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Nigam's Strategy for Safe Cholecystectomy (NSSC) - A way to prevent complications

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Abstract
Gallbladder stone disease is very common entity world over. The treatment for gallstones and cholecystitis is cholecystectomy. Laparoscopic cholecystectomy is a proven way to perform the removal of gallbladder. Laparoscopic cholecystectomy though is a minimal invasive procedure, but is associated with complications which may be serious. Nigam's strategy for safe cholecystectomy (NSSC) is a way to prevent these complications and provide a safe cholecystectomy.

Keywords: Cholecystitis, cholecystectomy, complications, laparoscopic cholecystectomy, safety

Introduction

Safe cholecystectomy is the essential need of cholecystectomy operation. Safe cholecystectomy means removal of gall bladder without injury to vascular and biliary structures, with minimum or no complications. To perform safe cholecystectomy surgeon must be conversant sufficiently with biliovascular anatomy. Critical view of safety (CVS) recognition is the essential part of safe cholecystectomy planning. CVS confirms that there are two only tubular structures encountered, identified, clipped and divided which prevents biliovascular damage. The critical view of safety can be achieved in the majority of cases during laparoscopic cholecystectomy [1].

Laparoscopic cholecystectomy (LC) is the current standard of care of symptomatic cholelithiasis. However, it is associated with higher incidence of complications such as bile duct injury (BDI) and vasculobiliary injury (VBI) than open cholecystectomy [2].

For achieving safe cholecystectomy, one has to make a strategy or plan for performing it. Various preventive strategies have been described to reduce the incidence of post-cholecystectomy BDI/VBI [3, 8].

The approach for safe cholecystectomy includes various factors such as achievement of critical view of safety (CVS), safe and proper use of energy devices, careful & safe tissue dissection and using a strategy or plan for surgical steps. A strong knowledge of anatomy including normal and aberrant anatomy is important. Given the immediate morbidity, higher mortality, decreased quality of life and decreased long term survival associated with VDI or vasculobiliary injury (VBI), as well as its medicolegal implications [9, 13].

The complications of laparoscopic cholecystectomy can be devastating as vascular and biliary injuries can lead to life-threatening problems. Bile duct injury is an especially serious and potentially life-threatening complication that occurs at a rate of 0.08-1.5% [14, 17].

Laparoscopic cholecystectomy is a common surgical gallbladder removal procedure world-wide but it also carries serious complications so.

To perform safe cholecystectomy, the surgeon should have a plan or strategy based on sound understanding of anatomical landmarks and dissection skills.

We have developed our strategy for safe cholecystectomy i.e. Nigam's strategy for safe cholecystectomy (NSSC). We follow certain methods and principles, based on universal understanding of the ways to achieve safe cholecystectomy. We are proposing a strategy to do the cholecystectomy safely though a large number of strategies have been proposed to safeguard against BDI/VBI [18, 22].

Post-operative surgical complications are common with laparoscopic cholecystectomy. It is associated with an overall complication rate of approximately ten percent with a higher risk of biliary injury (0.1%-1.5%) [23, 25] when compared to the open approach (0.1%-0.25%) [26, 27].

The R4U line is called the safety line, safe zone of dissection lies cephalad to the line extending from the roof of the Rouviere's sulcus (M. Henri Rouviere described it in 1924) to the umbilical fissure through the base of the segment 4 [28].

Safe laparoscopic cholecystectomy is the ultimate and essential need of cholecystectomy. To reduce the complications rate to zero level should be the goal – various strategies are advised by various workers to achieve these goals – we also have developed a strategy called – Nigam's Strategy for Safe Cholecystectomy (NSSC) to do safe laparoscopic cholecystectomy with low rate of complications. NSSC has steps for preoperative discussion through operative steps and two intraoperative timeouts to the end of the surgery. We follow certain methods and principles, based on universal understanding of the ways to achieve safe chole cystectomy. We are proposing a strategy to do the cholecystectomy safely though a large number of strategies have been proposed to safeguard against BDI/VBI [29].

Materials and Methods

This study of NSSC was done at Max Hospital, Gurgaon, Haryana, India. Total number of cases in this study were 248 cases. The study included cases of cholecystitis (acute and chronic) with gall stones, gangrene and perforation of gallbladder, mucocele and pyocele. Cases of cholangitis and pregnancy were excluded from the study. Same surgeon with same surgical team operated all cases by the same strategy for safe cholecystectomy, NSSC.

Surgeon and assistant surgeon examine the various investigation reports of the patients before the surgery and planned the strategy. This preoperative discussion also involved the concerned radiologist who performed the imaging investigations to understand the level of inflammation in the wall of the gallbladder and in the pericholecystic area. The preoperative discussion helped to prepare the surgical team for difficult gallbladder.

NSSC includes following steps

1. Exploration of peritoneal cavity.
2. Identification of anatomical landmarks.
3. Hepatocystic triangle dissection with division of posterior and anterior leaves of peritoneal fold.
4. Dissection and exposure of cystic duct and artery.
5. Dissection to separate lower part of gallbladder from cystic plate.
6. Critical view of safety (CVS) achievement.
7. Clipping of cystic duct and cystic artery.
8. Division of cystic duct and cystic artery.
9. Drain or no drain.
10. Completion of surgery.

The preoperative discussion between surgeon and assistant surgeon is done on various investigation reports and also with the concerned radiologist. This helps in making a plan for the procedure. The discussion with radiologist helps in understanding the level of infection and suspicion of gangrenous cholecystitis and also helps in preparation for a difficult gallbladder.

Identification of anatomical landmarks is concerned with bile ducts Rouviere's sulcus, cystic artery and Calot's triangle recognition. If there is adhesions, adhesiolysis is done. First, the fundus of gallbladder is retracted towards right shoulder of the patient to expose the whole gallbladder. The posterior layer of the cystic pedicle is divided first and then the anterior layer is divided. All fibro-fatty tissue present in the HCT is removed to expose the cystic duct and cystic artery. Separation of the lower part of the gallbladder along with infundibulum and neck from cystic plate of liver is done with sharp and blunt dissection. CVS is now achieved and confirmed that only two structures, cystic duct and cystic artery, are entering the gallbladder. Clipping of cystic duct and cystic artery is done and then both structures are divided under doublet vision. Now the gallbladder is extracted out of the abdominal cavity through 10 mm port site. The epigastric port is now closed with sutures.

Results

The study contains 248 patients out of which 200 (80.6%) patients were females and 48 (19.4%) were male. Age of the patients in this study varied from 18-59 years. The mean age was 38.5 years. Maximum number of patients belong to the age group (41-50 years). BMI ranged from 19-34.

Table 1: Demographics as per gender

Gender	Number	Percentage
Male	48	19.4%
Female	200	80.6%

(n=248)

It was found that cholecystitis incidence is more in females than males as confirmed by our study also.

Table 2: Demographic as per age

Age	Number	Percentage
21-30	21	8.5%
31-40	30	12.0%
41-50	176	71.0%
Above 51	21	8.5%

(n=248)

Cholecystitis is a disease of women who are around 40 years of age, our study shows the same.

Table 3: Demographic as per weight

BMI (Kg/m^2)	Number of patients	Percentage
18.5-25 (Normal)	5	2.0%
25-30 (Over Weight)	98	39.5%
31-35 (Obese)	125	51.5%
36-40 (Obese +)	20	8.0%

(n=248)

As the teaching is that cholecystitis is a disease of fatty females, our study has indicated same.

Table 4: Number of cases as per type of cholecystitis

Type of cholecystitis	Number of patients	Percentage
Acute cholecystitis	84	33.9%
Chronic cholecystitis	156	62.9%
Acute cholecystitis with perforation of gallbladder	2	0.8%
Acute cholecystitis with gangrene of gallbladder	6	2.4%

(n=248)

The study included only the patients of calculous cholecystitis. Cases of acalculous cholecystitis were not included in this study. Patients were divided into 4 groups as per the degree of inflammation and complications like perforation and gangrene.

Table 5: Distribution of cases as per cholecystectomy

Type of cholecystectomy	Number o patients	Percentage
Routine cholecystectomy	225	90.7%
Subtotal cholecystectomy	14	5.7%
Conversion to open cholecystectomy	9	3.6%

(n=248)

It was found in the study that difficult gallbladder cases were first tried with laparoscopic cholecystectomy, but when it was found difficult to proceed then 14 cases (5.7%) were converted to subtotal cholecystectomy and 9 cases (3.6%) were converted to open cholecystectomy.

Table 6: Distribution of cases as per post-operative complications

Post-operative Complications	Number of patients	Percentage
Bile leak	14	5.7%
Port site infection	11	4.4%
Bile duct injury	0	0%
Vascular injury	0	0%
Perforation of gallbladder during cholecystectomy	8	3.2%

(n=248/33)

The study noticed some complication which subsided within few days and no serious complication like BDI/VI were encountered. In eight cases (3.2%) perforation of gallbladder happened while handling the gallbladder. It was due to extreme inflammation causing friable gallbladder wall.

Discussion

Gallstone disease is treated by only surgical removal of gallbladder. Laparoscopic cholecystectomy is the gold standard and globally accepted method of treatment for gallstones and cholecystitis.

Laparoscopic cholecystectomy is the current standard of care for symptomatic cholelithiasis. However, it is associated with higher incidence of complications such as bile duct injury (BDI) and vasculobiliary injury (VBI) than open cholecystectomy [30]. The most common underlying mechanism of major post-cholecystectomy BDI/VBI involves misidentification of anatomical structures [31, 32, 33].

Though there are many strategies forwarded by various workers for safe cholecystectomy, but we planned our own method of safe cholecystectomy which we call Nigam's strategy for safe cholecystectomy (NSSC). NSSC is a plan in which various steps of the surgery are included with timeouts and discussions. These timeouts and discussions before and during operation help to progress safely with dissection and good results. Calot's triangle is a crucial surgical and anatomical landmark in cholecystectomy and it should be properly identified, dissected and explored without causing any injury to bile ducts and vessels. Jean C Francois Calot (French Surgeon, 1861-1944,) originally described this triangle in 1890 which included the cystic duct, the common hepatic duct and the cystic artery (not the inferior border of liver as is commonly believed) [34, 35].

The fundus should be retracted towards the right shoulder of the patient and the infundibulum should be retracted in ferolaterally towards right side of patient [36]. this will ex pose the anterior peritoneal layer over the HCT. The cystic lymphnode often lies superficial to the cystic artery and acts as a landmark to locate this artery [37]. the artery should be divided on the right side of this lymphnode close to the gallbladder to avoid injury to the right hepatic artery [38].

Like Calot's triangle, we must also take care of Rouviere's Sulcus which must be identified. Identification of all the landmarks are important to avoid injuries. Critical view of safety (CVS) is the basis of laparoscopic cholecystectomy and is the critical to the safe cholecystectomy. Strasberg and colleagues in 1995 first suggested a three-pronged strategy called the 'critical view of safety' (CVS), to minimize the risk of bile duct injuries in laparo scopic cholecystectomy [39]. Line of safety which is also called R4U (Rouviere's sulcus, segment 4 of liver, umbilical fissure) divides the safe and unsafe zones for dissection.

Majority of vasculobiliary injuries during laparoscopic cholecystectomy continue to occur at 0.2% to 0.6% and the vast majority (upto 0.75%) are related to misidentification of anatomical structures [40].

BDI and VBI during laparoscopic cholecystectomy are dangerous and even become lethal so the dissection must be careful and minimal. Use of cautery should be as minimal as possible. Inspite of achieving CVS the biliary and vascular injuries are not 100% prevented. Large case series of laparoscopic cholecystectomies in which the CVS was routinely applied, have reported rate of major bile duct injuries upto 0.54% [26-28]. With proper understanding and training, the CVS can be attained in 85-95% of cases in routine practice.[41]

Bile duct injury is an especially serious and potentially life-threatening complication that occurs at a reported rate of 0.08-1.5%.[42-45] Thorough knowledge of anatomy and recognition of the anatomical landmarks is the basic factor in performing safe cholecystectomy along with the achievement of CVS.

We have observed in NSSC that there should be proper and careful planning to deal with "difficult gallbladder". "Difficult cholecystectomy" is sometimes very troublesome and requires thought provoking planning as we do in NSSC. The preoperative suspicious of difficult gallbladder is important for being ready to deal with difficulties in cholecystectomy. It also helps the surgeon in being better prepared to anticipate the intra-operative difficulties.[46]

In order to enhance the safety of cholecystectomy and re duce the rate of biliary duct injury, in 2014 the society of Gastrointestinal and Endoscopic Surgeons (SAGES) formed the Safe Cholecystectomy Task Force with the goal of enhancing a culture of safety around this procedure.[47] As the insight into the mechanisms involved in BDI/VBI during LC has evolved[48-50] a large number of strategies have been proposed to safeguard against BDI/VBI.[51,52] Our strategy of doing safe cholecystectomy is also an attempt to explain the way to do it without BDI/VBI. NSSC always considers critical view of safety achievement as a basis of safe cholecystectomy.

We have noticed that planning for a safe cholecystectomy by using NSSC reduces the rate of complication and abolishes the serious complications like bile duct injury and vasculobiliary injury. NSSC should be extensively promoted to lead more and more safe laparoscopic cholecystectomies with least complications.

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Declaration of patient consent

Informed consent was taken from patients.

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Conflicts of interest

There are no conflicts of interest.

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