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General Anesthesia Used in Laparoscopic Cholecystectomy

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Abstract

Background: Laparoscopic cholecystectomy is presenting new anesthetic challenges. The choice of the anesthetic technique for laparoscopic cholecystectomy is limited most frequently to general anesthesia. The most widely used anesthesia technique is balanced general anesthesia, including several intravenous and inhalation agents, with neuromuscular blocking drugs, tracheal intubation, and intermittent positive pressure ventilation (IPPV). The physiological effects of intraperitoneal carbon dioxide insufflation combined with variations in patient positioning can have a major impact on the cardiorespiratory function, particularly in elderly patients with comorbidities.

Aims and Methods: This prospective descriptive study was performed during January 2015 – December 2019 and included data from 2707 patients ASA I-III, admitted to the hospital for General Surgery with a diagnosis of calculus cholecystitis. The patients were divided into two groups: in the first were included patients that performed open cholecystectomy and in the second groups patients that performed laparoscopic cholecystectomy. General anesthesia according to protocol was the same and was applied to all patients. We analyzed PONV (postoperative nausea and vomiting) and POPC (postoperative pulmonary complications) during the 24 first hours.

Results: We analyzed in total 2707 patients, 1728 (64%) were female and 979 (36%) were male with ages ranging between 13-94 years (the mean age was 57.7 years). According to the procedure,

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2293 (84.7%) patients performed open cholecystectomy and 414 (15.3%) patients performed laparoscopic cholecystectomy. PONV was especially present after laparoscopic surgery requiring antiemetic medication in 244 (59%) of patients, while it was present in 940 (41%) of cases in patients who performed open cholecystectomy, especially in female patients 855 (91%). Postoperative pulmonary function was presented through reduction of 29% in forced vital capacity after laparoscopy cholecystectomy, and of 51% after open cholecystectomy while the pain was reduced by about 40% after laparoscopic cholecystectomy.

Conclusion: Laparoscopic cholecystectomy has been demonstrated to be a major development in the treatment of patients with symptomatic gallbladder disease. The ideal anesthetic technique for laparoscopic cholecystectomy should maintain stable the cardiovascular and respiratory functions, provide rapid post-operatory recovery, lead to minimal PONV, and provide good post-operatory pain relief for early mobility.

Keywords: General anesthesia, laparoscopic cholecystectomy, open cholecystectomy, pneumoperitoneum.

INTRODUCTION

Laparoscopic surgery is considered as a minimally invasive therapy, which aims to reduce the trauma of the interventional process and postoperative morbidity. The first laparoscopic cholecystectomy was performed by Prof Dr. Med Erich Mühe of Böblingen, on September 12, 1985(1). In recent years, laparoscopic cholecystectomy has become a common clinical practice and it is performed and advocated for geriatric patients, although pneumoperitoneum with CO2 had an important role for cardiac and pulmonary comorbidities, enjoying ever-increasing popularity and presenting new anesthetic challenges. Patients' benefits after laparoscopic cholecystectomy include shorter surgical time, reduction in postoperative pain, shorter hospital stay, quicker return to normal activities, reduction in overall medical cost, and better cosmetic results. (2)

The intraoperative requirements of laparoscopic surgery however can lead to serious physiological changes and complications. The major problems are related to the cardiopulmonary effects of pneumoperitoneum, systemic carbon dioxide absorption, extra peritoneal gas insufflation, venous gas embolism, and unintentional injuries to intra-abdominal structures. The circulatory flow reduces in the renal, hepatic, and intestinal districts. Respiratory effects include reduced static compliance, increased airway pressures, and ventilation/perfusion alterations. Carbon dioxide absorption causes circulatory effects (tachycardia, vasoconstriction) and CNS depression. Although nowadays laparoscopic cholecystectomy is a day -surgery practice, the anesthetic technique often is general anesthesia according to standardized anesthetic protocols or techniques that reduces medical outcomes. Controlled ventilation avoids hypercarbia due to pneumoperitoneum but together with inhalator anesthetic and especially when we used nitrous oxide and narcotics during laparoscopic cholecystectomy, we increased the risk for PONV. So we need to plan an anesthetic technique that includes antiemetics and nonsteroidal anti-inflammatory agents to reduce nausea and vomiting after surgery. Laparoscopic cholecystectomy is a major development in the management of patients in postoperative recovery. However, in now a day's pressure of health system for cost control, geriatric and ASA III-IV patients may present for these interventions on the day of surgery without adequate preoperative evaluation. Therefore, anesthesiologists should be ready for conversion to an open procedure all the times that can detect hemodynamic changes, deoxygenation, or hypoventilation during the procedures. (3,4).

Routine blood tests and ECGs are usually sufficient in healthy and young patients according to protocol written by anesthesia department. Associated conditions (pulmonary, cardiac, obesity) may require closer evaluation. However, contraindications to laparoscopic surgery are diminishing. (4)

Appropriate anesthetic techniques and monitoring facilitate surgery and allow early

detection and reduction of complications. The need for early recovery and a short hospital stay imposes additional requirements on the anesthesia teams for skillful practice. (4,5)

The most widely used anesthesia technique is balanced general anesthesia, including several intravenous and inhalational agents, with neuromuscular blocking drugs, tracheal intubation, and intermittent positive pressure ventilation (**IPPV**). It is important to avoid stomach inflation during ventilation in order to avoid gastric injury during trocar insertion. Tracheal intubation and IPPV ensure airway protection and control of pulmonary ventilation to maintain normocarbia. Ventilation with a 10 ml/kg tidal volume and frequency respiratory rate 12 breaths·min-1 prevents hypoxemia and allows for effective carbon dioxide elimination. (6)

Successful laparoscopic cholecystectomy has been performed on anticoagulated, pregnant, and morbidly obese patients (3,4,5). Careful evaluation of the potential problems is essential to optimize the results of anesthesia for lengthy procedures and complicated patients.

Nitrous oxide can cause intestinal distension, increase postoperative nausea and vomiting (PONV), and accumulate in closed peritoneal space, and is most often excluded.

PONV is particularly concerning in 40-70% of patients after laparoscopic surgery and they required antiemetic therapy, so a prophylactic antiemetic treatment should be given routinely. Ondansetron has proven to be effective in these cases. (7)

Postoperative pain consists of early transient vagal abdominal and shoulder discomfort due to peritoneal irritation by residual carbon dioxide and abdominal over distension in case of excessive intra-abdominal pressure. Patients can also experience deep-seated pain related to trauma at the surgical site. The use of NSAIDs for postoperative analgesia, with no association with opioids, has been described to minimize PONV. As well the association with local anesthetics has been demonstrated to be effective in reducing pain. However, pain from the puncture wounds of the trocars is generally mild, because the wounds are small and are produced without cutting muscle fibers. After being studied the anesthesia used for laparoscopic cholecystectomy and its challenges it was found that postoperative pulmonary function was better, forced vital capacity was reduced by 27% after laparoscopy, and by 48% after open surgery. (6,7,8)

METHODS

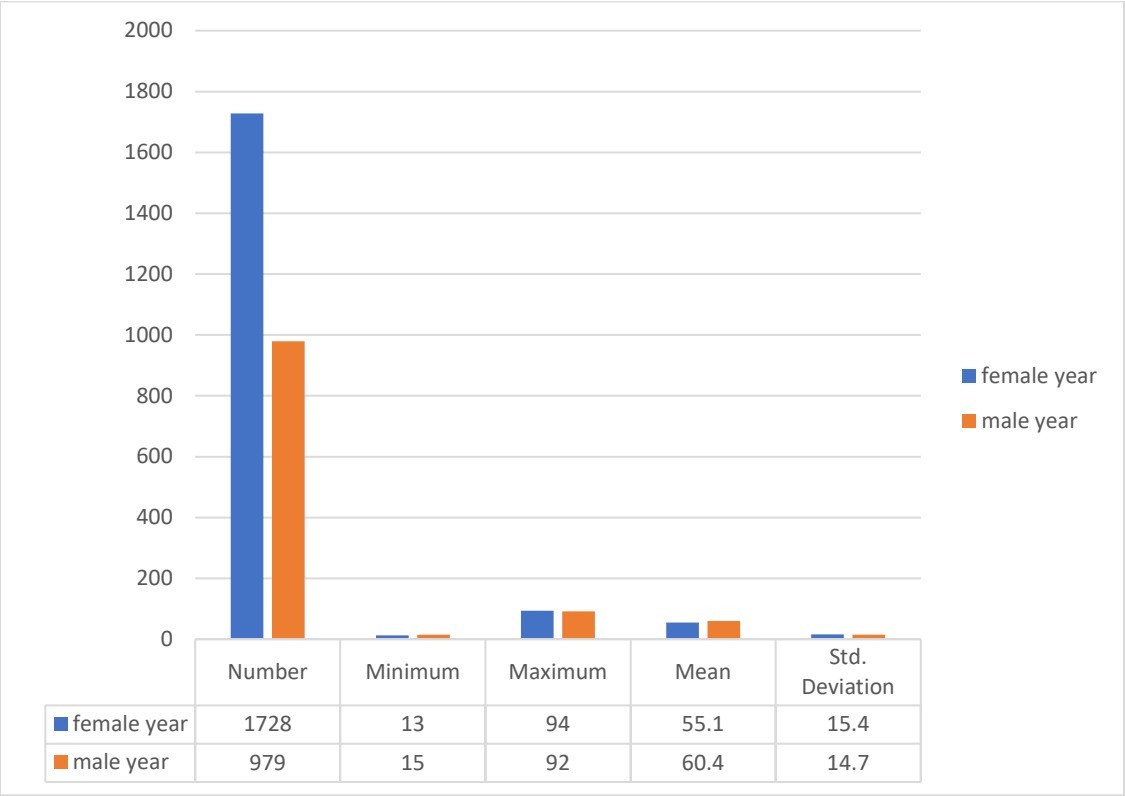
This prospective descriptive study was performed during January 2015 – December 2019 and included data from 2707 patients ASA I-III, aged over 13 years, admitted to the hospital for General Surgery with a diagnosis of calculus's cholecystitis. The patients were divided into two groups: in the first were included patients that performed open cholecystectomy and in the second one patients that performed laparoscopic cholecystectomy. General anesthesia was applied to all patients. The end tracheal intubation was performed after induction with thiopentone

5mg/kg, fentanyl 2µg/kg, succinylcholine 1mg/kg, and ondansetron 8 mg, maintain of anesthesia was performed with sevoflurane according to MAC= 1.2, fentanyl 50 µg every 30 minutes, and vecuronium (0.1 $mg.kg^{-1}$). A nasogastric tube was inserted in all patients and suction applied to empty the stomach of air and secretions. Before tracheal extubating, the nasogastric tube was suctioned and removed. At the end of surgery all patients received 1gr paracetamol IV. We analyzed PONV and POPC (postoperative pulmonary complications) according to EPCO (European perioperative clinical outcomes) during the 24 first hours after surgery. Data were analyzed using Excel 2016 statistical program. For continuous variables, the mean, standard deviation, and rank are calculated, while for discrete variables the respective absolute and relative frequencies are calculated.

RESULTS

In the present study, we analyzed 2707 patients that performed cholecystectomy. 1728 (64%) were females versus 979 (36%) males with ages between 13-94 years, and the mean age was 57.75 years with Std. Deviation=15.05.

These demographic data are illustrated in the diagram below.



	Number	Minimum	Maximum	Mean	Std. Deviation
female year	1728	13	94	55.1	15.4
male year	979	15	92	60.4	14.7

Figure 1. The distribution of patient depending on gender, number and age

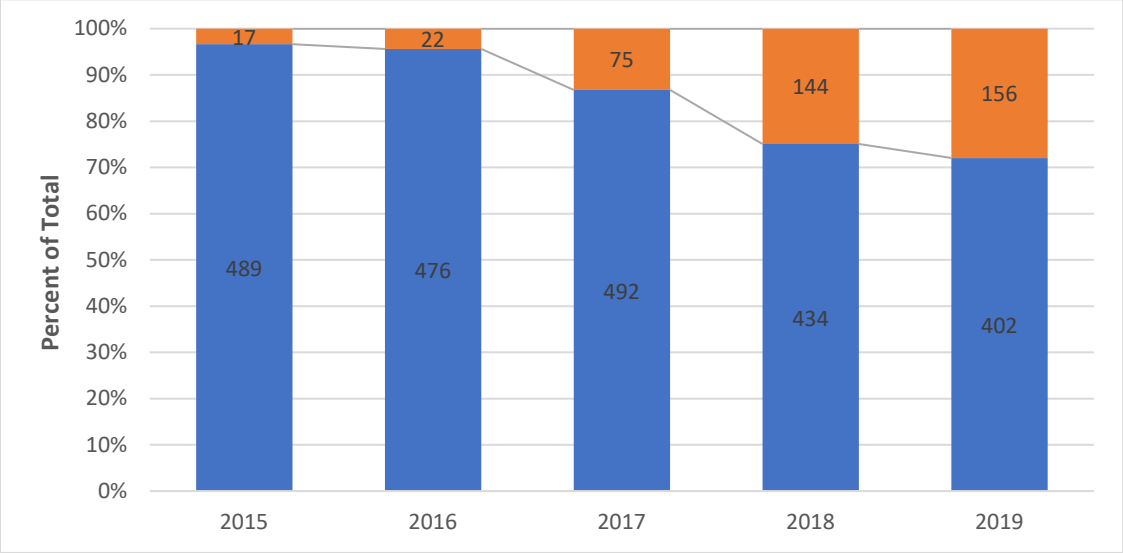


Figure 2. The distribution of the procedures according to the year of the surgery and to applied surgery (blue color = open cholecystectomy; orange color = laparoscopic cholecystectomy)

Of all patients, 2293 (84.7%) performed open cholecystectomy and only 414 (15.3%) performed laparoscopic cholecystectomy. The distribution of the procedures according to the year of the surgery is presented in Figure 2.

In figure 3, the distribution is presented according to age, gender and surgery procedure performed ($p<0.001$).

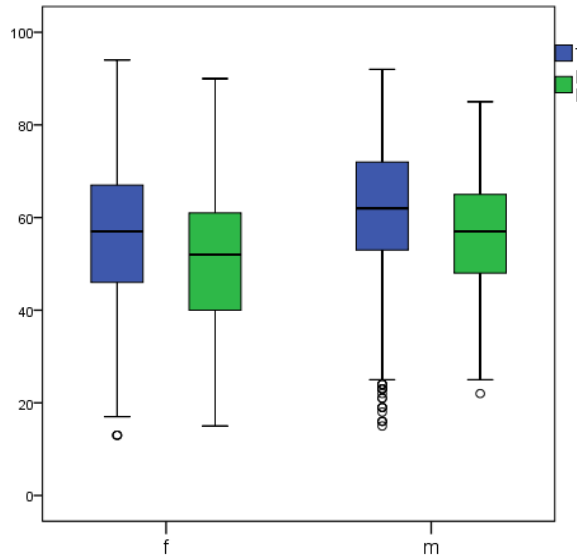


Figure 3. Distribution of patients according to age, gender and surgery procedure (Blue color = open cholecystectomy; green color = laparoscopic cholecystectomy)

Binary logistic regression has assessed the impact of gender and age to perform laparoscopic cholecystectomy or open cholecystectomy. The logistic regression is significant $\chi 2 = 75.326$, p <.001. Females had a higher chance of having laparoscopic cholecystectomies than males. OR (95% CI) 1.572 (1.236-1.999), p <0.001. Age is significant for the selection of the surgical procedure, but the value of OR is close to 1. OR (95% CI) 0.976 (0.970-0.983), p <0.001.

According to our data, PONV was present in patients that performed open cholecystectomy in 940 (41%) patients and especially in female patients (91%). While in laparoscopic cholecystectomy we recorded 244 (59%) patients with PONV and in female patients (75%). (Figure 4)

forced vital capacity was reduced by 29% after laparoscopy cholecystectomy, and by 51% after open cholecystectomy. Males are more likely to develop postoperative respiratory complications compared to females, OR: 2.35, 95% CI: 1.57-3.52, P <0.0001. Weight loss in the last 3-6 months is a risk factor for the development of postoperative pulmonary complications, OR: 3.74, 95% CI: 2.53-5.52, P <0.0001. Patients with preoperative O2 Saturation values lower than 90% are more likely to develop complications: OR: 25.78, 95% CI: 8.86-74.98, P <0.0001. Preoperative concomitant diseases are a risk factor for the development of complications: OR: 6.17, 95% CI: 3.87-9.81, P <0.0001. The pain was reduced by about 40% after laparoscopic cholecystectomy.

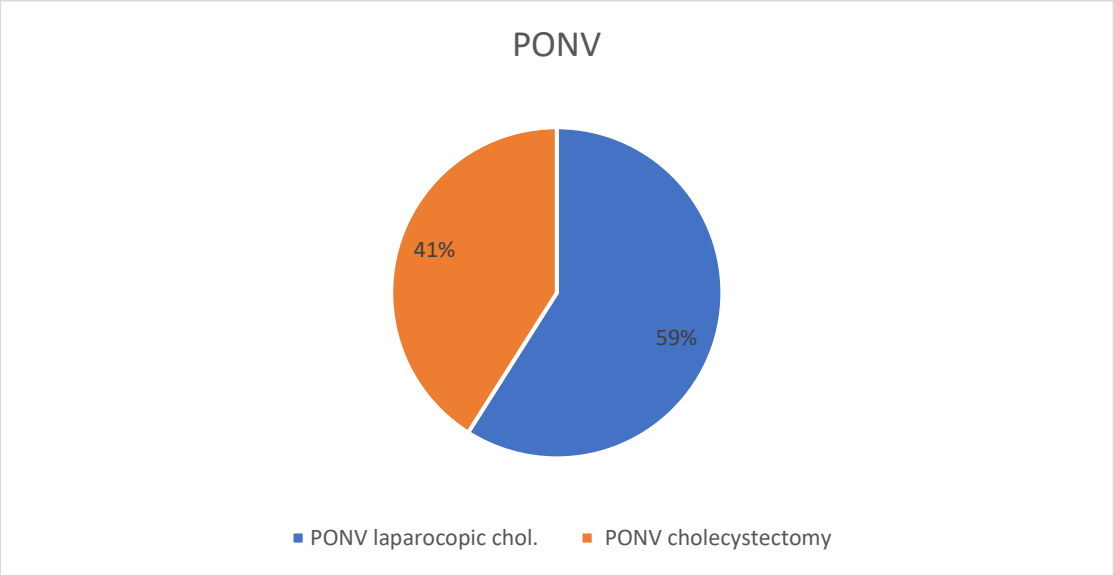


Figure 4. Distribution of patients depending on PONV after cholecystectomy

We analyzed postoperative respiratory complications after cholecystectomies. Postoperative pulmonary function was better:

DISCUSSION

Laparoscopic cholecystectomy is a standard procedure of high-volume general surgery. It is commonly done as ambulatory surgery nowadays. The key challenge in laparoscopic surgery is the occurrence of pneumoperitoneum with carbon dioxide. Laparoscopic cholecystectomy under general anesthesia has been reported as safe and feasible even in high-risk patients. Considerable difficulties in managing anesthesia are experienced during laparoscopic surgery. Hemodynamic instability in patients with cardiopulmonary dysfunction may develop due to pneumoperitoneum and position changes during the operation. PONV is particularly troublesome after laparoscopic surgery: over 50% of patients require antiemetic therapy, so a prophylactic antiemetic treatment should be given routinely. According to studies, Ondansetron has proven to be effective (10). Inserting of nasogastric tube help us to decrease the stomach secretions and reduce the risk for visceral puncture during insertions of pneumoperitoneum (11). The literature and our experience suggested the combination of non-opioid analgesics, paracetamol, and NSAIDs or avoidance of prolonged fasting, together with sufficient rehydration. In patients treated in general endo tracheal anesthesia, the local infiltration of the trocar wounds at the end of the procedure seems to reduce PONV and the need for opioids (12). The lowest effective intra-abdominal pressure must be used to create an adequate working field, awareness of the effects from pneumoperitoneum and vigilant monitoring to maintain physiology, oxygenation, and oxygen delivery and potential gas entrainment to surrounding tissues and/or vascular space. Whether a risk-scoring system should guide the administration of prophylactic antiemetic drugs. (6,11)

Laparoscopic cholecystectomy is a modern surgical technique which has started to use widely in our clinic nowadays. There are several advantages of laparoscopic cholecystectomy when compared with open cholecystectomy. These include reduced pain, minimal blood loss, and shorter recovery time. CO2-induced pneumoperitoneum during laparoscopic cholecystectomy may affect cardiopulmonary function, consequently, cardiopulmonary compromised patients should be assessed preoperatively by an anesthetist. High risk consent with intensive monitoring is mandatory to prevent mishaps. Laparoscopic cholecystectomies have been traditionally performed under general anesthesia due to the concerns about pneumoperitoneum and related respiratory changes associated with it. General anesthesia using a balanced anesthesia technique including several intravenous and inhalational agents with the use of muscle relaxants showed a rapid recovery and cardiovascular stability (7). As newer and more extensive laparoscopic procedures have been implemented, close cooperation between the laparoscopic surgeon and the anesthesiologist is required.

CONCLUSIONS

Laparoscopic cholecystectomy has been demonstrated to be a major development in the treatment of patients with symptomatic gallbladder disease. The ideal anesthetic technique for laparoscopic cholecystectomy should maintain stable the cardiovascular and respiratory functions, provide rapid post-operatory recovery, lead to minimal PONV, and provide good post-operatory pain relief for early mobility.

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Conflict of Interest Statement: The authors declare that they have no conflict of interest.

REFERENCES

1. Walker R Jr, The First Laparoscopic Cholecystectomy. JSLS 2001; 5(1):89–94.

2. Andrew T. Bates D. Laparoscopic Surgery in the Elderly: A Review of the Literature. Aging Dis 2015; 6(2): 149–155. doi: 10.14336/AD.2014.0429.

3. Irene E L, Anthony J C. Anaesthetic considerations for laparoscopic cholecystectomy. Best Pract Res Clin Anaesthesiol 2002;16(1):1-20. DOI: 10.1053/bean.2001.0204.

4. C. R. Bailey, M. Ahuja, K. Bartholomew&ba. Guidelines for day-case surgery 2019. Anaesthesia 2019, 74, 778–792. doi:10.1111/anae.14639.

5. S D Fitzgerald , P V Bailey, G J Liebscher, C H Andrus, Laparoscopic cholecystectomy in anticoagulated patients. Surg Endosc 1991;5(4):166-9.

6. Ishikawa S, Makita K, Sawa T, Toyooka H, Amaha K. Ventilatory effects of laparoscopic cholecystectomy under general anesthesia. J Anesth 1997;11(3):179-183.

7. V. K. Grover, P. J. Mathew, H. Hegde. Efficacy of orally disintegrating ondansetron in preventing postoperative nausea and vomiting after laparoscopic cholecystectomy: a randomised, double-blind placebo controlled study. Anaesthesia 2009, 64,595–600.

8. Leong T, Jaewook Oh. Safety and efficacy of a laparoscopic cholecystectomy in the morbid and super obese patients, HPB (Oxford) 2015;17(7): 600–604.

9. A J Cunningham , S J Brull. Laparoscopic cholecystectomy: anesthetic implications, Anesth Analg 1993;76(5):1120-33.

10. Frederic J G, Ghassan E K, Samar I J. Anesthesia for laparoscopy: a review. J Clin Anesth 2006;18(1):67-78.

11. A P Marco, C J Yeo, P Rock. Anesthesia for a patient undergoing laparoscopic cholecystectomy Anesthesiology 1990;73(6):1268-70.

12. Rutherford D, Massie EM, Worsley C, Wilson MS. Intraperitoneal local anaesthetic instillation versus no intraperitoneal local anaesthetic instillation for laparoscopic cholecystectomy. Cochrane Database Syst Rev 2021;10(10):CD007337.