Surgical implications of a left-sided gallbladder

Russell W. Strong, M.D.*, Jonathan Fawcett, M.D., Michael Hatzifotis, M.D., Peter Hodgkinson, M.D., Stephen Lynch, M.D., Thomas O’Rourke, M.D., Kellee Slater, M.D., Shinn Yeung, M.D.

Hepatobiliary Unit, Princess Alexandra Hospital, Ipswich Road, Woolloongabba, Queensland 4102, Australia

Abstract

BACKGROUND: A left-sided gallbladder in a normally positioned liver is considered to be a very uncommon anomaly. Laparoscopic cholecystectomy can be performed safely, but bile duct injury is not unusual. It is associated with anomalous intrahepatic portal and biliary systems which impacts any form of partial hepatectomy.

METHODS: We performed a retrospective review of patients with left-sided gallbladder who were managed by the hepatobiliary surgeons at our institution since 1996.

RESULTS: Nineteen patients with left-sided gallbladder underwent a hepatobiliary procedure. Of the 13 patients with gallstones, only 1 was diagnosed before cholecystectomy. Nine operations were completed laparoscopically, whereas 4 required an open procedure. Two patients were referred with bile duct injuries. There was 1 liver resection for a colorectal metastasis. Left-sided gallbladders in 3 deceased organ donors resulted in major implications in the performance of liver transplantation.

CONCLUSIONS: Left-sided gallbladders are probably more common than generally believed but are rarely diagnosed before cholecystectomy. Associated bile duct injury appears to be not infrequent. Because of the aberrant vasculobiliary anatomy, any form of liver resection requires careful planning.

The authors declare no conflicts of interest.

* Corresponding author. Tel.: +61-7-3176-2111; fax: +61-7-3176-7011.
E-mail address: russell_strong@health.qld.gov.au
Manuscript received July 10, 2012; revised manuscript September 10, 2012

Left-sided gallbladder is considered to be a very uncommon anomaly. The first published account of sinistroposition of the gallbladder was in 1886, and fewer than 150 cases have been reported in the literature. However, the condition may not be as rare as generally believed, and the diagnosis is frequently missed even with ultrasonography and endoscopic retrograde cholangiopancreatography. Although laparoscopic cholecystectomy for left-sided gallbladders can be performed safely, it would appear from the literature that bile duct injury at cholecystectomy is not unusual. Because of the anomalous intrahepatic portal venous and biliary systems associated with sinistroposition, the implications are considerable when performing any form of partial hepatectomy, including reduced-size and living-donor liver transplantation.

Patients and Methods

A retrospective review was performed on patients with left-sided gallbladder who were managed by the Princess Alexandra Hospital hepatobiliary surgeons since 1996. The patients were identified by way of unit log books. When possible, appropriate radiographs were retrieved and analyzed, together with intraoperative photographs when taken. The preoperative diagnosis of left-sided gallbladder was assessed. The details of the operative procedure were scrutinized, and particular attention was paid to the method of gallbladder removal, either laparoscopically or as an
open operation. In those patients with left-sided gallbladder in whom partial hepatectomy, including reduced-size liver transplantation, was performed or planned, the consequences related to the anomalous portal venous and biliary systems were assessed.

Results

There were 19 patients with left-sided gallbladders who underwent surgical procedures (Table 1). Thirteen patients presented with typical biliary-type pain, and gallstones were diagnosed by ultrasonography. However, only 1 patient was diagnosed preoperatively as having a left-sided gallbladder, and this was as a result of computed tomography performed for another reason.

Of the 13 patients undergoing cholecystectomy, 9 procedures were successfully performed laparoscopically; 1 procedure was converted to an open operation to complete exploration and remove a stone in the common bile duct. Three procedures were converted to open operations to complete the cholecystectomy. One patient who had gallstones diagnosed by ultrasonography was referred by a surgeon who could not find the gallbladder at open operation. At reoperation by one of our surgeons (S.L.), the gallbladder could not be found extrahepatically, but a hard lump was palpable intrahepatically in segment 3. Opening the liver identified the intrahepatic gallbladder, which was then removed. However, there were 5 bile ducts draining directly into the gallbladder, and a challenging Roux-en-Y biliary reconstruction of the 5 ducts ensued. The patient was well with normal liver function 4 years later.

There were 2 patients who sustained bile duct injury during cholecystectomy of a left-sided gallbladder at other institutions. They were immediately referred to the hepatobiliary unit at Princess Alexandra Hospital, and 1 of the surgeons (J.F.) traveled to these hospitals to perform biliary reconstruction. The patients have been well since that time.

There was 1 patient with a colorectal liver metastasis, which was originally thought to be in the left hemiliver, but identification of a left-sided gallbladder led to the realization that there was an absent segment 4, and a left-sided resection would necessitate extension into segments 5 and 8. This was achieved without any problems.

There were 3 deceased organ donors with left-sided gallbladders. All donor operations were performed by 1 of our surgeons (R.S.). The first was in 1997 and was from an adult donor. The intention was to harvest a reduced-size graft for a child who was in desperate need of liver transplantation. The intrahepatic vasculobiliary anatomy was confusing, and the procedure would have been abandoned except for the relative urgency. Within 48 hours of transplantation, portal vein thrombosis had occurred, necessitating urgent repeated transplantation.

The second donor liver with sinistroposition of the gallbladder was intended to be used as a split liver—the right side for an adult recipient and the left side for a child. On finding a left-sided gallbladder, the proposition was abandoned, the surgeon being very aware of the previous experience. The liver was used purely as a whole liver graft for an adult. A cholangiogram after transplantation showed the biliary anatomy, (Fig. 1) which in itself would have made split liver transplantation extremely difficult, but together with the likely aberrations of the intrahepatic portal and hepatic venous systems, it was virtually impossible.

The third donor with a left-sided gallbladder was a 12-year-old girl who had cardiac arrest outside a major provincial hospital. She was resuscitated but became brain dead and was an organ donor. She had previously had open heart surgery. At the donor operation, she was found to have a left-sided gallbladder; a preduodenal portal vein, hepatic artery, and common bile duct; no short hepatic veins between the liver and the inferior vena cava (IVC), and the major hepatic veins bypassing the IVC and connected directly to the right atrium. It was decided not to use the liver for transplantation.

Comments

The finding of a left-sided gallbladder signifies a developmental aberration, which may have major consequences when performing cholecystectomy or any form of hepatectomy. The vast majority of publications on the subject have emanated from Asian countries, especially Japan, but whether the incidence is greater there or is just identified with greater frequency is not known. The reported incidence of the condition ranges from 0.2% to 1.1%. In a recent publication from the University of Tokyo Hospital, a 3-dimensional reconstruction of the vascular structures of the liver among 8,050 consecutive image readings by 1 radiologist over a 7-year period found 35 patients (0.4%) who were incidentally diagnosed.

Table 1

<table>
<thead>
<tr>
<th>Hepatobiliary surgical procedure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholecystectomy</td>
<td>13</td>
</tr>
<tr>
<td>Biliary reconstruction after bile duct injury elsewhere</td>
<td>2</td>
</tr>
<tr>
<td>Liver resection for colorectal metastasis</td>
<td>1</td>
</tr>
<tr>
<td>Donor liver for transplantation</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
</tr>
</tbody>
</table>
vein atrophies. After obstruction of the left umbilical vein and ductus venosus, the typical umbilical portion to the left main portal vein is formed. Atrophy of the left umbilical vein, with persistence of the right umbilical vein, probably accounts for the anomaly. It can be associated with other anomalies, including a preduodenal portal vein, as identified in 1 of the liver donors in this series, or azygos continuation of the IVC. On occasion, all of these anomalies are considered to accompany developmental failure of other intra-abdominal vascular systems.8,9

Nagai et al8 from Japan do not regard it as a left-sided gallbladder but as a right-sided round ligament, which is associated with abnormal intrahepatic venous branching and has significant implications during liver resection. This concept is supported by Shindoh et al,3 who concluded that it was a right-sided round ligament with anomalous connection to the right paramedian portal pedicle, was not a malposition of the gallbladder, and its origin was caused by a persistence of the right umbilical vein.

In contrast, Savier et al6 in Paris believe that it is best understood as a failure of development of the medial segment of the left hemiliver, ie, segment 4, and fusion of the midplane and left intersectional plane. Further, in a later study using multidetector-row computed tomography with 3-dimensional volume rendering reconstruction, the same authors were firm in their belief that the abnormality is not a consequence of the persistence of the right umbilical vein but the result of defective development of the medial section of the left hemiliver during embryonic life and, therefore, fusion of the planes.10

Implications for cholecystectomy

This is all somewhat academic for the surgeon who is about to perform a cholecystectomy and is unexpectedly faced with a left-sided gallbladder. Both in the present series and from reports in the literature, the preoperative diagnosis of a left-sided gallbladder is rare.2,4,5,11 It is associated with anomalies of the cystic duct and artery.2,4,12 The cystic artery originates from the right hepatic artery, which lies to the right of the common hepatic duct (CHD), always passing from right to left across in front of the CHD to the gallbladder.4 The cystic duct most commonly curls around the CHD to enter it on the right side but may enter the CHD on its left side or, as in 1 case in the present series, enter the left hepatic duct. The possibility of an anomaly of the bile ducts should always be considered when a left-sided gallbladder is encountered.2

There is no doubt that patients with left-sided gallbladder can have it successfully removed laparoscopically as in the present series and as reported in the literature.4,5,13 Although cholecystectomy can be performed with the standard port sites, the best arrangement consists of medial positioning of the gallbladder retracting ports Fig. 2A and placement of the right-hand operating port well to the left of the midline. According to Idu et al,4 the most useful simple procedure for improving exposure is the falciform lift, which lifts the central portion of the liver and moves the ligament off the operative field Fig. 2B.

It would seem most prudent to perform a retrograde dissection, fundus down, whether laparoscopically or as an open procedure Fig. 2C. During laparoscopic cholecystectomy, the main problem seems to be surgical exposure because of the vicinity of several bile ducts in a limited space under the round ligament, including the hepatoduodenal ligament just behind the neck of the gallbladder Fig. 2D,E. A cautious laparoscopic approach would seem reasonable, taking into account other local conditions such as inflammation, remembering that bile duct injury would appear to be more likely to occur with a left-sided gallbladder.2,6 In addition, there is a variable degree to which the gallbladder is embedded within the liver parenchyma, which in itself causes technical difficulties. The extreme end of the spectrum was manifested in 1 case in this series.

There should be a strong tendency to convert to an open procedure when there is anatomical uncertainty, particularly when there is marked inflammation. The gallbladder obscures the hepatoduodenal ligament structures. The inability to dissect and reveal the Calot triangle, as in cholecystectomy of a gallbladder in the normal position, is almost certainly a contributing factor toward an increased propensity to cause bile duct injury, and awareness of such issues should help avoid this. Perception and orientation are extremely important in surgery, and especially in minimal access surgery, as pointed out in a recent article by Sodergren et al.14 Way et al,15 in an analysis of 252 cases of laparoscopic bile duct injuries, found the primary error in 97% of cases was a visual perceptual illusion, leading to operator disorientation, and Hugh16 suggested that misidentification of biliary anatomy with inadequate extrabiliary reference points led to disorientation and was a major cause of
bile duct injury during laparoscopic cholecystectomy. If these parameters are instrumental in such problems during so-called routine laparoscopic cholecystectomy, think of how much more likely bile duct injury is to occur when dealing with a left-sided gallbladder.

Implications for hepatic resection and liver transplantation

Although detailed vascular and biliary anatomy is not necessary before performing a cholecystectomy, it is absolutely essential before performing a partial hepatectomy, including the use of reduced-size grafts for liver transplantation. In addition, routine intraoperative confirmation of the vascular structures using ultrasonography or a test clamp before ligation of prominent vessels may reduce the risk of anatomic misinterpretation and subsequent surgical complications. Close attention must be paid to the abnormal branching of the intrahepatic portal vein. When performing a right hemihepatectomy, only the portal branches that arise from the right umbilical vein and course to the right should be divided. Ligation of the right portal vein itself results in interruption of portal flow to a portion of the left hemiliver.

What about the use of partial livers for transplantation from donors with left-sided gallbladders? There have been successful living donor transplantations, mainly adult to child, using the left side, but even in these cases technical modifications were required, and considerable preoperative imaging and preparation was necessary. In the setting of deceased donors, who are the main source of organs in Western societies, this imaging and preparation is not possible, and it would seem most appropriate to use the whole liver in these circumstances.

Conclusions

In conclusion, left-sided gallbladders are probably more common than generally believed. They are rarely diagnosed before cholecystectomy. It would appear that cholecystectomy
is associated with a higher rate of bile duct injury with left-sided gallbladders than when the gallbladder is in its normal position. Because of the aberrant intrahepatic vasculobiliary anatomy, any form of liver resection is complex and requires careful planning.

References