



and Other Interventional Techniques

Color doppler ultrasound detection and classification of the tangential hepatic vein before laparoscopic cholecystectomy

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Abstract

Background: Unexpected fatal bleeding from the gallbladder bed during laparoscopic cholecystectomy is often associated with injury to the middle hepatic vein. This paper studies whether preoperative color Doppler ultrasound is effective in reducing the risk of injury. Also a venous classification is suggested.

Methods: Between June 1999 and February 2004, 2,146 patients undergoing laparoscopic cholecystectomy by standard method received preoperative color Doppler ultrasound examinations. The closest distance between the hepatic vein and the gallbladder was studied. Also, cases of liver cirrhosis, number of conversions to open cholecystectomy, intraoperative blood loss, operative time, complications, and hospital stay were recorded (group D). At the end of the study, we retrospectively reviewed the same parameter of another 2,146 patients who received laparoscopic cholecystectomy without preoperative color Doppler ultrasound between the period of March 1995 and June 1999 (group ND).

Results: In group D, 108 patients had cirrhosis. Four hundred and ninety-six patients (27 cases of cirrhosis) had a closest distance of 1 mm or less between the vein and the gallbladder. There were two conversions to open cholecystectomy, but none related to gallbladder bed bleeding. In group ND, there were five conversions, including four cases of gallbladder bed bleeding from the middle hepatic vein and one case of severe adhesion. The conversion rate was significantly higher. In group ND, the mean intraoperative blood loss in the cases of liver cirrhosis was significantly greater. Also, the operative time of patients with the closest vein and gallbladder distance of 1 mm or less in group D was significantly longer.

Conclusions: Color Doppler ultrasound is an effective method for detecting the presence of potential bleeders. Although the operative time will be a bit longer, the

operation can be done under meticulous care and complete preparation, so that the conversion rate and the risk of fatal hemorrhage can be reduced, especially in patients with liver cirrhosis.

Key words: color Doppler ultrasound — hepatic vein — laparoscopic cholecystectomy — liver cirrhosis

Laparoscopic cholecystectomy (LC) has been widely used as a standard surgical treatment for gallbladder (GB) diseases. One serious intraoperative complication is fatal hemorrhage from the GB bed due to hepatic vein injury during dissection. It is often difficult to control endoscopically and is eventually converted to open cholecystectomy [2, 6, 8, 9, 11]. The situation is often more serious in cases of liver cirrhosis because of the hard texture of the liver and poor hemostatic condition.

Brisk bleeding from the GB bed is caused by the injured middle hepatic vein (mHV) [19, 20], which is known to run close to the GB bed [5]. The closer the vessel is to the GB, the higher is the risk of injury.

Since June 1999, we have routinely used color Doppler ultrasound to examine the GB bed of every patient who was going to receive LC. Our purpose for this study is to determine whether Doppler ultrasound is a good method for preoperative detection of the vein so that accidental injury can be prevented. Also, a venous classification based on the anatomical relationship with the GB is suggested for the ease of description. More important, the vein location will be of great help for the surgeon during the dissection.

Materials and methods

Study group (Group D)

Between June 1999 and February 2004, we performed color Doppler ultrasound (Toshiba 340A, Tokyo, Japan; with probe 3.75 MHz) on



Fig. 1. Picture of ultrasound of a huge THV_R (blue) that was almost adherent to the GB. The caliber is over 3 mm.

2,146 consecutive patients who were going to receive LC at our hospital (group D). They were all diagnosed with GB disease by the same senior gastroenterologist. The examination focused on the GB bed to determine whether the mHV ran close and tangential to the GB wall. When the closest distance (d) between the mHV and the GB was 1 mm or less, we referred to it as the tangential hepatic vein (THV) (Fig. 1). We further classified the THV into THV_R , THV_M and THV_L for d at the right, middle, and left side of the gallbladder, respectively. The measurement of 1 mm was chosen because the possibility of injury for the distance over 1 mm was significantly less under the techniques of our team.

The number of conversions to open cholecystectomy, blood loss, operative time, hospital stay, and complications were recorded.

Retrospective group (Group ND)

We retrospectively reviewed the data of another 2,146 consecutive patients who received LC between March 1995 and June 1999 (group ND). The same parameters as for group D were recorded. No patient in this group received routine preoperative color Doppler ultrasound or had any record focus on the mHV.

The demographic data of the two groups are shown and compared in Table 1.

Statistical analysis

Chi-square test and Student's t -test were used where $p < 0.05$ was considered statistically significant.

Results

The age, sex ratio, ratio of noncirrhosis to cirrhosis and ratio of Child A and B were not significantly different

Table 1. Demographic data for Group D and ND

	Group D	Group ND	<i>P</i> -value
Age (years)	45–67	43–65	NS
M:F	1.8:1	1.9:1	NS
Noncirrhosis:cirrhosis	2,038:108	2,025:121	NS
Child A:B	83:25	91:30	NS

By Chi-square test
NS, Not significant

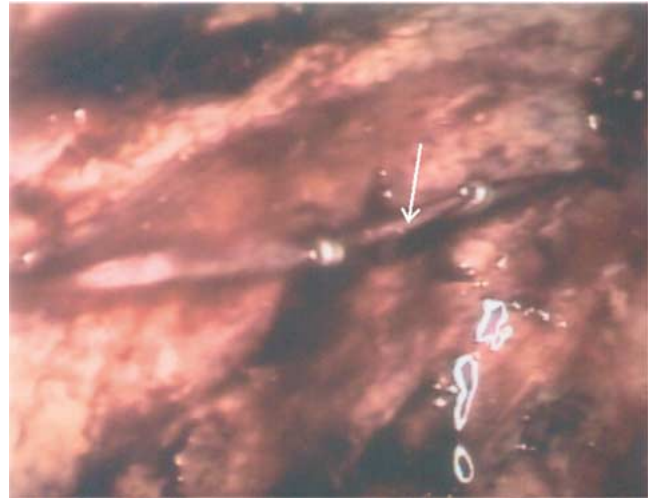


Fig. 2. One case of THV (arrow) that was dissected and clipped.

between groups D and ND (Table 1). In group D, 108 patients had cirrhosis of Child A or B, 61.2% had GB stone with biliary colic, 20.5% had stone with chronic cholecystitis, and 10.1% had stone with acute cholecystitis. The rest included GB polyp, polyp with stone, and shrunken GB. Four hundred and ninety-six patients, including 27 cases of cirrhosis, had THV. Two hundred and eighty-seven cases (58%) were THV_R (Fig. 1), 119 cases (24%) were THV_M and 90 cases (18%) were THV_L . The rest of the patients had an average GB bed and hepatic vein distance of 6.1 ± 4.6 mm. They all received the standard four-trocar laparoscopic technique, and the GB was resected by retrograde procedure. In the case of positive THV, *extra* caution was applied during dissection by the surgeon, especially in cirrhotic patients. Seven THV_R were successfully dissected and clipped during the procedure (Fig. 2). All were cirrhotic patients. There were two conversions to open cholecystectomy, but none related to GB bed bleeding. In group ND, 56.4% had GB stone with biliary colic, 23.95% had stone with chronic cholecystitis, 12.9% had stone with acute cholecystitis. The rest were GB polyp, stone with acute and chronic cholecystitis and shrunken GB. The mean blood loss, operative time, hospital stay and complications of the two groups are shown and compared in Table 2. They were not significantly different. The number of conversions to open cholecystectomy in Group ND, mean blood loss in cirrhotic cases in Group

Table 2. Comparison of both groups

	Group D	Group ND	P-value
*Conversion related to GB bed bleeding	0	4	< 0.05
Mean blood loss (ml)	93.25 ± 24.13	98.18 ± 36.22	NS
*Mean blood loss (ml) of cirrhotic patients	150.15 ± 62.016	240.40 ± 130.008	< 0.05
Mean operative time (minute)	77.36 ± 23.73	73.00 ± 19.724	NS
	*For positive THV: 92.25 ± 22.447		< 0.05
Complications (number)	11	13	NS
Hospital stay (days)	3.7 ± 1.2	3.8 ± 1.8	NS

By Student's *t*-test

NS, Not significant; *significance: $P < 0.05$

ND and the mean operative time in patients with positive THV were significantly greater.

The complications included bile leakage, hematoma, wound infections, aspiration pneumonia, and ascites, which were not significantly different between the two groups. There were three cases of hospital mortality in group D due to one case of cardiac arrhythmia and two cases of pneumonia, and four deceased in group ND due to three cases of sepsis and one case of cardiac failure.

Both operative results are compared in Table 2.

Discussion

During the past decade, LC has become a popular and even standard treatment for cholelithiasis in the general population, for it allows shorter hospital stay, less operative time, and fewer wound complications [4, 10, 14, 15, 18]. As we know, one of the dangerous complications of LC is unexpected massive bleeding from the THV in the GB bed during dissection. Seventy-five cases of such bleeding in 77,604 LC cases requiring open cholecystectomy due to GB bed bleeding were reported by Deziel et al. [6]. Nenner et al. [11] and Reddick et al. [13] reported that GB bed bleeding was related to injury of the hepatic vein. However, both studies did not focus on the preoperative examination of the hepatic vein and the prevention of fatal hemorrhage. Furthermore, no detailed study about the anatomical relationship between the hepatic vein and GB has been performed.

In 1999, color Doppler ultrasound assessment of the branches of the mHV was reported by Takeyuki et al. [20]. Sixteen percent of patients had THV. However, the study population included only 50 healthy volunteers and a retrospective review of four patients of postlaparoscopic cholecystectomy. The author did not engage in further prospective study as to whether color Doppler ultrasound was beneficial for the general population or whether the examination actually helped the patients with cirrhosis.

As we know, the incidence of cholelithiasis in cirrhotic patients is about twice that in noncirrhotic patients [3, 12, 17]. The chances of treating a cirrhotic gallbladder stone are great. However, cholecystectomy for these patients presents a great challenge. The high mortality reported is mainly due to the tendency to bleed [1, 7, 16], which causes excessive blood loss. Aranha et al. [1] even reported a mortality of 83% in pa-

tients where the PT was elevated > 2.5 sec. In order to reduce the risk of GB bed bleeding to a minimum, in addition to improvement of the hemostatic condition, identifying the definite anatomical relationship between the mHV and the GB is very important. Accidental injury to the THV is better to be averted, since the hard texture of the liver is difficult to suture and compress in order to stop bleeding.

There were two cases of conversion in group D. One was due to severe adhesion, and the other was due to bleeding from the abdominal wall varices. None was related to GB bed bleeding. However, in group ND, five conversions were noted. All were cirrhotic patients. Four were due to GB bed bleeding from the mHV, and one was due to adhesion. In the general population of both groups, no conversion was noted.

The blood loss in group D was 93.25 ± 24.12 ml, whereas blood loss in Group ND was 98.18 ± 36.22 ml. This was not significantly different. However, when we compared the cirrhotic cases in both groups, which were 150.15 ± 62.016 ml and 240.4 ± 130.008 ml, group D was significantly less (Student's *t*-test). Since the hemostatic condition was not significantly different between the two groups, the difference of blood loss should be mainly due to the injured THV.

The mean operative time was not significantly different between D and ND. However, when the operative times of the cases of positive THV were compared with those for the rest, the former were significantly longer (Student's *t*-test). This can be explained by the fact that more time was spent in meticulous and cautious dissection.

There was the occasional intraoperative diagnosis of liver cirrhosis. In such a case, a lower than usual wattage was employed (25 watts was suggested to prevent further spark gap thermal injury), in addition to gentle and accurate dissection. We had two such cases, and the procedures were performed uneventfully.

More than that, there is no need to dissect the vein, but if necessary or technically feasible, the THV can be found out and clipped. We have seven such cases, and all were cirrhotic patients.

Finally, we need to emphasize that the authors in the present series have experience in about 7,500 cases of laparoscopic cholecystectomy. There were no technical discrepancies between the two different groups, although the patients were not operated on in the same period.

We are not deliberately comparing the results of the two groups because the disease severity or the conditions of the populations may not be absolutely the same. The authors are simply presenting the applicability and the advantages of this simple noninvasive examination.

Conclusions

The routine prelaparoscopic cholecystectomy color Doppler ultrasound is convenient method for preoperative detection of the tangential hepatic vein. It is popular in most hospitals in Taiwan and the cost of examination is low. It has effectively prevented cases of unexpected fatal bleeding and has reduced unnecessary blood loss during dissection, especially in patients with liver cirrhosis. When encountering the potential for bleeding, the surgeon should (i) be well prepared for an emergency conversion to open cholecystectomy before initiating the LC, (ii) use a lower wattage, and (iii) be extremely cautious in dissection, especially in cases of liver cirrhosis.

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