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REVIEW ARTICLE

Postoperative Analgesia in Laparoscopic Cholecystectomy in Obese Patients

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ABSTRACT

Background: Obesity is an excessive or aberrant build up of fat in the adipose tissue to the point where it compromises health. An estimated 6% of adults have grade 3 obesity (BMI ≥40), while one-third of individuals are obese, defined as having a body mass index (BMI) of 30 or above. This subgroup is especially vulnerable to the effects of opioids and anesthetics due to the combination of chronic hypoxemia and hypercapnia, which can cause acute and persistent hypoventilation as well as respiratory arrest in the early postoperative phase. The three types of pain following laparoscopic cholecystectomy are somatic (incisional), visceral (deep intra-abdominal), and shoulder pain. The intensity and duration of these pains vary greatly between individuals. In the first 24 hours following surgery, visceral discomfort from the trauma of gallbladder resection and diaphragmatic irritation from the CO2 pneumoperitoneum appear to be more noticeable. Coughing exacerbates this pain, which is unaffected by mobilization.

Conclusion: The analgesic strategy should be multimodal because of the complexity of pain following laparoscopic cholecystectomy.

Keywords: Postoperative analgesia; laparoscopic cholecystectomy; obese patients.

INTRODUCTION

The buildup of abnormal or extra body fat is the fundamental definition of obesity. Genetic and environmental factors interact to cause this complicated, multifaceted disease. Increased morbidity and mortality, such as a higher chance of heart disease and type 2 diabetes, dyslipidemia, sleep apnea syndrome, osteoarthritis, and some types of cancer, are linked to excess body weight [1].

The most popular measure that is highly correlated with body adiposity is the body mass index (BMI), which is computed by dividing the weight in kilograms by the square of the height in meters (kg/m2). According to the World Health Organization (WHO), a person is deemed overweight if their BMI is 25 kg/m2 or more, and obese if their BMI exceeds 30 kg/m2. Class I individuals have a BMI of 30 to 34.9 kg/m2, Class II individuals have a BMI of 35 to 39.9 kg/m2, Class III individuals have a BMI of 40 to 49.9 kg/m2, and Class IV individuals are considered super obese if their BMI is 50.0 kg/m2 or over. Morbidly obese people are those with a BMI of greater than 40, or greater than 35 kg/m2, with comorbidities associated with obesity. [2].

Obesity and post-operative morbidity

1. ***Respiratory complications:***

In addition to the pulmonary disorders of sleep apnea (also known as obstructive sleep apnea syndrome or OSAS) and hypoventilation syndrome, obesity is associated with decreased vital capacity, functional residual capacity, forced expiratory volume, and arterial oxygen tension. Although some research has linked obesity and overweight to an increased risk of pulmonary embolism, atelectasis, and pneumonia following surgery, other research has not shown a link between these conditions and respiratory problems [3].

2. ***Atrial arrhythmia***

Changes in the anatomy of the atrium and ventricle are linked to It has been discovered that obesity increases the risk of atrial fibrillation as well as ventricular diastolic function. Obesity has been linked to atrial arrhythmia in a number of studies. The most common cardiac arrhythmia and the most frequent post-operative complication is atrial fibrillation. Atrial fibrillation is linked to higher rates of post-operative morbidity and mortality [4].

3. *Wound dehiscence:*

Reopening of a wound, also known as wound dehiscence, is a risky postoperative complication associated with increased rates of morbidity and mortality. Obesity is thought to increase the risk of wound dehiscence both directly by increasing tension on the fascial borders during wound closure and indirectly by increasing the chance of wound infection, which is also a risk factor for dehiscence. Nonetheless, research examining wound dehiscence risk factors has both endorsed and refuted the idea that obesity raises the risk of wound dehiscence [5].

4. *Infectious complications:*

Obesity raises the likelihood of post-operative infection, according to strong evidence. Infection rates were substantially lower in the normal weight group (0.5%) than in the obese group (2.8%, $P < 0.05$) and severely obese group (4.3%, $P < 0.01$), according to a study by Choban et al. [6].

In a related research of 395 surgical patients, Canturk et al. [7] found that 24.3% of patients developed one or more nosocomial infections (pulmonary, urinary, and surgical site infections), with obese patients experiencing considerably higher rates of infections than normal-weight patients ($P < 0.05$).

After many kinds of surgery, wound infections are a leading source of morbidity and are linked to higher mortality, wound dehiscence, and longer hospital stays [3].

Merkow et al.'s recent study [8] demonstrated identified a substantial risk factor for wound complications was morbid obesity (BMI > 35 kg m2). Morbidly obese patients had a 2.6-fold increased risk of a superficial or deep surgical site infection and a 3.5-fold higher incidence of wound dehiscence than people with a normal body mass index.

Laparoscopic surgery and mechanism of pain in laparoscopic cholecystectomy

Although laparoscopy is a great way to reduce a patient's stress and suffering after surgery, there are still some obstacles to reducing a patient's post-operative discomfort. Although it varies greatly from patient to patient, the discomfort peaks six hours after the treatment and then progressively subsides over a few days [9]. The complex etiology of pain includes damage to the abdominal wall's structures, increased visceral trauma and inflammation, peritoneal irritation from CO_2 entrapment beneath the hemidiaphragms, neuropraxia of the phrenic nerve from diaphragm distention during gas insufflations, and/or acid milieu from CO_2 dissolution [9].

Postoperative Pain Management

Providing appropriate analgesia by reducing medication side effects without generating problems, particularly respiratory issues, is the primary goal of postoperative pain management for obese patients. For this, a variety of multimodal analgesia options are employed. These include peripheral nerve blocks, epidural analgesia, systemic opioids, non-opioid analgesics, and infusions at the surgical site [10].

- ***Non-Opioid Analgesics***

The goal of multimodal analgesia is to relieve pain by utilizing the synergistic or additive effects of using two or more distinct analgesics together, while also reducing the dosage and adverse effects of individual medications. In multimodal analgesia, nonsteroidal anti-inflammatory medications (NSAIDs) are commonly utilized. By inhibiting the cyclooxygenase enzyme, NSAIDs work. Although this pharmacological group is useful in treating postoperative pain, certain individuals should use it with caution due to potential gastrointestinal, renal, and platelet problems [11].

They offer efficient analgesia without any significant adverse effects when combined with regional anesthetic procedures. NSAIDs also have antipyretic and anti-inflammatory properties. Postoperative pain is frequently treated with paracetamol. It has a minimal profile of side effects and spares opioids. Studies have demonstrated that when used either alone or in combination, it lessens the demand for opioids. The dosage of paracetamol should be given based on the ideal body weight because the plasma concentration levels in obese and non-obese patients were identical [12].

Systemic Opioids

Among the most potent analgesics are systemic opioids. When no alternative treatment is available for postoperative pain, it is administered as a rescue medication. Constipation, sedation, respiratory depression, and postoperative nausea and vomiting (PONV) are some of its adverse effects. Due to the increased risk of respiratory depression and hypoventilation in obese patients, they should only be administered in conjunction with titration. Furthermore, it has been demonstrated that using opioids as IV patient-controlled analgesia rather than oral, intramuscular, or IV single dose delivery improves patient satisfaction, reduces pulmonary problems, and produces more potent analgesia [13].

- ***Epidural Analgesia***

A popular strategy that has been shown in trials to produce more effective analgesia than other approaches is epidural analgesia. It has been demonstrated that the epidural analgesia approach not only effectively manages pain but also improves lung functions and lowers postoperative pulmonary problems. Early mobilization, reduced PONV, and decreased medication use during the postoperative phase are further advantages of epidural analgesia. But it's important to remember that the epidural approach might cause problems such nerve damage, hypotension or epidural hematoma, pruritus, and urine retention [14].

The gold standard for controlling pain during major abdominal surgery is still epidural analgesia, despite the fact that it is not always feasible. Continuous TAP block is recommended by recent research as a secure and efficient substitute for epidurals [15].

Adjuvant Drugs

By using adjuvant medications, the multimodal analgesia method lessens the requirement for opioids. For this reason, adjuvant medications such as clonidine, dexmedetomidine, magnesium, and pregabalin are used to treat postoperative pain in obese individuals [16].

- ***Peripheral Nerve Blocks***

A crucial element of multimodal pain management, peripheral nerve blocks with local anesthetics are commonly utilized for both anesthesia and postoperative pain management in obese individuals. Peripheral nerve blocks may not work in obese patients because of their enlarged adipose tissue, which makes landmarks difficult to palpate or lowers ultrasonography picture quality. However, it has been shown that the success rate for peripheral nerve blocks in obese and non-obese patients is not significantly different, depending on the ability of the anesthesiologist. In particular, continuous peripheral nerve blocks provide efficient pain relief, reduce the demand for opioids, and prevent side effects like PONV and drowsiness [17].

1. TAP block

For procedures involving the abdominal wall, a variety of peripheral nerve blocks can be employed to deliver regional anesthesia. These blocks are often guided by ultrasonography (US) and include injecting a local anesthetic (LA) solution into interfascial planes. LA is injected between the internal oblique (IO) and transversus abdominis (TA) muscles during a US-guided transversus abdominis plane (TAP) block. The TAP block can also be targeted using Petit triangle-level anatomical markers. The iliohypogastric, ilioinguinal, subcostal, and intercostal nerves are located in this interfascial plane. These nerves provide feeling to the parietal peritoneum and the anterior and lateral abdominal walls, but they only result in somatic analgesia—not visceral [18].

Both open and laparoscopic abdominal operations, as well as inpatient and outpatient surgical procedures, benefit from the TAP block's ability to manage postoperative analgesia. For unilateral surgical procedures such as kidney transplants, nephrectomy, appendectomy, and cholecystectomy, unilateral blocks are employed on either the left or right side. On the other hand, midline and transverse abdominal incisions, including hysterectomy, prostatectomy, cesarean births, and correction of umbilical or ventral hernias, are performed using bilateral TAP blocks. For abdominal surgeries, TAP blocks are a part of multimodal pain treatment which benefits patients by providing analgesics and lowering the need for opioids after surgery. Usually, The intraoperative insertion of TAP blocks occurs either before or after the surgical incision. just prior to the patient emerging from anesthesia. The propagation of LA across the interfacial plane is necessary for the TAP block to be effective. Somatic and more recent tissue plane blocks, such the quadratus lumborum block, produce visceral analgesia. The TAP block is one of the most widely utilized truncal blocks for postoperative analgesia after abdominal surgeries [19].

Recommended strategies for pre-intra-operative and postoperative interventions to manage LC pain in obese patients are summarized in Table 1.

Table 1: Recommended strategies for pre-intra-operative and postoperative interventions to manage LC pain in obese patients.

Type of intervention	Recommendation
Pre-operative drugs	Pre-operative IV. paracetamol and NSAIDs/COX-2 selective inhibitors are recommended
Intra-operative drugs	If not administered pre-operatively, intra-operative IV. paracetamol and NSAIDs/COX-2 selective inhibitors are recommended IV Dexamethasone is recommended
Regional techniques	Port-site wound infiltration or intraperitoneal LA installation is recommended ESP block and TAP block are recommended as second-line regional techniques
Surgical techniques	3-port lap CCE is recommended Low-pressure pneumoperitoneum (< 12 mmHg) is recommended Umbilical port extraction is recommended Active aspiration of the pneumoperitoneum is recommended Normal saline irrigation is recommended
Postoperative drugs	Paracetamol and NSAIDs/Cox2 inhibitors are recommended up to 72 h postoperative Opioids as rescue are recommended Gabapentinoids are recommended when basic analgesia is not possible

Indications

In many abdominal procedures, the TAP block is indicated by the provision of analgesia following an abdominal wall treatment. Both open abdominal surgery and laparoscopic procedures can use the TAP block. In order to treat postoperative pain after abdominal surgeries, the block is a simpler and less dangerous option than epidural anesthesia [20].

- A **unilateral block** is employed for one-sided procedures such as kidney transplants, nephrectomy, cholecystectomy, and appendectomy.
- **Bilateral blocks** are employed for transverse and midline abdominal incisions, including bariatric surgery, laparoscopic surgery, radical retropubic prostatectomy, hysterectomy, bariatric surgery, exploratory laparotomy, colostomy closure, ventral hernia repair, umbilical hernia repair, and cesarean delivery.
- Chronic pain may also benefit from the usage of TAP blocks [21].

Contraindications

The following situations make this operation contraindicated:

• Refusal on the part of the patient

• Infection at the injection site

• LA allergy

Caution should be used while treating patients on therapeutic anticoagulation, pregnant women, and those whose anatomical landmarks are difficult to see (e.g., elderly or very thin individuals) [22].

Complications

TAP block-related issues are uncommon. Among the issues mentioned in the literature are:

Hematoma, liver/spleen laceration, and bowel perforation

• LA injections intraperitoneally and intrahepatic

Vascular injury-induced retroperitoneal hematoma; temporary femoral nerve obstruction; intravascular injection; local infection; and systemic toxicity from LA

To improve the success rate and reduce these issues, US guidance is advised instead of anatomical landmarks. Since the US-guided approach for the TAP block was widely adopted, there have been few reported problems [23].

Neurological injury is rare in TAP blocks because they are field blocks and depend on the enormous volume of LA delivered to permit sufficient blocking of the nerves in the compartment rather than targeting a specific nerve. A neurologic lesion may result from a hematoma, a local infection, or direct needle-induced nerve damage. Furthermore, excessive needle insertion can lead to issues including vascular damage, visceral trauma, intraperitoneal injection, or intrahepatic injection, especially in thin, old, or deconditioned patients [24].

Additionally, some LA injected for the TAP block trailing on the fascia iliaca beneath the inguinal ligament may unintentionally block the femoral nerve, resulting in transient femoral nerve palsy, according to case studies. The surgical team should be contacted if the patient experiences a fall, and the patient should be made aware of the potential risk of falls. Before injecting a LA within the TAP block, which is situated within a well-vascularized interfascial plane, the operator should carefully aspirate to avoid an accidental vascular puncture and intravascular injection that could cause LA systemic toxicity (LAST), a rare but known TAP block complication [25].

Paravertebral block (PVB)

In both intraoperative and postoperative settings, PVB has been found to be an efficient analgesic technique. In some new applications, it may even be able to take the place of general anesthesia for specific procedures. The use of PVB as a postoperative analgesic strategy has shown decreased opioid usage and faster PACU discharge when compared to other techniques such intercostal nerve block, erector spinae plane block, pectoralis II block, and patient-controlled analgesia. Thoracic epidural analgesia and a serratus anterior plane block are similar options to PVB. Few new risks are discovered as PVB use rises, and the frequency of adverse events is consistently reported to be very low [26].

Because PVB is a sort of superior analgesia, it offers a significant advantage in numerous surgical procedures. The distribution of local anesthetic is contentious when PVB is used with the blind approach; failure rates of over 13% have been observed [27]. Due to its ease of administration, non-invasive nature, and safety, regional anesthesia administered under ultrasound (US) supervision has become more common and widespread in recent years [28].

Through paravertebral block, ipsilateral, segmental, somatic, and sympathetic nerves can be blocked. Injection operations can be performed at one or more levels, unilaterally or bilaterally. Clinicians have used varying guidelines for PVB injections so far. While PVB injections were first performed using a landmark-based conventional technique, the nerve stimulation approach and ultrasound-guided PVB operations have been effectively used in recent years for pain control following a variety of thoracic and abdominal surgeries. Among the advantages of ultrasound as an imaging modality for emergency situations are its affordability, accessibility, bedside examination capabilities, and real-time imaging. Ultrasound is increasingly being used to guide a range of interventional therapies. Ultrasound-guided nerve blocks have been performed more successfully and with fewer issues by providing real-time views of the targeted anatomical structure or area, nearby structures, and the approaching needle [29].

Aydin and Aydin, [29] discovered that a practical and secure method for managing pain both during and after LC is ultrasound-guided PVB. Additionally, preoperative block can lower the rate at which postoperative analgesia and intraoperative opioids are needed.

Shibata and Nishiwaki were the first to report a transverse, in-plane ultrasound-guided thoracic PVB. Various ultrasound-guided PVB methods have been developed recently [30, 31]. Ultrasound-guided PVB can be performed using either in-plane or out-of-plane techniques, with the probe positioned sagittally or transversely on the paravertebral area. In the transverse orientation, the injections might be administered medially or laterally. Sonographic markers include the ribs, costotransverse joints, pleura, and the spine's transverse and spinous processes. These methods have already been thoroughly described elsewhere [32].

Indications

The TPVB is advised for anesthesia when the related discomfort is mostly unilateral in the chest , belly and analgesia during any hemithorax surgical operation. During the thoracic portion of big abdominal procedures, perioperative bilateral TPVB applications have also been reported. In minimally invasive heart surgery, video-assisted thoracoscopic surgery, breast surgery, renal surgery, thoracic surgery, and more recently, in combination with general anesthesia, in breast reconstruction surgery, it is commonly utilized as an adjuvant to multimodal postoperative analgesia[33].

Using the TPVB as an alternative anesthesia technique for breast surgery may be beneficial for patients who are at high risk of perioperative and postoperative complications after general anesthesia, especially elderly patients with low vital capacity, low lung reserve, or patients with cardiac morbidity [34].

According to recent studies, TPVB significantly improves the quality of recovery after surgery and is useful for major breast surgeries. It has minimal adverse effects and a low conversion rate to general anesthetic [35].

Contraindications

TPVB's primary contraindications include [36]:

Patient refusal; coagulopathy or systemic anticoagulation (INR>1.4 or insufficient time since quitting anticoagulant according to ASRA guidelines); hypersensitivity reaction or allergy to local anesthetics.

A contamination at the injection location.
A tumor that is present in the area
Due to the possibility of pneumothorax, respiratory infections or chronic pleural enlargement may occur. Some authors claim that a rib cage deformity could make a pleural or intrathecal puncture more likely.

Complications

Aside from the typical side effects of localized anesthetic procedures, such as nerve damage, hematomas at the site of the puncture, infections at the site, and toxicity from an overdose of local anesthetics etc. According to certain writers, there are particular risks associated with paravertebral blocks, including the possibility of hemothorax, pneumothorax, or intrathecal injection [37].

There have been reports of pulmonary bleeding in individuals who had paravertebral block during thoracic surgery. **Steven et al.** [38] noted additional issues such hemi-diaphragmatic paresis and ipsilateral brachial plexus block.

Additionally, **Crawley** [39] discovered that during TPVB, diffusion to the ipsilateral stellate ganglion was the origin of ipsilateral Horner syndrome.

Erector spinae plane block (ESPB)

To treat thoracic neuropathic pain, erector spinae plane block (ESPB) guided by ultrasound (US) was initially described in 2016. Somatic and visceral pain can be reduced by injecting the ESPB local anesthetic into the fascial plane deep into the erector spinae muscle, which is distributed craniocaudally. By affecting the ventral and dorsal rami of spinal nerves, it results in sensory blockage that is both somatic and visceral. For abdominal procedures carried out at the lower thoracic vertebral level (T7 or T8), the ESPB can offer analgesia [40].

Indications

In addition to managing acute and chronic pain disorders, for a variety of surgical procedures in the anterior, posterior, and lateral thoracic and abdominal regions, the ESP block can offer regional analgesia. Case reports and anecdotal clinical experience serve as the foundation for the great majority of ESP block indications [41].

Contraindications

Absolute contraindications for executing an ESP block include patient refusal or infection at the injection site in the paraspinal area. There are no clear guidelines, but anticoagulation may be a relative contraindication to ESP block. Anticoagulation and paraspinal blocks are not particularly included in the most current ASRA consensus statement from 2018. [42].

Complications

Due to the injection site's distance from the spinal cord, major blood vessels, and the pleura, complications are quite uncommon. The main side effects include vascular puncture, pleural puncture, pneumothorax, failure block, infection at the needle insertion site, as well as toxicity or sensitivity to local anesthetics. More research (such as randomized controlled trials, or RCTs) is required to confirm the safety, efficacy, and rates of complications of this approach due to the paucity of published data. In fact, just four RCTs were found in a recent evidence-based analysis, and their endpoints varied widely. [42].

2. Quadratus lumborum block (QLB)

The US-guided quadratus lumborum block (QLB), a modification of the trans-versus-abdominis plane (TAP) block, was initially described in 2007. It is an interfascial planar block that employs a number of methods. Based on the location of medication application, QLB is classified into four types: intramuscular QLB (QLB 4), anterior/transmuscular QLB (QLB 3), posterior QLB (QLB 2), and lateral QLB (QLB 1). Through the thoracolumbar fascia (TLF) and the endothelial fascia, the local anesthetic travels into the paravertebral region and cranially to the T10 segment. Local anesthetic blocking of pain receptors, including sympathetic neurons' high- and low-threshold mechanoreceptors in the superficial layer of the TLF, explains the QLB analgesia. For orthopedic, renal, gastrointestinal, and cesarean section surgeries, the QLB offers postoperative analgesia. [43].

Indications

A wide region of sensory suppression of (usually T7 to L1) is produced by the QLB's wide dispersion of local anesthetic. As a result, QLBs can be employed to give pelvic and abdominal postoperative analgesia. Because of this, the QLB is frequently used to relieve pain following urologic, gynecologic, abdominal, and obstetric operations. Additionally, there are case reports of successful QLB use in lumbar vertebral, femur, and hip procedures [44].

Contraindications

The contraindications for the QLB are comparable to those for other fascia plane blocks, including the fascia iliaca block and the transversus abdominis plane block. The following are examples of these absolute contraindications [45]:

• Refusal on the part of the patient
• Real allergy to local anesthetics

• Danger of local anesthetic toxicity, meaning the patient has already received the highest dosage of local anesthetic advised.
• A local infection at the site of the surgery

The safety of performing the QLB or other plane blocks in a patient on anticoagulants or during a coagulopathy is a matter of debate. In situations where coagulation has changed, some experts believe that plane blocks may be safe. The most recent evidence-based guidelines for the use of regional anesthesia in patients receiving thrombolytic or antithrombotic medication from the American Society of Regional Anesthesia and Pain Medicine oppose deep regional anesthetic treatments in anticoagulated patients. This is because several case reports have shown that such procedures result in significant morbidity [46, 47].

Complications

To prevent infection, practitioners must be careful to perform this block using a sterile approach. There are no documented instances of infectious consequences from QLB, and theoretically, QLBs carry a reduced risk of infection than more central neuraxial techniques. Before conducting the block, it is important to address any history of coagulopathy or anticoagulant use in order to prevent excessive bleeding or the formation of hematomas [48].

Every regional anesthesia operation that involves local anesthetic medications carries the risk of local anesthetic systemic toxicity (LAST) due to the fact that local anesthetics are absorbed throughout the body. Compared to TAP blocks, the QLB is linked to lower plasma ropivacaine levels, which may make it safer [49].

CONCLUSION

Pain following laparoscopic cholecystectomy is caused by a number of complex factors. Numerous medications are being researched and administered either prior to, during, or following surgery in an effort to lessen the postoperative pain associated with LC. IV paracetamol has been shown to be a crucial component of multimodal postoperative pain treatment. Also helpful in managing pain were a number of pharmaceutical medications, such as magnesium sulfate, dexamethasone, local anesthetics and NSAIDs. Furthermore, non-pharmacological methods have demonstrated their effectiveness in managing postoperative pain in LC patients. To find the best methods for treating pain in LC patients, more thorough medical study involving different treatment groups and additional participants is required.

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Consent for publication

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Competing interests

The authors declare that they have no competing interest.

REFERENCES

1. Jin X, Qiu T, Li L, Yu R, Chen X, Li C, et al. Pathophysiology of obesity and its associated diseases. Acta Pharm. Sin. B., 2023; 13(6): 2403-24.
2. Fusco K, Thompson C, Woodman R, Horwood C, Hakendorf P, Sharma Y. The impact of morbid obesity on the health outcomes of hospital inpatients: an observational study. J. Clin. Med., 2021; 10(19):4382.
3. Doyle SL, Lysaght J, Reynolds JV. Obesity and post-operative complications in patients undergoing non-bariatric surgery. Obes. Rev., 2010; 11(12): 875-86.
4. Lopes LA, Agrawal DK. Post-Operative Atrial Fibrillation: Current Treatments and Etiologies for a Persistent Surgical Complication. J Surg Res (Houst)., 2022; 5(1):159-72.
5. Rosen RD, Manna B. Wound dehiscence. 2022.
6. Choban PS, Heckler R, Burge JC, Flancbaum L. Increased incidence of nosocomial infections in obese surgical patients. Am Surg., 1995; 61: 1001–5.
7. Canturk Z, Canturk NZ, Cetinarslan B, Utkan NZ, Tarkun I. Nosocomial infections and obesity in surgical patients. Obes Res, 2003; 11: 769–75.
8. Merkow RP, Bilimoria KY, McCarter MD, Bentrem DJ. Effect of body mass index on short-term outcomes after colectomy for cancer. J Am Coll Surg, 2009; 208: 53–61.
9. Haque MI, Bashir HA, Hassan G, Ahmed G. Efficacy of Local Anesthetic in Post-Operative Laparoscopic Cholecystectomy. SAS J Surg., 2023; 7: 629-32
10. De Jong A, Rollé A, Souche FR, Yengui O, Verzilli D, Chanques G, et al. How can I manage anaesthesia in obese patients?. Anaesth Crit Care Pain Med., 2020; 39(2): 229-38.
11. Paladini A, Varrassi G. Multimodal pharmacological analgesia in pain management. Pain management-practices, novel therapies and bioactives. 2020.
12. Freo U. Paracetamol for multimodal analgesia.

Pain Manag., 2022; 12(6):737-50.
13. Wick EC, Grant MC, Wu CL. Postoperative multimodal analgesia pain management with nonopioid analgesics and techniques: a review. JAMA Surg., 2017; 152(7): 691-7.
14. Rawal N. Epidural analgesia for postoperative pain: Improving outcomes or adding risks?. Best Pract Res Clin Anaesthesiol., 2021; 35(1): 53-65.
15. Grice A, Boyd N, Marshall S. Analgesia for abdominal surgery. AAGBI core topics in anaesthesia., 2011; 56-71.
16. El-sawy AH, Amin NM. Overview of Post-Operative Pain Management in Obese Patients Undergoing Elective Abdominal Gynecological Surgery. NeuroQuantology., 2022; 20(11):1073.
17. Demir E, Demir CE. Postoperative Pain Management in Obese Patients. practice., 2019; 3(1):1-42.
18. Mavarez AC, Hendrix JM, Ahmed AA. Transabdominal Plane Block. 2023. [Updated 2023 Nov 13]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560527/
19. Tsai HC, Yoshida T, Chuang TY, Yang SF, Chang CC, Yao HY, et al. Transversus Abdominis Plane Block: An Updated Review of Anatomy and Techniques. Biomed Res Int., 2017; 2017:8284363.
20. Elsharydah A, De La Cruz R, Horani SM, Xiao CY. Utilization of Truncal Fascial Plane Nerve Blocks for Chronic Pain Management: A Narrative Review. Curr Pain Headache Rep., 2023; 27(6):149-55.
21. Aggarwal AK, Ottestad E, Pfaff KE, Huai-Yu Li A, Xu L, Derby R, et al. Review of Ultrasound-Guided Procedures in the Management of Chronic Pain. Anesthesiol Clin., 2023; 41(2):395-470.
22. Sellam S, Nguyen AT, Pogu M, Kianmanesh R, Malinovsky JM, Renard Y. Transversus Abdominis Plane Block in the Treatment of Chronic Postsurgical Abdominal Wall Pain Improves Patient Quality of Life: A Retrospective Study and Literature Review. Pain Physician., 2023; 26(2):E91-E100.
23. Mukhtar K, Singh S. Ultrasound-guided transversus abdominis plane block. Br J Anaesth., 2009; 103(6):900; author reply 900-1.
24. Farooq M, Carey M. A case of liver trauma with a blunt regional anesthesia needle while performing transversus abdominis plane block. Reg Anesth Pain Med., 2008; 33(3):274-5.
25. Salaria ON, Kannan M, Kerner B, Goldman H. A Rare Complication of a TAP Block Performed after Caesarean Delivery. Case Rep Anesthesiol., 2017; 2017:1072576.
26. Slinchenkova K, Lee K, Choudhury S, Sundarapandiyan D, Gritsenko K. A review of the paravertebral block: Benefits and complications. Curr. Pain Headache Rep., 2023; 27(8):203-8.
27. Thavaneswaran P, Rudkin EG, Cooter RD, Moyes DG, Perera CL, Maddern GJ. Paravertebral Block for Anesthesia: A Systematic Review. Anesth Analg, 2010; 110-6.
28. Pace MM, Sharma B, Anderson-Dam J, Fleischmann K, Warren L, Stefanovich P. Ultrasound-guided thoracic paravertebral blockade: a retrospective study of the incidence of complications. Anesth Analg, 2016; 122: 1186-91.
29. Aydin G, Aydin O. The efficacy of ultrasound-guided paravertebral block in laparoscopic cholecystectomy. Med., 2018; 54(5):75.
30. Paraskeuopoulos T, Saranteas T, Kouladouros K, Krepi H, Nakou M, Kostopanagiotou G, et al. Thoracic paravertebral spread using two different ultrasound-guided intercostal injection techniques in human cadavers. Clin. Anat., 2010; 23(7):840-7.
31. Luyet C, Herrmann G, Ross S, Vogt A, Greif R, Moriggl B, et al. Ultrasound-guided thoracic paravertebral puncture and placement of catheters in human cadavers: where do catheters go?. Br. J. Anaesth., 2011; 106(2):246-54.
32. Krediet AC, Moayeri N, van Geffen GJ, Bruhn J, Renes S, Bigeleisen PE, et al. Different approaches to ultrasound-guided thoracic paravertebral block: an illustrated review. Anesthesiology., 2015; 123(2):459-74.
33. Zheng C, Wang J, Xie S. Ultrasound-Guided Thoracic Paravertebral Nerve Block on Postoperative Pain, Quality of Life, and Recovery in Patients with Non-Small-Cell Lung Cancer. Biomed Res Int., 2021; 2021:6692815.
34. Zemedkun A, Destaw B, Milkias M. Anatomic Landmark Technique Thoracic Paravertebral Nerve Block as a Sole Anesthesia for Modified Radical Mastectomy in a Resource-Poor Setting: A Clinical Case Report. Local Reg Anesth., 2021; 14:1-5.
35. Hu L, Xu X, Tian H, He J. Effect of Single-Injection Thoracic Paravertebral Block via the Intrathoracic Approach for Analgesia After

Single-Port Video-Assisted Thoracoscopic Lung Wedge Resection: A Randomized Controlled Trial. Pain Ther., 2021; 10(1):433-42.

36. Ben Aziz M, Mukhdomi J. Thoracic Paravertebral Block. 2023. [Updated 2023 Feb 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK570560/
37. Lekhak B, Bartley C, Conacher ID, Nouraei SM. Total spinal anaesthesia in association with insertion of a paravertebral catheter. Br J Anaesth., 2001; 86(2):280-2.
38. Renes SH, van Geffen GJ, Snoeren MM, Gielen MJ, Groen GJ. Ipsilateral brachial plexus block and hemidiaphragmatic paresis as adverse effect of a high thoracic paravertebral block. Reg Anesth Pain Med., 2011; 36(2):198-201.
39. Crawley SM. Coexisting harlequin and Horner syndromes after high thoracic paravertebral block. Br J Anaesth., 2006; 96(4):537-8.
40. Duan L, Wang Z, Sun M, Huang L, Ye Q, Wang H. Effect of Ultrasound-Guided Erector Spinae Plane Block on Pain After Laparoscopic Transabdominal Preperitoneal Repair: A Prospective, DoubleBlind, Randomized Controlled Study. Altern Ther Health Med., 2024; 30(9).
41. Schwartzmann A, Peng P, Maciel MA, Forero M. Mechanism of the erector spinae plane block: insights from a magnetic resonance imaging study. Can J Anaesth., 2018; 65(10):1165-6.
42. Krishnan S, Cascella M. Erector Spinae Plane Block. 2023. [Updated 2023 Jun 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK545305/
43. Ashoor TM, Jalal AS, Said AM, Ali MM, Esmat IM. Ultrasound-guided techniques for postoperative analgesia in patients undergoing laparoscopic sleeve gastrectomy: erector spinae plane block vs. quadratus lumborum block. Pain Physician., 2023; 26(3):245.
44. Ueshima H, Hiroshi O. Lumbar vertebra surgery performed with a bilateral posterior quadratus lumborum block. J Clin Anesth., 2017; 41:61.
45. Young MJ, Gorlin AW, Modest VE, Quraishi SA. Clinical implications of the transversus abdominis plane block in adults. Anesthesiol Res Pract. 2012;2012:731645.
46. Mrunalini P, Raju NV, Nath VN, Saheb SM. Efficacy of transversus abdominis plane block in patients undergoing emergency laparotomies. Anesth Essays Res., 2014; 8(3):377-82.
47. Horlocker TT, Vandermeuelen E, Kopp SL, Gogarten W, Leffert LR, Benzon HT. Regional Anesthesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (Fourth Edition). Reg Anesth Pain Med., 2018; 43(3):263-309.
48. Akerman M, Pejčić N, Veličković I. A Review of the Quadratus Lumborum Block and ERAS. Front Med (Lausanne)., 2018; 5:44.
49. Murouchi T, Iwasaki S, Yamakage M. Quadratus Lumborum Block: Analgesic Effects and Chronological Ropivacaine Concentrations After Laparoscopic Surgery. Reg Anesth Pain Med., 20160; 41(2):146-50.

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