Original Article

Anatomical variations and congenital anomalies of Extra Hepatic Biliary System encountered during Laparoscopic Cholecystectomy

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Abstract

Objective: To assess the frequency of anatomical variations of extrahepatic biliary system in patients undergoing laparoscopic cholecystectomy.

Methods: This is an observational study performed in the Department of Surgery, Liaquat University of Medical and Health Sciences, Jamshoro for a period of four years from January 2004 to December 2007.

All diagnosed patients of cholelithiasis undergoing routine laparoscopic cholecystectomy were assessed for anatomical/congenital extra hepatic biliary and vascular anomalies. Structures mainly assessed for anomalies were gall bladder, cystic duct, supraduodenal part of Common Bile Duct (CBD), cystic artery and hepatic artery which are routinely handled during laparoscopy. However, assessment of variations and anomalies, of hepatic ducts, portal vein, retroduodenal and pancreatic parts of CBD were not done due to possibility of iatrogenic injuries.

Results: Three hundred cases of cholelithiasis comprising 255 (85%) females and 45 (15%) males with mean age of 39.85 ± 18.82 years were included in the study. Patients mainly presented with upper abdominal pain including pain in right hypochondrium (71.67%), pain in right hypochondrium and epigastrium (19%) and pain in epigastrium alone (9.33%) as main symptoms. Operative findings revealed variations in 61 (20.33%) patients mainly involving cystic artery (10.67%), cystic duct (4.33%), right hepatic artery (2.67%) and gallbladder (2%).

Postoperatively 3.67% revealed bleeding and 1.67% biliary leak from drain as main complications related to anatomical variations giving rise to 1% morbidity, however, no mortality was seen in this series.

Conclusion: Congenital anomalies and normal variants of biliary tree, are not common but may be of significance during laparoscopic surgery as failure to recognize them leads to iatrogenic injuries and can increase morbidity and mortality (JPMA 60:89; 2010).

Introduction

Variations in the anatomy of gallbladder, bile ducts and the arteries that supply them and liver are important to the surgeon[1] because failure to recognize them may lead to inadvertent ductal ligation, biliary leaks and strictures after laparoscopic cholecystectomy.[2,3] Congenital anomalies of extra hepatic biliary tree have long been recognized[4] but are rare[5] and may be of clinical importance[6] because they may provide surgeons with an unusual surprise during laparoscopic cholecystectomy.[7] These anomalies include aberrant or accessory biliary ducts, aberrant cystic duct, bile duct cysts, alteration of biliary tract associated with situs inversus and anomalous junction of bile duct to pancreatic duct along with vascular anomalies[6] Several less common and more complicated anatomic variations can also be found.[8]

The basic knowledge of embryologic development and normal anatomy of biliary tree will help in understanding and identifying this group of anomalies.[9] Biliary tree develops from hepatic diverticulum which gives rise to gallbladder, extra-hepatic ductal system with hepatic parenchyma whereas intrahepatic ducts are derived from endoderm at the tip of diverticulum. The accessory anomalies or aberrant bile ducts may result when interconnecting ducts persists.[10] The extra hepatic bile duct system is divided into four topographic portions. Cystic duct and gall bladder, right and left hepatic ducts, common hepatic and bile duct including its supra and retro-duodenal parts and the pancreatic and intraduodenal portions.[11]

Familiarity of these variants is important prior to laparoscopic cholecystectomy, however, preoperative diagnosis by routine investigations is difficult[7] and is only seen in exceptional cases and they often turn out to be unexpected findings during laparoscopic surgery. However, a wide spectrum of biliary tree malformations along with pancreatic anomalies can be recognized by radiologic evaluation.[9] Recent advances in MRI, MRCP and Multi-Detector (MD) or Helical CT Scan have improved image quality greatly and have contributed to increased recognition of these entities.[3] The purpose of this study is to evaluate the frequency of Anatomical variations and congenital anomalies of the Extra Hepatic Biliary System encountered during Laparoscopic Cholecystectomy.

Patients and Methods

This study was conducted on diagnosed 300 patients of cholelithiasis at the department of surgery Liaquat University of Medical and Health Sciences, Jamshoro for a period of 4 years from January 2004 to December 2007. Sampling strategy was convenient including all patients of cholelithiasis admitted for laparoscopic cholecystectomy. The patients with acute cholecystitis, empyema, gall bladder, pancreatitis, obstructive jaundice and carcinoma of gall bladder were excluded from study because in these cases it would have been difficult to identify the anomalies due to obscured biliary anatomy. Base line investigations along with ultrasound abdomen were carried out in all cases and no other special investigations were done to evaluate the patients because our purpose was not to assess these anomalies pre operatively by any conventional or special investigation.

All cases undergoing routine laparoscopic colecystectomy were assessed for different extra hepatic biliary ductal and vascular anomalies accessible during the procedure and their importance in relation to operative difficulties and post operative complications particularly due to these anomalies. Structures mainly assessed were gall bladder, cystic duct, supraduodenal part of CBD, cystic artery and hepatic artery which are easily handled during laparoscopic cholecystectomy. However, assessment of hepatic ducts, portal vein and retroduodenal and pancreatic parts of CBD was not done due to the possibility of iatrogenic injuries.

The data were evaluated in statistical programme version 16.0. Mean ± standard deviation were presented for numerical parameters and categorical variables were expressed as n (%) on 95% confidence interval. No other statistical test was applied.

Results

Out of 300 cases of cholelithiasis 85% were females and 15% males with female to male ratio of 5.66:1. Age ranged from 10-80 years with highest incidence during 3rd, 4th and 5th decade having mean age of 39.85 ± 18.82 years and median age of 41 years. Most of the patients presented with upper abdominal pain in form of right hypochondrial pain (71.67%), epigastric and right hypochondrial pain (19.0%) and epigastric pain (9.33%) as main symptoms (Table-1). Multiple stones were present in 79.67% and 20.33% had single stone. Operative findings revealed

Table-1: Pre-operative patients characteristics.

Characteristics	No of Pts:	%age
Sex:		
Female	255	85%
Male	45	15%
Age (Years):		
Mean age	39.85±18.82	
Median range	41 (10-80)	
Symptoms:		
Pain in Right Hypochondrium (RHC)	215	71.67%
Pain in Epigastium	28	9.33%
Pain in RHC + Epigastrium	57	19.00%
Dyspepsia	35	11.67%
Nausea & Vomiting	56	18.67

Male & Female Ratio: 5.66:1.

Table-2: Congenital anomalies and anatomical variations seen during laparoscopic choleycstectomy.

Site of Anomaly	Type of Anomalies	No. Of Patients	%age
Gall bladder anomalies	i) Buried gall bladder	3	1.00%
(n = 6) (2%)	ii) Floating gall bladder	1	0.33%
	iii) Phrygian cap gall bladder	1	0.33%
	iv) Parallel to CBD	1	0.33%
Cystic duct anomalies	i) Short cystic duct	8	2.67%
(n = 13) (4.33%)	ii) Long cystic duct	3	1.00%
	iii) Accessory cholecysto hepatic duct	2	0.67%
Right hepatic artery anomalies			
(n = 8) (2.67%)	i) Moynihan's hump anomaly	8	2.67%
Common hepatic artery (n = 2) (0.67%)	i) Long and tortouous cases	2	0.67%
Cystic artery anomalies (n = 32) (10.67%)	i) Artery arising above calot's	3	1.00%
	ii) Artery anterior to cystic duct	8	2.67%
	iii) Artery posterior to cystic duct	4	1.33%
	iv) Artery right to cystic duct	2	0.67%
	v) Double cystic artery	3	1.00%
	vi) Aberrant cystic artery	7	2.33%
	vii) Short cystic artery	5	1.67%

Total anomalies seen were 20.33% (61 cases).
Over all vascular anomalies seen were 14% (42 cases).

Table-3: Postoperative patients characteristics.

Parameters	No. of Pts:	% age
Main Postoperative Complications		
Bleeding from drain	11	3.67%
Biliary Leakage	5	1.67%
Port site sepsis	22	7.33%
Shoulder pain	7	2.33%
Re-exploration	3	1.00%
Hospital Stay:		
1 day	50	16.67%
2 days	90	30.00%
3 days	70	23.33%
4 days	38	12.67%
5 days	23	5.00%
6 days	15	
7 days	9	3.00%
15 days	5	1.67%

Mean stay 2.75±1.95 days.

variations in 61 cases (20.33%) mainly involving cystic artery 10.67%, cystic duct (4.33%), right hepatic artery (2.67%), gall bladder (2.0%) and common hepatic artery (0.67%) (Table-2). No anomaly of CBD was seen and no operative difficulty was encountered during surgery due to receiving anomalies in majority of cases as all precautions were taken during surgery when these anomalies were identified. Postoperatively patients developed complications in form of sepsis (7.33%), right shoulder pain (2.33%), bleeding (3.67%) and biliary leak (1.67%) as main complications (Table-3). The complications possibly seen due to failure of recognition of aberrant anatomy were bleeding and biliary leak as identified by amount and duration of contents coming from drain. Majority of the cases were controlled by conservative treatment but only 3 cases (1%) were re-explored. The patient with bleeding (0.33%) revealed accessory cystic artery as a source of haemorrhage which was ligated and the other two cases (0.67%) of biliary leak were found to have damaged right sectorial duct in one case which was managed by Roux-en-Y hepatico-jejunostomy and slippage of clip in other case due to short cystic duct which was dealt with by ligature application.

Hospital stay ranged from 1 to 15 days except 3 cases of re-exploration with mean stay of 2.75 ± 1.95 days (Table-3). Majority of cases were discharged within 72 hours (70.0%) except 14 cases (4.67%) who stayed for one to two weeks due to port-site (Port is an area where Trocar is placed in abdomen for laparoscopic Cholecystectomy. Four ports are used in the procedure) wound sepsis, biliary leak and bleeding problems. Patients with re-exploration remained more them 3 weeks.

Discussion

The use of laparoscopy for gallstone disease with high resolution and magnification reveals clear anatomy of biliary tree as compared to open cholecystectomy. Therefore extra-hepatic biliary system can easily be assessed for its anatomical variations and congenital anomalies during laparoscopic cholecystetcomy. It is important to emphasize that it is difficult to obtain the diagnosis of these malformations pre-operatively by investigations utilized for diagnosis of gallbladder disease, however, they can be seen by special radiological evaluation.[9] The overall incidence of these anomalies found in this study was 20.33%.

The gallbladder anomalies were seen in 2% of patients in form of buried gallbladder (1%) and floating gallbladder, Phrygian cap gallbladder and gallbladder lying parallel to common bile duct each in 0.33% of cases. However congenital anomalies of gallbladder are rare and can be

accompanied with other biliary and vascular malformations.[7] Phrygian cap (Folded fundus) deformity is the commonest congenital anomaly of gallbladder but has no pathological significance4 and is seen in 2-6% of cholecystogrms.[12] Abnormal locations of gall-bladder has been described as intrahepatic, retrohepatic, within falciform ligament, retro-duodenal and retropancreatic areas.[13] But no such anomaly was seen in this study.

The course and pattern of entry of cystic duct is extremely variable,[14] however, it classically joins to common hepatic duct below the confluence of right and left hepatic duct on lateral side in 58%[15] to 75%[16] of cases whereas in the remainder it runs parallel to hepatic duct or winds round it before joining bile duct. There are three common variants of cystic duct insertion in the form of low cystic duct insertion (9%), medial cystic duct insertion (10-17%) and parallel course of cystic duct with common bile duct (1.2-25%).[9] The cystic duct anomalies seen in this study were 4.33% in the form of short cystic duct (2.67%), long cystic duct (1%) with low insertion and accessory cholecystohepatic duct (0.67%). The true congenital absence of cystic duct is very rare.[17] however, most of the cases are due to severe fibrosis and impaction of stone in the duct. Double cystic duct anomaly,[18,19] is also rare but well described in the literature and may be responsible for post-operative biliary leak. No double cystic duct or its absence was seen in this series. The incidence of accessory bile ducts varies form 1%[20] to 30%.[21] They can arise form right lobe of liver in majority of cases but occasionally from left or caudate lobe and they can join to right hepatic, common hepatic or cystic duct or gall bladder.[21] Here one case (0.33%) of accessory cholecysto-hepatic duct was found which was responsible for re-exploration in that patient.

The arterial anomalies should be recognized during laparoscopic cholecystectomy to prevent arterial bleeding and hence iatrogenic injuries. The most dangerous anomaly is tortuous course of common hepatic artery or right hepatic artery on the front of the origin of cystic duct known as "Cater pillar turn or Moynihan's hump."[16] The vascular anomalies assessed in our study were 14% out of which 2.67% revealed Moynihan's hump. The most important thing is the short cystic artery arising from the looped right hepatic artery[22] and most vulnerable to trauma during cholecystectomy. The short cystic artery was seen in 1.67% of cases in this study. In 15% of cases right hepatic artery and cystic artery cross infront of the common hepatic and cystic duct,[16] where as accessory cystic artery is found in 20% of cases.[23] The variations in the course of cystic artery found in this series were artery crossing anterior to cystic duct in 2.67%, posterior in 1.33% and right to cystic duct in 0.67% of cases. Variations in number of cystic artery like double cystic artery is seen in 15% of cases where as single cystic artery is present in 85% of cases.[24] Double cystic artery was seen in 1% of cases in this study. Aberrant cystic artery was seen in 2.33% of cases.

Due to these anatomical variations complications seen were bleeding in 3.67% of cases and biliary leak from drain in 1.67% of cases. Three patients were re-explored one for bleeding and other two for biliary leak giving rise to morbidity of 1%. No mortality was seen in this series. However morbidity assessed by Leghari AA et al.[25] in their study of laparoscopic cholecystectomy in complicated gallstone disease was 1.67% which is higher than the present study. Minor biliary leaks in other cases could be due to accessory cholecystohepatic ducts passing directly into the liver bed which are unusual[21] and not recognized during laparoscopic procedure.

Conclusion

Congenital anomalies and anatomical variations of extra- hepatic biliary tree though are not common but can be of clinical importance and surprise if present. So every surgeon should assess for these anomalies during laparoscopic cholecystectomy in order to prevent inadvertent ductal clipping, ductal injuries, strictures and bleeding problems. Awareness of these anomalies will decrease morbidity, conversion and re-exploration in these patients.

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