# The role of magnesium sulphate infusion vs lidocaine infusion on pulmonary functions and pain management in patients undergoing open cholecystectomy

Thesis

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# Abstract

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Abstract: I.v. lidocaine and magnesium improved postoperative analgesia and reduced intraoperative and postoperative opioid requirements in patients undergoing Open cholecytectomy. The recovery rates of FVC were significantly faster for the lidocaine group compared to the other two groups. The improvement of quality of recovery might facilitate rapid hospital discharge.

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# List of abbreviations

- **VAS : Visual analog score.**
- **LC : Laparoscopic Cholecystectomy.**
- **OC : Open Cholecystectomy.**
- **NMDA : N -Methyl - D- Aspartate.**
- **I.V : Intravenous injection.**
- **V-Q : Ventilation Perfusion ratio.**
- **CNS : Central Nervous System.**
- **COPD : Chronic obstructive pulmonary disease.**
- **OR : Odds ratio.**
- **ASA : American Society of Anesthesiologists.**
- **FEV1 : Forced expiratory volume $1^{st}$ second.**
- **CABG : Coronary Artery Bypass Graft.**
- **NYHA : New York Heart Association.**
- **CPAP : Continuous positive airway pressure.**
- **FVC : Forced vital capacity.**
- **PFT : Pulmonary function test.**
- **POSSUM : Physiologic & operative severity score for enumeration of mortality and morbidity.**
- **ACCP : American college of chest physicians.**
- **DLCO : Diffusing capacity of the lung for carbon monoxide.**
- **MVo2 : Myocardial oxygen consumption.**
- **PPOFEV1 : Predicted post operative FEV1.**
- **CT : Computed tomography.**
- **ADLs : Activities of daily living.**
- **AAA : Abdominal Aortic Aneurysm.**
- **IPPB : Intermittent positive pressure breathing.**
- **ACTH : Adreno cortico trophic hormone.**

- **TSH : Thyroid – stimulating hormone .**
- **FSH : Follicle – stimulating hormone.**
- **LH : Luteinizing hormone.**
- **IGF : Insulin like growth factor.**
- **T3 : Thyroxin.**
- **T4 : Tri-iodo thyronine .**
- **TBG : Thyroid binding globulin.**
- **LAs : Local anesthetics.**
- **TNF : Tumor necrosis factor.**
- **IL-1 : Interleukin – 1.**
- **IL-6 : Interleukin – 6.**
- **CRP : C-reactive protein.**
- **PACU : Post anesthesia care unit.**
- **CI : Confidence intervals.**
- **GABA : Gama amino butyric acid.**
- **PEFR : Peak expiratory flow rate.**
- **SD : standard deviation.**
- **P : Bonferroni`s correction.**
- **BIS : Bispectral index.**

# Introduction

Gall bladder stones disease and its effect on patients have a huge impact on general surgery.The prevalence of gallstone disease at rate of 3-12% of normal population. Although laparoscopic cholecystectomy (LC) is performed on an ambulatory basis, open cholecystectomy (OC) is still performed in many cases either due to surgical causes or deficient resources. Open cholecystectomy requires longer hospital stay than laparoscopic surgery mainly due to painful incision that affects pulmonary functions and requires adequate analgesia, for these reasons the adequate pain control is essential. Perioperative analgesia has been administered traditionally by opioid analgesics, but routine use of opioids for post-operative analgesia has recently been critically challenged.[(1)]Excessive use of potent opioids may actually increase postoperative pain as a result of rapid elimination and/ or development of acute tolerance and decrease patient satisfaction.[(2)]

Multi-analgesic regimens using smaller doses of opioids in combination with a non-opioid analgesic are becoming increasingly popular for improving post-operative analgesia and yielding a high success rate for outpatient OC.[(3)]N-methyl-D-aspartate (NMDA) receptors are critically involved in the induction and maintenance of neuronal hyperexcitability after noxious events.[(4)]Thus, the use of NMDA antagonists before surgical incision reduces the excitability of the central nervous system and its clinical outcome: hyperalgesia.[(5)]

Magnesium is a non-competitive NMDA receptor antagonist and a physiological calcium antagonist at different voltage-gated channels, which may contribute to the anti-nociception mechanism.[6]Intravenous (i.v.) lidocaine has analgesic, anti-hyperalgesic, and anti-inflammatory effects.[7,8]A variety of mechanisms mediate these properties, including sodium channel blockade[9] and inhibitionofNMDA receptors.[10]I.v. lidocaine might be a potential option to treat complex pain following OC.[11]

This double-blind, prospective randomized study was aimed at the evaluation and comparison of the effects of i.v. magnesium and lidocaine on perioperative opioid consumption and post-operative pain control in patients undergoing OC.

# Pain and pulmonary functions

**Background**

Postoperative pulmonary complications contribute significantly to overall perioperative morbidity and mortality rates. Such complications account for about 25% of deaths occurring within 6 days of surgery. The frequency rate of these complications varies from 5-70%. This wide range is due to variations among studies in the definition of postoperative pulmonary complications, as well as variability in patient- and procedure-related factors.

The goal of perioperative pulmonary management is to identify patients at high risk of significant postoperative pulmonary complications, so that appropriate interventions can be provided to minimize that risk. In most cases, even in high-risk patients, the procedure can be performed safely as planned, but occasionally postponement, modification, or cancellation are warranted.

One of the more comprehensive lists of postoperative pulmonary complications includes fever (due to microatelectasis), cough, dyspnea, bronchospasm, hypoxemia, atelectasis, hypercapnia, adverse reaction to a pulmonary medication, pleural effusion, pneumonia, pneumothorax, and ventilatory failure.[12] Such a broad definition risks including complications that have no clinical significance. Most investigators thus define a postoperative pulmonary complication as an abnormality that produces identifiable disease or dysfunction, is clinically significant, and adversely affects the clinical course.

Determining which complications fit this definition is challenging, but likely include atelectasis, infection (eg, bronchitis, pneumonia), prolonged mechanical ventilation and respiratory failure, exacerbation of an underlying chronic lung disease, and bronchospasm. When such a definition is employed, postoperative pulmonary complications prolong the hospital stay by an average of 1-2 weeks, and are likewise associated with increased morbidity and mortality.

The risk of postoperative complications varies with the type of surgery being performed. Pulmonary complications occur much more often than cardiac complications in patients undergoing elective surgery to the thorax and upper abdomen. Operations at sites farther from the diaphragm are associated with a much lower incidence of postoperative pulmonary complications. Preoperative evaluation for patients undergoing lung resection (ie, for lung cancer) differs considerably from that for those undergoing non-resectional surgery.

Postoperative pulmonary complications are also more common in patients with preexisting lung disease, medical comorbidities, poor nutritional status, overall poor health, and in those who smoke. Not all of these risk factors are modifiable, although strategies exist to reduce the risk of postoperative pulmonary complications even among high-risk patients.

## Perioperative Pulmonary Physiology

### Respiratory effects of general anesthesia:

Anesthetic agents are associated with marked alterations in respiratory drive. Such agents cause a diminished response to both hypercapnia and hypoxemia. In combination with neuromuscular blockers, anesthetic agents cause diaphragm and

chest wall relaxation, which results in a marked reduction in the functional reserve capacity and, thereby, thoracic volume.

This decrease in lung volume promotes atelectasis in the dependent lung regions and persists for more than 24 hours in 50% of patients. Consequently, arterial hypoxemia occurs from ventilation-perfusion (V-Q) mismatching and increased shunt fraction.

**Postoperative respiratory physiology in upper abdominal and thoracic surgery:**

Thoracic and upper abdominal surgery is associated with a reduction in vital capacity by 50% and in functional residual capacity by 30%. Diaphragmatic dysfunction, postoperative pain, and splinting cause these changes.

Following upper abdominal surgery, patients shift to a breathing pattern with which ribcage excursions and abdominal expiratory muscle activities increase. This shift is attributed to decreased central nervous system (CNS) output to the phrenic nerves, thus inhibiting diaphragmatic stimulation. A reflex mechanism arising from the sympathetic, vagal, or splanchnic receptors is thought to be responsible. In humans, this reflex inhibition is partially reversed by epidural anesthesia.

Following upper abdominal and thoracic surgery, patients maintain adequate minute volume, but the tidal volume is smaller and the respiratory rate increases (ie, rapid shallow breathing). These breathing patterns, along with the residual

effects of anesthesia and postoperative narcotics, inhibit cough, impair mucociliary clearance, and contribute to the risk of postoperative pneumonia.

Other factors that may contribute to increased respiratory complications include electrolyte imbalance (eg, hypokalemia, hypophosphatemia, hypocalcemia), general debilitation, and underlying lung disease (eg, chronic obstructive pulmonary disease [COPD]).

**Patient and Procedure-Related Risk Factors:**

Numerous studies have been designed to investigate the relationship between various risk factors and postoperative complications. One of the larger ones was designed as a prospective cohort study where postoperative pulmonary complications ascertained by an investigator blinded to perioperative variables was conducted to determine the risk factors for pulmonary complications after elective non-thoracic surgery.**(13)**

Of 1055 consecutive patients, 28 (2.7%) suffered a postoperative pulmonary complication within 7 days of surgery; 13 developed respiratory failure that required ventilatory support; 9 developed pneumonia; 5 developed atelectasis that required bronchoscopic intervention; and 1 developed pneumothorax that required intervention.**(13)**Multivariate analyses revealed that 4 factors were independently associated with increased risk of pulmonary complications: age (odds ratio [OR] 5.9 for age 65 y or older), positive cough test (OR 3.8), perioperative nasogastric tube (OR 7.7), and duration of anesthesia (OR 3.3 for operations lasting at least 2.5 h).**(13)**

A systematic review of the performance of variables commonly used in the prediction of postoperative pulmonary complications in patients undergoing nonthoracic surgery was performed by Fisher et al.[14] Seven studies fulfilled the investigators' inclusion criteria, and the incidence of postoperative pulmonary complications varied from 2% to 19%. Of 28 preoperative or operative risk factors evaluated in the 7 studies, 16 were associated significantly with postoperative pulmonary complications. [14] Only 2 (duration of anesthesia and postoperative nasogastric tube placement) were significant in more than 1 study. However, these 16 variables had only modest predictive value. Neither hypercarbia nor reduced spirometry values were independently associated with an increased risk of postoperative pulmonary complications.

**Patient-related risk factors:**

**Age:**

Age appears to be an independent risk factor for postoperative pulmonary complications. [15] This conclusion is controversial, as several other studies have shown that age is not a predictor for postoperative pulmonary complications. Importantly, acceptable operative mortality rates can be achieved in older patients.

In a study of patients older than 80 years, the overall 30-day mortality rate was 6.2%, and the mortality rate for patients who belonged to American Society of Anesthesiologists (ASA) class II scale was less than 1%. [16]As age is obviously a nonmodifiable risk factor, and the potential risk of complications does not invariably translate into increased mortality, surgery should not be declined because of advanced age alone.