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## Awake laparoscopic cholecystectomy: A case report and review of literature

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### Abstract

#### BACKGROUND

Laparoscopic cholecystectomy (LC) is one of the most widely practiced surgical procedures in abdominal surgery. Patients undergo LC during general anaesthesia; however, in recent years, several studies have suggested the ability to perform LC in patients who are awake. We report a case of awake LC and a literature review.

#### CASE SUMMARY

A 69-year-old patient with severe pulmonary disease affected by cholelithiasis was scheduled for LC under regional anaesthesia. We first performed peridural anaesthesia at the T8-T9 level and then spinal anaesthesia at the T12-L1 level. The procedure was managed in total comfort for both the patient and the surgeon. The intra-abdominal pressure was 8 mmHg. The patient remained stable throughout the procedure, and the postoperative course was uneventful.

#### CONCLUSION

Evidence has warranted the safe use of spinal and epidural anaesthesia, with minimal side effects easily managed with medications. Regional anaesthesia in selected patients may provide some advantages over general anaesthesia, such as no airway manipulation, maintenance of spontaneous breathing, effective postoperative analgesia, less nausea and vomiting, and early recovery. However, this technique for LC is not widely used in Europe; this is the first case reported in Italy in the literature. Regional anaesthesia is feasible and safe in performing some types of laparoscopic procedures. Further studies should be carried out to introduce this type of anaesthesia in routine clinical practice.

**Key Words:** Laparoscopic cholecystectomy; Awake surgery; Awake laparoscopy; Gallstone disease; Regional anaesthesia; Spinal anesthesia; Case report

**Core Tip:** We present the first Italian case of awake laparoscopic cholecystectomy (LC) in a patient with severe pulmonary disease. The use of regional anesthesia during LC is safe, with minimal side effects, and may provide advantages over general anesthesia.

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## INTRODUCTION

The first laparoscopic cholecystectomy (LC) was performed in 1996 by Moutet[1]; since then, this procedure has been the gold standard for all benign gallbladder diseases[2-4]. Among these diseases, cholelithiasis is the most common pathology worldwide, with approximately 20 million people affected in the United States, reaching 1.8 million outpatient surgical visits *per year* and 750000 surgical operations, mainly performed laparoscopically[5,6]. Data from European studies, which are few in number compared to United States studies, have reported an incidence of gallstones in < 1/100 people *per year*; they also show that cholelithiasis increases with age and is more common in women than men. The rate of cholecystectomy is highly variable among different European countries, ranging from 62 to 213 *per 100000 people*[5,7,8]. The surgical technique of LC is standardized, and when intraperitoneal conditions allow, it can be performed in approximately 50 min[4]. Enhanced recovery after surgery protocols suggest that laparoscopy ensures greater comfort for the patient and both a better and faster recovery[9]. However, during laparoscopy, the induction of pneumoperitoneum, mechanical ventilation and reverse Trendelenburg position could cause haemodynamic and respiratory mechanism alterations [10,11]. Some patients with cardiovascular or respiratory disease tolerate these physiopathological changes less. These cases are a challenge to both the anaesthesiologist and to the surgeon because they are associated with ventilatory impairments, cardiac problems and other difficulties during the surgical procedure, awakening, and postoperative period. New frontiers in surgery and anaesthesia open up the possibility of subjecting this kind of patient to the same surgical procedures under regional anaesthesia [12].

Herein, we report a case of cholelithiasis in a patient affected by severe respiratory impairment who underwent awake LC, which is the first case in Italy reported in the literature.

## CASE PRESENTATION

### Chief complaints

A 69-year-old man came to our observation with complaints of invalidating abdominal pain.

### History of present illness

Abdominal ultrasound showed a 5-mm infundibular stone, and the patient was scheduled for elective LC.

### History of past illness

Past medical history revealed poliomyelitis at a young age with subsequent motor impairment in the left leg and arthrosis in the right knee that made him unable to walk and obliged to use a wheelchair. He had undergone a medium pulmonary lobectomy for lung adenocarcinoma seven years prior.

### Personal and family history

He also suffered from idiopathic pulmonary fibrosis, causing chronic respiratory failure and a severe restrictive deficit.

### Physical examination

The spirometry has shown: Forced vital capacity (FVC) 55%; forced expiratory volume in 1 second (FEV1) 56%; FEV1/FVC ratio 78% with a reduction in diffusing capacity for carbon monoxide (DLCO) (34%). For these reasons, oxygen therapy 24 h a day at a flow of 2 L/min was prescribed.

### Laboratory examinations

Laboratory examinations have not shown an increasing of cholestasis markers.

### Imaging examinations

Also imaging examinations have not evidence signs of biliary ducts dilatation. Therefore, the possibility of concurrent choledocholithiasis was excluded.

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## FINAL DIAGNOSIS

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The final diagnosis was gallbladder lithiasis in patient with severe respiratory failure.

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## TREATMENT

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Considering the patient's comorbidity, we decided to perform LC under regional anaesthesia. Clear informed consent was obtained. Pre- and intraoperative monitoring included electrocardiogram, peripheral oxygen levels, and invasive arterial blood pressure (BP). Antibiotic prophylaxis with penicillin was administered.

Using a 19-G × 90 cm an epidural catheter was inserted at the T8-T9 level. Spinal-anaesthesia was performed with a 25-G atraumatic sprotte needle at the T12-L1 level, injecting Ropivacaine (14 mg) and Fentanyl (25 mcg) diluted with saline solution for a total volume of 4 mL.

Five minutes later, the patient received dexmedetomidine 0.2-0.3 mcg/kg/h. Two boluses of 10 mL of 0.8% mepivacaine were peridurally administered.

The achieved level of anaesthesia, as tested by the pin-prick test, was T1.

Pneumoperitoneum was performed by insufflating CO<sub>2</sub> until an intra-abdominal pressure of 8 mmHg was achieved.

At the onset of pneumoperitoneum, the patient complained of shoulder pain. Fentanyl (100 mcg) and two boluses of ketamine (5 mg) with propofol (10 mg) were administered intravenously. The shoulder discomfort regressed enough to be well tolerated during the surgical procedure.

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## OUTCOME AND FOLLOW-UP

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Cholecystectomy was performed by a standard technique, and the operating time was 60 min.

During the procedure, the patient breathed spontaneously and without difficulty.

At the end of the cholecystectomy, the patient had no pain, and the motor skills of the lower limbs started to recover. Vital signs were recorded: Respiratory rate was 15 breaths/min, SaO<sub>2</sub> 98%, heart rate (HR) 70 beats/min, and BP 130/70 mmHg.

The patient completely recovered the motility and sensitivity of the legs 2.5 h postoperatively.

The antithrombotic prophylaxis included low molecular weight heparin once a day and early mobilization. Postoperative pain was treated with paracetamol (1 g) three times a day.

The postoperative course was uneventful, with feeding resumed on postoperative day 1. The patient was discharged on postoperative day 2.

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## DISCUSSION

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Laparoscopic procedures have conventionally been performed under general anaesthesia. Nevertheless, the use of regional anaesthesia has been recently introduced in laparoscopic surgery[13]. Evidence has demonstrated the safe use of spinal and epidural anaesthesia, with minimal side effects that can be easily managed with available medications, even if the patient is awake[14]. Indeed, regional anaesthesia may provide some advantages over general anaesthesia, such as a lack of airway manipulation, maintenance of spontaneous breathing, effective postoperative analgesia, minimal nausea and vomiting, and early recovery[10].

Several cases of awake LC have been reported in the scientific literature, as shown in Table 1; however, in Italy, this procedure has not yet been successful.

In 1998, in England, a series of 6 cases was published showing that LC can be performed safely under regional anaesthesia[15].

A large study with 3492 enrolled patients was conducted in India in 2009[16], and many Indian authors have enrolled a large population in the following years[13,17-20].

Table 1 Patients submitted to awake laparoscopic cholecystectomy reported in the literature

Country	Ref.	Year of publication	Number of patients	Main indications
Pennsylvania (United States)	Costantino <i>et al</i> [30]	1994	1	Pregnancy
Florida (United States)	Edelman[31]	1994	1	Pregnancy
England	Pursnani <i>et al</i> [15]	1998	6	ASA grade III/IV, FEV1/FVC 0.52 due to asthma and COPD
Argentina	Gramatica <i>et al</i> [21]	2002	29	Pulmonary disease
Egypt	Hamad and El-Khattary [28]	2003	9	Non-selectively
Netherlands	van Zundert <i>et al</i> [32]	2007	20	ASA grade I/II
Turkey	Yukseket <i>al</i> [23]	2008	26	ASA grade I/II
Greece	Tzovaras <i>et al</i> [33]	2006	50	ASA grade I/II
India	Sinha <i>et al</i> [16]	2009	3492	SA as first choice
Pakistan	Turkstani <i>et al</i> [26]	2009	25	ASA grade I/II
Korea	Lee <i>et al</i> [27]	2010	11	ASA grade I/II
India	Mehta <i>et al</i> [17]	2010	30	Randomly, healthy, ASA grade I/II
India	Kar <i>et al</i> [18]	2011	291	Non-selectively
Egypt	Bessa <i>et al</i> [29]	2012	86	Randomily
India	Tiwari <i>et al</i> [19]	2013	110	Randomily, ASA grade I/II/III
India	Kalaivani <i>et al</i> [20]	2014	23	Randomily, ASA grade I/II
India	Hajong <i>et al</i> [13]	2014	18	ASA grade I/II
Brasil	Imbelloni[22]	2014	369	SA as first option
Turkey	Bilgi <i>et al</i> [24]	2015	96	Non-selectively
Turkey	Donmez <i>et al</i> [25]	2017	24	Randomily
Total			4717	

ASA: American Society of Anaesthesiologists physical status classification; FEV1: Forced expiratory volume in 1 second; FVC: Forced vital capacity; COPD: Chronic obstructive pulmonary disease.

A total of 398 awake LCs have been performed in South America[21,22], 146 in Turkey[23-25], 25 in Pakistan[26], 11 in Korea[27], 95 in Egypt[28,29], and 2 in the United States[30,31].

The scientific literature has shown only 76 cases in the last 20 years in Europe[15,32,33], but none of these were performed in Italy.

There have been two case reports of successful LC under epidural anaesthesia in pregnant patients during the third trimester[30,31]; in these cases, regional anaesthesia (RA) could be very useful because it does not cause significant changes in foetal HR, variability in HR or uterine tone[34].

Kim *et al*[35] presented a case report in which a patient requiring cholecystectomy due to bronchiectasis and consequent poor functional capacity underwent epidural anaesthesia and did not report any complications or difficulties in the execution of the intervention or in the postoperative period. In this case, as in our case, the use of regional anaesthesia was a choice due to the patient's severe respiratory disease[35].

Hausman *et al*[36], in a retrospective cohort study, examined patients with severe chronic obstructive pulmonary disease; approximately 2644 patients were subjected to regional anaesthesia and 2644 to general anaesthesia during different surgical procedures. The study found that patients who received general anaesthesia had a higher incidence of postoperative pneumonia (3.3% *vs* 2.3%), prolonged ventilator dependence (2.1% *vs* 0.9%), and unplanned postoperative intubation (2.6% *vs* 1.8%). Composite morbidity was higher in the group undergoing general anaesthesia (15.4% *vs* 12.6%). Postoperative morbidity and complications in patients who were already respiratory defecated were lower in the group undergoing regional anaesthesia[36].

During awake LC, one of the key points is where to perform anaesthesia at the spinal cord level and whether it is better to perform epidural or subarachnoid (spinal) anaesthesia.

A high block, namely, T2-T4 levels, is required to abolish the discomfort of surgical stimulation of upper gastrointestinal structures[22,37].

In a study conducted in 2014, 369 patients were enrolled for LC under spinal anaesthesia, comparing lumbar versus thoracic puncture and evaluating the best anaesthetic dose. Thoracic puncture and low doses of hyperbaric bupivacaine (7.5 mg) resulted in better haemodynamic stability, less hypotension, and a shorter duration of both sensory and motor block than lumbar spinal anaesthesia using the conventional dose (15 mg)[22].

In our case, we achieved a sensory block at the T1 level, performing epidural anaesthesia at the T8-T9 level and spinal anaesthesia at the T12-L1 level; furthermore, the patient did not show any discomfort.

The first to use combined anaesthesia was van Zundert *et al*[38] in 2006 when he published a case report of an awake LC showing that the combined spinal/epidural anaesthesia technique, applied in the lower thoracic region (T10 level), can be used to provide a segmental subarachnoid block[38].

Donmez *et al*[25], in a prospective randomized study, submitted 28 patients to combined spinal/epidural anaesthesia at the L2-L3 levels and then inserted an epidural catheter cephalically[25].

We preferred to perform a spinal puncture at the T12-L1 level to avoid puncturing the dura mater in the thoracic region and then insert an epidural catheter at the T8-T9 level.

During laparoscopy, CO<sub>2</sub> insufflation could cause severe irritation to the parietal peritoneum, producing severe abdominal pain and discomfort[39]; for this reason, some authors have preferred to perform awake LC insufflating nitrous oxide[28], but it is not currently used. We created the pneumoperitoneum by insufflating CO<sub>2</sub> for its high water solubility and its high capacity of exchange in the lungs. Our patient complained of shoulder pain during pneumoperitoneum insufflation, which was easily treated without any consequence.

One of the most important problems of LC under spinal anaesthesia is the inadequate relaxation of abdominal muscles, resulting in difficulties in performing the procedure[8,40].

Tzovaras *et al*[33] demonstrated that surgery can be performed safely without exceeding 8 mmHg of pneumoperitoneum[33].

During cholecystectomy, the pneumoperitoneum pressure is approximately 12-15 mmHg[41]. In our case, spinal anaesthesia did not modify the surgical technique except for the reduction of intraperitoneal pressure to 8 mmHg to avoid vagal reflex and bradycardia. In fact, despite the low pressure and the consequent reduced camera, the cholecystectomy surgical technique used was the French position, which is usual in our clinical practice, and did not require any change in technique. For this reason, according to the surgeon's expertise, there are no local contraindications for cholecystectomy under RA, as shown in Table 2.

The main indication for cholecystectomy under RA is symptomatic gallbladder lithiasis. Even patients affected by acute or chronic cholecystitis can be approached with this technique; however, in these cases, advanced laparoscopic skills are required to guarantee a safe procedure.

In the case of suspected calculus of the main biliary tract or in the case of previous biliary pancreatitis occurrences, magnetic resonance cholangiopancreatography is mandatory; if choledocholithiasis is confirmed, the patient will be submitted to preoperative endoscopic retrograde cholangiopancreatography.

Of course, even patients with benign gallbladder wall disease can be treated by cholecystectomy under RA; however, if malignancy is suspected, laparoscopy is not the standard of care[42].

The only contraindications, for which general anaesthesia (GA) rather than RA is necessary, are the anaesthetic ones: Coagulopathic states[43], infection of the injection site and sepsis, patient rejection and hypovolemia uncorrected[44].

In the reported case, no intraoperative complications occurred.

No cases of anaesthetic technique conversion due to surgical problems have been reported in the literature. However, the conversion from RA to GA was reported in 33 of 4717 (0.7%) cases of anaesthesiologic complications. In 17 cases (0.36%) conversion was due to intolerable shoulder pain[13, 18-20,23,27,28]; in 15 cases (0.31%) conversion was due to patient anxiety[16,19]; and in 1 case (0.02%) conversion was due to nausea and vomiting[19].

In our opinion, the main indication for conversion from RA to GA, according to Tiwari *et al's* study, is surgical bleeding not easily controlled[19].

Other complications, such as biliary leakage or poor bleeding that is normally resolvable laparoscopically, can be managed even in awake patients, maintaining a comfortable environment for the patient.

One of the major intraoperative problems of LC under regional anaesthesia is right shoulder pain [45]. In a review and meta-analyses, Longo *et al*[46] showed that the pooled prevalence of shoulder pain during awake laparoscopy was 25% and required anaesthetic conversion in 3.4% of cases[46].

In our case, the pain was mild and disappeared in a short time with fentanyl injection.

Additionally, hypotension is a very frequent side effect of spinal anaesthesia[28,33] due to sympathetic blockage and the mechanical effect of pneumoperitoneum. In our case, it appeared at the beginning of the procedure, but it was easily managed with etilefrine chloride (2 mg) and norepinephrine infusion (0.05 gamma/kg/min) stopped at the end of the procedure.

Sinha *et al*[16] compared 3492 patients who underwent LC under spinal anaesthesia and 538 patients under general anaesthesia, demonstrating that the surgical aspects did not show any differences between the two groups. The use of spinal anaesthesia did not cause greater difficulties in technique,

**Table 2** Indications for cholecystectomy under regional anaesthesia

No.	Indications
1	Gallbladder lithiasis
2	Cholecystitis
3	Biliary pancreatitis ( previous MRCP to exclude choledocholithiasis)
4	Benign disease of gallbladder wall

MRCP: Magnetic resonance cholangiopancreatography.

longer operating times or complications. In addition, it has been shown that patients require less pain medication (61.57% *vs* 91.45%) and report less vomiting (2.29% *vs* 30.30%) and discomfort. In the same study, they also demonstrated how it was technically possible to perform the procedure even with pneumoperitoneum pressures between 8-10 mmHg[16].

Spinal anaesthesia is also associated with a low risk of complications and mortality rates compared with general anaesthesia and has numerous advantages.

Among the advantages are the patients being awake and oriented at the end of the procedure, less postoperative pain, and the ability to ambulate earlier than patients receiving general anaesthesia[22].

Turkstani *et al*[26] compared spinal and general anaesthesia in 50 patients who underwent LC under RA, demonstrating the occurrence of less pain in the postoperative period and focusing attention on the lower cost of spinal anaesthesia for the same patient outcomes[26].

During the postoperative period, our patient did not need painkilling therapy except for paracetamol.

Imbelloni *et al*[14] conducted a randomized, case-control study in healthy patients undergoing cholecystectomy to compare general and regional anaesthesia. The authors demonstrated that the use of regional anaesthesia, thereby maintaining low levels of abdominal pressure, can be a viable alternative to general anaesthesia, also providing a lower risk of thromboembolism, respiratory depression, myocardial infarction, and reduction of renal function[14].

Literature data show that awake LC is safe, feasible and could be advantageous to the whole population; however, at present, it is proposed to patients for whom total anaesthesia is particularly dangerous.

## CONCLUSION

Unexpectedly, in the era of minimally invasive medicine, the use of regional anaesthesia in LC has not yet become widespread in clinical practice.

In fact, even if it is a safe and feasible procedure, the absence of numerous trials about the impact of RA, related outcomes and complications discourages surgeons and anaesthetists from proposing this procedure as the first choice of anaesthesia for LC unless the patient is not fit for general anaesthesia [47].

The possibility of using regional anaesthesia in our patient, with severe pulmonary disease and chronic respiratory failure, has allowed us to treat an invalidating pathology for the life of the subject in question, thereby reducing anaesthesiologic risks.

In conclusion, even though regional anaesthesia during LC is not a new technique, especially in patients with severe respiratory disease, new studies are certainly needed to standardize this technique and, above all, to clarify the guidelines about the indications for this procedure for all kinds of patients and to introduce this type of anaesthesia in routine clinical practice.

## FOOTNOTES

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