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ORIGINAL ARTICLE

INTRAOPERATIVE ASSESSMENT OF BILIARY ANATOMY FOR PREVENTION OF BILE DUCT INJURY DURING LAPAROSCOPIC CHOLECYSTECTOMY

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Abstract

Abstract: Introduction & Aim of work: Bile duct injury (BDI) is a dreaded complication of laparoscopic cholecystectomy, often caused by misinterpretation of biliary anatomy. To prevent BDI, many techniques have been developed for intraoperative assessment of bile duct anatomy. Biliary tree injuries may be decreased by direct coloration of the gall bladder, the cystic duct, and CBD.

Methods: gall bladder fundus was punctured by Veress needle and all the bile was aspirated. The same amount of 50% methylene blue diluted by saline solution was injected into the gall bladder for coloration of biliary tree. The dissection of Calot's triangle was much more safely performed after blue coloration of the gall bladder, cystic duct and CBD.

Results: 48 patients were operated on (39 females and 9 males), methylene blue dye succeeded to paint the biliary tree in 42 patients (87.5 %). In 6 patients (12.5%) there were no free passages of the dye to the CBD because gall bladders were filled with stones, gall bladders were occluded by a large stone at Hartman's pouch, or gall bladder had very thick wall. There were no patients with BDI.

Conclusion: The number of bile duct injuries related to anatomic misidentification can be decreased and even vanished by using intraoperative methylene blue injection technique into the gall bladder fundus intra-operatively.

Keywords: Methylene blue, biliary tree, laparoscopic cholecystectomy.

INTRODUCTION

In the current era, laparoscopic cholecystectomy (LC) is the gold standard treatment for gallstone disease. The rate for conversion because of intraoperative complications has been reported by various authors as ranging from 2% to 6%.[1-3] The incidence of bile duct injury (BDI) in LC is 0.3% to 1.0%[1,3,4] which is higher than the incidence reported for open cholecystectomy (0.1–0.2%).[5]

The burden of BDI on patients is considerable. Reinterventions through surgical, endoscopic, or radiologic procedures in specialist centres are frequently necessary.[6-8] BDI has low but finite short- and long-term mortality rates.[9,10] A recent study reported that BDI had

a significant negative effect on quality of life even 10 years after the event.[11] Consequently, surgeons all over the world are relentlessly trying to find the ways and means to lower this incidence.[12]

During LC the primary cause of BDI is an error of visual perception (in 71–97% of cases), not insufficient technical skill of the surgeon.[13,14] Factors that impede visual assessment and increase the risk of BDI include past or ongoing inflammation, variant ductal anatomy, and limited surgical experience.[15,16]

To prevent BDI, systematic safety interventions have been developed to provide insight into the biliary anatomy during cholecystectomy. For such an intervention to be effective, it first needs to be safe for patients and personnel. Second, it needs to be simple to use and easy to interpret since a wide range of surgeons and residents perform cholecystectomies. Third, considering the large volume of cholecystectomies and the continuous pressure to keep health-care expenditures under control, extra operating time, material expenses, and personnel expenses need to be kept to a minimum.[17]

Here, I tried a relatively new technique, with the hope to reduce bile duct injuries during LC.

MATERIAL AND METHODS

This work was performed in Qena university hospital, Qena Faculty of Medicine during 8 months period (between June 2012 and end of Jan 2013). Forty eight patients suffered from gall stones were included in this study. All patients were investigated using:

- Routine laboratory investigations; as complete blood counts, liver function tests, random blood sugar and serum urea & creatinine.
- Abdominal ultrasound.
- Magnetic Resonance Cholangio-Pancreatography (MRCP) in some cases to exclude CBD stones.

Intra-operative, the classic 4 trocars method were used. The patients were in supine position. After introduction of the umbilical trocar, slight head up with slight left side tilting of the patient were done. The gall bladder fundus was grasped and held tight towards the anterior abdominal wall with the help of two atraumatic graspers introduced via right anterior axillary and subxyphoid trocars. The gall bladder fundus was punctured by a Veress needle (or spinal needle) which was introduced via the abdominal wall in projection to this area. All the bile in the gall bladder was aspirated and 50 % diluted methylene blue equal to the amount of aspirated bile was injected slowly into the gall bladder (Fig. 1). In order to prevent bile leakage, the gall bladder fundus was held tight anteriorly during the withdrawal of the Veress needle and a grasper introduced via the anterior axillary line trocar was applied immediately to the puncture site and was held so throughout the operation. During cholecystectomy, the gall bladder, cystic duct and common bile duct were visible with methylene blue dye and the dissection was performed more safely (Fig. 2). After securing the cystic duct and cystic artery with titanium clips, dissection of the gall bladder from its bed was continued up to the fundus (Fig. 3). Extraction of the gall bladder was done through the subxyphoid trocar after complete aspiration of methylene blue dye to minimize peritoneal soiling by the blue dye.

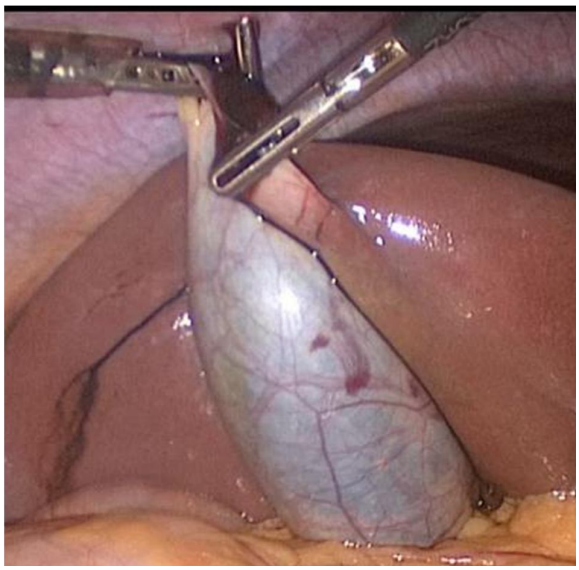

Fig 1. Filling of the Gall Bladder with the methylene blue dye.

Fig 2. Common Hepatic Duct- cystic duct junction is clear.

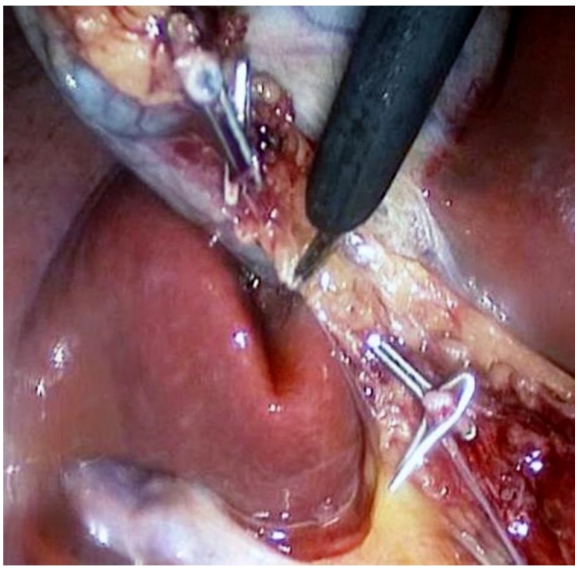

Fig 3. Dissection of the Gall Bladder out of its bed.

RESULTS

Forty eight patients were operated on by this method. They were 39 females and 9 males. Their ages ranged between 21 to 68 years (mean 33± 1.5 years).

In 42 (87.5%) patients there were free passages of the blue dye to the cystic duct with complete visualization of the CBD, and in some cases blue discolouration of the duodenum were evident.

In 6 (12.5%) cases, the cystic duct and CBD were not discoloured. In 3 out of the 6 cases (50%) the gall bladders were nearly filled with stones and very little amount of the blue dye was injected, in 2 cases (33.3%) there were an impacted large stone at the Hartman pouch that prevent the free passage of the due, while in one case (16.7%) the gall bladder had a very thick wall which may impair the dye passage and visualization.

In the 42 patients with free passage of the dye, 38 patients (90.5%) showed classic biliary tree anatomy (i.e. 2 hepatic ducts, junction of cystic and common hepatic duct to form CBD), 2 patients (4.76%) showed insertion of the cystic duct at the right hepatic duct, one patient (2.38%) showed a long cystic duct with low junction with the common hepatic duct, and one patient (2.38%) showed an accessory hepatic duct arising from the liver at the gall bladder bed and inserted directly into the gall bladder.

The time required for aspiration of bile from the gall bladder, injection of Methylene blue dye and re-aspiration of the dye before gall bladder extraction from the epigastric wound ranged between 3-5 minutes.

There was blue soiling of the peritoneal cavity in 5 cases out of the 42 cases (11.9%) due to dye leakage from the bladder either during dissection from its bed or during bladder extraction from the peritoneal cavity.

All patients discharged the day after the operation. None of the patients suffered any major complications as BDI or vascular injury.

Six case (14.29%) suffered superficial surgical site infection of the epigastric wound which respond to repeated dressing and oral Antibiotic.

DISCUSSION

During medical education, in Textbooks of Anatomy, we have seen the arteries nicely colored in red, the veins in blue and the lymphatics in yellow. Later on, facing the truth in cadavers, we were all somewhat disappointed.[18]

The idea of using methylene blue dye intra-operatively to colorize the anatomic details, is in fact based on this simple truth. The basic principle is to minimize the probable injuries by painting the gall bladder, cystic duct and CBD intra-operatively.[18]

As explained in the technique, a few minutes after methylene blue injection into the gall bladder, the gall bladder, cystic duct , CBD and in most of the cases even the duodenum have been painted. So the dissection can easily be performed. Also it is not associated with increased cost. Additionally, the flow of methylene blue from the nasogastric tube (noted by the anesthesiologist) and/or the coloration of the duodenum may lead to indirect conclusion that the bile duct flow is uninterrupted.

This simple method succeeded to delineate the biliary tree in 42/48 patients (87.5%) but not in all patient. Sari et al., in 1995 showed 93.48% success rate (43/46 patients),[18] while Xu et al., in 1994 showed 90% success rate (18/20 patients).[19] In this study, the causes of failure were due to filling of gall bladder with stones, the dye pathway was obstructed by large stone at Hartman's pouch or the thick gall bladder wall.

Comparing Methylene blue dye injection with other methods of intra-operative visualization of the biliary tree (Table 1).

Table 1. The most common methods used for intra-operative visualization of Biliary Tree.

Method used for Intra-operative visualization of Biliary system	Rata of success
Intra-Operative Cholangiogram (IOC)	≥ 90%
laparoscopic ultrasonography (LUS)	95-100%
Intra venous injection of Indocyanin Green (ICG)	71.43%- 100%
Cholecystocholangiography (CCC)	~80%

Intra-Operative Cholangiogram (IOC) showed a success rate around or up to 90%.[20,21] IOC has several disadvantages which impede routine implementation. Cystic duct cannulation can be challenging, and the reported extra time needed for IOC is 10–27 min.[22-24] Special attention should be paid to the learning curve for interpreting IOC, as some studies report high proportions of incorrectly interpreted cholangiograms.[13]

An alternative to radiography for intraoperative assessment of biliary anatomy is laparoscopic ultrasonography (LUS), Catheline et al., in 2002 showed LUS success 100%;[25] Tranter et al., in 2003 showed LUS success 97%,[26] Machi et al., in 2007 showed LUS success in 97%;[27] Perry et al., in 2008 showed LUS success in 95%.[28]

One of the main drawbacks of LUS is the reported long learning curve. Machi et al., in 2009 suggested that it takes 50–100 operations before one can successfully apply LUS.[29]

As regarding the intra venous injection of Indocyanin Green (ICG) dye as a method to visualize the biliary tree intra-operative, Aoki et al., in 2010 identified CBD-cystic duct junction 10/14 patients (71.43%),[30] Ishizawa et al., in 2010 identified CBD-cystic duct junction in 50/52 patients (96.15%),[31] While Tagaya et al., in 2010 after intravenous ICG and Hepatoduodenal ligament compression with plastic device for improved exposure, The CBD-cystic duct junction was identified in all patients.[32]

Cholecystocholangiography (CCC) is performed by injecting radiographic contrast directly into the gallbladder. An alternative instrument for ''partial'' CCC is the so-called ''Kumar clamp,'' which is placed across the base of the gallbladder, after which radiographic contrast is injected into Hartmann's pouch.[17] CCC is a simple technique with a steep learning curve,[33] requires no cystic duct cannulation, and is faster than IOC. However, the success rate is low (~80%), and even when successful, the image quality is often poor. Of extra concern is the report of hypotension and gallbladder perforation when the gallbladder is distended.[34]

So we can see that the methylene blue injection inside the gall bladder during laparoscopic cholecystectomy may clarify the biliary tree during dissection of the gall bladder, so this method can be used routinely to minimize the incidence of bile duct injuries during Laparoscopic cholecystectomy.

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