral in 10% and parallel in 10%. In 90% cases the cysto-hepatic junction is within 4 cm of the hepatic duct junction. One case (1.43%) of cystic duct entering the right hepatic duct was identified. The valve of Heister consisted of three spiral turns in 73% of the cases with a range from 0 to 5. In 3/70 specimens the spiral valve did not exist.

Key words: cystic duct, Heister valves, laparoscopic cholecystectomy

INTRODUCTION:
Open surgery standards suggest that the incision and/or division of the cystic duct should be performed close to the common bile duct, at a distance of approximately 5-10 mm. The main rational reason for this kind of procedure is to avoid leaving a long stump.7

Laparoscopic cholecystectomy seems to have changed this standard since most surgeons seem to incise/divide the cystic duct close to the gallbladder neck.1,2,8 This procedure seems natural for laparoscopic cholecystectomy.

The aim of this study was to provide anatomical background, which might account for this new approach, of course, apart from the simple fear of the inexperienced surgeon.

MATERIALS AND METHODS
Seventy consecutive fresh (up to 24 hrs.) human autopsy specimens were obtained from patients (37 men and 33 women) with a mean age of 56 (range 26-83) years deceased at Belgrade City Hospital from January to July 1997. The inclusion criterion for the study was that there should be no macroscopic pathological changes in the liver, so 6 additional autopsies (metastatic liver disease n=3, liver cirrhosis n=1, hydatid liver cyst n=1, liver trauma n=1) did not enter the study. The liver and hepatoduodenal ligament were removed en bloc through a midline incision of the anterior abdominal wall. The inferior caval vein was divided cranial to the mobilized liver. The duodenum was dissected free from the retroperitoneum. The hepatic artery proper, common bile duct and portal vein were transected close to the head of the pancreas. The inferior caval vein was then divided caudal to the liver. Specimens were placed into a warm (37°C) 0.9% saline solution. Fifty specimens underwent corrosion casting and 20 underwent postmortem cholangiography. The hepatic artery proper was identified and inserted with a 10 Fr polyethylene catheter, secured by ligature. The artery was afterwards irrigated with warm saline solution to wash out all the blood clots and to identify collateral vessels. Branches of the artery were identified and ligated to prevent leakage of cold polymerizing methyl-metacrylate during injection. The common bile duct was prepared in a similar manner. After placement of the 10 Fr catheter irrigation was performed to remove sludge from the bile ducts and particularly the cystic duct. Ligation of side bile duct branches was not performed.

All blood clots were removed by forceps from the portal vein lumen, which was then thoroughly irrigated through a polyethylene catheter until clear saline solution appeared from the inferior caval vein. The identification and ligation of collateral vessels (the right gastric vein, the
Corrosion casting was carried out by injecting cold polymerizing methyl metacrylate (dyed with different colors) through the catheters. During injection specimens were immersed in water to regain their original shape. Acrylate was first injected into the hepatic artery proper and then into the portal vein. Once the solidification occurred in the arteries and veins, the cystic duct was identified and ligated at the gallbladder neck to prevent filling of the gallbladder which would have otherwise broken the specimen, due to the weight of the gallbladder cast. The bile ducts were then injected. Corrosion was performed in a 35% potassium hydroxide solution, additionally heated in order to accelerate saponification. After that, the casts were rinsed off all remnants of organic tissue, and mounted on stands.

Postmortem cholangiography was performed without preparation of arteries and veins and ligature of the cystic duct. After the 10 Fr polyethylene catheter was placed and sutured in the common bile duct irrigation with saline solution was performed. Barium sulfate suspension was then injected through the catheter and radiography was made. A metallic parameter was used for comparison to avoid the influence of magnification in measurements. A nonius scaleable ruler and flexible copper wire measured size and length, respectively, of the arteries, veins and bile ducts. If the location of an artery appeared to be the deep surrounding vessels were shaved off in order to allow measuring. External diameters of arteries, veins and bile ducts were assumed to correspond to a 20% increase of the inner values (calibers) due to the methodology used.

RESULTS

The mean length of the cystic duct was 34.6 mm (range 8-62 mm). In 62 specimens (88.6%) its length was within 1-5 cm. It was shorter than 1 cm in only 3 specimens (4.3%), and longer than 5 cm in 5 specimens (7.1%). The diameter of the cystic duct was measured in three different positions: next to the gallbladder neck (mean 1.95 mm, range 0.6-4.0 mm), within the valve of Heisteri (mean 0.42 mm, range 0.3-0.6 mm) and 5 mm proximal to the junction of the cystic duct and the common hepatic duct, where this valvular mechanism ceases to exist (mean 1.85, mm, range 0.5-3.3 mm). The mode of cysto-hepatic junction was divided into three groups: lateral (55 specimens, 78.6%), spiral (7 specimens, 10%) and parallel (7 specimens, 10%). The spiral mode of cystohepatic junction was classified as: anterior, in 5 specimens (7.14%), and posterior, in 2 specimens (2.86%). A parallel course of the cystic duct longer than 4 cm was identified in 2 specimens (2.86%). In one specimen the cystic duct entered the right hepatic duct (1.43%). The cysto-hepatic junction was within 4 cm of the hepatic ducts' junction in 63 specimens (90%), and below that distance in 6 (8.6%).

The mucosa of the cystic duct is built in a spiral manner, the spiral valve of Heisteri (Fig 1). The results show that this valve consists of 3 spiral turns in 72.86% (51 of 70 specimens), with a range between 0 and 5. In 3 (4.29%) specimens the cystic duct was short and wide, and a spiral mechanism was not identified.

DISCUSSION

An old, well-established dogma in open surgery is the imperative need for leaving a short cystic duct stump in order to avoid the rest cystic duct syndrome. After the introduction of a minimally invasive-laparoscopic technique for cholecystectomy, there have been many studies which show that leaving a long cystic duct shows no changes in the incidence of the so-called postcholecystectomy syndrome. It has been shown that this syndrome occurs only in cases of a calculus left over in the cystic duct.

On the other hand, the anatomical mechanism of Heister's valve has not been well evaluated. Our results show a rather constant pattern in its construction, three mucosal spiral turns within which the caliber of the cystic duct is smaller than that of any catheter used for intraoperative trans-cystic duct cholangiography. The positive aspect of this mechanism is that it controls the passage of bile and represents a restraint for sludge and calculi, which can present as a problem for the surgeon trying to perform cholangiography. If instrumental dilatation of this mechanism is not sufficient to pass a catheter, the cystic duct can be dissected 5 mm lower within the next mucosal spiral turn. There is no fear of causing a lesion to the common bile duct if the spiral mechanism is present due to the fact that it ceases to exist at 5 mm proximal to the junction with the common hepatic duct, and that its length is greater than 1 cm in most of the cases. This maneuver can be a safeguard for the surgeon, for if a spiral mechanism is not identified and the catheter is passed easily into the bile duct, it could mean that this is not the cystic duct, but rather the common bile duct.

In conclusion one can say that a good degree of anatomical knowledge allows a surgeon to be safe when performing laparoscopic surgery. The cystic duct should be divided next to the infundibulum because a long cystic duct stump is not symptomatic. Only in cases of difficult placement of a catheter for operative cholangiography the
cystic duct should be dissected lower, and this procedure performed in stepwise sequences of 5 mm.

**BIBLIOGRAPHY**