

# Complications in Laparoscopic Cholecystectomy: Experiences from A Study of 1425 Cases

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## Abstract:

**Objective:** To evaluate the complications of laparoscopic cholecystectomy in the symptomatic cholelithiasis and other benign gall bladder diseases.

**Methods:** This descriptive observational study was carried out at CMH Dhaka and CMH Jashore from March 2016 to Jun 2022, to evaluate the frequency and outcome of management of all the complications in laparoscopic cholecystectomy. A total of 1425 patients of laparoscopic cholecystectomy were included in this study. Patients were followed up for a period of three months after operation. The complications in laparoscopic cholecystectomy observed in this study were divided into (i) Access related (ii) Intraoperative (biliary and extrabiliary) and (iii) Postoperative.

**Results:** The incidence of access-related, intraoperative or procedure-related biliary, extrabiliary and postoperative complications were 3.64%, 2.95%, 4.98% and 1.96% respectively. Access related complications were extraperitoneal insufflations 1.40%, port site bleeding 1.19%, small bowel laceration 0.21% and transverse colon injury 0.07%. Procedural biliary complications included common bile duct (CBD) injury 0.14%, common hepatic duct (CHD) injury 0.07% and iatrogenic gall bladder perforation with bile leakage 2.74%. Procedural extrabiliary complications were Liver injury 0.56%, duodenal perforation 0.07%, colon perforation 0.07%, bleeding

through cystic artery 0.49% and bleeding from gall bladder fossa 1.12%. Two colonic perforations and one duodenal perforation were the major complications encountered in this series. Two colonic perforations required conversion to open procedure but duodenal perforation was managed laparoscopically by intracorporeal suturing. Total nine (0.63%) patients required conversion to open procedure. Postoperative complications included port site infection (PSI) 1.05%, port site hernia 0.56%, major sepsis 0.14% and ischemic stroke 0.07%. There was no retained stone, biliary stricture and mortality reported in this series.

**Conclusion:** Complications in laparoscopic cholecystectomy are mainly due to access related and intraoperative and have their own characteristics. CBD transaction, CHD injury, Colonic perforations and duodenal perforations were the major complications requiring conversion to open procedure except duodenal perforation which was dealt laparoscopically. Conversion to open procedure should not be considered as a complication.

**Keywords:** Biliary and Extra-biliary complications, laparoscopic cholecystectomy, CBD and CHD injury, colonic and duodenal perforation, port site infection (PSI), morbidity and mortality.

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## Introduction:

Laparoscopic cholecystectomy (LC) is considered superior to open cholecystectomy in terms of morbidity,

cosmesis and rate of operative complications.<sup>1-3</sup> There are other studies which report an increased rate of intraoperative complications during laparoscopic cholecystectomy compared to open cholecystectomy.<sup>4-8</sup> Intraoperative biliary and extra-biliary complications in laparoscopic cholecystectomy have been reported in many studies.<sup>9-11</sup> Both the biliary and extra-biliary complications do occur with almost the same frequency and severity in laparoscopic cholecystectomy but tend to be under-reported in the literature.<sup>12</sup> The complications in laparoscopic cholecystectomy can be access-related, intraoperative or procedure-related (biliary and extra-biliary) and postoperative. Different techniques of initial abdominal access for creating pneumoperitoneum have been described but none has been found to be superior in terms of preventing access-related injuries.<sup>13</sup> Although these complications now a

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days are not as common as they were in the past, but still laparoscopic cholecystectomy as a procedure associated with both fatal and non-fatal trocar-related injuries.<sup>14</sup>

The intraoperative complications of LC like bowel and vascular injury specially during initial trocar insertion and bile duct injuries decrease with the passage of time, because of increased experience of the surgeons and introduction of new instruments.<sup>4</sup>

This study presents our six years experiences of laparoscopic cholecystectomy with the aim to evaluate the frequency, severity and outcome of management of all complications in laparoscopic cholecystectomy in symptomatic cholelithiasis and other benign gallbladder diseases.

#### Materials and Method

This is a descriptive observational study carried out at CMH Dhaka and CMH Jashore from March 2016 to Jun 2022. A total of 1425 patients with symptomatic cholelithiasis and other benign gall bladder diseases who underwent laparoscopic cholecystectomy, were included in this study. Patients with jaundice, gall bladder mass, who are not suitable for general anesthesia and who underwent open cholecystectomy were excluded from the study. Informed written consent was taken for general anesthesia and intended surgical procedure for all patients. Ethical clearance for the study was taken from hospital ethical committee.

The cases were operated upon by six surgeons with different levels of experience. All patients were operated by the classical four port technique of laparoscopic cholecystectomy. Patients were followed up for a period of three months after operation. Data were collected in a data sheet which included demographic information, operative procedures, access related, intraoperative (biliary and extra biliary) and postoperative complications and outcome of their management. All data were fed into IBM SPSS vs 23 program and necessary statistical analysis was done. Non parametric Chi-square test was done to see the association between complications with age and sex of the patients. P value <0.05 was considered as statistically significant.

#### Results

A total of 1425 patients who underwent Laparoscopic cholecystectomy were studied.

In this study, there were 228 (16%) males and 1197 (84%) females with a male to female ratio of 1:5 (Fig-1).

Fig 2: Showed the age group of the patients. The age ranged from 25 to 65 years with a mean age of  $42 \pm 7.452$  years. Among them highest no of patients, 768 (54%) were in the 35-44 age group followed by 45-54 age group, 313 (22%).

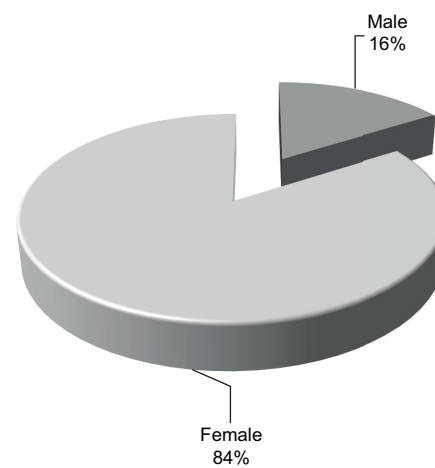


Fig.-1: Sex distribution of patients (n=1425)

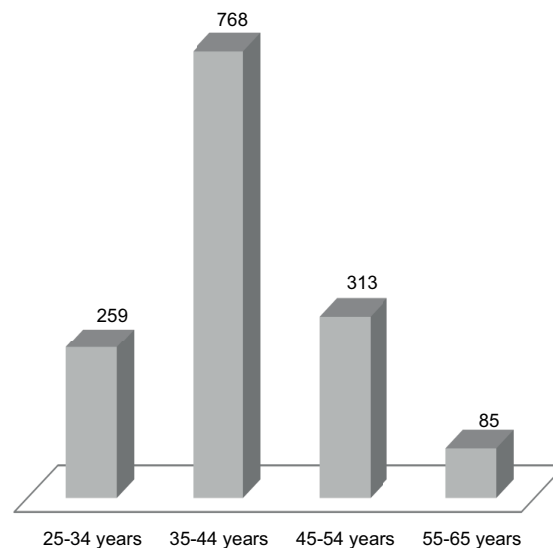


Fig.-2: Distribution of patients by age groups (n=1425)

**Table-I**

<i>Access related complications (n=1425)</i>						
Complication	Frequency			%	P Value	Management
	Total	25-44 years	45-65 years			
Extraperitoneal insufflations	20	3	17	1.40		Extracorporeal squeezing of anterior abdominal wall keeping port in situ.
Port site bleeding	17	6	11	1.19	0.608	Laparoscopic transfascial suturing & electrocautery.
Small bowel laceration	03	1	2	0.21		Conservative approach
Transverse colon injury	01	0	1	0.07		Converted to open procedure - repair of transverse colon and open cholecystectomy
Omental laceration	11	4	7	0.77		Laparoscopic hemostasis
Total	52	14	38	3.64	-	

**Table-II**

<i>Intraoperative(procedural) biliary complications (n=1425)</i>						
Complications	Frequency			%	P Value	Management
	Total	Male	Female			
Common Bile Duct (CBD) injury	02	0	2	0.14		Converted to open procedure '!' direct repair over T-tube(01) & Roux-en-Y hepaticojejunostomy (01)
Common Hepatic Duct(CHD) injury	01	1	0	0.07	0.829	Re exploration & Roux-en-Y hepaticojejunostomy after 02 weeks
Iatrogenic gall bladder perforation and bile leakage	39	12	27	2.74		Laparoscopic suction, irrigation with NS and suction
Total	42	13	29	2.95		

**Table-III**

<i>Intraoperative (procedural) extra biliary Complications (n=1425)</i>						
Complications	Frequency			%	P Value	Management
	Total	Male	Female			
Liver injury	08	2	6	0.56		Laparoscopic hemostasis
Duodenal perforation	01	1	0	0.07		Laparoscopic repair by intracorporeal suturing
Perforation of transverse colon due to cholecystoic fistula	01	1	0	0.07		Conversion to open procedure -> open cholecystectomy and Right hemicolectomy
Bleeding through cystic artery	07	2	5	0.49	0.868	One case converted to open procedure and others were dealt laparoscopically
Bleeding from gall bladder bed	16	4	12	1.12		Hemostasis with laparoscopic maneuver
Spillage of stones in the peritoneal cavity	38	8	30	2.67		Laparoscopic retrieval of all stones with laparoscopic stone removal forceps
Total	71	18	53	4.98		

**Table-IV**

<i>Postoperative Complications (n=1425)</i>						
Complications	Frequency			%	P Value	Management
	Total	Male	Female			
Port site infection(PSI) (Pyogenic-10 & Tubercular-5)	15	3	12	1.05		Daily dressing and antibiotic in 10 cases of pyogenic infections. Early excision with 2 <sup>nd</sup> line ATT in 05 cases of tubercular infections.
Subhepatic bilious collection	02	1	1	0.14		Redo laparoscopy and drainage
Port site hernia	08	1	7	0.56		Open repair of port site hernia
Major Sepsis	02	1	1	0.14	0.377	Conservative approach with ICU support
Ischemic stroke	01	0	1	0.07		Conservative approach with HDU support
Retained stone in CBD	nil	-	-	nil		-
Biliary Stricture	nil	-	-	nil		-
Mortality	nil	-	-	nil		-
<b>Total</b>	<b>28</b>	<b>06</b>	<b>22</b>	<b>1.96</b>		

**Table-V**

<i>Causes of conversion to open procedure (n=1425)</i>			
Complications/Causes	Frequency	No of conversion	%
Complete transection of CBD	02	02	0.14
Injury to CHD	01	01	0.07
Colon perforation	02	02	0.14
Bleeding through cystic artery	07	01	0.07
Mirizzi II syndrome	03	01	0.07
Empyema gall bladder	15	02	0.14
<b>Total</b>	<b>30</b>	<b>09</b>	<b>0.63%</b>

**Discussion:**

Complications of laparoscopic cholecystectomy reported in this series were access-related, intraoperative or procedure-related and postoperative. Access-related complications are common despite various changes made in the access techniques. Studies have reported trocar injuries to bowel and major blood vessels to be as high as 1% and most of them have occurred during the insertion of the first trocar.<sup>14-15</sup> Initial blind trocar insertions and veress needle accesses remained the important causes of complications, reported in different studies.<sup>16-18</sup> On the other hand, open technique of trocar insertion have reduced the access-related major vascular injury and mortality rate, reported in many studies.<sup>19-21</sup>

In this study, initial access and pneumoperitoneum was made by direct trocar insertion (DTI) technique in 1362 (95.5%) cases, followed by Hasson open and veress needle techniques in 45 (3.1%) and 18(1.2%) respectively. Adequate relaxation and manual lifting of the anterior abdominal wall holding with or without towel clip forceps during first trocar insertion gives a good safety.<sup>22</sup> This technique was adopted in cases of DTI method of creating initial pneumoperitoneum in this series.

In this study, access related complications were encountered in 3.64% patients in total. Port site bleeding occurred in 1.19% patients mainly in the epigastric port which were managed effectively by laparoscopic

transfascial suture ligation and laparoscopic electrocautery. Radunovic M et al. reported 1.21% port site bleeding encountered in their study<sup>16</sup>. Malik A M et al in their study reported 1.24% cases of port site bleeding.<sup>18</sup> Extra-peritoneal insufflations resulting surgical emphysema, observed in 1.40% obese patients in this study, comparatively less than other studies.<sup>22</sup> Extraperitoneal insufflations were reduced by extracorporeal squeezing of anterior abdominal wall keeping initial port in situ. Previous operations may make abdominal access difficult and liable to produce bowel injury. Access-related bowel injuries were found more common with closed technique of abdominal access.<sup>23-25</sup> Small bowel and omental lacerations occurred in 0.21% and 0.77% cases respectively in this study and managed with conservative approach, comparable to other studies.<sup>19,23</sup> In this study, one female patient of 57 years, transverse colon was entered inadvertently during first trocar insertion by DTI method and needed conversion to open procedure. Immediate laparotomy, repair of transverse colon and open cholecystectomy was done accordingly. Sudden unexplained hemodynamic instability observed shortly after veress needle insertion or DTI may be due to vascular injury even in the absence of any visible bleeding and operating team should be alert.<sup>19</sup> However, no major vascular injury encountered in this series on the contrary to other studies.<sup>16,18,19</sup> However, no statistically significant association was found between access related complications and age of the patients in this study ( $P > 0.05$ ).

Intraoperative or procedure related biliary complications observed in 2.95% cases in this series. Mostly occurred in complicated gall bladder diseases like repeated attack of acute cholecystitis, empyema gall bladder, chronic cholecystitis with dense adhesions with surrounding structures, distortion of anatomy in Calot's triangle and mirizzi syndrome as mentioned in other study.<sup>18</sup> Bile duct injuries included complete transaction of CBD encountered in two (0.14%) cases and electrocautery injury of CHD in one (0.07%) case in this series. Lee S et al. reported bile duct injury 1.1% in his study<sup>7</sup> where as Muqim R et al. reported bile duct injury 1.42%.<sup>2</sup> Incidence of bile duct injury in our study is less in comparison to the study done by Malik A M (0.6%).<sup>19</sup> The incidence of bile duct injury was less in this series may be due to careful dissection in the calot's triangle ensuring Critical

View of Safety (CVS) in maximum cases, availability of experienced surgeon and a low threshold for conversion in difficult cases. Primary repair of CBD over T-tube was done in one case converting laparoscopic procedure into open. One case of CHD injury revealed in the postoperative period. Exploration and hepaticojejunostomy was done after two weeks in that particular case. Iatrogenic gall bladder perforations with bile leakage occurred in 2.74% cases during difficult dissection of gall bladder in complicated cases, negotiated with suction, irrigation with normal saline and again suction of all subhepatic collection.

Procedure related extra biliary complications observed in 4.98% cases in this series which is less than other study done by Malik A M et al. (6%).<sup>18</sup> Liver injury includes penetrating injury mainly and few subcapsular haematoma during inadvertent forceps maneuver, occurred in eight (0.56%) patients in this study, which is comparatively less than the study done by Malik A M et al. (0.86%).<sup>18</sup> Spillage of stones in the peritoneal cavity ensued in 38 (2.60%) patients due to perforation of gall bladder in the cases of difficult dissection of thin walled gall bladder. Malik A M et al. reported spillage of gall stones due to iatrogenic perforation of gall bladder in 1.62% patients whereas Agarwal Sanjeev et al. reported spilled gall stones in 2% cases.<sup>18,20</sup> However, all spilled stones were retrieved with laparoscopic stone removal forceps in this series. Bleeding through Cystic artery occurred in 07 (0.49%) patients but needed immediate conversion to open procedure only in one case, in the early part of this study, due to excessive bleeding due to slippage of clips inadvertently; others were managed by laparoscopic maneuver. Radunovic M et al. reported in his study 0.67% bleeding through cystic artery.<sup>16</sup> Malik A M et al. mentioned 1.8% bleeding from cystic artery in his study.<sup>18</sup> Bleeding from gall bladder bed occurred in 16(1.12%) patients in this study due to opening of venous sinuses or injury to accessory cystic artery and all were managed laparoscopically by pressure with gall bladder itself or surgical gauge, clipping and electrocautery as needed. Faruquzzaman Q et al. and Malik A M et al showed bleeding from gall bladder bed in 3.4% and 1.05% patients respectively.<sup>6,18</sup>

Procedural injuries to gastrointestinal tract are associated with a high mortality rate as indicated by various studies.<sup>23-25</sup> Procedure related colonic perforation encountered in one (0.07%) patient with

cholecystocolic fistula, needed conversion to open procedure. Then exploratory laparotomy, open cholecystectomy and right hemicolectomy were done in that particular case. The total no of colonic injury in this study was two (0.14%) comparatively less than other studies conducted by Farukuzzaman et al. 1.1%, Malik A M et al. 0.20% but consisted with the study done by Deziel et al. 0.14%.<sup>6,18,19</sup> Only one (0.07%) duodenal perforation encountered in this study during difficult posterior dissection near cystic duct as it was adhered with duodenum. This is comparatively less than other study conducted by Malik A M et al. (0.5%).<sup>18</sup> However; this duodenal perforation was repaired laparoscopically by intracorporeal suturing. Patience, clear displaying of anatomy and identification of structures in the hepatocystic triangle of Calot (Critical View of Safety) before cutting or applying clips are vital to safe outcome in laparoscopic cholecystectomy.<sup>22</sup> Above all procedural complications were less in this series, in comparison to other studies.<sup>16,18,19</sup> More accountable working places (CMHs), starting laparoscopic surgery after adequate training, availability of expertise and adopting CVS technique in maximum cases probably might have contributed in the above all low rate of procedural complications in this series. There was no statistically significant association between intraoperative (biliary and extrabiliary) complications and sex of the patients in this study ( $P > 0.05$ ).

Postoperative complications were observed in 1.96% patients in this series. Port site infection (PSI) developed in 15 (1.05%) cases which is little higher than other study conducted by Radunovic M et al. (0.94%) but less than the study conducted by Maitra T K et al. (5.2%).<sup>16,17</sup> Port site infection was seen mainly in epigastric port (10 cases, 0.70%) caused by Pyogenic bacteria specially when potentially infected gall bladder was delivered through it and managed with daily dressing and antibiotic. Routine use of modified endobag made from surgical hand gloves for retrieval of infected gall bladder and stones might have reduced the infection rate in this study. In 05 (0.35%) cases of PSI were seen in epigastric port caused by atypical mycobacteria diagnosed clinically and managed with early excision and 2<sup>nd</sup> line anti tubercular drugs which is consistent with other studies.<sup>19</sup> Subhepatic bilious collection developed in 0.14% cases in this study, diagnosed on 3-5<sup>th</sup> POD and managed by redo laparoscopy and drainage, which is comparatively less

than other study conducted by Radunovic M et al. (0.40%).<sup>16</sup> Port site hernias developed in 08 (0.56%) patients in the umbilical port site which is comparatively higher than other study conducted by Radunovic M et al. (0.40%) but less than the study done by Muqim R et al. (0.85%).<sup>2,16</sup> Umbilical port site hernia developed in early part of this study may be due to poor port closure technique –failing to incorporate linia alba or rectus sheath in the stitches by the surgical trainee. But careful port closure technique incorporating linia alba or rectus sheath in the stitches reduced the frequency of port site hernia almost zero in the later part of this study. Two patients (0.14%) with empyema gall bladder in this series developed major sepsis which required ICU support. A 57 years old female patient developed ischemic stroke and diagnosed on first POD. After CT scan evaluation of brain, she was found to have new brain infarct along with old infarct with no preoperative neurological deficit. However, she was managed conservatively with physiotherapy and medication and improved significantly within three months. There was no incidence of retained stone, biliary stricture and mortality reported in this series, on the contrary to other studies.<sup>16,19,25</sup> However, no statistically significant association was found between postoperative complications and sex of the patients in this study ( $P > 0.05$ ).

In the modern era of minimal access surgery, conversion in laparoscopic cholecystectomy is not considered to be a complication but instead a way for the surgeon to safely finish the surgery. Therefore, a surgeon should have a low threshold for conversion when it is exactly required.<sup>16</sup> In this study conversion rate was 0.63% which is less than other studies conducted by Radunovic M et al. 3.91%, Maitra T K et al. 9.9%, Malik A M et al. 1.5% and Deziel et al. 1.2% cases.<sup>16-19</sup> This may be due to careful selection of cases, availability of expertise when needed, adoption of critical view of safety and other principles of safe laparoscopic surgery in maximum cases.

The limitation of this study is that it was a descriptive observational study carried out on small sample size (1425 cases only). Another limitation is, the study was carried out only at two hospitals. Thus this study may not reflect the actual scenario of complications in laparoscopic cholecystectomy nationwide. So a multicentric analytical study incorporating a large size sample is required to determine the actual incidence of complications in laparoscopic cholecystectomy nationwide and to formulate their management strategy.

## Conclusion

Access related, intraoperative and postoperative complications in laparoscopic cholecystectomy have their own specific characteristics. Complications in laparoscopic cholecystectomy in this study were mainly due to access related and intraoperative. Bleeding through cystic artery, CBD transaction, CHD injury, Colonic perforations and duodenal perforations were the major complications which required open conversion except duodenal perforation which was dealt laparoscopically. It is important recognizing intraoperative complications during the surgery so that those can be taken care of in a timely manner. Patience, clear displaying of anatomy, identification of structures in the hepatocystic triangle (CVS) before cutting or applying clips and low threshold for conversion in difficult cases can substantially decrease morbidity and mortality. Conversion to open procedure should not be considered as a complication.

## References

- Ishizaki Y, Miwa K, Yoshimoto J, Sugo H, Sawasaki S. Conversion of elective laparoscopic cholecystectomy to open cholecystectomy between 1993 and 2004. *Br J Surg.* 2006;93:987–91.
- Muqim R, Alam QJ, Zarin M, Aurangzaib M, Wazir A. Complications of laparoscopic cholecystectomy. *World J Laparoscop Surg.* 2008;1(1):1-5.
- Ros A, Gustafsson L, Krook H, Nordgren CE, Thorell A, Wallin G, et al. Laparoscopic cholecystectomy versus mini-laparotomy cholecystectomy: A prospective, randomized, single blinded study. *Ann Surg.* 2001;234:741–9.
- Shamiyeh A, Wanyand W. Laparoscopic cholecystectomy: early and late complication and their treatment, *Langenbecks ArchSurg*2004;389:164-71.
- Hanney RM, Bond G, de Costa A. Laparoscopic cholecystectomy: The missed diagnosis. *Aust N Z J Surg.* 1997; 67:166–7.
- Faruquzzaman Q, Hossain SM. Overall operative outcomes of laparoscopic cholecystectomy and our experience in statistics. *Arch Clin Gastroenterol.* 2017;3(2):33-6.
- Lee S, Na BG, Yoo YS, Mun SP, Choi NK. Clinical outcome for laparoscopic cholecystectomy in extremely elderly patients. *Ann Surg Treat Res.* 2015;88(3):145-51.
- Usal H, Sayad P, Hayek N, Hallak A, Huie F, Ferzli G. Major vascular injuries during laparoscopic cholecystectomy: An institutional review of experience with 2589 procedures and literature review. *SurgEndosc.* 1998; 12:960–2.
- Hobbs MS, Mai Q, Knuiman MW, Fletcher DR, Ridout SC. Surgeon experience and trends in intra-operative complications in laparoscopic cholecystectomy. *Br J Surg.* 2006;93:844–53.
- Targarona EM, Marco C, Balague C, Rodriguez J, Cugat E, Hoyvela C, et al. How, when and why bile duct injury occurs: A comparison between open and laparoscopic cholecystectomy. *SurgEndosc.* 1998;12:322–6.
- Rajdeep S, Robin K, Rajeev SK, Ashok A. Non-biliary mishaps during laparoscopic cholecystectomy. *Indian J Gastroenterol.* 2004;23:47–9.
- Schoonderwoerd L, Swark DJ. The role of optical access trocars in laparoscopic surgery. *SurgTechnol Int.* 2005;14: 61–7.
- Fuller J, Ashar BS, Carry-Corrado J. Trocar associated injuries and fatalities: An analysis of 1399 reports to the FDA. *J Minim Invasive Gynecol.* 2005;12:302–7.
- Hashizume M, Sugimachi K. Needle and trocar injury during laparoscopic surgery in Japan. *SurgEndosc.* 1997;11:1198–201.
- Schafer M, Lauper M, Krahenbuhl L. Trocar and veress needle injuries during laparoscopy. *SurgEndosc.* 2001;15:275–80.
- Radunovic M, Lazovic R, Popovic N, Magdelinic M, Bulajic M, Radunovic L, Vukovic M, Radunovic M. Complications of Laparoscopic Cholecystectomy: Our Experience from a Retrospective Analysis. *Open Access Maced J Med Sci.* 2016 15;4(4):641-646.
- Maitra T K, Ullah M E, Faruquzzaman, Mondol S K. Operative and Postoperative Complications of Laparoscopic Cholecystectomy: Experience from a Tertiary Care Hospital of Bangladesh. *Bangladesh Critical Care Journal.*2017;5:11-16
- Malik A M, A ALaghari, Q Mallah, et al :Extra-biliary complications during laparoscopic cholecystectomy: How serious is the problem? *J Minim Access Surg.* 2008 Jan-Mar; 4(1): 5–8.
- Deziel, Daniel J. et al. Complications of laparoscopic cholecystectomy: A national survey of 4,292 hospitals and an analysis of 77,604 case. *The American Journal of Surgery.*1993; 165(1): 9 – 14.
- Sanjeev A, J Arpit D. Perioperative complications of laparoscopic cholecystectomy: a cross-sectional observational study. *International Surgery Journal.* 2020; 7(5):1490-1495,
- Mayol J, Garcia-Aguilar J, Ortiz-Oshiro E, De-Diego Carmona JA, Fernandez-Represa JA. Risks of minimal approach for laparoscopic surgery: Multivariate analysis of morbidity related to umbilical trocar insertion. *World J Surg.* 1997;21:529–33.
- Orlando R, Palatini P, Lirrusi F. Needle and trocar injuries in diagnostic laparoscopy under local anesthesia: What is the true incidence of these complications? *J Laparoendosc Adv Surg Tech A.* 2003;13:181–4.
- Van der Voort M, Heijnsdijk EA, Gouma DJ. Bowel injury as a complication of laparoscopy. *Br J Surg.* 2004; 91(10):1253-8.
- Schäfer M, Lauper M, Krähenbühl L. Trocar and Veress needle injuries during laparoscopy. *Surg Endosc.* 2001;15(3):275-80.
- Binenbaum SJ, Goldfarb SJ. Inadvertent enterotomy in minimally invasive abdominal surgery. *JSLS.* 2006;10: 336–40.