
HEPATOBIILIARY DISEASE

CHOLEDOCHODUODENOSTOMY: REAPPRAISAL IN THE LAPAROSCOPIC ERA

KAMRAN KHALID,* MOHAMMAD SHAFI, HAROON M. DAR AND KHALID M. DURRANI

Department of General Surgery, Shaikh Zayed Postgraduate Medical Institute, Lahore, Pakistan

Background: With the advent of interventional endoscopic procedures and with growing experience of laparoscopic surgery, the indications for open biliary procedures have become limited. This prospective study reviews the indications of open choledochoduodenostomy for benign biliary diseases and presents the short-term and long-term outcomes of this procedure in the present minimally invasive surgical era.

Methods: Side-to-side choledochoduodenostomy was carried out for various benign obstructive pathologies of the biliary tract. The various parameters recorded were the demographic data, indications for surgery, early and late complications and the long-term outcome of the procedure.

Results: Results of choledochoduodenostomy on 54 consecutive patients over a 9-year period are presented. The mean age was 49.7 years with a male to female ratio of 1:2.6. Thirty (55.5%) patients presented with obstructive jaundice and 42.6% had cholangitis. Overall hospital morbidity was 13% with zero mortality. After a mean follow up of 7.8 years, 96.3% patients had 'good' or 'fair' and 3.7% experienced 'poor' results. No recurrent disease or biliary malignancy was observed.

Conclusion: Open biliary drainage procedures may still be indicated in select patients where the facility or expertise for minimally invasive biliary procedures is not available. Choledochoduodenostomy remains an effective biliary drainage procedure with acceptable morbidity and mortality, especially in the high-risk and elderly population. The procedure should be regarded as an essential in the general surgical knowledge and training.

Key words: choledochoduodenostomy, indication, outcome.

Abbreviations: CBD, common bile duct; CDD, choledochoduodenostomy; CT, computed tomography; ERCP, endoscopic retrograde cholangiopacreatography; HIDA, hepatobiliary iminodiacetic acid; SZPGMI, Shaikh Zayed Postgraduate Medical Institute.

INTRODUCTION

With the introduction and increasing experience of endoscopic and advanced laparoscopic biliary procedures, the indications of open exploration of common bile duct (CBD) and biliary drainage procedures have become limited. Endoscopic management is useful, but requires the expertise of a gastroenterologist. In addition, early complication rates of up to 10% and a procedure-related mortality of 0.4–1% have been reported.¹ Reports on laparoscopic choledochoduodenostomy (CDD) have been published, but these procedures need considerable experience and expensive technologies.^{2–4} Moreover, even the basic laparoscopic facility may not be available at many centres. CDD provides a safe and effective biliary drainage when carried out for carefully chosen indications. The procedure may still be required in selected cases, even with all the endoscopic and laparoscopic advances.

K. Khalid FCPS, FRCSI, FRCSEd; **M. Shafi** MS; **H. M. Dar** FCPS; **K. M. Durrani** FRCSEd.

*Present address: Department of General Surgery, Surgical Unit I, Services Institute of Medical Sciences, Lahore, Pakistan.

Correspondence: Dr Kamran Khalid, House Number 321, Block A, Johar Town, Lahore 53780, Pakistan.
Email: kkkhawaja@hotmail.com

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Shaikh Zayed Postgraduate Medical Institute (SZPGMI) is a tertiary referral centre in Lahore, Pakistan. Laparoscopic surgery was started in the institute in 1990, although laparoscopic CBD exploration has not yet been introduced. The centre has a well-equipped gastroenterology unit involved in various diagnostic and therapeutic endoscopic procedures. This prospective study reviews the results of 54 consecutive cases of CDD carried out for various indications over a period of 9 years. The objective was to review the indications and outcome of the procedure in the present era of endoscopic and laparoscopic management of various biliary diseases.

PATIENTS AND METHODS

From January 1995 to December 2003, 14 018 patients were admitted to the Department of General Surgery, SZPGMI, Lahore. Out of these, 2523 patients (18%) were admitted for various benign biliary diseases and 2327 patients (16.6%) underwent a biliary operation. CBD exploration was carried out 335 (14.4%) cases and CDD was carried out in 59 (17.6%) of these patients. Five patients were lost to follow up. The results on remaining 54 patients are presented. Various indications used for selection of the patients included a dilated (>1.5 cm) CBD associated with: multiple ductal calculi, especially in the elderly patients (>50 years of age), stenosis of Vater's ampulla resistant to passage of a 3-mm Bakes dilator, ampullary stenosis associated

with impacted calculus, periampullary diverticulum, short stricture (<1 cm) in the distal common duct and residual or recurrent calculi in a dilated duct requiring second biliary operation. Preoperative evaluation included a detailed history and physical examination. Various haematological and biochemical investigations carried out were complete blood count, estimation of blood urea nitrogen, creatinine, electrolytes and serum amylase levels. Liver functions tests, coagulation profile and hepatitis screening were carried out in all cases. Imaging included plain radiographs of the chest and abdomen. An abdominal ultrasound was obtained in all cases and was the mainstay of diagnosis and subsequent management. Preoperative endoscopic retrograde cholangiopancreatography (ERCP) was requested in 33 (61%) cases. Various indications of ERCP included inconclusive abdominal ultrasound with dilated common duct with or without gallstones, an abrupt termination of common duct on ultrasonography (suggestive of stricture or impacted stone), recurrent attacks of pancreatitis and in postcholecystectomy cases with persistent biliary symptoms and inconclusive ultrasonography. No therapeutic intervention was carried out at ERCP because of the lack of available expertise during the period of study. A T-tube cholangiogram was obtained in all postoperative cases where cholecystectomy was combined with CBD exploration. A computed tomography (CT) scan was obtained in all patients with diagnosis of distal CBD stricture to exclude malignancy. Peroperative cholangiography was used selectively in patients where operative findings were not consistent with preoperative diagnosis. Adequate hydration, correction of electrolytes and coagulation profile and optimization of renal function were stressed as important preoperative measures. All patients were given therapeutic doses of cefuroxime and metronidazole, commencing at induction and continued for 5 days. Right subcostal or paramedian incision was used in all cases. Cholecystectomy was carried out first where symptomatic gallstones were associated findings. The duodenum was completely mobilized. A vertical supraduodenal choledochotomy was carried out in the lower part of the common duct for exploration and subsequent anastomosis. Papillary stenosis was defined as inability to pass a 3-mm Bakes dilator. An incision was made in the posterosuperior wall of first part of the duodenum and an ellipse of mucosa was excised. A side-to-side CDD was then carried out using interrupted 3-0 polygalactin 910 (Vicaryl; Ethicon, UK) sutures. The area of ampulla was always felt with a finger from within the duodenotomy before anastomosis to avoid blind omission of an ampullary tumour. The operative area was drained using a tube drain. Postoperative morbidity and mortality were recorded. All patients had serum amylase checked on the second postoperative day and thereafter only if indicated. Postoperative pancreatitis was diagnosed when severe abdominal pain was associated with fever, increased fluid requirement, shock, hyperamylasaemia and increase in liver enzymes. The patients were followed every month for the first 6 months, every 3 months for the next 6 months and then every 6 months thereafter. Subjective evaluation of clinical improvement was made by symptomatic relief. Liver function tests were checked on every follow-up visit. A plain radiograph abdomen was obtained in all cases on second follow-up visit to show pneumobilia. Detailed investigations (abdominal ultrasonography, gastroduodenoscopy, barium meal and hepatobiliary iminodiacetic acid (HIDA) scan) were requested only if patients had persistent or recurrent biliary symptoms or in cases with persistently deranged liver functions tests. Outcome was considered 'good' if the patient had no further symptoms, required no further surgery for persistent biliary com-

plaints and returned to usual activities. Results were labelled as 'fair' in case of incomplete symptomatic relief or transient recurrent symptoms requiring no further biliary surgery. Persistent biliary symptoms, frequent or recurrent attacks of pain or pancreatitis necessitating further surgery or procedure-related death after discharge from the hospital was categorized under 'poor' results.

RESULTS

Table 1 summarizes the demographic and clinical details of 54 patients included in the study. Twenty-six (48%) patients were above 50 years of age. Nine patients (16.7%) had cholecystectomy in past and 6 (11%) had undergone previous CBD exploration. Three of these patients had a T-tube retained after CBD exploration carried out elsewhere and referred to our institute for ERCP and further management. Mean haemoglobin was 10.9 gram/dL (range 8.9–13.5 gram%) and mean total white cell count was 11.7×10^9 (range 5.7–23.2). Deranged liver function tests were observed in 34 (63%) cases. Mean total bilirubin was 61.8 Umol/L (range 5.9–179 Umol/L). Abdominal ultrasound showed gall bladder stones in 42 (78%) cases, whereas 4 (7.4%) had no gallstones and 9 (16.7%) had previous cholecystectomy. The CBD was dilated (mean 2.2 cm) in all cases and CBD stones were verified in 30 (55.5%) patients. ERCP was carried out in 33 (61%) cases. The procedure confirmed dilated CBD with multiple common duct calculi in 23 (42.6%) patients. Short stricture (~1 cm) in the lower end of the common duct was reported in 4 (7.4%) patients. Impacted calculus with ampullary stenosis was verified in further two (3.7%) cases. Ampullary stenosis with periampullary diverticulum was found in one additional (1.8%) patient. The procedure failed in three (9%) of these patients. Three (5.5%) patients had a T-tube retained after previous biliary surgery. The T-tube cholangiogram showed residual stones and distal stricture in all these cases. Table 2 summarizes the indications for surgery and operative findings in 54 cases. Six (11%) patients had evidence of pancreatitis whereas three (5.5%) had acute cholecystitis. The operative findings in nine patients with previous biliary surgery included: residual stones (three patients: ERCP not available in one and failed in two cases due to disturbed anatomy), recurrent stones (three

Table 1. Clinical and demographic details of 54 patients

Demographic and clinical details	Values
Demographic details	
Male, <i>n</i> (%)	15 (27.8)
Female, <i>n</i> (%)	39 (72.2)
Female : Male	2.6:1
Mean age in years (range)	49.7 (31–71)
Clinical presentation, <i>n</i> (%)	
Upper abdominal pain	52 (96)
Flatulent dyspepsia	36 (67)
Obstructive jaundice	30 (55.5)
Cholangitis	23 (42.6)
Acute pancreatitis	3 (5.6)
Laboratory parameters, <i>n</i> (%)	
Deranged liver function tests (mean total bilirubin, 61.8 Umol/L)	34 (63)
Deranged coagulation profile	18 (33)
Diabetes	13 (24)
Increased serum amylase (mean 890 U/L)	6 (11)
Hepatitis C positive	5 (9)

Table 2. Indications of operation and operative findings in 54 patients

Indications and findings	n (%)†
Multiple common duct stones	42 (78)
Multiple common duct calculi associated with ampullary stenosis	04 (7.4)
Ampullary stenosis with impacted calculus	03 (5.5)
Short low CBD stricture (up to 1 cm)	04 (7.4)
Periampullary diverticulum with ampullary stenosis	01 (1.8)
Associated findings	
Purulent cholangitis	09 (16.6)
Pancreatitis	06 (11)
Acute cholecystitis	03 (5.5)
Findings in nine patients with previous biliary surgery†	
Residual stones	03 (5.5)
Missed stones	02 (3.7)
Recurrent stones	03 (5.5)
Short distal common duct stricture (up to 1 cm)	01 (1.8)

†Percentages calculated against total number of patients (67). CBD, common bile duct.

patients: ERCP not available in two and failed due to lack of cooperation in one), distal CBD stricture (one patient: ERCP suggested surgery) and missed stones in two (1.5%) cases (ERCP not available). The histopathology of gall bladder was reported as chronic calculus cholecystitis in 39 (87%), chronic acalculous cholecystitis in 3 (6.6%) and acute cholecystitis in 3 (6.6%) of 45 patients undergoing first surgery. Histopathology of the ampullary region obtained in all cases of stenosis and stricture suggested chronic non-specific inflammation.

Overall postoperative morbidity was 13% (seven patients). Wound infection was the commonest complication (11%) followed by chest infection (9%). Two (3.7%) patients developed transient duodenal leak, managed with continued conservative management. There was no hospital death. Follow up was available for a mean period of 7.8 years (range 3.5–11 years). Results were rated as ‘good’ in 48 (88.9%), ‘fair’ in 4 (7.4%) and ‘poor’ in 2 (3.7%) patients. Patients with ‘fair results’ complained of occasional episodes of mild to moderate postprandial upper abdominal discomfort and flatulent dyspepsia. Symptomatic relief used to obtain by dietary modification, oral antacids or antispasmodic agents and frequency or severity of symptoms never warranted an emergency admission or necessitated any active surgical intervention. Apart from regular blood and imaging investigations at follow-up visits, these patients declined any further interventional diagnostic or management intervention. Two patients with ‘poor’ results experienced recurrent moderate to severe upper abdominal pain (sometimes colicky in nature), flatulent dyspepsia, nausea and malaise, sometimes associated with fever (up to 32.2°C) without rigors or jaundice. Occasionally these episodes warranted emergency admissions (1–3 times a year), were always of short duration (never exceeding 5 days), accompanied with leucocytosis and moderate alterations in liver enzymes (alkaline phosphatase never more than 480 U/L). Symptoms were always controlled by oral antibiotic therapy of short duration (4–5 days). Both these patients showed no pathology necessitating re-exploration; even with extensive investigations, including contrast studies, ERCP and HIDA scan. The symptoms of recurrent upper abdominal pain persisted even after endoscopic sphincterotomy carried out after a mean period of 3.4 years of CDD. These patients remain dissatisfied with the

results although the operation had apparently been a technical success.

DISCUSSION

Indications of open CDD have become limited in the modern era of laparoscopic surgery and interventional endoscopy. Endoscopic treatment is effective, but the procedure has an overall morbidity of 10% and mortality of 2.3%.^{5–7} Concerns have also been expressed for the long-term results of endoscopic sphincterotomy. Late complications have been reported in 5.8–24% patients.⁸ These include stone recurrence or papillary stenosis reported mostly within 10 years of endoscopic treatment. The failure or inability to carry out the treatment has been reported in another 5–10% of cases.^{9,10} Laparoscopic exploration of the CBD or a combined laparoendoscopic approach is becoming more popular, but is associated with substantial variation in results signifying that different patient groups have been studied. The procedure has been recommended to replace the endoscopic sphincterotomy for young and fit patients.^{11,12}

Although CDD is infrequently carried out these days, the procedure may still be indicated in selected or difficult cases where the expertise of advanced laparoscopic biliary surgery is not available, especially in the high-risk and elderly patients. The female preponderance in this study (2.6:1) is similar to other reports.^{13–15} The mean age of 49.7 years correlates well to 44–62 years reported in earlier studies.^{13–15} Almost half the patients (48%) were above 50 years of age. This is similar to other reports and justifies a drainage procedure in the elderly population to avoid recurrent disease.^{15–18} Obstructive jaundice was observed in 55% and pancreatitis in 11% cases in this study. Kaminski *et al.* in their study of 25 patients reported obstructive jaundice in 82% and pancreatitis in 17% cases.¹⁹ Cholangitis was the presenting feature in 42.6% patients in this study. This figure is higher than 4.7–25% reported in earlier studies and may show late presentation in our patient group.^{14,15,20} Common duct stones (91%) (multiple, impacted or with associated ampullary stenosis) constituted the commonest indication for CDD and correlates well to the works of other authors.^{13–18,20} Patients with ampullary stenosis were 13% of the study patients. Various authors have quoted 9–55% figures of ampullary stenosis as indication for the procedure.^{14,16,21} The overall postoperative morbidity in the present study is 13%. Various studies have quoted the morbidity figures ranging from 5 to 36.8%.^{13,14,19,22–24} No patient developed postoperative pancreatitis after common duct exploration in this study. Postoperative pancreatitis does occur after supraduodenal exploration of the CBD (5.7%) and endoscopic sphincterotomy (2.9%).^{25,26} Duodenal leak is another feared complication of the procedure. In the present study there were 2 (4.2%) transient duodenal leaks, both closing spontaneously with conservative management. This figure is well within 2–7% duodenal leaks reported by other authors.^{13,20,22} Duodenal leak is usually a minor problem and almost all authors report a successful conservative management. In the long-term complications, recurrent cholangitis and ‘sump syndrome’ are the two most notable objections to side-to-side CDD.^{27,28} Although duodenal contents do reflux into the biliary tree following CDD and bacteribilia is common, it is well accepted that cholangitis results from stasis are because of anastomotic narrowing and are not due to reflux.^{28,29} Despite endoscopic and barium meal showing a reflux, there is no evidence that adequately carried out CDD predisposes to a higher incidence of postoperative cholangitis.^{13,21,28,29}

Madden, in a review of 1255 patients of CDD, reported only a 0.4% incidence of cholangitis.³⁰ Others have found less than 3% incidence of recurrent cholangitis over a long-term follow up of 5–20 years.^{14,31,32} No patient in this study developed early or late cholangitis. Cholangitis may be regarded as a consequence of anastomotic narrowing and subsequent biliary stasis rather than reflux.^{13,21,28} Rutledge emphasizes that the prime consideration to avoid such a complication should be a larger anastomosis that is at least 2.5 cm in diameter.³³ Excision of an ellipse of duodenal mucosa is recommended to prevent future anastomotic stenosis.^{14,33} The other concern about CDD is the ‘sump syndrome’ due to retained food debris, bacteria or calculi in the blind end of the duct.³⁴ Incidence of sump syndrome has been variedly reported in the published work. Smith reoperated 25 patients, preserving CDD and adding sphincteroplasty to clean out and drain the distal blind end.³¹ Baker *et al.* treated six of their eight patients by endoscopic sphincterotomy and remaining two by revision CDD.²⁰ Madden *et al.*¹³ in their study of 100 patients and Vogt and Hermann in a series of 88 patients did not observe any patient of sump syndrome.²¹ Two patients (4.2%) in this study with poor results may be regarded as example of sump syndrome, but have neither been documented by any investigation nor responded to endoscopic sphincterotomy. To avoid recurrent cholangitis and ‘sump’ syndrome, various authorities have emphasized that the procedure must be carried out only on a dilated common duct, stoma of CDD should measure no less than 2.5 cm in diameter and should be located at the lowest possible site of the common duct. This prevents strictures of the anastomosis and long blind pouches between papilla of Vater and CDD.^{10,14,17,21,33}

The prevalence of missed and residual and recurrent stones (14.8%) is similar to the 16–25% reported in earlier studies.^{19,20} This emphasizes the decision to add a definitive biliary drainage procedure in patients with dilated common duct, especially in the elderly, to avoid the recurrent disease, as cholestasis is considered an important contributory factor in such patients. Conventional choledochotomy and T-tube drainage, despite the use of intraoperative cholangiography or choledochoscopy, cannot completely eliminate the risk of residual or recurrent stones, in this group of patients.^{19,24,28} Lygidakis reported a 20.9% recurrence and reoperations rate after choledochotomy and T-tube drainage in striking contrast to CDD where no recurrence and reoperations were required.²⁴ Roux-en-Y hepaticojejunostomy or choledochojejunostomy is considered another alternative to CDD in benign obstructive biliary pathologies.²¹ Associated advantages of this operation include avoiding reflux of duodenal and pancreatic contents and cholangitis and prevention of ‘sump’ syndrome.²¹ The procedure, however, is technically more difficult and complicated, is time-consuming, is less physiological and has additional disadvantages of adding two anastomoses and sometime complete transection of the CBD.^{18,21} This operation, therefore, is not routinely recommended for high-risk elderly population with dilated common duct due to benign biliary pathologies.^{14,18,21,24} One disadvantage of CDD is that it is considered a blind procedure and pathology in the ampullary area may be overlooked. Palpation of the ampullary area through duodenotomy before anastomosis is recommended to deal with this potential disadvantage.^{14,22,33} CDD has been described to carry an overall mortality rate ranging from 0 to 11%.^{14,16,20,21,23,33} Various studies have identified old age, low albumen, high bilirubin, associated illness (renal impairment, diabetes and so on), and presence of sepsis as significant contributory factors affecting mortality after CDD.^{13,14,16,20,21,23,35} Despite 42%

patients presenting with jaundice in this study, no hospital death was observed. This may partly be explained by a relative younger mean age of the patients (49.7 years), strict adherence to the operative principles, appropriate selection of the patients and a better perioperative care. With the better understanding of pathophysiological basis of the disease and improvement in the perioperative care, including effective preoperative preparation, treatment of infection, minimal manipulation within the CBD, the incidence of procedure-related morbidity and mortality can be reduced. Table 3 compares the morbidity and mortality of present study with earlier studies.

As regarding the outcome of the procedure in terms of symptomatic relief and absence of recurrent disease, follow up was available for a mean period of 7.8 years. Results were regarded as ‘good’ in 88.9%, ‘fair’ in 7.4% and ‘poor’ in 3.7% patients. These findings correlate well to the experience of other authors (Table 4).^{13,14,16,17,20–22,24,28,31,33,36,37} No patient developed recurrent stones, ampullary stenosis or malignancy during the follow-up period, although four patients have died of various non-biliary causes. Recent studies have reported a 0–2.4% rate for recurrent choledocholithiasis following CDD after long-term follow up.^{38,39} These results are much better than stone recurrence rate of 5.8% and papillary stenosis of 24% described mostly within 10 years of endoscopic sphincterotomy.⁸

Table 3. Comparison of hospital morbidity and mortality

Author/s (reference)	Total no. patients	Overall morbidity (%)	Mortality (%)
Madden <i>et al.</i> ¹³	100	20	3.0
Thomas <i>et al.</i> ²²	57	36.8	3.5
Degenshein ¹⁴	175	5.1	3.2
Kaminski <i>et al.</i> ¹⁹	25	28	4.0
Lygidakis ²³	342	6.1	0
Baker <i>et al.</i> ²⁰	190	11.6	5.3
Escudero-Fabre <i>et al.</i> ²⁸	71	31	11.3
Sgroi <i>et al.</i> ³⁶	36	15.8	0
Ravindra <i>et al.</i> ³⁵	50	24	2.0
Present study	54	13.0	0

Table 4. Comparison of long-term outcome after choledochoduodenostomy

Author/s (reference)	Total patients†	Good/fair (%)	Poor (%)
Madden <i>et al.</i> ¹³	73	100	0
Thomas <i>et al.</i> ²²	55	94.5	5.5
Stuart and Hoerr ³¹	41	80.5	19.5
Degenshein ¹⁴	148	98.6	1.4
Rutledge ³³	11	91.0	9.0
Engelberg <i>et al.</i> ¹⁶	52	94.2	5.8
Vogt and Hermann ²¹	50	96.0	4.0
Lygidakis ²⁴	40	97.7	2.3
Baker <i>et al.</i> ²⁰	115	92.4	7.6
Berlatzky and Freund ¹⁷	41	100	0
Escudero-Fabre <i>et al.</i> ²⁸	71	95.8	4.2
Sgroi <i>et al.</i> ³⁶	36	69.4	16.6
de Almeida <i>et al.</i> ³⁷	123	97.5	2.5
Present study	54	96.3	3.7

†Number of patients followed up after discharge (does not represent total patients in the study).

Some serious concerns have been expressed regarding the late development of bile duct cancer after surgical biliary drainage in some reports with long follow up.⁴⁰⁻⁴² Tocchi *et al.* in a study of 1003 patients with a mean follow up of 129.6 months reported late development of bile duct cancer 11–19 years following biliary–enteric drainage for benign diseases. The incidence of cholangiocarcinoma was reported to be 5.8% after transduodenal sphincteroplasty, 7.6% after CDD and 1.9% after hepaticojejunostomy. The authors concluded that chronic inflammatory changes consequent to biliary–enteric drainage should be closely monitored for the late development of biliary tract malignancies and further emphasized the potential advantage of hepaticojejunostomy in avoiding this complication.⁴¹ These patients usually present with jaundice and cholangitis. Recurrent cholangitis has been observed to be most significant factor associated with development of late cholangiocarcinoma.^{41,42} A close monitoring and follow up is advised for this group of patient who are generally categorized under ‘poor’ results. Follow up in the present study (mean 7.8 years) may not be considered long enough to confirm or negate this aspect of biliary drainage and continued follow up for longer periods is needed to substantiate this observation. However, two patients with ‘poor’ results in this study are being closely followed up with liver function tests and ultrasonography every 6 months and endoscopy and HIDA scan and abdominal CT scan at yearly intervals.

CONCLUSION

Side-to-side CDD remains a simple and effective biliary drainage procedure requiring less manipulation of the pancreas and bile ducts. The procedure is technically easy and faster and is especially suitable for the obese, elderly or poor-risk patients. It more adequately drains a hugely dilated and thick-walled bile duct and may be used for unusually long strictures of the distal bile duct. CDD should be considered a fundamental part of the knowledge and training of a general surgeon even in the present endoscopic and laparoscopic era.

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