J Hepatobiliary Pancreat Surg (2009) 16:458–462
DOI 10.1007/s00534-009-0071-0

ORIGINAL ARTICLE

Prevention of iatrogenic bile duct injuries in difficult laparoscopic cholecystectomies: is the naso-biliary drain the answer?

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Received: 20 June 2008 / Accepted: 1 August 2008 / Published online: 17 March 2009

Abstract
Background Prevention of iatrogenic injuries is of paramount importance in difficult laparoscopic cholecystectomies (LC). The objective of this study was to analyze the effectiveness of cholangiography using a pre-inserted endoscopic naso-biliary drain (ENBD) for navigation during difficult cholecystectomies.
Methods The study design was a retrospective case analysis. In 508 patients who underwent LC in a tertiary referral university hospital from 1996 through 2007, difficult cholecystectomy was anticipated in 26 patients due to possibly aberrant biliary anatomy (four patients), unclear cystic duct anatomy during magnetic resonance cholangiopancreatography (MRCP) and/or endoscopic retrograde cholangiopancreatography (ERCP) (three patients), and acute cholecystitis (19 patients). An ENBD was inserted during ERCP prior to LC for cholangiography (ENBDC) to facilitate safe dissection during LC. Prevalence of biliary complications was assessed as the main outcome measurement.
Results The majority (68%) of the patients who underwent ENBDC had complicated cholecystitis. Advanced technical expertise was not required for insertion of an ENBD. In retrospect, ENBDC was useful in prevention of a possible catastrophe in 69% of cases. Open conversion was necessary in five patients and biliary complications occurred in five patients only in the non-ENBD group. There were no procedure-related complications. One limitation of the study was that it was not randomized and there was no comparison with patients without ENBDC.
Conclusions ENBDC is a useful and safe tool in the prevention of iatrogenic bile duct injuries in LC.

Keywords Endoscopic naso-biliary drainage · Iatrogenic injury · Endoscopic retrograde cholangiopancreatography · Bile duct injury · Laparoscopic cholecystectomy

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Introduction

Laparoscopic cholecystectomy (LC) has emerged as a gold standard of cholecystectomy worldwide [1]. It is undoubtedly the commonest laparoscopic surgical procedure currently undertaken by surgeons [2]. As surgical skills have developed, ever more difficult gallbladders are attempted laparoscopically. Acute cholecystitis is no longer a contraindication, and neither are many other clinical conditions that used to be taboo in LC in yester years [3]. However, difficult LCs are always associated with an element of danger. Damage to structures around the Calot's triangle is a common misadventure in LCs with unclear anatomy [3]. We note a lot of clinical research and published articles on the management of complications of LC including iatrogenic bile duct injury [4]. Nevertheless, studies emphasizing measures to prevent bile duct injury in LC are sparse. We believe that prevention of iatrogenic injury is important as it will decrease morbidity and mortality, while at the same time reaffirming that the laparoscopic approach reduces the morbidity associated with surgery for this is the very reason why laparoscopic surgery evolved [5]. In this context, we investigated the use of an endoscopic nasobiliary drain (ENBD) as a guiding

tool during difficult cholecystectomies. This article is an attempt to analyze our results of placement of an ENBD in LC patients.

Methods

We undertook almost all cholecystectomies laparoscopically. In patients with anticipated hazardous anatomy, an ENBD was inserted prior to surgery. Male gender, old age, ASA (American Society of Anaesthesia) score of 2 or 3, high BMI and acute cholecystitis proved to be independent predictors of possible pre- or post-operative complications associated with LC [6, 7]. In our unit the decision to insert an ENBD was based on anticipated difficult dissection when the anatomy of the Calot's triangle could not be demonstrated during magnetic resonance cholangiopancreatography MRCP) or endoscopic retrograde cholangiopancreatography (ERCP) (Fig. 1a), and when there was a suspicion of aberrant biliary anatomy. Patients with acute cholecystitis requiring early surgery were also offered an ENBD.

Cholecystectomy was performed in 576 patients during the 12-year study period from 1996 through 2007, including 37 who received an ENBD. Of these, 19 patients with open cholecystectomy and 49 with open or laparoscopic common bile duct exploration were excluded, leaving 508 patients with gallstones (392 patients), gallstones and common bile duct stones (55 patients), and polyps, adenomyomatosis, or early cancer in the gallbladder (61 patients). These patients were analyzed retrospectively. Details of patient demography, the reason for the ENBD, duration of surgery, comorbidity, a detailed description of the operation notes, complications of ENBD and the surgery, and whether the surgeon found the ENBD useful, were collected. All the authors are surgeons performing laparoscopic and open biliary surgery, ERCP, sphincterotomy, and ENBD. Thus, data on usefulness were easily obtained from their records of endoscopy and surgery.

The use of the ENBD tube came to light during LC. If the anatomy was obscure when the surgeon started to dissect the Calot's triangle, the ENBD could be used to navigate the anatomy by ENBD cholangiography (ENBDC). This technique reduced the additional burden on the surgeon when struggling at the difficult Calot's triangle as laparoscopic catheterization for intraoperative cholangiography can be a challenge on its own. The proposed location of transection of the cystic duct was usually marked using a temporary clip, and the position confirmed by ENBDC (Fig. 1b). Radio-opaque threads could also be used to sling the vital structures for identification. If the structure turned out not to be the cystic duct, disaster could be prevented by removing the temporary marker and looking for the "real" cystic duct. Having accomplished its purpose, the ENBD could be removed readily by simply pulling out the tube.

The ENBD was inserted without sphincterotomy 1–2 days prior to the proposed cholecystectomy, using a 5 French pig-tailed ENBD tube (Olympus MS, Tokyo, Japan) after ERCP. Informed written consent was obtained after careful explanation of the reason why this additional step was undertaken for the patient's own safety.

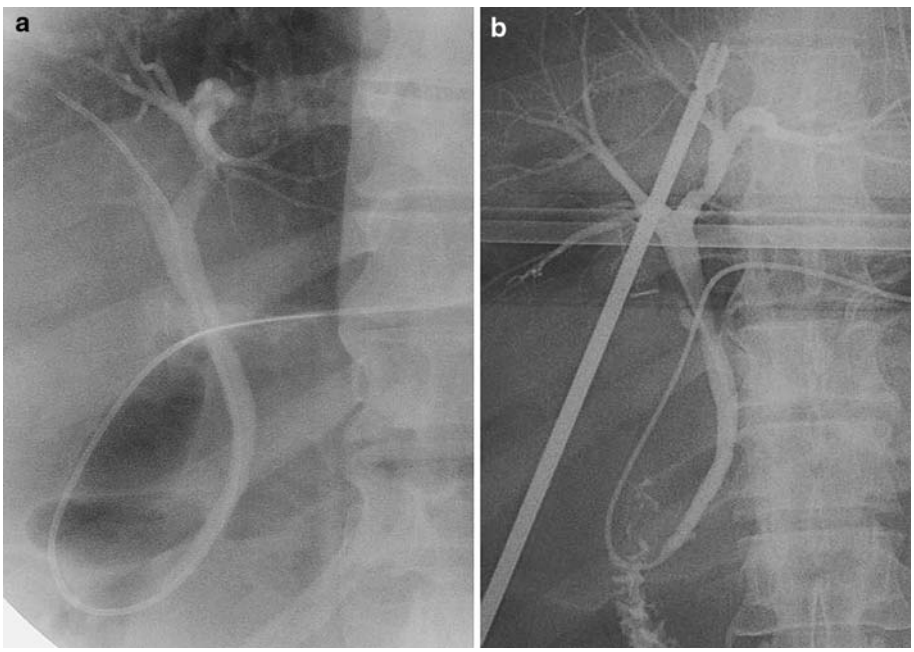

Fig. 1 **a** Endoscopic nasobiliary drain (ENBD) cholangiogram showing no visualization of the cystic duct. **b** ENBD cholangiogram after placing a clip on a structure around the Calot's triangle during laparoscopic cholecystectomy

Table 1 Reasons for endoscopic nasobiliary drain (ENBD) prior to surgery

Reason	Number	Percentage (%)
Acute cholecystitis	18	69
Double gall bladder	1	4
Variation in the anatomy	3	12
Cystic duct (and gallbladder) not visualized	2	8
Mirizzi's syndrome	1	4
History of repeated laparotomy	1	4

Results

Laparoscopic cholecystectomy was accomplished in 499 of 508 patients but converted to open in the other nine. Biliary complications occurred in 7 of the 508 patients (bile duct stricture 1, bile leak 4, bile duct injury 2) and non-biliary complications in four (wound infection 2, bleeding 1, abscess 1).

A total of 26 patients (male:female 14:12, age range 23–83 years, median 59.9) underwent ENBD for three reasons as follows (Table 1). Aberrant biliary anatomy was observed in four patients (double gallbladder 1, cystic duct originating from the right segmental duct 2 (Fig. 2), accessory right hepatic duct 1). The cystic duct (and gallbladder) was not visualized well by MRCP or ERCP in three patients, leading to ENBD. One of them had the Mirizzi's syndrome. ENBD was useful in accomplishing cholecystectomy successfully. None of the patients suffered from open conversion or biliary complications.

The majority of the patients underwent ENBD following attacks of acute cholecystitis. Acute cholecystitis, defined as fever, pain and inflammatory laboratory findings requiring admission and fluid replacement, occurred in 85 patients. Eleven of them underwent open cholecystectomy because they had a previous history of upper abdominal surgery. The remaining 74 patients with current or recent acute cholecystitis underwent LC with (19 patients) or without (55 patients) ENBD. Out of the 19 patients with ENBD, four had repeated attacks of cholecystitis. Open conversion was necessary in five patients only in the non-ENBD group. Moreover, biliary complications occurred in five patients (bile duct stricture 1, bile leak 2, bile duct injury 2) only in the non-ENBD group. There was no single case of open conversion or biliary complication in the ENBD group. The prevalence of open conversion and biliary complication tended to be lower in the ENBD group, although the difference was not statistically significant ($P = 0.08$). Bleeding occurred in one patient in the ENBD group, and wound infection in one patient in the non-ENBD group as non-biliary complications. In a patient

Fig. 2 ENBD cholangiogram demonstrating the cystic duct arising from the right posterior segmental bile duct

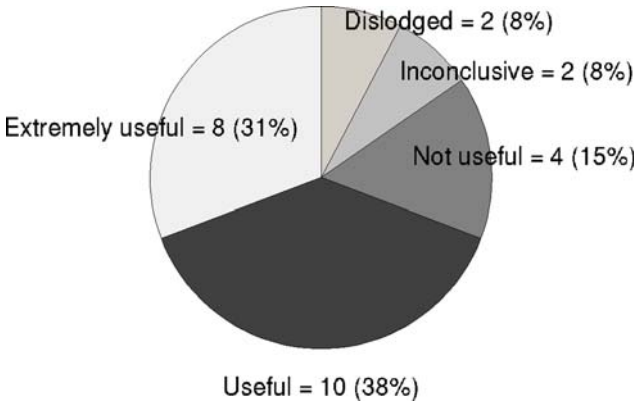

Fig. 3 Surgeons' perception on usefulness of ENBD during surgery

with the Mirizzi syndrome, we could feel the inserted ENBD in the common hepatic duct by touching with a clamp in addition to using it for cholangiography to facilitate identification of the cystic duct during surgery.

Next, the usefulness of the ENBD as evaluated by 26 surgeons during the operative procedure was analyzed (Fig. 3). According to first hand information from the surgeons, in 69% of the surgeries ENBDC was a useful adjunct, while in 31% it was an extremely useful technique. As the tube was already inserted, no additional time had to be spent on catheterization of the cystic duct. In 15% it was not useful in laparoscopic dissection. Two of the tubes were found to be dislodged at the time of surgery due to poor patient compliance. It is interesting to note that the

operating surgeon claimed that visualization of the common bile duct was impossible during the operation in seven patients (27%), in whom the ENBD was extremely valuable. One reason for this was hemorrhage from the gallbladder; in this particular patient ENBD was used for completion cholangiography. There were no ENBD procedure-related complications.

Discussion

ENBD was first reported by Nagai et al. [8] more than 30 years ago. Despite the many effective interventions that can be undertaken by ENBD it is generally underused. It is interesting to note that many laparoscopists and endoscopists use the ENBD tube in the management of bile duct injury and in drainage of the obstructed and infected biliary tract [9–11]. However, we have found it to be a useful tool in the prevention of iatrogenic injury during LC, especially when the anatomy is obscure.

Recently, more and more surgeons agree that it is wise to utilize safer techniques in LC, while not ignoring the significant increase in the cost and the time spent on the procedures. From this viewpoint it is important to make the decision to use the ENBD properly. Since it is an invasive procedure, many surgeons may be reluctant to use it and opt for an on-table cholangiography during surgery. Unless it is a part of a protocol, its use will be based on the decision of individual surgeons. If ERCP is performed in a patient undergoing cholecystectomy, insertion of an ENBD tube is not a great hazard. It does not require additional expensive equipment or expertise except for a safe endoscopist with experience on ERCP and an ENBD tube. To perform ENBDC is much more convenient and faster than on-table cholangiography by cystic duct catheterization. Furthermore, an already placed tube when you need it for guidance is an absolute blessing.

In this analysis of our experience with ENBD, we found that many surgeons used it to great advantage, and a significant number of them found it extremely useful. ENBD helped identify a cystic duct arising from the right hepatic duct and safely clamp the cystic duct while avoiding a catastrophe in two of the 26 patients analyzed. Two double gallbladder cholecystectomies were also successfully navigated using ENBD.

Patients with acute cholecystitis undergoing LC benefit greatly from intraoperative cholangiography [12, 13]. In acute cholecystitis we recommend that the ENBD tube be inserted into the gallbladder whenever possible, as it will also help in drainage during the acute setting. However, although this step is useful, it is not essential as a tube in the bile duct or hepatic duct facilitates good intraoperative cholangiography. In various stages of the operation cholangiography can be done without difficulty using this tube. During identification of the cystic duct, we usually mark it using a clip placed temporarily on adjacent tissue of the suspected structure. If it is confirmed, a radio-opaque thread is used to properly secure the cystic duct and repeat cholangiography will be done to reconfirm. Up to this step all the events are reversible. Thus, it is clearly safe when we finally have to divide the duct.

In this study 4/26 (15%) surgeons found that ENBD was not effective, because they could manage LC without the use of ENBD. Further analysis of these cases showed that their main indication for LC was cholecystitis. However, these surgeons used ENBD even in these cases for double checking. In this series there were no reported events of post procedural complications related to ENBD cholangiography. One patient had an open exploration due to bleeding from the gall bladder and none had to be opened up for difficulty in delineating anatomy. There were also no complaints from the patients about the procedure.

Conclusions

In retrospect, we feel that ENBD-guided cholangiography is a very useful technique, which is underused at the moment. It is mandatory that proper patient selection is done for this technique. From our experience we can suggest that ENBD will facilitate the surgery in complicated acute cholecystitis, abnormal anatomy of the biliary tract, past abdominal or biliary tract surgery, and repeated attacks of cholecystitis. We conclude that ENBD is a safe and effective technique and should be done without hesitation, especially if the patient is to undergo ERCP.

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