J Surg Med. 2024;8(7):123-127.
https://doi.org/10.28982/josam.7667

JOSAM

Journal of Surgery and Medicine

e-ISSN: 2602-2079

Case report
https://jsurgmed.com/

Hepatic artery injury in a six-year-old patient after laparoscopic cholecystectomy: A management challenge

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Informed Consent
The authors stated that the written consent was obtained from the parents of the patient presented with images in the study.

Conflict of Interest
No conflict of interest was declared by the authors.

Financial Disclosure
The authors declared that this study has received no financial support.

Previous Presentation
We presented this case at the Annual Congress of the Turkish Pediatric Surgical Association Congress, November 25–28, 2021, Belek, Antalya, Turkey.

Published
2024 July11

Abstract

Laparoscopic cholecystectomy is among the most common surgeries in adults and is increasing in the pediatric age group. However, data are lacking on complications of the surgery and their treatment in children. Although many case series can be found that address hepatic artery injury after cholecystectomy in adults, we could not find similar publications in the English literature relating to the pediatric age group. This report shares the complex diagnosis and treatment process of a six-year-old female patient who presented with jaundice eight months after laparoscopic cholecystectomy. During the treatment process, it was observed that the common bile duct went into lysis in the late period due to haptic artery injury. The treatment continued with redo hepaticojejunostomy and catheters passed through the anastomosis line in the patient, who had anastomotic stenosis after hepaticojejunostomy. Twenty-four months after the patient's first operation, she had no active complaints. Complications may occur months after a cholecystectomy. In this case, arterial injury should be kept in mind. We wanted to contribute by presenting the first case in the literature on hepatic artery injury in the pediatric age group.

Keywords: laparoscopic cholecystectomy, hepatic artery injury, pediatric, jaundice

Introduction

Laparoscopic cholecystectomy (LC) is the gold standard in managing calculous cholecystitis in adults, and it is one of the most frequently employed abdominal surgical procedures [1]. Consequently, there is broad information on the LC approach and its complications in adults. Although currently, laparoscopic cholecystectomy is performed more frequently in children due to the rise in the rate of calculous cholecystitis, there is still limited data in the literature about this approach and its complications in children [1–4]. Almost all of the publications on both LC and its complications are series from general surgery due to the large number of patients in that branch [1,2]. Although the procedure has been employed very frequently, simple or serious complications may be encountered due to surgeon inexperience or variations of the bile ducts and liver vessels. One of the most common complications is prolonged bile leak (BL); numerous causes have been reported for this complication in adults. The diagnosis and treatment are easy for most of these causes. One of the very rare causes of prolonged BL and jaundice in adults is injuries in major hepatic vessels.

In the adult series, it has been claimed that 0.3–0.7% of the patients have biliary injuries, most of which are accompanied by vascular injuries. Although there is enough information about the diagnosis and treatment of bile duct complications due to arterial injury in adults, managing such cases is quite challenging for both physicians and patients [1–3]. In our English literature review, we found no information about prolonged BL and jaundice secondary to right hepatic artery injury in the pediatric age group. Therefore, we wanted to contribute to the literature by sharing the process and the problems experienced in the diagnosis and treatment of bile duct damage secondary to right hepatic artery injury.

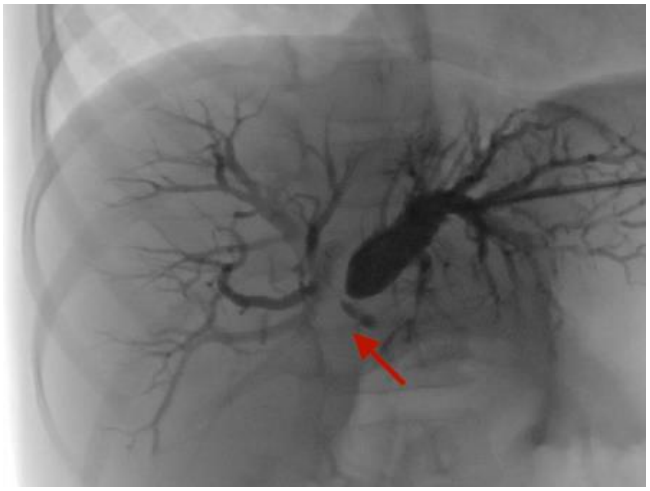
How to cite: Akış Yıldız Z, Su ŞM, İlçe Z. Hepatic artery injury in a six-year-old patient after laparoscopic cholecystectomy: A management challenge. J Surg Med. 2024;8(7):123-127.

Case presentation

A six-year-old female patient with no comorbid conditions had an LC for cholelithiasis in another medical center. The patient had bilious drainage on the second postoperative day. A laparoscopy was performed on the fifth postoperative day due to BL. It was observed that there was BL from the gallbladder bed, and it was clipped laparoscopically. The BL continued; therefore, laparotomy was performed three weeks after the first procedure, and the BL was repaired. The patient did not have any active complaints afterward and returned with complaints of acholic stool and scleral jaundice eight months after the first surgical procedure. The patient was referred to our clinic due to the high direct bilirubin level and magnetic resonance cholangiography (MRC) showing the absence of the common bile duct.

The physical examination was normal except for mild scleral icterus and a subcostal incision scar. Laboratory tests revealed aspartate transaminases (AST): 82 U/L, alanine transaminases (ALT):75 U/L, total serum bilirubin (TB): 4.98 mg/dL, and direct bilirubin (DB): 3.52 mg/dL. Complete blood count and other blood biochemistry tests were within normal limits. Abdominal ultrasonography (USG) was reported as the intrahepatic bile ducts were dilated (the diameter of the right hepatic duct was 5 mm, and the diameter of the left hepatic duct was 9 mm); the echogenicity was increased at the junction of the right and left hepatic ducts and the point of junction was not observed; the common bile duct could not be clearly visualized, and there was increased echogenicity in its bed (stricture?). The patient's MRC was reinterpreted in our hospital, and the common bile duct was not observed. The stricture of the common bile duct was considered. The patient's bilirubin level continued to increase (DB: 7.6 mg/dl). Percutaneous cholangiography (PC) was performed on the third day after the patient was admitted. It was observed that the left hepatic duct terminated bluntly. The intrahepatic bile ducts were found to be dilated in the right lobe, the right and left hepatic ducts ended bluntly, and there was no transition to the common bile duct (Figure 1).

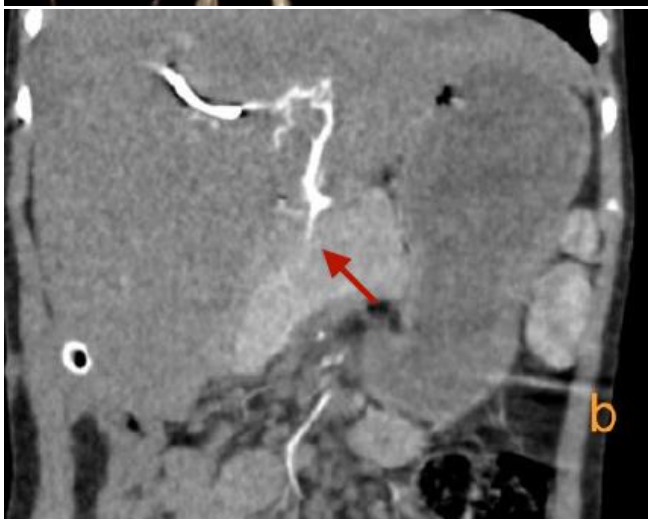
Figure 1: Percutaneous cholangiography of the patient at the first admission. The right and left common bile ducts end bluntly and there is no transition to the common bile duct.



Percutaneous transhepatic drainage catheters (PTCs) were inserted into both main hepatic ducts. Laparotomy was planned since there was no passage from the right and left hepatic ducts into the common bile duct. The laparotomy performed nine months after the LC revealed that the right lobe of the liver was darker, but the appearance was not suggestive of a blood supply insufficiency. The distal end of the fibrotic connective tissue in the location of the common bile duct was followed up to the duodenum, but luminous structures could not be seen. It was supposed that the common bile duct was lysed. The medical team chose to perform a hepaticojejunostomy (HJ). It was observed that the anterior wall of hepatic confluence was absent, but its posterior wall was intact. The right and left hepatic ducts were exposed. HJ was performed by widening the anastomosis line toward the left bile duct. However, since such a case had not been encountered before, and the right and left hepatic ducts appeared normal, vessel injury was not considered and a catheter was not placed into the biliary tract.

Postoperatively, the patient consulted with the adult hepatobiliary surgery team and the liver transplantation team. The teams stated that the patient had a typical right hepatic artery injury, that there were such cases in adult series, and that performing HJ was the right decision. They recommended that computed tomography angiography (CTA) be performed when the patient was stabilized to confirm the pathology. Postoperatively, the patient's TB values decreased to the normal limits. The right hepatic artery was not observed on CTA, and it was seen that collateral vessels had developed (Figures 2a and 2b).

Figures 2: The right hepatic artery is not observed; however, collaterals are seen.



The patient had abdominal pain four weeks after HJ, and subcapsular fluid collection that was 10 cm in diameter, determined to be a bilioma, was seen in the right lobe of the liver on USG. Interventional radiologists drained the bilioma. PC was

performed by injecting opaque material into the right and left hepatic ducts. The opaque material injected into the right hepatic duct did not pass through the HJ region. The opaque material passed into the jejunum when injected from the left side (Figure 3). The procedure was terminated by inserting a PTC into the right hepatic duct. Afterward, 200 to 400 cc/day of bile was drained from the patient's biliary catheter. Bilirubin values were within normal limits and stool was cholic.

Figure 3: Cholangiography performed one month after the first hepaticojejunostomy surgery shows a minimal transition from the left hepatic duct into the jejunum.

In the follow-up, it was observed that the patient had a biliary fistula on the skin, whose biliary catheter was incidentally removed. Three hundred to 400 cc of bile drained daily from the fistula. The fistula closed approximately four months after the hepaticojeunostomy was performed. The patient's stool became acholic, and the laboratory results showed AST: 64 U/L, ALT: 54 U/L, TB: 0.43, gamma-glutamyl transpeptidase (GGT):101 U/L, and alkaline phosphatase (ALP): 627 U/L. PC was performed again. It was observed that there was no passage through the HJ area. A laparotomy was planned. An intraoperative cholangiography was performed. On cholangiography, there was a distance of approximately 2 cm between the right and left hepatic ducts and the previously anastomosed jejunum. On laparotomy, 1 cm-thick scar tissue was seen at the site of anastomosis. It was observed that there was no bile passage due to this stenosis. The scar tissue was removed, and an HJ was performed again. Two 8 Fr catheters were placed from the jejunum into the right and left hepatic ducts, and their opposite ends were exited through the skin. A control cholangiography was performed two weeks after the second HJ to prevent the formation of a new stricture, considering that the catheters inserted during the surgery could not be left there for a long time. Percutaneous trans anastomotic 8 Fr catheters were inserted from the right and left hepatic ducts. The trans anastomotic catheters placed during the surgery were removed.

Afterward, the patient had no active complaints, and no free fluid was detected on the abdominal USG. The patient was discharged. Five months after discharge, PTCs were removed, and four F guides were placed. The guides were removed after two months.

Thirty-four months after the patient's LC procedure and 20 months after the second HJ, the patient had not been catheterized for 13 months, was in good general condition, and had good liver function tests.

Discussion

The prevalence of cholelithiasis has been gradually increasing in children and is reported at 0.13–1.9%. This compares to a prevalence of 3–70% in adults [4,5]. Cholecystectomy is the most common abdominal surgery in adults, and more than 80% are performed laparoscopically. Although cholecystectomy is not performed in children as frequently as in adults, the rate among children has been increasing in parallel with the increasing prevalence of cholelithiasis. LC is preferred more often in children, as in adults [2,4,5].

The major complications after cholecystectomy are bleeding, infection, wound problems, bile duct injury, vascular injury, and BL. Bile duct injury has been reported as the most common and most serious complication in both adults and children. The rate of bile duct injury has been reported as 0.3–0.7% in adults and 0.44% in children [1–3].

The causes of iatrogenic bile duct injuries are clipping, thermal injury, direct injury, and transection. These injuries are largely accompanied by vascular injuries. The most common accompanying vascular injury is the injury of the right hepatic artery [3,6].

Although Bismuth and Strasberg's classifications were used in the past for the treatment and follow-up of bile duct injuries in adult series, bile duct injuries are currently divided into two groups—low-grade and high-grade injuries, referring to the severity of BL. The cases needing aggressive treatment and having poor prognosis were included in the high-grade group [6,7]. Many articles in the literature have focused on just high-grade injuries. Our case had a biliary injury that was categorized as high-grade since its treatment required complex and repetitive interventions.

After cholecystectomy, bile duct injuries result in strictures, transections, or, most frequently, BL, which is seen at a rate of 0.3–2.7%. Stones in the biliary tract or inflammation and fibrosis due to acute cholecystitis have been reported as risk factors for BL, particularly after LC. It has been proposed that those cases mostly have high-grade bile duct injuries [6].

Treatment of BL has changed direction from surgery to minimally invasive endoscopic interventions, particularly in adults. Although the success rate for endoscopic interventions has been reported as approximately 90% in adult series, there is not enough data on this subject in the pediatric age group. In addition, the incidence and treatment of complications are often not detailed in publications on pediatric cholecystectomy [1–3,6].

Although most BL can be treated with minimal interventions, complex bile leaks may require more than one

intervention and surgery. HJ is a widely accepted procedure, particularly in the treatment of high-grade bile duct injuries. However, in some of the patients who underwent HJ, it was observed that re-intervention was required due to anastomotic stenosis. This is because most bile duct injuries are accompanied by vascular injury [3,6–8].

Bile duct problems may be secondary to intraoperative injury or may be due to ischemia. Vascular injury should be considered, especially in cases with prolonged bile duct complications. Although portal vein and arterial injuries are less frequent than biliary complications, they are serious and are often associated with biliary complications. Right hepatic artery injury is the most common vascular injury, with a rate of 92% in the adult series. However, vascular injuries are often not diagnosed without imaging or autopsy [9].

Vascular injuries are mostly diagnosed with radiological imaging after they cause serious complications. Alves et al. asserted that the vascular injury rate may be as high as 47% if angiography were performed routinely after biliary injury [3]. Although the publications on adults report a high rate of vascular injury, the lack of vascular injury in pediatric series gives the impression that vascular injury is missed in pediatric cases. Possibly children are not diagnosed with vascular injuries because hepatic artery injuries post-LC are mostly asymptomatic in childhood and angiography is not performed routinely. It has been stated that arterial injury after cholecystectomy may lead to serious problems such as abscess formation, necrosis, and atrophy in the liver, and attempts to repair the biliary tract may be unsuccessful. However, others have called these possibilities rare, and most patients with arterial injuries have been asymptomatic [10].

In our case, the common bile duct was seen to be intact during the BL repair procedure performed three weeks after the first surgery, but necrosis was observed eight months later. Contrary to the blood supply of the liver parenchyma from both the hepatic artery and the portal vein, the blood supply to the biliary system flows only from the hepatic arteries. Approximately 40% of the blood supply of the extrahepatic biliary system comes from the right hepatic artery and 60% from the gastroduodenal and retroduodenal arteries. Excessive dissection of the common bile duct during cholecystectomy may disrupt its blood supply. When the arterial blood flow of the common bile duct is impaired, the most severe ischemic damage is seen in its middle third and at the biliary confluence. Although not proven, delayed biliary stricture is explained in this way [7]. The necrosis of the intact common bile duct after eight months in our case may be explained in this way. Li et al. reported cases of right hepatic artery injury and bile duct ischemia. However, bile duct ischemia developed in a shorter time after cholecystectomy in those cases [11].

In the adult series, some authors performed routine CTA in every case with biliary complications after cholecystectomy to reveal any accompanying arterial injury; however, others performed CT angiography only in patients with prolonged BL. CTA is not performed in most cases with hepatic artery injuries [3,9].

Hepatic artery injury was not considered in the first stage, and preoperative CTA was not performed in our patient due to the lack of information about hepatic artery injury in the literature in the pediatric age group. Although there was a demarcation line between the right and left lobes of the liver on laparotomy, the blood circulation was good. Therefore, we did not consider hepatic artery injury first. However, when we consulted with the adult Hepatobiliary Surgery Department postoperatively to reveal the etiology, we were told that the cause of common bile duct necrosis might have been right hepatic artery injury and that this condition was rarely seen in adults. The right hepatic artery was not observed on the CTA. Although hepatic artery injury has not been reported in children, CTA should be kept in mind to reveal the etiology in children with prolonged BL and obstructive jaundice that appears late after surgery. In late biliary complications, HJ is usually performed. In cases with hepatic artery injury and biliary injury, the possibility of anastomotic stenosis is high [3,8]. Therefore, several studies have investigated methods to prevent anastomotic stenosis. Some authors have recommended the placement of a trans anastomotic catheter. Although placing a trans anastomotic catheter is controversial, it is mainly recommended in cases where biliary reconstruction is complex or in cases of recurrent anastomotic stenosis [8]. Since hepatic artery injury was not initially considered in our patient, the previously placed catheters were removed and no stents were placed.

Another recommendation is the Hepp-Couinad approach—that is, widening the anastomosis toward the left hepatic duct. Here, the aim is to move away from the distal confluence, which is sensitive to ischemia in cases with right hepatic artery injury [3,9]. In our case, it was observed that the distal part of the bile duct confluence went completely into necrosis. Although hepatic artery injury was not considered in the first stage, the process was thought to be an ischemic one, and therefore anastomosis was performed by expanding it toward the left hepatic duct. However, anastomotic stenosis developed again. Therefore, when we performed a revision surgery due to anastomotic stenosis, we placed a trans anastomotic catheter, as the literature on the adult series has recommended. Afterward, these were replaced with PTC, and we tried to prevent strictures from developing. Our patient had anastomotic stenosis one month after the first surgical procedure; however, stenosis was not encountered after the second HJ procedure in which a stent was placed.

Conclusion

It should be kept in mind that there may be an accompanying arterial injury in pediatric cholecystectomy cases with biliary complications. CTA may help in managing the process more efficiently in pediatric cases with prolonged biliary complications. Even after the repair of the biliary complications, it should be kept in mind that complications may occur again after a long period in cases of concomitant arterial injury, and patients should be followed up closely. While repairing a biliary injury accompanied by arterial injury, surgeons may find that the patient may benefit from a trans anastomotic catheter that can be left in the anastomosis line for a long time. However, since the trans anastomotic catheters inserted during the surgery cannot be left in place for a lengthy time, a PTC may be inserted. These catheters should be left in place until the end of the ischemic process.

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