

False Aneurysm of the Hepatic Artery after Laparoscopic Cholecystectomy

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Abstract. *Purpose* : A rare complication of laparoscopic cholecystectomy is defined : iatrogenic injuries to hepatic artery system which may evolve to pseudoaneurysms in the late postoperative period. This rare phenomenon may be overlooked and pose a challenge to surgeons.

Material and methods : We will describe three cases with iatrogenic pseudoaneurysms after laparoscopic cholecystectomy.

The onset of symptoms and the course of the disease was not uniform. Diagnosis was made after a considerable delay. In the first case, a small, uncomplicated extrahepatic pseudoaneurysm was successfully treated with coil embolization. The second patient who had an intrahepatic pseudoaneurysm with multiple injuries to the common bile duct and portal vein, did not survive despite surgical and endovascular interventions. In the latter, surgical treatment for a large pseudoaneurysm that had ruptured into the liver parenchyma was successfully conducted.

Review of the literature reveals fifty-four more cholecystectomy-related pseudoaneurysms. The site of injury was the right hepatic artery in 61% of the cases and the presenting symptom was upper gastrointestinal bleeding (haemobilia) in two-third of the patients. Embolization was performed in 82% of the cases, and surgery was undertaken in the remaining 18%.

Conclusion : Pseudoaneurysm is an uncommon complication of laparoscopic cholecystectomy. Prompt attention is necessary since the lesion has a high risk of rupture. Embolization is the first line of treatment and surgery is reserved for more complex injuries and cases with life-threatening rupture of the aneurysm.

Introduction

Vascular injury with pseudoaneurysm (PA) formation is a rare complication of laparoscopic cholecystectomy. These injuries can occur in an analogous way to biliary injuries, with laceration, transection or occlusion of blood vessels. Relatively late onset of symptoms and frequent misinterpretation of imaging studies may confuse the surgeon. In the literature, these patients are usually presented with different clinical pictures such as, haemobilia or secondary intraabdominal bleeding. However, most of the published papers are sporadic case reports. In this study, the aetiology and outcome of these iatrogenic lesions are analysed in an attempt to define a rational therapeutical approach for this rare complication. The recommended management of hepatic artery PAs with probable technical pitfalls of surgery is also discussed.

Material and methods

During the past six years, three patients with PAs of the hepatic artery following laparoscopic cholecystectomy were admitted.

Case 1

A 29-year-old man was admitted with abdominal pain. He had undergone a laparoscopic cholecystectomy and a second exploration for intraabdominal haemorrhage. At palpation, the abdomen was tender. Ultrasonography showed a small subcapsullary haematoma in the gall-bladder fossa. Persistent symptoms and elevation of liver enzymes led to further Doppler ultrasonography which showed a PA of the hepatic artery. The pseudoaneurysm was successfully embolized with coils (Fig. 1) and the patient was discharged three days later.

Case 2

A 69-year old female was admitted for a biliary fistula on the tenth day after converted-to-open laparoscopic cholecystectomy operation. The patient referred with 400 cc/day bile drainage from the abdominal drain. Computerized tomography investigation was inconclusive to show the extend of the injury. Endoscopic retrograde cholangiopancreatography (ERCP) revealed extravasation of contrast from the common hepatic duct. Selective hepatic and mesenteric angiography showed an intrahepatic PA of the hepatic artery communicating



Fig. 1

Hepatic angiogram showing spiral coils occluding the pseudoaneurysm beside right hepatic artery near laparoscopy clips.



Fig. 2

Hepatic angiogram with a contrast filling cavity through right hepatic artery.

with the portal vein. During the surgical exploration, a haematoma filling subhepatic space was evacuated. The defect found on the lateral side of the portal vein involved all of the vessels downstream to superior mesenteric vein. Whipple operation and portal vein repair with a vein patch was performed. The abdomen was closed upon inspection of no apparent bleeding. During the postoperative period, septic discharges were treated with appropriate antibiotics. There were two bouts of gastrointestinal haemorrhage, however; upper and lower gastrointestinal endoscopy failed to reveal the source of bleeding. On the 26th day of the operation, bleeding was detected from the indwelling biliary catheter. Repeated hepatic angiography revealed three separate intrahepatic PAs which were inaccessible for embolization. The patient died from multiorgan failure after unsuccessful surgical re-exploration.

Case 3

A 43-year old woman was admitted with pain in the right upper abdominal quadrant and remittent fever, which had begun after laparoscopic cholecystectomy two months before. Physical examination was unremarkable except for tenderness in the right hypocondrium. Laboratory tests performed before referral to our institution showed mild anaemia, elevated cholestatic enzymes and transaminases which were normal levels on admission. Doppler US showed an aneurysm of 54 × 35 mm size communicating with the hepatic artery which had some peripheral thrombi. Selective hepatic angiography confirmed the presence of a 4 × 5 cm PA originating from

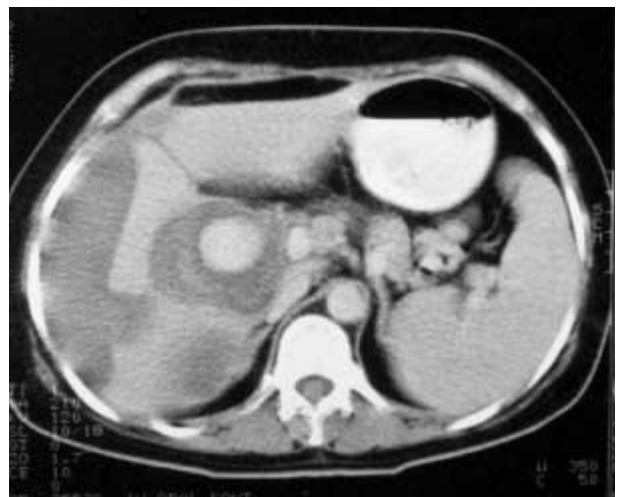


Fig. 3

CT demonstration of the contrast filling of the same case with extension of large subcapsullary haematoma (secondary rupture).

the major anterior branch of the right hepatic artery (Fig. 2). Embolization could not be performed due to anatomical reasons: absence of a neck in the considerably large aneurysm. An emergency CT examination performed because of sudden pain onset showed rupture of the PA with contrast enhancement throughout the right lobe of the liver (Fig. 3). The pseudoaneurysm could not be directly localized at laparotomy, therefore, proximal control was established by portal dissection of hepatic artery followed by transparenchymal access to

PA with pseudoaneurysmotomy (Fig. 4). Thrombi were evacuated and neck of the PA was identified high in the liver substance. Repair was considered impossible and while temporary occlusion did not show any ischaemia sign, the artery was ligated. The patient was discharged on day fourteen. She remained well thereafter.

Discussion

False aneurysms of visceral arteries are known to be provoked by intraabdominal inflammatory processes such as pancreatitis, cholecystitis or other long-standing infections. Most of these lesions are asymptomatic and are detected incidentally during ultrasound or CT examinations performed for other reasons. Iatrogenic trauma has recently become the leading aetiological factor for pseudoaneurysm formation. Aside from vascular anastomotic sites, gastrointestinal anastomoses like pancreaticojejunostomy that may be the origin of a PA. An intrahepatic PA formation with life-threatening gastrointestinal bleeding following endoscopic retrograde cholangiopancreatography has also been reported (1).

After the advent of laparoscopic cholecystectomy, biliary surgery has outnumbered the other iatrogenic factors. Following cholecystectomy, the injury may occur at any level in hepatic arteries or cystic artery. The PA may be associated with a bile-duct and/or portal vein injury. Review of the recent literature from 1990 to 1999, reveals 132 cases with visceral artery PAs. A literature search for PA of hepatic arterial system reveals 81 cases (including the three cases in this study) fifty-seven of which occurred following laparoscopic cholecystectomy (2-11). There has recently been a steady increase in the incidence of iatrogenic hepatic PAs since laparoscopic cholecystectomy became popular some ten years ago (Fig. 5). True incidence of cholecystectomy-related PA might even be higher since many small, subclinical PA thrombose and resolve spontaneously.

Most of the patients have a history of a difficult cholecystectomy operation. Time intervals between cholecystectomy and onset of symptoms were variable; however, most of the patients were readmitted approximately one month after the initial laparoscopic cholecystectomy. The "silent period" ranged between 13 months and 5 years in two different reports.

Rupture with intraparenchymal or intraperitoneal haemorrhage or rupture into the gastrointestinal tract may occur during the course of an expanding PA. Rupture of a PA into the biliary tree is the most common sequel. The process occurs after a considerable delay, and haemobilia is detected on admission. Upper gastrointestinal bleeding was found to be the presenting symptom in about two-third of the cases. Rupture of a PA into the peritoneal cavity may present as acute cardiovascular collapse or be temporally contained by

surrounding tissue, which is often called "double rupture phenomenon". The rupture risk of a PA rises with increasing size. PAs larger than 5 cm have a ten-fold risk of rupture. In small PAs there may not be any sign or symptom at all except minimal discomfort. A bruit may occasionally be heard.

If an endoscopy is inconclusive in determining the source of upper gastrointestinal bleeding in a patient with history of cholecystectomy, the presence of haemobilia should be investigated. Duplex scanning is usually preferred because it is easy to perform, noninvasive and highly accurate. Computed tomography or magnetic resonance imaging may be necessary to rule out other lesions such as neoplasms. Selective hepatic angiography not only establishes the diagnosis and angioarchitecture of a PA necessary for surgical management, but also provides a therapeutic option (embolization). PAs originate from the right hepatic artery in two-third of the cases (Table 1).

First line of treatment in hepatic artery PA is embolization, followed by surgical repair in cases where endovascular approach is not possible. Embolization was successful in 82% of PAs, while 18% were managed surgically according to the literature. Embolization has many advantages; it is less traumatic, general anaesthesia is not required, there is less parenchymal injury and hospitalization following the procedure is considerably shortened. Lesions with a distinct communication with the vessel lumen are easily treated by coil embolization. Transcatheter embolization can be performed using several types of material, such as synthetic occlusive emulsions, gelatin sponges or other particles, and metallic microcoils. Complications like pyogenic abscess (12) are infrequent and the procedure does not compromise the surgical intervention, should it be necessary. N-butyl cyanoacrylate injection in conjunction with coil embolization for ruptured PAs of visceral arteries was reported to be superior to coil embolization alone (13). The use of percutaneous thrombin injection in visceral PAs is yet to be evaluated.

Large PAs are less available for coil embolization, and often necessitate surgical repair. Recurrence of the PA despite successful embolization is another indication for surgery. Surgical therapy of PAs is cumbersome and demanding. Although several surgical therapeutic options such as primary repair, patch angioplasty, saphenous vein or graft interposition are available, it may be impossible to surgically repair intrahepatic or major lacerations with tissue loss. If the supplying artery can not be isolated, an aneurysmotomy and repair from inside the cavity can then be performed. Direct vascular reconstruction should be tried with either prosthetic or autologous grafts when compromised liver blood flow becomes apparent. Twelve patients had undergone vascular reconstruction for true hepatic artery aneurysms at

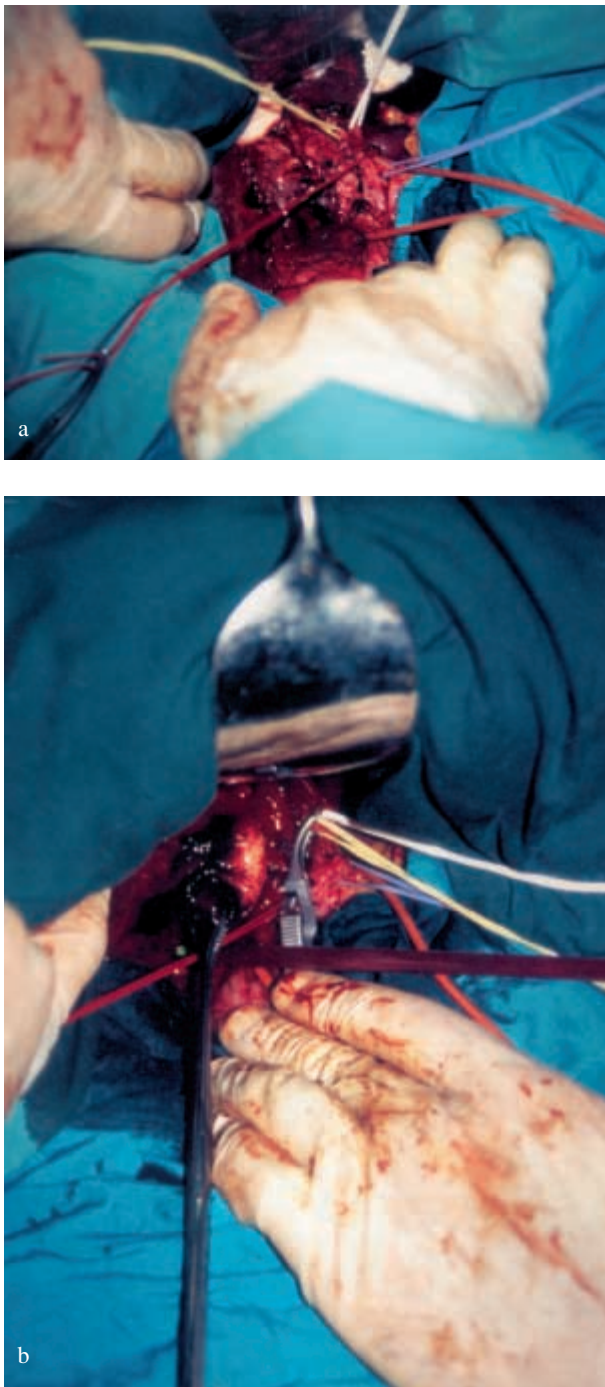


Fig. 4

Surgical exploration of case 3 : a. proximal vascular control of right hepatic artery (yellow tape) ; b. evacuation of thrombus ; c. ligation of the artery.

Mayo Clinic. Mortality of 17% and poor graft patency have been reported ; however ; there is no hepatic morbidity (14). In the absence of coexisting liver disease, complex arterial reconstructions may be avoided. The surgeon might then decide to ligate the artery if repair is not feasible. A formal hepatic resection might be neces-

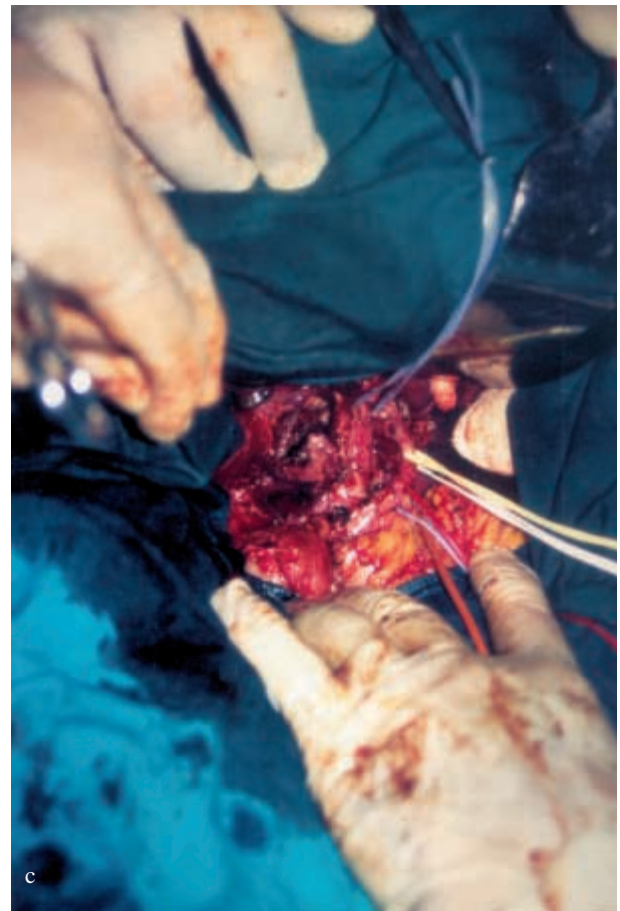


Fig. 5

Reported hepatic artery pseudoaneurysms following cholecystectomy in the last ten years

sary in the presence of hepatic ischaemia following embolization or surgical ligation.

The main concern is the prevention of the iatrogenic injury. Awareness of the anatomical variations of the hepatic and cystic arteries encountered in 50% of individuals is important in prevention of iatrogenic

Table 1

Sites of injury, clinical presentations and therapy methods in pseudoaneurysms of hepatic artery, as stated in the literature (NS : not stated)

Injury site	Number of cases (%)
Right hepatic artery	31 (60.8)
Common hepatic artery	14 (27.4)
Cystic artery	5 (9.8)
Left hepatic artery	1 (2.0)
NS	6
<i>Signs and symptoms</i>	
Haemobilia	25 (67.6)
Abdominal discomfort-pain	6 (16.2)
Biliary-duodenal fistula	4 (8.1)
Intraabdominal haemorrhage	2 (5.4)
Jaundice	2 (5.4)
Portal hypertension	1 (2.7)
NS	17
<i>Therapy</i>	
Embolization	41 (82.0)
Surgery (ligation-repair)	9 (18.0)
NS	7

injury (15). Three important anatomic variations are double cystic artery (20%), "caterpillar hump" of right hepatic artery and cystic artery course anterior to common hepatic duct. Laparoscopic cholecystectomy can safely be performed if some rules, - like keeping the dissection plane near the gallbladder wall, freeing the infundibulum first in order to widen Calot's triangle (pediculization) and meticulous dissection without bleeding to visualize all the structures within -, are applied. At best, cystic artery is followed until it enters gallbladder wall before clipping. Separate clipping of the cystic duct and artery is performed to avoid arteriobiliary fistula. When bleeding occurs, the surgeon should never attempt blind clipping or coagulation, and not hesitate to convert to open cholecystectomy especially in complicated patients.

In conclusion, although the incidence of hepatic artery injuries in laparoscopic cholecystectomy is not as high as common bile duct injuries, PA of the hepatic vascular system should be addressed as a rare complication. This observation has clinical implications, since untreated PAs frequently enlarge and subsequently rupture. Radiological embolization is the treatment of choice in most centers while surgery remains appropriate for complex injuries and complicated cases. The most favorable outcome can be accomplished by multidisciplinary approach of surgery and radiology teams.

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