Original Research Article

Evaluation of low-pressure pneumoperitoneum laparoscopic cholecystectomy

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Abstract

Laparoscopic cholecystectomy has become the most standard procedure for management of symptomatic cholelithiasis or acute cholecystitis in patients without and specific contraindications. Exposure of gallbladder anatomy during laparoscopic cholecystectomy requires creation of pneumoperitoneum by carbon dioxide insufflation. However, the application of carbon dioxide pneumoperitoneum may induce undesirable consequences due to either hypercapnea or increased intraabdominal pressure. The physiological changes observed during laparoscopic surgery are a result of patient position, introduction of exogenous insufflation gas and increased intraabdominal pressure due to pneumoperitoneum. Although laparoscopic cholecystectomy results in less postoperative pain and reduced analgesic consumption as compared with open cholecystectomy. The type of pain after laparoscopy differs considerably from that after laparotomy i.e; visceral pain. Shoulder pain is a common complaint following laparoscopic surgery, initially being recognised by gynaecologists during early experience with laparoscopic sterilization. The present study was conducted to evaluate the technique of low-pressure pneumoperitoneum during laparoscopic cholecystectomy. Fifty patients admitted for elective laparoscopic cholecystectomy were included in the study. Laparoscopic cholecystectomy was performed using standard four ports. Low pressure pneumoperitoneum was generated using carbon dioxide insufflation at a pressure of 8 mmHg. Rest of the steps followed were same as in conventional laparoscopic cholecystectomy. No major intraoperative or postoperative complication was noted. No conversion was required to standard pressure laparoscopic cholecystectomy or open cholecystectomy. Low-pressure pneumoperitoneum offers the surgeon the same safety and versatility during laparoscopic cholecystectomy as it confers during normal pressure pneumoperitoneum and helps in reducing immediate postoperative complications especially postoperative shoulder pain.

Keywords: low-pressure pneumoperitoneum, laparoscopic cholecystectomy, cholelithiasis, shoulder tip pain

Introduction

Laparoscopic cholecystectomy has rapidly replaced open cholecystectomy for treatment of patients with gall bladder disease especially cholelithiasis and has now become the procedure of choice for patients with symptomatic cholelithiasis.

The use of laparoscopic technique in general surgery has gained increasing popularity in the last few decades. The small limited incisions are well accepted by the patients and there is the benefit of faster recovery. Health costs may be decreased by diminishing length of postoperative hospital stay and by reducing the need for postoperative analgesia[1]. The benefits reported after laparoscopic surgery explains its increasing success.

During laparoscopic cholecystectomy patient is placed in the Trendelenburg position and the surgery is performed through three or four conventional ports. Adequate exposure of the gall bladder anatomy is provided by pneumoperitoneum created by carbon dioxide insufflation. However, the application of carbon dioxide pneumoperitoneum may induce undesirable consequences due to either hypercapnea or increased intraabdominal pressure. The physiological changes observed during laparoscopic surgery are a result of patient position, introduction of exogenous insufflation gas and increased intraabdominal pressure due to pneumoperitoneum[2].

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Although laparoscopic cholecystectomy results in less postoperative pain and reduced analgesic consumption as compared with open cholecystectomy.The type of pain after laparoscopy differs considerably from that after laparotomy. Indeed, whereas laparotomy results mainly in parietal pain (abdominal pain), patients complain more of visceral pain after operative laparoscopy. Shoulder pain is a common complaint following laparoscopic surgery, initially being recognised by gynaecologists during early experience with laparoscopic sterilization[3].Numerous clinical trials have been done to compare low-pressure pneumoperitoneum with standard pressure pneumoperitoneum in laparoscopic cholecystectomy[4]. A high intra-abdominal pressure pneumoperitoneum was found to be associated with more fluctuations in hemodynamic parameters and increased peritoneal absorption of carbon dioxide as compared to low-pressure pneumoperitoneum in laparoscopic cholecystectomy[5].Low-pressure pneumoperitoneum offers the surgeon the same safety and versatility during laparoscopic cholecystectomy as it confers during normal pressure pneumoperitoneum and helps in reducing immediate postoperative complications especially postoperative shoulder pain. The present study was conducted to evaluate the technique of low-pressure pneumoperitoneum during laparoscopic cholecystectomy.

Material and method

Sample size

50 patients admitted for elective laparoscopic cholecystectomy.

Criteria for Inclusion

1. Elective surgery for gall stones.
2. Normal common bile duct (on preoperative ultrasound).

Criteria for Exclusion

1. Conversion to open cholecystectomy.

2. Acute inflammation or any other complication of gall stone disease.
3. Choledocholithiasis.
4. Co-existent liver disease.

Consent

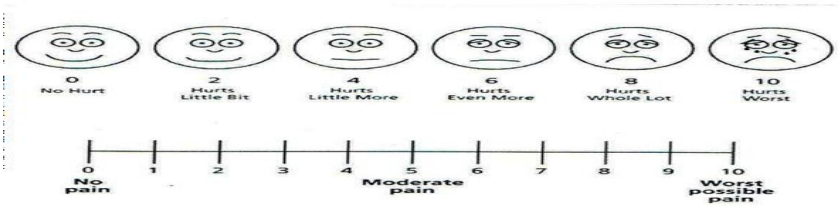
After explaining the study, a written informed consent was taken from every patient.

Operative procedure

Laparoscopic cholecystectomy was performed using four ports, two ports of 10mm diameter each in epigastrium and umbilical regions and other two of 5mm each in right hypochondrium and flank, respectively. Low pressure pneumoperitoneum was generated using carbon dioxide insufflation at a pressure of 8 mm Hg. Rest of the steps followed were same as in conventional laparoscopic cholecystectomy.

The observations were made in terms of duration of surgery, intraoperative complications and their management, conversion to normal pressure pneumoperitoneum and reason for conversion, conversion to open cholecystectomy and reason for conversion, postoperative pain assessment, start of oral feeds, drainage and postoperative removal of drain, ambulation and hospital stay.

Postoperative shoulder tip pain was also assessed at 4, 8, 24 hours after operation by the Visual Analogue Scale of Pain (V.A.S). The pain scale, with scores ranging from 0 (no pain) to 10 (agonising pain) was used, allowing patients to mark a point along the scale that best represented their shoulder tip pain at that time. Patients were aware that the scale served to analyse the presence and intensity of generalized postoperative discomfort. Analgesic requirements of all the patients in the postoperative period and length of hospital stay were also recorded.



All data was tabulated, graphical analysis was made and statistical analysis in the form of ratios and percentages was done. The data is depicted into as mean ± standard deviation or n (%) for continuous and descriptive data respectively. The suitable statistical test was applied to the available data for subgroup analysis.

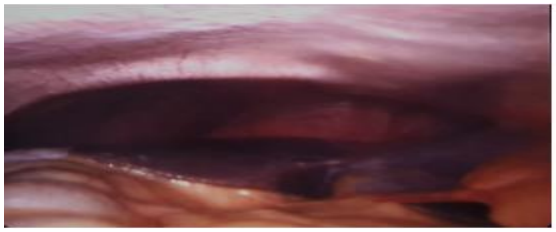


Fig 1: Laparoscopic view of abdominal cavity during low-pressure laparoscopic cholecystectomy.

Fig 2: Calot's triangle being dissected.

Fig 3: Gallbladder being dissected from liver bed.

Fig 4: Liver bed after low-pressure laparoscopic cholecystectomy.

Observations

Table 1: Distribution of cases according to duration of surgery (operative time).

Operative time (minutes)	Number of cases	Percentage
20-30	7	14
30-40	36	72
40-50	6	12
>50	1	02
Mean operative time	34.38±5.31	

Table 2: Distribution of patients according to mean scores of postoperative shoulder tip pain on V.A.S.

Time after surgery (hours)	Mean score (V.A.S)	Standard Deviation
4	4.2	0.45
8	2.2	1.1
24	0.2	0.45

Table 3: Distribution of patients according to postoperative day of start of oral feeds.

Postoperative day	Number of patients	Percentage
0th POD	45	90
1st POD	04	08
>1st POD	01	02

Results

The study was conducted on 50 patients including 28 females (56%) and 22 males (44%), undergoing elective laparoscopic cholecystectomy. Most of the patients were in the third and fourth decade of life. Pain right upper quadrant was the commonest presenting symptom (80%). All the patients had ultrasonography documented cholelithiasis without signs of inflammation. Most of the patients had multiple stones in gallbladder (78%). Intraoperatively gallbladder was normal sized in 23 cases (46%), distended in 14 cases (28%) and contracted in 13 cases (26%), cholesterosis was present in 5 cases (10%) and biliary sludge in 9 cases (18%). No major intraoperative complication was noted. No conversion was made to normal pressure laparoscopic cholecystectomy or open cholecystectomy. The mean operative time was 34.38±5.31 minutes. Pain scores for postoperative shoulder tip pain, as analysed by visual analogue scale, were 4.2±0.45, 2.2±1.1 and 0.2±0.45 at 4, 8 and 24 hours respectively. Oral feeds were started on 0th postoperative day in 90% of the patients. 96% of the patients were ambulating on 0th postoperative day. The mean postoperative stay was 1.1±0.45 days. No major complications were observed on mean 6 months follow-up.

Discussion

Gallstone disease is the most common biliary pathology and has plagued mankind for over 2000 years[6].During the last several centuries, numerous innovative and creative techniques have been introduced in an effort to manage patients with symptomatic gallbladder stone disease. Earlier, injection of water rich in magnesium sulphate was recommended to relieve biliary colic. As surgical techniques began to evolve, John Bobhs, an Indian surgeon[6] and others attempted to perform cholecystolithotomy which, although ameliorated the acute symptoms, was associated with higher incidence of recurrence. Then came the bile acid dissolution therapy. Presently, two agents for oral dissolution of gall stones are commercially available but indications are limited and recurrence rate is high. The high prevalence and recurrence rate makes cholecystectomy the treatment of choice for gall stone disease. Cholecystectomy today is the commonest major abdominal surgery performed by general surgeons throughout the world. Though no cumulative data is available from India, reports indicate that about 10-25% of all surgeries are related to the biliary tract[7].The first cholecystectomy was performed on July 15, 1882 by Karl Langenbuch in berlin[8] and with him immortalized the quotation, "The gall bladder should be removed not because it contains stones, but because it forms them." Though cholecystectomy has remained the gold standard for patients with symptomatic cholelithiasis, the treatment modality has been a bone of contention with the surgeons, gastroenterologists, interventional radiologists and of late, the surgical endoscopist.The first laparoscopic cholecystectomy recorded in Medical literature was performed by Philip Mouret in 1987 in Paris, France[9]. Reddick and Oslen however devised the currently used method for laparoscopic cholecystectomy performing their first case in September 1988. Overnight, the technique was accepted and rapidly developed into a procedure that is now the standard for management of calculus disease of the biliary system[10].Reddick EJ *et al* (1990) devised the currently used method for laparoscopic cholecystectomy in 1988 and offered this procedure on an outpatient basis. The traditional approach to laparoscopic cholecystectomy is to begin at Calot's triangle, identifying structures at porta hepatis, and thence proceeding with dissection towards the fundus[11]. During laparoscopic cholecystectomy, adequate exposure to the gallbladder anatomy is provided by pneumoperitoneum created by carbon dioxide insufflation using a pressure regulating automatic insufflator. "The higher the pressure, the better the view" used to be the axiom invoked by surgeons who needed adequate exposure for laparoscopic procedures. However, it is probable that intra-abdominal pressures exceeding 12 mmHg hardly lead to an effective enlargement of the gas filled abdominal cavity, even in obese patients. The maintenance of elevated intra-abdominal pressure for the duration of the procedure is associated with numerous undesirable consequences due to either hypercapnia or increased intra-abdominal pressure. The physiological changes observed during laparoscopic cholecystectomy are a result of patient position, introduction of exogenous insufflation gas, carbon dioxide and increased intra-abdominal pressure due to pneumoperitoneum[2].Shoulder pain was first reported by gynaecologists during early experience with laparoscopic sterilization[3]. Shoulder pain is common after laparoscopic cholecystectomy. The incidence varies, but is common, being experienced in approximately one third of patients following laparoscopic cholecystectomy[12]. The pain usually lasts 2-3 days and is relieved by simple analgesics such as paracetamol and codeine[13]. Several causes of shoulder pain following laparoscopic surgery have been suggested which include the effect of carbon dioxide pneumoperitoneum, peritoneal stretching, diaphragmatic irritation, diaphragmatic injury and even shoulder abduction during surgery[14]. The prolonged presence of shoulder tip pain suggests excitation of the phrenic nerve. Some authors believe that carbon dioxide transformed by combining with fluid in the peritoneal cavity to irritative carbonic acid, while others emphasized diaphragmatic irritation due to CO2 pneumoperitoneum as a frequent cause of shoulder pain[15]. A number of methods have been tried to reduce the incidence of shoulder tip pain following laparoscopic cholecystectomy like, low-pressure insufflations[16], slow rate of insufflations[17], pre-emptive diaphragmatic local anaesthetic irrigation[18], regional anaesthesia to peritoneal surfaces in the operative area[19]. The use of low-pressure pneumoperitoneum decreases the demand for postoperative analgesics, decreases postoperative hospital stay and hence improves the quality of life in early stages of postoperative rehabilitation. Low-pressure pneumoperitoneum remains a safe option for laparoscopic cholecystectomy. Its use contributes to significantly to a substantial reduction of the postoperative complications especially shoulder tip pain. In turn, especially in difficult cases, low-pressure laparoscopic cholecystectomy would become a technically demanding procedure, even in experienced hands, and its adoption needs good surgical judgement. The procedure should be performed by experienced laparoscopic surgeon and increasing the pressure is still an option and should not be deemed as a failure. It compels the surgeon to focus his or her attention on technical aspects and standardization of the procedure in order to achieve a high safety standard.

Conclusion

Low-pressure pneumoperitoneum during laparoscopic cholecystectomy is safe in experienced hands with less incidence of early postoperative complications especially shoulder tip pain. It is beneficial in special cases as it causes less hemodynamic changes intraoperatively, the longer learning curve being the only limiting factor.

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