

OPTIMIZATION OF ANESTHESIOLOGICAL MANAGEMENT IN ELDERLY PATIENTS UNDERGOING LAPAROSCOPIC CHOLECYSTECTOMY

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Laparoscopic cholecystectomy is a widely used minimally invasive surgical treatment method, especially in elderly patients. However, the need for carbon dioxide pneumoperitoneum and mechanical ventilation creates significant hemodynamic and respiratory challenges. This study compares the effects of combined multimodal anesthesia (epidural blockade with mechanical ventilation) and conventional total intravenous anesthesia with mechanical ventilation in elderly patients aged 60–74 years. By analyzing intraoperative and postoperative hemodynamic stability, respiratory function, and analgesic outcomes, this research aims to determine the optimal anesthesiological approach to enhance patient safety and postoperative recovery.

Keywords: *Laparoscopic cholecystectomy; elderly patients; multimodal anesthesia; epidural anesthesia; total intravenous anesthesia; hemodynamic stability; postoperative recovery.*

INTRODUCTION

Laparoscopic cholecystectomy is considered the gold standard for the treatment of gallstone disease, as it provides reduced postoperative pain, shorter recovery time, and minimal surgical trauma.

However, in elderly patients, the physiological effects of increased intra-abdominal pressure caused by carbon dioxide pneumoperitoneum, as well as the impact of general anesthesia on the cardiovascular and respiratory systems, require a carefully planned anesthetic approach. Elderly patients frequently present with comorbid conditions such as arterial hypertension, ischemic heart disease, and chronic respiratory diseases, which increase their susceptibility to perioperative complications.

The creation of pneumoperitoneum during laparoscopic surgery may further exacerbate these risks by increasing intra-abdominal pressure, reducing venous return, and potentially leading to hemodynamic instability.

In addition, prolonged mechanical ventilation in elderly patients may contribute to the development of postoperative pulmonary complications, including atelectasis and pneumonia. Traditional total intravenous anesthesia (TIVA) with oxygen mechanical ventilation remains a standard technique; however, it is often associated with hemodynamic fluctuations and prolonged postoperative recovery.

The use of intravenous anesthetics alone may be insufficient to adequately attenuate the surgical stress response, resulting in increased catecholamine release and hemodynamic instability. As an alternative, combined multimodal anesthesia (CMA) based on epidural blockade combined with oxygen mechanical ventilation has demonstrated potential advantages in mitigating these adverse effects.

Epidural anesthesia provides superior analgesia, reduces the need for systemic opioids, and minimizes hemodynamic fluctuations by decreasing sympathetic nervous system activation.

Moreover, CMA is assumed to promote improved postoperative recovery through earlier mobilization and a reduced incidence of postoperative cognitive dysfunction in elderly patients. The present study evaluates these two anesthetic strategies by assessing intraoperative stability, postoperative pain control, and respiratory function.

By comparing CMA with TIVA, we aim to determine which approach optimally balances hemodynamic stability, respiratory function, and postoperative recovery outcomes in elderly patients undergoing laparoscopic cholecystectomy.

Materials and Methods: A total of 80 elderly patients aged 60–74 years scheduled for elective laparoscopic cholecystectomy in the surgical department of Samarkand State Medical University were enrolled in the study. Patients were randomly assigned into two groups:

- Group 1 (n = 40): Total intravenous anesthesia (TIVA) with oxygen mechanical ventilation.
- Group 2 (n = 40): Combined multimodal anesthesia (CMA) based on epidural blockade with oxygen mechanical ventilation.

Inclusion Criteria

- ASA physical status II–III.
- Absence of severe cardiovascular and respiratory complications.
- No history of adverse reactions to anesthetic agents used in the study.

Exclusion Criteria

- Emergency surgical procedures.
- Coagulopathies or contraindications to epidural anesthesia.
- Chronic obstructive pulmonary disease (COPD) or other significant pulmonary dysfunction.
- Uncontrolled arterial hypertension or other severe cardiovascular disorders.

Preoperative Preparation

All patients underwent comprehensive preoperative evaluation, including detailed medical history, electrocardiography (ECG), pulmonary function tests, and laboratory blood analyses. Standard fasting guidelines were observed.

One hour before surgery, patients received premedication with midazolam (0.05 mg/kg) and ranitidine (50 mg intravenously).

Anesthesia Protocols

- Group 1 (TIVA): Anesthesia induction was performed using propofol (2 mg/kg) and fentanyl (2 µg/kg), with maintenance achieved through continuous propofol infusion. Rocuronium was administered for neuromuscular relaxation.
- Group 2 (CMA): Epidural anesthesia was performed at the L2–L3 level using 0.5% bupivacaine (8–10 mL) and fentanyl (2 µg/kg). This was followed by induction with propofol (1.5–2 mg/kg) and rocuronium (0.6 mg/kg) to facilitate tracheal intubation. Intraoperative epidural infusion was maintained with a combination of 0.125% bupivacaine and fentanyl (2 µg/mL) at a rate of 6 mL/h.

Results and Discussion

Hemodynamic Stability: Combined multimodal anesthesia (CMA) demonstrated significantly smaller fluctuations in arterial blood pressure and heart rate compared with total intravenous anesthesia (TIVA) ($p < 0.05$).

Patients in the TIVA group more frequently experienced episodes of intraoperative hypotension requiring vasopressor support. In addition, patients receiving CMA exhibited a more stable cardiac index and smaller variations in systemic vascular resistance, resulting in a reduced need for intraoperative vasopressors.

Respiratory Function: CMA was associated with better oxygen saturation (SpO_2) values and lower peak airway pressures during mechanical ventilation, thereby reducing the risk of postoperative pulmonary complications. Patients in the TIVA group had a higher incidence of postoperative atelectasis ($p < 0.01$) and required prolonged oxygen therapy.

Analgesia and Recovery: Postoperative pain scores assessed at 1, 6, and 24 hours were significantly lower in the CMA group ($p < 0.01$). Opioid consumption was reduced by approximately 30% in patients receiving CMA, leading to a decrease in opioid-related adverse effects such as nausea and excessive sedation. Furthermore, early mobilization was achieved more effectively in the CMA group, which reduced the risk of thromboembolic complications and improved overall recovery.

Adverse Events: Postoperative nausea and vomiting were observed in 18% of patients receiving TIVA compared with 8% of patients receiving CMA ($p < 0.05$). In addition, postoperative delirium occurred in 12% of patients in the TIVA group versus 4% in the CMA group, indicating a neuroprotective advantage of epidural anesthesia.

The obtained data indicate that CMA provides superior hemodynamic stability, improved respiratory function, and better pain control compared with TIVA. Epidural anesthesia attenuates the sympathetic stress response, thereby minimizing intraoperative fluctuations in cardiovascular parameters. Moreover, CMA enhances postoperative recovery by reducing opioid requirements and preventing respiratory depression.

The reduced incidence of postoperative nausea, vomiting, and delirium in the CMA group highlights the neuroprotective benefits of regional anesthesia. Improved analgesia in patients receiving CMA facilitated earlier mobilization and reduced opioid dependence, which plays a crucial role in preventing opioid-related complications such as respiratory depression and gastrointestinal dysmotility. This is particularly

important in elderly patients, in whom prolonged opioid use is associated with an increased risk of delirium, ileus, and prolonged hospitalization. Another key advantage of CMA is the reduction in respiratory complications. By preserving better lung mechanics and avoiding deep sedation, CMA appears to decrease the incidence of postoperative atelectasis and pneumonia, which are common in elderly patients undergoing laparoscopic surgery. The reduced need for prolonged oxygen therapy further supports the benefits of epidural anesthesia in improving pulmonary outcomes.

Conclusion: For elderly patients undergoing laparoscopic cholecystectomy, combined multimodal anesthesia with epidural blockade and mechanical ventilation offers significant advantages over total intravenous anesthesia. By optimizing hemodynamic parameters and minimizing respiratory complications, CMA represents a safer and more effective approach to anesthetic management in this high-risk patient population.

Furthermore, improved postoperative pain control, reduced opioid dependence, and earlier mobilization make CMA a preferable strategy for minimizing postoperative complications and accelerating recovery. Future studies should focus on long-term outcomes, including cognitive function, quality of life, and rehabilitation progress, to further refine perioperative anesthetic strategies for elderly patients.

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