Introduction

Choledochoduodenostomy (CDD) is an excellent technique for internal drainage of an obstructed and dilated common bile duct (CBD) [1-3]. However, with the advent of endoscopic retrograde cholangiopancreatography (ERCP) and the expansion of laparoscopic common bile duct exploration (LCBDE), indications for choledochoduodenostomy have been drastically reduced [4-8].

Although laparoscopic choledochoduodenostomy (LCDD) seems to be an attractive alternative in selected cases, technical difficulty in intracorporeal suture associated with laparoscopic biliary-enteric anastomosis, explains this technique has not widely adopted [9,10].

In fact, and although LCDD was firstly performed by Franklin et al. [11] in 1991 for benign recurrent bile duct obstruction, very little has been published in the literature except a few cases series with limited number of patients [12-16].

The purpose of the article is to review the current status of laparoscopic choledochoduodenostomy for the management of obstructive biliary tract in the ERCP era.

Patients and Methods

A review of the literature limited to studies published from 1989 to 2013, reported in English language and performed on humans was conducted on PubMed using the following key words: "laparoscopic choledochoduodenostomy". Articles retrieved by the PubMed search were reviewed. Case reports, series related to laparoscopic hepaticojejunostomies (LHJ), bypass combined with...
excision of choledochal cyst, and LCDD combined with LCBDE or LH/Laparoscopic cholecystojejunostomy (LCCJ) were excluded. Figure 1 shows a graphic with the number of abstracts and full publications reached with our search. Operative details, perioperative outcomes, and follow-up data were examined.

**Results**

A total of 5 studies cumulative reporting the outcomes of 90 patients undergoing LCDD were identified utilizing the above search criteria. The majority of the procedures were performed for benign disease (84 cases=93.3%). The mean age of patients was 60.34 years (range, 19-89 years). There were 69 female and 21 male patients (Table 1). ERCP was preoperative performed in attempt of CBD clearance in 32 patients of 59 possible because there were not dates available in two series (54.23%).

Mean operative time was 180.16 minutes and conversion to open surgery was necessary in 5 cases (7.7%) (Table 2). Average hospital stay was 6 days (range, 2-32 days). The overall success rate in achieving a CBD clearance was 100%, with a morbidity rate of 11% and a mortality rate of 3.3% (3 patients).

However, there was no operative mortality or procedure related complications: One patient died after a reoperation on the sixth day, through a laparotomy, for mesenteric ischemia. The second patient with known severe coronary artery disease, hypertension and hiperlipidemia did well in the early postoperative period but died as an outpatient on the 28th day due to acute myocardial infarction. The last death, in an 86 years old patient, was due to unrelated causes (atrial fibrillation, aortic insufficiency, acute renal failure, and myocardial infarction).

Among the postoperative complications, three of the patients developed a biliary leak (3.3%) but were resolved with a conservative management.

After a mid-term follow-up, recurrence of symptoms, cholangitis or any evidence of sump syndrome was reported in only one patient (1%). This patient was found to have recurrent jaundice and fever, but responded to antibiotics (Table 3).

**Discussion**

Historically, choledochoduodenostomy has been an excellent technique for internal drainage of an obstructed and dilated CBD [1-3]. However, nowadays, with the advent of ERCP and the expansion of LCBD, indications for choledochoduodenostomy have been drastically reduced [4-8].

Although ERCP is the first line of treatment in patients with choledocholithiasis, it is not without risk of morbidity and even mortality. The reported incidence of post-ERCP complications varies widely from study to study and ranges for pancreatitis (1-5%), hemorrhage (1-4%), perforation (1-2%) and cholangitis (1-5%) [17-22].

Moreover, reported rates of failure to clear the CBD by ERCP ranged from 4.4% to 10% [23]. Additionally, recurrent bile duct stone formation is not uncommon following endoscopic sphinterotomy, with a variable incidence ranging from 4-24% [17].

On the other hand, LCDD is an attractive alternative in cases of multiple CBD stones with a dilated biliary duct, benign distal strictures, recurrent CBD after failed ERCP, cholangitis and even for treatment of unresectable pancreatic neoplasm [24-28]. Proponents of LCDD argue that this laparoscopic approach avoids the morbidity of open surgery and provides definitive relief of jaundice while avoiding the risks of ERCP.

Although there have been some concerns about the bile reflux, cholangitis and sump syndrome after LCDD [27], the worry is not substantiated by well-designed comparative studies and large scale cohort studies [29,30]. The rate of recurrent cholangitis after CDD range from 0% to 6% of patients, but this problem is more frequent related to anastomosis stricture rather than an ascending cause [31].

In fact, and although the first LCDD was reported in 1991 by Franklin et al. [11], very little has been published in the literature except a few cases series with limited number of patients [9,10,12-16]. Technical difficulty in intracorporeal suture associated with laparoscopic biliary-enteric anastomosis, explains this technique has not widely adopted.

However, there are some technical aspects that remain controversial. The choledochoduodenal anastomosis can either

**Table 1**: Patient demographics.

<table>
<thead>
<tr>
<th>Series</th>
<th>N° Patients</th>
<th>Mean age (range)</th>
<th>Sex</th>
<th>Indications for surgery</th>
<th>Previous ERCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chander et al.</td>
<td>27</td>
<td>45.7 years (19-70 years)</td>
<td>21 female (77.78%) 6 male (22.22%)</td>
<td>CBD stones: 27 cases</td>
<td>5 patients (18.5%)</td>
</tr>
<tr>
<td>Khajanchee et al.</td>
<td>20</td>
<td>61 years (33-89 years)</td>
<td>17 female (85%) 3 male (15%)</td>
<td>Choledocholithiasis: 15 cases</td>
<td>15 patients (75%)</td>
</tr>
<tr>
<td>Tinoco et al.</td>
<td>25</td>
<td>68.7 years (40-62 years)</td>
<td>19 female (76%) 6 male (24%)</td>
<td>Chronic pancreatitis: 3 cases</td>
<td>NA</td>
</tr>
<tr>
<td>Tang et al.</td>
<td>12</td>
<td>62 years (40-77 years)</td>
<td>9 female (75%) 3 male (25%)</td>
<td>Distal CBD stricture: 2 cases</td>
<td>12 patients (100%)</td>
</tr>
<tr>
<td>Jeyapalan et al.</td>
<td>6</td>
<td>64.3 years (41-86 years)</td>
<td>3 female (50%) 3 male (50%)</td>
<td>Cholangitis: 6 cases</td>
<td>NA</td>
</tr>
</tbody>
</table>

NA: Not available.
be side-to-side, end-to-end, diamond-shaped or even Roux-en Y hepaticojejunostomy (LHJ). There has been controversy over the years as to which of these procedures is best. Cuschieri and Adamson [23]. To our knowledge, this is the largest review of the literature of LCDD appears to be safe, because although 3 deaths (3.3%) were described in the review, authors did not consider them such as operative mortality or procedure related complications. Furthermore, the morbidity rate was only 11%, being the rate of biliary leak 3.3%. These results are excellent if we compared to outcomes reported in large open series [1,2,6-8], where the morbidity and mortality rates after open CDD range from 9.8% to 22% and 0-11.2% respectively. Moreover, LCDD offers the advantages of a minimally invasive technique: less postoperative pain, less demand for analgesics, reduced hospital stay, faster return to normal life and better cosmetic results.

Finally, the overall success rate in achieving a CBD clearance was 100% in the reviewed studies and after a mid-term follow-up, recurrence of symptoms, cholangitis or any evidence of sump syndrome was reported in only one patient (1%). These results improve those obtained if we compare with the reported rates of failure to clear the CBD by ERCP that ranges between 4.4% and 10% [23].

**Conclusion**

To our knowledge, this is the largest review of the literature of laparoscopic choledochoduodenostomy for the management of obstructive biliary tract, and especially for the treatment of biliary stone diseases. This review shows LCDD is a safe, single-stage and feasible surgical procedure in cases of CBD disease with a low mortality rate.

Having mentioned the technical advantages of LCDD, the type of suture is different between all the series studied [9,10,12-14] (running or interrupted sutures), but in all the cases, the material preferred to perform the anastomosis was absorbable (Vicryl or Monocryl).

<table>
<thead>
<tr>
<th>Table 2: Operative details.</th>
<th>Diameter of CBD</th>
<th>Technique anastomosis</th>
<th>Suture anastomosis</th>
<th>Operative time</th>
<th>Conversion to open rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chander et al. [9]</td>
<td>19.6 mm (range, 15-32 mm)</td>
<td>Diamond-shaped</td>
<td>Vicryl 3/0 Interrupted suture</td>
<td>156.3 min (range, 90-190 min)</td>
<td>0%</td>
</tr>
<tr>
<td>Khajanchee et al. [10]</td>
<td>15-20 mm</td>
<td>Side-to-side</td>
<td>Absorbable (interrupted or running suture)</td>
<td>270 min</td>
<td>5 patients (25%)</td>
</tr>
<tr>
<td>Tinoco et al. [12]</td>
<td>20 mm</td>
<td>Side-to-side</td>
<td>Polyglycolic 3/0 Running suture</td>
<td>115 min (range, 45-180 min)</td>
<td>NA</td>
</tr>
<tr>
<td>Tang et al. [13]</td>
<td>20 mm (range, 15-33 mm)</td>
<td>Diamond-shaped</td>
<td>Monocryl 2-0 (interrupted posterior wall and continuous anterior wall)</td>
<td>137.5 min (range, 90-270 min)</td>
<td>0%</td>
</tr>
<tr>
<td>Jeyapalan et al. [14]</td>
<td>NA</td>
<td>Diamond-shaped</td>
<td>Seromuscular: interrupted suture with silk 3-0. Mucosa: Vicryl, Monocryl, Polytabsorb 3-0</td>
<td>222 min (range, 129-277 min)</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3: Postoperative and follow-up outcomes.</th>
<th>Postoperative stay</th>
<th>Complications</th>
<th>Mortality</th>
<th>Follow-up</th>
<th>Recurrence of symptoms or cholangitis (sump syndrome)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chander et al. [9]</td>
<td>6.4 days (range, 4-21 days)</td>
<td>1 patient (3.7%): Leak</td>
<td>0%</td>
<td>2 months to 9 years</td>
<td>0%</td>
</tr>
<tr>
<td>Khajanchee et al. [10]</td>
<td>6 days (range, 2-32)</td>
<td>6 patients (30%): -Readjuditation of COPD -PVT-PD -Mesh infection -Leak -Wound dehisence -Anemia</td>
<td>1 patient (5%)</td>
<td>21 months</td>
<td>1 patient (5%)</td>
</tr>
<tr>
<td>Tinoco et al. [12]</td>
<td>4.2 days (range, 3-8 days)</td>
<td>1 patient (4%): Mesenteric ischemia</td>
<td>1 patient (4%)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Tang et al. [13]</td>
<td>7.5 days (range, 5-20 days)</td>
<td>1 patient (8.3%): Leak</td>
<td>0%</td>
<td>37.6 months (range, 6-91 months)</td>
<td>0%</td>
</tr>
<tr>
<td>Jeyapalan et al. [14]</td>
<td>6 days (range, 5-8 days)</td>
<td>1 patient (16.67%): -Atrial fibrillation, aortic insufficiency, acute renal failure and myocardial infarction.</td>
<td>1 patient (16.67%):</td>
<td>NA</td>
<td>0%</td>
</tr>
</tbody>
</table>
morbidity and mortality rates, and that offers a definitive solution of CBD stones and jaundice. However, the number of cases of LCDD in our review is small and more long-terms and randomized studies in compare with ERCP and open surgery should be done to validate the results. Due to the limited keyword used in this search, it is possible that there were further reports that may not be detected by the searchers carried out by this study.

References