Laparoscopic Cholecystectomy in High Risk Cardiac Patient with DM

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Abstract

Introduction: Laparoscopic cholecystectomy remains the standard treatment for cholelithiasis. Ever increasing number of patients with myriad of medical illness is being treated by this technique. However, significant concern prevails among the surgical community regarding its safety in patients with cardiac co-morbidity. Patients with diabetes, significant cardiac dysfunction and multiple co-morbidities were prospectively evaluated. Patients were assessed by cardiologists and anesthesiologists and laparoscopic cholecystectomy was performed.

Results: Patient demographics, details of peri-operative management and post-operative complications were studied. Between July 2014 and January 2018, 32 patients (M:F=24:08) with mean age of 55 years (range 36–78) and having significant cardiac dysfunction had undergone laparoscopic cholecystectomy. Of these, 24 patients were in NYHA class-II, while 8 belonged to class-III. Left ventricular ejection fraction, as recorded by transthoracic echocardiography, was 20–30% in 08 (25%) patients and 30–40% in the rest 24 (75%). In addition, 21 (71%) patients had regional wall motion abnormalities, 11 (34%) patients had cardiomyopathy while 09 (39%) patients had prior cardiac interventions. Following laparoscopic cholecystectomy, hypertension (21), tachyarrhythmia (4) and bradycardia (2) were the commonest events encountered. Two patients required dopamine in the immediate postoperative period but all other patients made an uneventful recovery.

Conclusion: With appropriate cardiological support, laparoscopic cholecystectomy may be safely performed in patients with significant cardiac dysfunction.

Keywords: Laparoscopy, Cholecystectomy, High Risk Cardiac Patient.

Introduction

Laparoscopic surgery has become very popular as its advantages include minimally invasive nature, less postoperative pain, early return to activities, less postoperative ileus, less wound infections and superior cosmesis1. Since the introduction of laparoscopic cholecystectomy by Philip Mouret in 1987, the technique was rapidly accepted by the surgical community2. The appeal of diminished pain and fatigue, early return to normal activities and superior cosmesis has made it a popular surgery3. Previous abdominal surgery, acute cholecystitis4, morbidobesity5, old age6 and pregnancy7 were traditional contraindications for laparoscopic cholecystectomy.

However, in the recent years, development of surgical skills and better understanding of the pathophysiology of pneumoperitoneum have made it possible to offer laparoscopic cholecystectomy to patients suffering from myriad of medical illness.
Nonetheless, concerns remain about thesafety of this technique in patients with cardiac comorbidity.

Diabetes mellitus is the most common endocrine abnormality encountered in surgical patients and is associated with increased perioperative morbidity and mortality mainly due to the complications of the disease.

Diabetic patients frequently have cardiovascular disorders such as hypertension, ischaemic heart disease and left ventricular dysfunction and very often associated with autonomic neuropathy which may aggravate during pneumoperitoneum. Therefore effective measures are to be sought to reduce these responses and minimize intra-operative hazards.

During laparoscopy, positive pressure pneumoperitoneum using carbon dioxide could have deleteriouseffects on the cardiovascular system [8]. Therefore, standard text books often cite patients with cardiacdysfunction a relative contraindication to laparoscopiccholecystectomy [4]. Similar anxiety also prevails amongst the surgical and anaesthetist community and laparoscopiccholecystectomy is often discouraged in patients withsignificant cardiac diseases.

On the contrary, the physiologicalstress following minimally invasive surgery is lesseras compared to patients undergoing open cholecystectomy [9–11]. This begs the question whether the purported risk of pneumoperitoneum could be offset by the diminished stressfollowing minimally invasive surgery, thereby bringing thepatients with cardiac co-morbidity within the ambit oflaparoscopic cholecystectomy. This prospective study was undertaken in a tertiary care hospital to evaluate thesafety of laparoscopic cholecystectomy in patients withischemic heart disease and significant cardiac dysfunction.

**Materials and Methods**

This observational study was started inJuly 2016. Since inception, patient demographics, operative data and post-operative course of all patients were prospectively recorded in a computerised database. Pre-operative Assessment Patients with significant ischemicheart disease were evaluated by resting ECG and transthoracic echocardiography. They were subsequently evaluated by cardiologists and anesthetist in pre anesthetic check up.

The patients were grouped according to the New York Heart Association (NYHA) functional classification system [12]. For this study, patients belonging to NYHA II and III were included. Diabetic was controlled by short acting insulin and other associated systemic diseases (like HTN, Br. Asthma) if present were optimized by taking consultation from respective consultant. Patients on antiplatelet drugs were asked to stop these medicines 5 days before surgery. Beta-blockers were started preoperatively in those who were not receiving such drugs previously. Patients on anticoagulants were switched over to some form of heparin according to standard dosage schedule and were taken up for surgery when international normalized ratio (INR) fell below 1.5.

All patients were premedicated with Midazolam (7.5 mg), Ondansetron (4 mg) and Omeprazole (20 mg) in the night before surgery and cardiac medications, except angiotensin converting enzyme inhibitors, were continued till the morning of surgery.

Operative management laparoscopic cholecystectomy was performed early in the morning after a minimum of 4 hours of fasting. Venous access was obtained with an 18 G peripheral venous cannula. Monitoring was started with the patient awake, pulse oximeter, temperature, noninvasive blood pressure (BP), and five lead electrocardiogram (ECG).

In patients who have had permanent pacemaker implanted, the mode was changed to fixed mode prior to surgery. Arrangement of temporary pacing, defibrillator and syringes with preloaded life saving drugs were kept ready. After preoxygenation with 100% oxygen, anaesthesia was induced with Fentanyl (2–3 mcg/kg), midazolam 0.03 mg/kg and Propofol (1–2 mg/kg) IV slowly. Atracurium (0.5 mg/kg) was used for intubation/ Laryngeal mask insertion while anaesthesia was maintained with Oxygen, continuous propofol pump, intermittent Atracurium and Fentanyl. Heart rate, blood pressure, oxygen saturation, ECG and end-tidal CO2 (ETCO2) were monitored continuously (Philips®, MP20, Germany). Intravenous crystalloid solution administered cautiously. All patients were mechanically ventilated and ETCO2 was maintained between 30–35 mmHg. Standard 4-port laparoscopiccholecystectomy was performed. The initial intra-umbilical camera port was introduced using theopen technique [12]. Carbon dioxide insufflation was initiated and maintained at 5 litres/ min and other ports were introduced under vision.

The higher limit of intra-abdominal pressure was kept at 8 mmHg and surgery was performed in 15°–20° reverse Trendelenburg position with right tilt.

The following parameters were measured heart rate (HR), BP, SpO2, peak airway pressures (PAPs), and lung compliance.
Upon completion of surgery, peritoneal carbon dioxide was released very slowly. Post-operative Management after the procedure, patients were closely monitored in the post-anaesthetic care unit for 4 to 5 hrs. Majority of the patients were shifted to the ward, while those with troubled intra-operative course were shifted to SICU for overnight observation. Adequate post-operative analgesia was ensured by continuous intravenous morphine (1 mg/hour) in the immediate post-operative period with oral paracetamol (10 mg/kg/dose) was administered subsequently.

Intravenous fluid was continued till the evening while oral intake was commenced after 4–5 hours. Anticoagulants and insulin were started according to well described guidelines.

**Results**

Between July 2016 and December 2018, a total of 3287 diabetic patients underwent laparoscopic cholecystectomy. Of these, 665 patients gave history of ischaemic heart disease, 11 patients had dilated cardiomyopathy, well maintained on cardiac medicines, 38 had undergone coronary artery bypass grafting while 58 patients had angioplasty and stenting in the past.

Amongst this heterogenous group, 32 patients belonging to NYHA grade II (24 patients) and grade III (8 patients) were included in this study (Table 1). The mean age was 55 years (range 38–76) with a striking male preponderance. Ten (31%) patients had some kind of cardiac intervention prior to surgical referral while the rest were under medical management. Two patients had bifascicular block but did not require temporary pacemaker during the perioperative period (Table 2). Transthoracic echocardiography showed a left ventricular ejection fraction of 20–30% in 08 patients, while it was between 30–40% in the rest 24 patients. In addition, echocardiography also picked up regional wall motion abnormalities in 21 (65%), cardiomyopathy in 11 (34%).

Laparoscopic cholecystectomy was performed in all patients (Table 3). The commonest intra-operative problem was episodes of hypertension (21 patients), which always started during peritoneal insufflation, and was controlled by GTN infusion.

On the other hand, 5 patients developed hypotension necessitating immediate desufflation and intravenous infusion of vesopressor agents (noradrenaline and adrenaline). One patient developed tachyarrhythmia during surgery, requiring Amiodarone infusion.

These Intraoperative situations did not require conversion to laparotomy and all the patients were extubated/remove LMA in the operating room. In the post-operative period, 3 patients developed tachyarrhythmia, which required defibrillation in 1 patient.

In the rest 2 patients, there was no haemodynamic compromise. These patients were monitored and the tachycardia subsided spontaneously.

**Table I: Patient Profile**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of Patient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>55 years (38-76)</td>
<td>55%</td>
</tr>
<tr>
<td>Male:Female ratio</td>
<td>24:08</td>
<td>24:08</td>
</tr>
<tr>
<td>Presence of Medical Comorbidity</td>
<td>30 patients</td>
<td>30%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>28</td>
<td>87.50%</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>01</td>
<td>3.2%</td>
</tr>
<tr>
<td>Asthma/COPD</td>
<td>05</td>
<td>15.62%</td>
</tr>
<tr>
<td>CRF</td>
<td>21</td>
<td>65.62%</td>
</tr>
<tr>
<td>Preveious history of cardiac intervention</td>
<td>10</td>
<td>31.25%</td>
</tr>
<tr>
<td>CABG</td>
<td>03</td>
<td>9.37%</td>
</tr>
<tr>
<td>PTCA</td>
<td>07</td>
<td>21.87%</td>
</tr>
<tr>
<td>Pacemaker</td>
<td>01</td>
<td>3.125%</td>
</tr>
<tr>
<td>NYHA</td>
<td>24</td>
<td>75.00%</td>
</tr>
<tr>
<td>Class-III</td>
<td>08</td>
<td>25.00%</td>
</tr>
</tbody>
</table>


**Table II: Pre-operative cardiac status of 32 patients as per Echocardiography findings**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>No. of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. LVEF between 20-30%</td>
<td>08</td>
<td>25%</td>
</tr>
<tr>
<td>LVEF between 30-40%</td>
<td>24</td>
<td>75%</td>
</tr>
<tr>
<td>Regional wall motion abnormality</td>
<td>21</td>
<td>65.62%</td>
</tr>
<tr>
<td>Dilated cardiomyopathy</td>
<td>11</td>
<td>34.37%</td>
</tr>
<tr>
<td>Bifascicular block</td>
<td>2</td>
<td>6.25%</td>
</tr>
<tr>
<td>Valvular disease</td>
<td>2</td>
<td>6.25%</td>
</tr>
</tbody>
</table>

LVEF: left ventricular ejection fraction
Discussion

This multispecialty hospital is the largest diabetic hospital in Bangladesh. More than 40,000 diabetic patients admitted in this hospital per year for their treatment. Amongst these a large number of patients are admitted for laparoscopic cholecystectomy. Most of these patients suffer from diabetic with cardiac illness or have had some kind of cardiac intervention.

Haemodynamic and cardiovascular changes of positive pressure CO\textsubscript{2} pneumoperitoneum on an anaesthetized patient lying in a reverse Trendelenberg position are often interrelated and their individual contribution is difficult to disentangle.

As a generalisation, pneumoperitoneum orchestrates a neurohormonal stress response which increases systemic vascular resistance, mean arterial blood pressure and heart rate\textsuperscript{14–16}. These factors increase the afterload and myocardial oxygen consumption which are poorly tolerated by patients with cardiac dysfunction\textsuperscript{17}. Elevated intra-abdominal pressure and reverse Trendelenburg position reduce venous return and preload and decrease cardiac output\textsuperscript{18,19}. This combination of decreased preload and increased afterload increase cardiac work load and could precipitate cardiac ischemia or infarction.

Patients with ischemic heart disease are prone to develop atrial fibrillation, a condition which could be precipitated by CO\textsubscript{2} pneumoperitoneum\textsuperscript{20}. Most of the studies addressing cardiovascular effects of CO\textsubscript{2} pneumoperitoneum have been performed in healthy subjects, who seem to tolerate pneumoperitoneum without untoward problem\textsuperscript{[15, 16, 21]}.

Similar issues have not been studied under the setting of randomized trial in patients with cardiac co-morbidities\textsuperscript{22}. May be hence, there is considerable reticence among surgeons in performing laparoscopy in patients with compromised heart.

However, laparoscopic cholecystectomy has been successfully performed in small series of 10-14 patients\textsuperscript{23,24,25} with ASA III/IV cardiac dysfunction. To avoid the complications of pneumoperitoneum, gasless laparoscopic cholecystectomy (abdominal wall lifting) has been used as an alternative to laparoscopy in high risk patients\textsuperscript{26}. Although abdominal wall lifting is associated with less circulatory changes and improved post-operative cognitive function, there is increased risk of surgical error\textsuperscript{27}.

Meticulous history taking and subjective assessment of patients undergoing laparoscopic cholecystectomy is an important aspect of managing such patients. Scoring systems like ASA physical status, Goldman cardiac index, Canadian Cardiac Scoring system, NYHA functional classification have been devised to assess the risk of intra- and postoperative cardiac complications.

Of these, the NYHA is the most commonly used grading system of cardiac dysfunction\textsuperscript{12,28}. It is interesting to note that although the left ventricular ejection (LVEF) on resting transthoracic echocardiography is very commonly used to assess cardiac function, LVEF is not apart of any of these scoring systems.

Hence there is little reason to discourage laparoscopic cholecystectomy on the basis of single

### Table -III: Results of laparoscopic cholecystectomy in 32 patients with cardiac co-morbidities

<table>
<thead>
<tr>
<th>Intra-operative course and complications</th>
<th>Number</th>
<th>percentage</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-operative complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Persistent HTN</td>
<td>21</td>
<td>65.62</td>
<td>GTN, Desufflation</td>
</tr>
<tr>
<td>• Hypotension and</td>
<td>05</td>
<td>15.62</td>
<td>IV pressor support</td>
</tr>
<tr>
<td>• Bradycardia</td>
<td>01</td>
<td>3.12</td>
<td>Inj. Atropine</td>
</tr>
<tr>
<td>• Tachyarrhythmia</td>
<td>01</td>
<td>3.12</td>
<td>Inj. Esmalol</td>
</tr>
<tr>
<td>Post-operative complication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Tachyarrhythmia</td>
<td>03</td>
<td>9.37</td>
<td>Beta-blocker</td>
</tr>
</tbody>
</table>

HTN: Hypertension, GTN: Glycerin tri-nitrate
LVEF value. Moreover, assessment of LVEF is operator dependent\textsuperscript{29}.

Despite these shortcomings, some textbooks continue to lay importance on LVEF, whereas a 40% cutoff value is considered safe for surgery\textsuperscript{30,31}. As a matter of policy, it has been our practice to refer such patients for rigorous preoperative assessment by cardiologist and anesthesiologist. Premedication with midazolam helps reduce anxiety and stress and the heart rate\textsuperscript{32}. Preoperative hydration or volume loading is thought to preserve cardiac output during laparoscopic surgery\textsuperscript{33}. But, in this study, intravenous volume overloading was not practiced; instead, fasting more than 4 hours was avoided and patients were operated early in the morning. Due to cardiac dysfunction, intravenous fluid was administered judiciously while oral fluid was commenced as early as 4-5 hours after surgery. To diminish the stress on the heart during induction and maintenance of anaesthesia, midazolam, propofol, fentanyl and low dose helothane were used. These agents cause very little cardiac and circulatory changes. Tachycardia should be prevented and in 6 (21\%) patients, intravenous esmolol, a cardio-specific beta-blocker, was used to control intraoperative tachycardia. Adequate depth of anaesthesia and pain control also helps prevent tachycardia. The pressure effects of pneumoperitoneum could be partially offset by using a low insufflation pressure. Some studies define ‘normal’ insufflation pressure as 12–15 mmHg and a ‘low’ pressure as 5–7 mmHg\textsuperscript{22} while a recent review arbitrarily considered anything less than 12 mmHg as low pressure\textsuperscript{34}. Studies in healthy individuals have shown less pronounced decrease in cardiac index using low-pressure peritoneal insufflation, while the pulmonary parameters have remained more or less in line in both the groups\textsuperscript{14,35,36}. By and large, the low pressure group has shown less post-operative pain and diminished analgesic requirement, but such was always not the case\textsuperscript{34}.

In patients with cardiac dysfunction, four nonrandomized studies have shown less haemodynamic alterations under low insufflation pressure\textsuperscript{6, 37-39}.

In the present study, a peritoneal pressure of 8 mmHg was used, and this figure was arbitrarily chosen. On occasions, this slow intra-peritoneal pressure prevented adequate exposure of the Calot’s triangle. In such situations, either the peritoneal pressure was temporarily increased to 12 mmHg, till the triangle was safely dissected, and cystic duct/artery were clipped and then the pressure was decreased to 8 mmHg. Rapid insufflation with CO\textsubscript{2} stretches the peritoneum and could precipitate cardiac arrhythmia\textsuperscript{40}. Therefore, a low rate of insufflation of 5 liters/min was routinely used in this study.

**Conclusion**

The present study showed that laparoscopic cholecystectomy may be safely performed in patients with significant cardiac dysfunction. Such patients need proper evaluation in pre anaesthetic check up and by the cardiologists.

A single transthoracic echocardiographic estimation of left ventricular ejection fraction should not be given undue importance. If considered safe to undergo general anaesthesia, such patients should not be denied the benefits of laparoscopic cholecystectomy.

Optimization of cardiac status, administration of balanced anaesthesia and low-pressure pneumoperitoneum are essential steps to ensure patient safety. The chances of life-threatening complications are rare, and in the eventuality, can be easily managed in a hospital with adequate cardiological support.

**References**


