ORIGINAL RESEARCH

The assessment of laparoscopic cholecystectomy using low-pressure pneumoperitoneum

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Received: 30 October, 2023 Accepted: 26 November, 2023

ABSTRACT

Aim: Assessment of laparoscopic cholecystectomy using low-pressure pneumoperitoneum.

Material and method: This research comprised a total of 70 patients who were hospitalised for elective laparoscopic cholecystectomy. The research excluded patients who had open cholecystectomy, those with acute inflammation or any other complications related to gallstone disease, and those with choledocholithiasis. Postoperative shoulder tip pain was evaluated at 6, 12, and 24 hours following the procedure using the Visual Analogue Scale of Pain (V.A.S). A pain scale, ranging from 0 (no pain) to 10 (agonising pain), was used to enable patients to indicate the severity of their shoulder tip discomfort by selecting a position on the scale that most accurately reflected their current condition. Patients were cognizant that the scale was used to assess the existence and severity of widespread postoperative pain.

Results: The mean operative time was 35.11±3.58 minutes. Pain scores for postoperative shoulder tip pain, as analysed by visual analogue scale, were 5.01±0.69, 2.55±0.19 and 0.29±0.01 at 6, 12 and 24 hours respectively. Oral feeds were started on 0^{th} postoperative day in 91.43% of the patients. The mean postoperative stay was 1.44±0.11 days. No major complications were observed on mean 6 months follow-up.

Conclusion: Low-pressure pneumoperitoneum during laparoscopic cholecystectomy is safe in skilled hands with fewer frequency of early postoperative problems notably shoulder tip discomfort.

Keywords: laparoscopic cholecystectomy, low-pressure pneumoperitoneum, Pain,

INTRODUCTION

Laparoscopic cholecystectomy has swiftly supplanted open cholecystectomy as the preferred therapy for individuals with gall bladder illness, particularly cholelithiasis. It is currently the preferred technique for patients with symptomatic cholelithiasis[1]. The use of laparoscopic technology in the field of general surgery has seen a boom in popularity over the last several decades. The patients readily accept the tiny, restricted incisions, which provide the advantage of expedited recuperation. Reducing the duration of postoperative hospitalisation and minimising the need for postoperative pain relief might help save healthcare expenses[2]. The rising success of laparoscopic surgery may be attributed to the purported advantages it offers. For laparoscopic cholecystectomy, the patient is positioned in the Trendelenburg position and the procedure is conducted using three or four standard ports. The gall bladder architecture is sufficiently visualised by the introduction of carbon dioxide gas into the abdominal cavity, which creates pneumoperitoneum[3]. Nevertheless, the use of carbon dioxide pneumoperitoneum might lead to unfavourable outcomes as a result of either excessive carbon dioxide levels in the blood or elevated pressure within the abdomen. The physiological alterations seen during laparoscopic surgery arise from the patient's positioning, the injection of external insufflation gas, and the rise in intraabdominal pressure caused by pneumoperitoneum[4]. Laparoscopic cholecystectomy is associated with lower postoperative discomfort and decreased use of pain medication compared to open cholecystectomy. The postoperative discomfort experienced after laparoscopy varies significantly from that after laparotomy. While laparotomy mostly leads to parietal discomfort (abdominal pain), patients tend to report experiencing greater visceral pain after surgical laparoscopy. The occurrence of shoulder discomfort is often reported after laparoscopic surgery, with gynaecologists first noting this phenomenon during their earliest encounters with laparoscopic sterilisation procedures[5]. Several clinical studies have been conducted to assess the use of low-pressure pneumoperitoneum with normal pressure pneumoperitoneum in laparoscopic

cholecystectomy[6]. Research has shown that a high level of pressure inside the abdomen, known as pneumoperitoneum, is linked to greater variations in hemodynamic parameters and higher absorption of carbon dioxide in the peritoneal cavity during laparoscopic cholecystectomy, as compared to a low-pressure pneumoperitoneum[7,8]. The use of low pressure pneumoperitoneum in laparoscopic cholecystectomy provides surgeons with equivalent safety and flexibility compared to normal pressure pneumoperitoneum. Additionally, it aids in minimising acute postoperative problems, particularly shoulder discomfort. The current research was undertaken to assess the efficacy of low pressure pneumoperitoneum during laparoscopic cholecystectomy.

MATERIAL AND METHOD

This research comprised a total of 70 patients who were hospitalised for elective laparoscopic cholecystectomy. The research excluded patients who had open cholecystectomy, those with acute inflammation or any other complications related to gallstone disease, and those with choledocholithiasis.

METHODOLOGY

A laparoscopic cholecystectomy was conducted using four ports. Specifically, two ports measuring 10mm in diameter were inserted in the epigastrium and umbilical areas, while the other two ports, measuring 5mm each, were placed in the right hypochondrium and flank. Carbon dioxide insufflation was used to create a low pressure pneumoperitoneum at 8 mm Hg. The remaining stages adhered to the same protocol as in a standard laparoscopic cholecystectomy. The observations were recorded regarding the duration of the surgery, any complications that occurred during the operation and how they were managed, instances where the surgical procedure had to be changed to normal pressure pneumoperitoneum and the reasons for this change, instances where the procedure had to be converted to an open cholecystectomy and the reasons for this conversion, assessment of postoperative pain, initiation of oral feeding, the use of drainage and the subsequent removal of the drain, patient mobility, and the length of hospital stay. Postoperative shoulder tip pain was evaluated at 6, 12, and 24 hours following the procedure using the Visual Analogue Scale of Pain (V.A.S). A pain scale, ranging from 0 (no pain) to 10 (agonising pain), was used to enable patients to indicate the severity of their shoulder tip discomfort by selecting a position on the scale that most accurately reflected their current condition. Patients were cognizant that the scale was used to assess the existence and severity of widespread postoperative pain. The analgesic needs of all patients throughout the postoperative phase and the duration of their hospital stay were also documented.

RESULTS

The study was conducted on 70 patients including 39females (55.71%) and 31 males (44.29%), undergoing elective laparoscopic cholecystectomy. Most of the patients were in the 25-35 years. Pain right upper quadrant was the commonest presenting symptom 55(78.57%). All the patients had ultrasonography documented cholelithiasis without signs of inflammation. Most of the patients had multiple stones in gallbladder 52(74.29%). Intraoperatively gallbladder was normal sized in 35 cases (50%), distended in 20 cases (28.57%) and contracted in 15 cases (21.43%), cholesterosis was present in 9 cases (12.86%) and biliary sludge in 14 cases (20%). No major intraoperative complication was noted. No conversion was made to normal pressure laparoscopic cholecystectomy or open cholecystectomy. The mean operative time was 35.11±3.58 minutes. Pain scores for postoperative shoulder tip pain, as analysed by visual analogue scale, were 5.01±0.69, 2.55±0.19 and 0.29±0.01 at 6, 12 and 24 hours respectively. Oral feeds were started on 0^{th} postoperative day in 91.43% of the patients. The mean postoperative stay was 1.44±0.11 days. No major complications were observed on mean 6 months follow-up.

Table: 1 Gender and age of the participants

Gender	Number=70	Percentage
Male	39	55.71
Female	31	44.29
Age		
below 25	10	14.29
25-35	50	71.43
35-45	8	11.43
Above 45	2	2.85

Table 2: Operative time

Operative time (minutes)	Mean	SD
	35.11	3.58

Table 3: Scores of postoperative shoulder tip pain on V.A.S

Time after surgery (hours)	Mean score (V.A.S)	Standard Deviation
6	5.01	0.69
12	2.55	0.19
24	0.29	0.01

Table 4: Postoperative day of start of oral feeds.

Postoperative day	Number of patients	Percentage
0^{th} POD	64	91.43
2^{nd} POD	5	7.14
$>2^{nd}$ POD	1	1.43

DISCUSSION

Over the last several centuries, a variety of inventive and imaginative methods have been developed to treat people suffering from symptomatic gallbladder stone illness. Previously, the administration of a magnesium sulphate solution was suggested as a treatment for biliary colic. As surgical methods advanced, John Bobhs, an Indian surgeon[9], and others sought to conduct cholecystolithotomy. However, this procedure, although improving the initial symptoms, had a greater risk of recurrence. Subsequently, the bile acid dissolution treatment was introduced. Currently, there are two commercially available medicines for the oral dissolving of gallstones. However, their indications are restricted and the incidence of recurrence is significant. Due to its high frequency and recurrence rate, cholecystectomy is considered the preferred therapy for gallstone disease. Cholecystectomy is now the most frequently performed major abdominal surgery by general surgeons worldwide. While there is no comprehensive data available from India, sources suggest that around 10-25% of all procedures are associated with the biliary tract[10]. Karl Langenbuch conducted the first cholecystectomy on July 15, 1882 in Berlin[11]. He famously said, "The gall bladder should be removed not due to the presence of stones, but because it is the source of their formation." Cholecystectomy has long been considered the most effective therapy for patients with symptomatic cholelithiasis. However, there has been ongoing disagreement among surgeons, gastroenterologists, interventional radiologists, and more recently, surgical endoscopists, on the best approach for this treatment. Philip Mouret conducted the first laparoscopic cholecystectomy, as documented in medical literature, in 1987 in Paris, France[12]. Reddick and Oslen developed the current technique for laparoscopic cholecystectomy and performed their first procedure in September 1988. Within a short period of time, the approach gained acceptance and underwent fast development, ultimately becoming the standard procedure for managing calculus disease of the biliary system[13]. In 1988, Reddick EJ et colleagues developed the current technique for laparoscopic cholecystectomy and made it available as an outpatient treatment. In the conventional method of laparoscopic cholecystectomy, the procedure starts at Calot's triangle, where the structures at porta hepatis are identified. From there, dissection is carried out towards the fundus[14].

The laparoscopic cholecystectomy procedure uses carbon dioxide insufflation, facilitated by a pressure controlling automated insufflator, to generate pneumoperitoneum and provide sufficient visibility of the gallbladder architecture. Surgeons doing laparoscopic surgeries used to quote the dictum "The greater the pressure, the superior the view" to emphasise the need of sufficient exposure. Nevertheless, it is likely that intra-abdominal pressures over 12 mmHg do not significantly result in a substantial increase in the gas-filled abdominal cavity, even among those who are overweight. The continuous maintenance of high pressure inside the abdomen throughout the surgery leads to several unfavourable outcomes, caused by either excessive carbon dioxide levels or increased pressure within the abdomen. The physiological changes noticed during laparoscopic cholecystectomy are caused by the patient's posture, the introduction of external insufflation gas (carbon dioxide), and the increased pressure inside the abdomen owing to pneumoperitoneum. Gynaecologists first observed shoulder soreness during their early encounters with laparoscopic sterilisation. Postoperative shoulder discomfort is a frequent occurrence after laparoscopic cholecystectomy. The occurrence of this condition varies, although it is prevalent, affecting around one third of individuals after undergoing laparoscopic cholecystectomy[15]. The duration of the discomfort typically spans 2-3 days and may be alleviated by common analgesics such paracetamol and codeine[16]. Various factors have been proposed as potential causes of shoulder discomfort after laparoscopic surgery, including the impact of carbon dioxide pneumoperitoneum, stretching of the peritoneum, irritation of the diaphragm, damage to the diaphragm, and even shoulder abduction during the procedure[17]. Shoulder tip discomfort that persists for an extended period of time indicates stimulation of the phrenic nerve. According to some writers, carbon dioxide undergoes a transformation by mixing with fluid in the peritoneal cavity, resulting in irritative carbonic acid. On the other hand, other authors highlight that shoulder discomfort is often caused by diaphragmatic irritation due to CO2

pneumoperitoneum. A number of methods have been tried to reduce the incidence of shoulder tip pain following laparoscopic cholecystectomy like, low-pressure insufflations[19], slow rate of insufflations[20], pre-emptive diaphragmatic local anaesthetic irrigation[21], regional anaesthesia to peritoneal surfaces in the operative area[22]. The use of low-pressure pneumoperitoneum minimises the need for postoperative analgesics, decreases postoperative hospital stay and consequently enhances the quality of life in early phases of postoperative rehabilitation. Low-pressure pneumoperitoneum remains a safe alternative for laparoscopic cholecystectomy. Its usage adds to greatly to a major decrease of the postoperative problems specifically shoulder tip discomfort. In turn, particularly in challenging instances, low-pressure laparoscopic cholecystectomy would become a technically hard technique, even in experienced hands, and its adoption required strong surgical judgement.

CONCLUSION

Low-pressure pneumoperitoneum during laparoscopic cholecystectomy is safe in skilled hands with fewer frequency of early postoperative problems notably shoulder tip discomfort. It is advantageous in certain instances since it generates fewer hemodynamic alterations intraoperatively, the longer learning curve being the sole limiting element.

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