Dorsal Approach to the Middle Hepatic Vein in Laparoscopic Left Hemihepatectomy

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Recently, laparoscopic hepatectomy has become a surgical technique with minimal invasiveness that is used worldwide.1 Lateral sectionectomy and partial resection in the easily accessible part of the liver are good indications for laparoscopic hepatectomy.2-4 However, the use of laparoscopic resection in major hepatectomy remains limited to specialized centers with substantial experience because of its technical difficulty.5 In order to achieve left hemihepatectomy safely and properly, exposure of the middle hepatic vein on the dissecting plane while maintaining a dry field is essential,6-9 as is safe division of the left hepatic duct without injury to the bile duct of the right liver.10,11 In laparoscopic hepatectomy, some laparoscope-specific approaches using the unique laparoscopic caudodorsal view are often useful.12 We present here our safe and feasible laparoscope-specific procedure for exposure of the middle hepatic vein in left hemihepatectomy.

METHODS

Patients

From November 2010 to June 2013, 6 patients underwent pure laparoscopic left hemihepatectomy at Tokyo Metropolitan Cancer and Infectious Diseases Center Komagome Hospital. Their median age was 64 years old (range 33 to 84 years). The male:female ratio was 3:3. Four patients had metastatic liver tumors and 1 each had hepatocellular carcinoma and intrahepatic cholelithiasis. Details of patient characteristics are shown in Table 1.

Operative procedure

Basically, the surgery proceeded in accordance with our standardized procedures for laparoscopic hepatectomy.12-14 The patient is placed in the supine position with the legs apart. A pneumoperitoneum is established through an

Table 1. Patient Characteristics and Operative Results

<table>
<thead>
<tr>
<th>Age/sex</th>
<th>Diagnosis</th>
<th>Operative time, min</th>
<th>Blood loss, g</th>
<th>Postoperative hospital stay, d</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>73/M</td>
<td>CRLM</td>
<td>390</td>
<td>300</td>
<td>5</td>
<td>None</td>
</tr>
<tr>
<td>72/F</td>
<td>CRLM</td>
<td>281</td>
<td>430</td>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>64/M</td>
<td>CRLM</td>
<td>312</td>
<td>150</td>
<td>10</td>
<td>None</td>
</tr>
<tr>
<td>84/M</td>
<td>HCC</td>
<td>240</td>
<td>0</td>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>33/F</td>
<td>Hepatolithiasis</td>
<td>329</td>
<td>20</td>
<td>6</td>
<td>None</td>
</tr>
<tr>
<td>56/F</td>
<td>CRLM</td>
<td>421</td>
<td>260</td>
<td>10</td>
<td>None</td>
</tr>
</tbody>
</table>

Mean 329 193 7.8

CRLM, metastatic liver tumor of colorectal cancer; F, female; HCC, hepatocellular carcinoma; M, male.

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Figure 1. Trocar placement. The patient is placed in a supine position with legs apart. The operator stands on the right side of the patient, while the assistant is on the left side and the scopist is between the legs. One umbilical trocar for the laparoscope and 4 working trocars along the costal arch (white circles) are placed. A tourniquet system is set for Pringle’s maneuver at the rightmost side (black circle).
umbilical trocar, through which a flexible laparoscope is usually inserted, and maintained at 10 mmHg. Four additional working trocars are placed along the costal arch at the right abdomen, right hypochondrium, median epigastrium, and left hypochondrium (Fig. 1). Dividing the falciform and left coronary ligaments, the ventral aspect of the common trunk of the left and middle hepatic veins is exposed. A tourniquet system 13 is set for Pringle’s maneuver at the rightmost side, and is used intermittently as necessary (Fig. 1). After isolating and dividing the left and middle hepatic arteries, the left portal vein is cut on the peripheral side of the Arantius duct. Lifting the lateral segment, the left-side hilar plate, from which the left and middle hepatic arteries and left portal vein have been dislodged, is divided on the peripheral side at the level of the Arantius duct in block. The Arantius duct is divided from the left hepatic vein and the dorsal aspect of the left and middle hepatic vein root is exposed continuously (Fig. 2A, 2B). To divide the liver parenchyma, a Cavitron ultrasonic surgical aspirator (Radionics) with particular low-voltage electric cautery, which works at the tip of the Cavitron ultrasonic surgical aspirator, and laparoscopic ultrasound shears are used. The parenchyma between the Arantius duct and the middle hepatic vein is divided, exposing the middle hepatic vein from the root toward the periphery on the remnant-side cutting plane (Fig. 3). On the liver surface on the diaphragmatic side, the demarcation line around the ischemic area is marked as a cutting line (Rex-Cantlie line) by electric cautery. Then, the parenchyma between this marked line and the middle hepatic vein is divided. The left hemihepatectomy is completed by cutting the left hepatic vein at just the peripheral side of the confluence to the middle hepatic vein (Fig. 4A, 4B). The triangular ligament is often cut in the final stage. The specimen is extracted within a plastic bag through the umbilical incision extended to approximately 6 cm in size. A round-type 19-Fr suction drain is always placed near the raw surface.

RESULTS
The mean operative time was 329 minutes (range 240 to 421 minutes), with mean blood loss of 193 g (range 0 to 430 g). There was no conversion to open surgery and no perioperative transfusion. In all patients, the postoperative course was uneventful. The mean postoperative hospital stay was 7.8 days (range 5 to 10 days). Operative results of each patient are shown in Table 1.
DISCUSSION

Laparoscopic hemihepatectomy has been increasingly reported by centers with substantial experience.\textsuperscript{15-21} In major hepatectomy, such as hemihepatectomy and sectionectomy, exposure of the hepatic vein on the dissecting plane is essential.\textsuperscript{6-9} Although exposing the major hepatic vein on the cutting plane is not required oncologically, except in hepatocellular carcinoma patients, such major vessels are very useful as a landmark to perform appropriate and safe hepatectomy without disorientation during dissection of liver parenchyma, especially in laparoscopic hepatectomy.\textsuperscript{14} Generally, owing to concerns about uncontrollable bleeding, there is a tendency to hesitate to expose the major hepatic vein via a laparoscopic approach much more than via an open approach. However, there are several approaches and advantages to exposing the major hepatic veins via laparoscopic approaches, as we have reported previously,\textsuperscript{12} so exposure of the major hepatic veins via a laparoscopic approach can be comparable to or better than an open approach when used effectively.

Among the available options, exposure of the major hepatic vein from the root side toward the periphery is the most reasonable for laparoscopic hepatectomy because this technique can avoid split injury of the major hepatic vein. A split injury, which is caused by dissection from the peripheral side, can be extended by reapproaching from the same side. Therefore, exposure of the left hepatic vein from the root side toward the periphery is the most reasonable.

FIGURE 4. Findings after completing division of the parenchyma. (A) The left hepatic vein (L) has been isolated. M, the middle hepatic vein. (B) The left hepatic vein is divided at just the peripheral side of the confluence to the middle hepatic vein using a stapler.

FIGURE 5. Split injury to the hepatic vein. A split injury is the most critical injury because this split, which is caused by dissection from the peripheral side, can be extended by reapproaching from the same side. Therefore, exposure of the left hepatic vein from the root side toward the periphery is the most reasonable.

FIGURE 6. Outline of this procedure. The middle hepatic vein trunk is very close behind the hilar plate. The parenchyma between the Arantius duct and the middle hepatic vein (sectioned plane) is divided in the current procedure. The Arantius duct is cut at the double red lines. GB, gall bladder; IVC, inferior vena cava. L, left hepatic vein; M, middle hepatic vein.
In addition, this dorsal approach prevents blood pooling at the dissecting portion because it is almost always located on the upper side. It is very important to maintain a dry operative field in order to divide the liver parenchyma precisely and speedily, exposing the major hepatic vein. Additionally, because the middle hepatic vein trunk is usually very close behind the hilar plate, it is comparatively easy to expose it from the caudal dorsal side after complete transection of hilum structures of the left lobe (Fig. 6). This means that the Arantius duct is close to the middle hepatic vein, so exposing the middle hepatic vein from the dorsal side first is fairly reasonable. In our experience, by integrating these advantages of the dorsal approach, the blood loss and transfusion rate are lower than those reported previously.\(^4,13,17,19\)

**CONCLUSIONS**

In conclusion, although our experience remains limited, we believe that this dorsal approach to the middle hepatic vein can become a standard procedure for laparoscopic left hemihepatectomy.

**Author Contributions**

Study conception and design: Honda

Acquisition of data: Okuda, Honda, Kurata, Kobayashi, Sakamoto

Analysis and interpretation of data: Okuda

Drafting of manuscript: Okuda

Critical revision: Honda

**REFERENCES**


