

# Feasibility of Intracholecystic Injection of Methylene Blue to Visualise the Biliary Tree during Laparoscopic Cholecystectomy

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## Abstract

Laparoscopic cholecystectomy is commonly practiced by surgeons and the most worrisome complication is biliary tree injury. On 60 patients undergoing Laparoscopic cholecystectomy we injected Methylene blue dye into the gall bladder trying to delineate the biliary tree. Cystic duct was painted in 56 patients (93%) while common bile duct and hepatic ducts were painted only in 38 patients (63%). The technique is easy to perform, without any radiation exposure hazards, without using special equipment and is less time consuming than other maneuvers used to delineate the biliary tree during laparoscopic cholecystectomy. It is cheap and can be done even with no prior special experience in the technique. The incidence of bile system injury related to anatomic misidentification can be decreased or even totally avoided. It may be of value in thin wall gall bladder but in thick wall gall bladder it is of questionable value and needs more investigation.

**Key words:** Methylene blue - intra-operative - laparoscopic cholecystectomy

## Introduction

Laparoscopic cholecystectomy was introduced and widely adopted by practicing general surgeons. Overall, over 90% of cholecystectomies are now done using the minimally invasive approach.<sup>1</sup> The most worrisome complication is biliary tree injury. The incidence of bile duct injury in laparoscopic cholecystectomy (LC) is still two times greater compared to classic open surgery.<sup>2</sup> Many factors have been incriminated in the occurrence of biliary tree injuries during LC, these factors are mainly anatomical misidentification of main ducts or of aberrant right hepatic duct, anatomical variations or unidentifiable anatomy, poor surgeon's experience, technical difficulties, poor visualization of the operative field, acute inflammation of the gall bladder and local factors such as excessive fat tissue and hemorrhage.<sup>3</sup> However, misidentification of the anatomy and surgeon's experience seems to be the most important factors.<sup>4</sup> Subsequent improvements in the equipment and refinement in technique, as well as improved learning curve in laparoscopic surgery, resulted in a progressive decrease of the incidence of these injuries. Nevertheless, global incidence of CBD injury has remained fairly constant around 0.5%, as reported by various meta-analysis studies over a 15-year period.<sup>5</sup>

Although there has been stress on the routine use of intra-operative cholangiography (IOC) in laparoscopic cholecystectomy to delineate the extra-hepatic biliary anatomy and to know the status of the common bile duct (CBD), its role remains controversial and selective use of IOC has been recommended by a significant

number of authors. Additionally, the operation room conditions should be suitable for IOC, the necessity of some disposable equipment, the need of surgical experience in addition to the inevitable prolongation of the operation time and the need of interpretation by an experienced radiologist have made its use more difficult.<sup>3</sup>

Sari and his coworkers in 2005 described a technique by which methylene blue (MB) dye is injected into the lumen of gall bladder to delineate the cystic duct and common bile duct. This technique seems easier to perform, without any radiation exposure and less time consuming than conventional IOC.<sup>6</sup>

Methylene Blue, the first synthetic drug, has a 120 year long history of diverse applications, both in medical treatments and as a staining reagent. In recent years there was a surge of interest in MB as an antimalarial agent and as a potential treatment of neuro-degenerative disorders such as Alzheimer's disease.<sup>7</sup> Since the usual capacity of the gallbladder is only about 30-60 ml, so the maximum amount that could be injected of the solution (50 percent diluted methylene blue equal to the amount of aspirated bile) is about 15-30 mg which is very safe (toxic dose is > 5 mg/kg).<sup>8</sup>

## Patients and methods

This work was carried out at El-Zahraa university hospital, El Azhar medical school for girls. Sixty patients were included in this study. All had chronic calculous cholecystitis and were investigated as appropriate. Patients with history of jaundice, elevated liver enzymes or acute cholecystitis

were not included in the study. All were informed about the procedure and consented. All patients were informed that they might pass greenish blue urine in the early post operative period. After inflation of the abdomen and looking for other visible pathology, 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 ports. The gall bladder fundus was then punctured by a Veress needle which was introduced via the abdominal wall in projection to this area. In cases of adherent gall bladder that couldn't be reached through the abdominal wall, a laparoscopic needle was used. All the bile in the gall bladder was aspirated and 50 percent diluted methylene blue equal to the amount of aspirated bile was injected slowly into the gall bladder. Since the usual capacity of the gallbladder is only about 30-60 ml, the maximum amount of 50 percent diluted methylene blue (equal to the amount of aspirated bile) that could be injected into the gall bladder was about 15-30 mg which is very safe. In order to prevent methylene blue leakage, the gall bladder fundus was held tight anteriorly during the withdrawal of the Veress needle and a grasper introduced via the xyphoid port was applied immediately to the puncture site and held so throughout the operation. After completion of the procedure, the gall bladder was completely aspirated before removal from the abdominal cavity.

## Results

Between January 2014 and December 2015, sixty patients underwent LC methylene blue dye injection technique. Forty eight patient were female and 12 patient were male as shown in **Table 1**. Age ranged between 18 and 64 years as shown in **Table 2**. Chronic calcular cholecystitis was proved in all patients in pre-operative ultrasonographic evaluation. Sixteen patients had solitary stone and ten of them had normal wall thickness while forty-four had multiple stones and only fourteen of them had normal wall thickness as shown in **Table 3**. The diameter of the largest stones in 38 patients was more than 1 centimeter and multiple small stones ranging between 5-9 mm, were found in 22 patients. None of the patients had another medical problem of surgical importance as diabetes or peptic ulcer disease as per history and appropriate investigation. The gall bladder, cystic duct and common bile duct were painted with methylene blue in 38 cases but only the gall bladder and proximal cystic duct were visualized in 18 cases. Cystic duct was not painted in 4 cases both had

multiple stones and thick walled gall bladder while the CBD was not painted in 22 cases. Two of them had a single stone with normal wall thickness, one with single stone and thick wall, 6 with multiple stones and normal wall while the remaining 12 had multiple stones and thick walled gall bladder as shown in **Tables 4,5**. In 12 cases methylene blue leakage from the gall bladder was observed into the abdominal cavity during the removal procedure. The region was irrigated with saline solution. We did not leave a drain except in those patients who had methylene blue leakage from the gall bladder. Operative time ranged between 48 and 112 minutes as shown in **Table 6**. The drains were removed in the next day and did not drain significant amount or color. None of the patients developed any complication and all of them were discharged the day after the operation.

**Table 1: Sex distribution**

Gender	Number	Female
Female	48	80%
Male	12	20%

**Table 2: Age distribution**

	No. female	No. male	Percentage
20-30	6	0	10%
20-30	12	0	30%
30-40	10	2	20%
40-50	10	2	20%
50-60	6	6	20%
60-65	4	2	10%

**Table 3: Stones size and wall thickness**

Stones	Number	Thin wall	Thick wall
Single	16	10	6
Multiple	44	14	30

**Table 4: Duct painting**

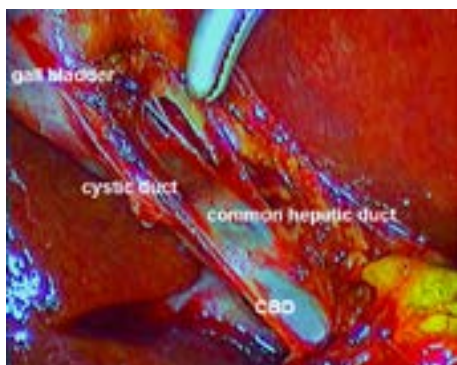
Duct	Painted	%
Cystic duct only	18	30%
Cystic & CBD	38	63%
Cystic duct overall	56	93%

**Table 5: Painting failure related to stones and wall thickness**

Not painted	Stone	Wall	Number	Percent
Cysic	Single	Thick	0	0%
		Thin	0	0%
	Multiple	Thick	4	7%
		Thin	0	0%
CBD	Single	Thick	2	3.5%
		Thin	2	3.5%
	Multiple	Thick	12	20%
		Thin	6	10%

**Table 6: Operative time**

Operative time	Number	Percentage
45-60min	6	10%
60-65min	30	20%
75-90min	12	20%
90-120min	12	20%



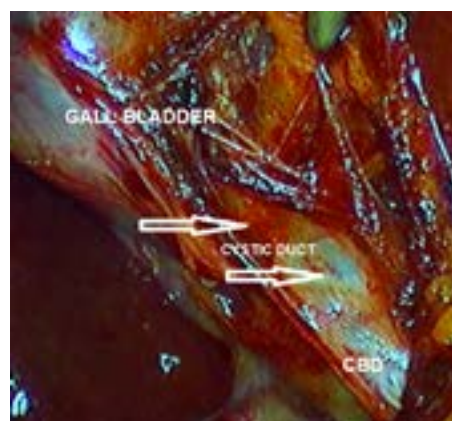
**Fig 1: Cystic duct, common hepatic duct and CBD all painted.**



**Fig 2: CBD visualized after ligation and transecting the cystic duct.**



**Fig 3: Injection of MB into the gall bladder after aspiration of bile using endoscopic needle.**



**Fig 4 Visualized cystic duct (arrows) and CBD.**



**Fig 5: Cystic duct painted but not the CBD.**

## Discussion

Our study included sixty cases with chronic calculous cholecystitis, who underwent laparoscopic cholecystectomy with trans-cholecystic MB injection technique. They ranged in age from 18 to 64 years (mean= 34.6±13.74 years).

Forty-eight patients (80%) were females (ranged from 18–64 years) with median age 37.66, and twelve patients (20%) were males (ranged from 32–63 years) with median age 50.33. From these results, it was found that females were more than males and tends to occur at younger age. Also, studies done by Nakeeb et al., and Cynthia & Sum, described a significant relationship noted between female sex and gall bladder stones.<sup>9,10</sup>

In current study, 16 patients (27%) had single stone while 44 patients (73%) had multiple stones. The mean age of single stone patients was 34.29±9.48 years and the mean age of multiple stone patients was 36.83±9.77 years. John and his co-workers showed that there was no significant age difference between single and multiple stones disease.<sup>11</sup>

By using this technique all gall bladders were painted, while 56 cystic ducts were painted (93%) -which is significantly important-while common bile duct and common hepatic ducts were painted in 38 patients (63%).

Regarding cystic duct painting, it was painted in 56 patients (93%) and not painted in 4 patients (7%). Comparing single with multiple stones patients, it was found that 16 patients (100% of those who had single stone) were painted, while 40 patients out of 44 patients who had multiple stones (90.9%) had their cystic duct painted. Those who had their cystic duct not visualized had their gall bladder wall thickened in ultrasonographic pre-operative evaluation. The method was of value in viewing the cystic duct in our patients specially in solitary stone patients.

Regarding common bile duct and hepatic ducts painting, only 38 patients (63%) had their ducts painted. Comparing single with multiple stones patients, it was found that 12 patients (31.5%) had single stone, while 26 patients (68.5%) had multiple stones. The ducts were not painted in 22 patients (37%), four had single stone (19%) and thick gall bladder wall, while 18 patients (81%) had multiple stones twelve of them had thick wall gall bladder while the other six had thin wall gall bladder. From these results it is clear that failure of painting the CBD is more in thick wall gall bladder.

Failure of passage of the dye to the cystic duct may be attributed to the very thick wall of the gall bladder and cystic duct. The CBD and CHD were

not visualized because gall bladders were filled with stones and MB could not be injected properly or gall bladders were occluded by a large stone at Hartman's pouch.

In 12 cases (20%), MB leakage from the gall bladder was observed into the abdominal cavity during injection of dye. 6 patients (50%) had single stone while the other 6 patients (50%) had multiple stones. From these results, it was found that MB leakage in patients who had multiple stones was equal to patients who had single stone. Although, this leakage did not affect the procedure but increased the mean operative time for irrigation with saline, the increased time was not significant. In comparison to study done by Sari and co-workers using the same technique, 10 cases (11%) had MB leakage from the gall bladder, which is statistically less than our results.<sup>6</sup>

The operation time ranged from 48-112 minutes with mean 78.63±12.37 minutes. It was observed that the mean operative time is slightly prolonged in patients in whom we failed to visualize the cystic duct by MB dye with mean operative time 84.31±12.22 minutes.

Pin and his coworkers concluded that the mean operative time for laparoscopic cholecystectomy for chronic calculous cholecystitis was 72 minutes,<sup>12</sup> and was 86 minutes in another study done by Mendoza and coworkers.<sup>13</sup> Grace and his coworkers in 1991 found that the mean operative time was 102±31 minutes.<sup>14</sup> More recently; in a study done by Hasbahceci and his coworkers on 1557 patients had laparoscopic cholecystectomy in non teaching hospital; they found that the mean operative time was 43.4 minutes.<sup>15</sup>

Post-operative hospital stay in all our patients was one day as all of them were discharged the next day. In a study done by Cuschieri and his coworkers in 2002, the median hospital stays was 3 days (range: 1 to 27 days).<sup>16</sup> In another study done by Grace and his coworkers, the mean hospital stay was 3.5±1.5 days.<sup>14</sup> In Hasbahceci and his coworkers study the mean hospital stay was 1.2 days.<sup>15</sup> In Priego and coworkers study on 1849 patients, it was 2.43 days.<sup>17</sup>

There was no biliary injuries encountered in our cases. The dissection was performed much more safely, since the boundaries of the gall bladder and bile ducts were significantly delineated and painted with MB in most of our patients.

In an informal cost analysis with IOC for CBD injury prevention, routine use was not considered cost effective because of the low absolute risk of bile duct injury and a relatively high number needed to treat to avoid a single CBD injury,<sup>18</sup> while in



our study, the cost of MB used for all the cases is negligible (less than 100 L.E for all the cases).

### Conclusion

The technique by which the methylene blue is injected into the lumen of gall bladder to delineate the cystic duct, common bile duct and common hepatic ducts is feasible, safe and easier to perform, without any radiation exposure, without using special equipment and is less time consuming than any other maneuvers used to delineate the biliary tree during laparoscopic cholecystectomy. It is cheap and can be done even with no prior special experience in the technique.

By this technique, biliary tract injury during laparoscopic cholecystectomy-caused by visual perceptual illusion-can be avoided by feasible, cheap and easy maneuver. Also, the incidence of biliary tract injury related to anatomic misidentification can be decreased or even totally avoided. It may be of value in thin wall gall bladder but in thick wall gall bladder it is of questionable value and needs more investigation.

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