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Review article

POST-LAPAROSCOPIC SHOULDER PAIN: A NARRATIVE REVIEW OF A FREQUENT POSTOPERATIVE SEQUELA

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Abstract: While the adoption of laparoscopic surgery has enhanced patient safety, comfort and satisfaction, a considerable number of patients experience post-laparoscopic shoulder pain (PLSP), which can slow down recovery. The literature in English language was reviewed after searching major academic databases and engines, including PubMed, Google Scholar, ResearchGate, and Web of Science to summarize the current understanding of the etiopathogenesis, associated risk factors, and management strategies for post-laparoscopic shoulder pain. The precise etiology remains undefined, and several theories have been proposed to account for PLSP. The most accepted theory suggests that PLSP is a form of referred pain caused by irritation of the diaphragm due to stretching from the pneumoperitoneum or the presence of residual gases and fluids. Currently, there are no universally accepted protocols for either the prevention or treatment of PLSP; consequently, a wide range of modalities are applied based on the surgeon's expertise and preference. There is a clear need to improve awareness of this condition to enable the standardization of management options, thus optimizing patient benefits.

Keywords*:* laparoscopic surgery, shoulder pain, referred pain, pneumoperitoneum, carbon dioxide, diaphragm, Phrenic nerve.

INTRODUCTION

The widespread integration of the minimally invasive laparoscopic techniques has transformed surgical practice in recent decades. This approach offers distinct advantages such as reduced blood loss, quicker recovery, shorter hospital stays, fewer complications, reduced risk of intestinal adhesions, and faster return to daily activities. Nevertheless, this approach has introduced a unique spectrum of complications (1).

Post-laparoscopic shoulder pain (PLSP) represents a frequent, yet often underappreciated, adverse outcome of laparoscopic abdominal operations (2). This is shoulder pain that typically manifests within hours of a laparoscopic procedure. It is classically defined as a referred pain phenomenon, wherein the perceived pain location differs from the actual site of the noxious stimulus. Although PLSP is typically self-limiting, it can significantly impair a patient's immediate postoperative quality of life (3, 4).

This narrative review critically examines the etiopathogenesis, identifies the established risk factors, and outlines the management strategies for PLSP, intending to offer a thorough overview for both clinicians and researchers.

MATERIAL AND METHODS

A comprehensive review of the available literature was conducted via electronic searches of PubMed, Google Scholar, ResearchGate, and Web of Science. The search employed Medical Subject Headings (MeSH) and keywords, including "Laparoscopic Surgery," "Shoulder Pain," "Referred Pain," and "Pneumoperitoneum". No restrictions were placed on the date of publication.

Inclusion criteria were restricted to articles published in peer-reviewed English-language journals, with publications in other languages being excluded. The search was performed in September 2025, and the methodology involved scrutinizing the titles, abstracts, and full texts of the identified articles. A total of 62 articles were selected and utilized as references for developing this narrative review.

Since this review relies exclusively on previously published data and involves no new experimentation on human or animal subjects, institutional ethical committee approval was not required.

Etiopathogenesis of PLSP

While various theories have been proposed (Table 1), the precise etiology of PLSP remains unclear. The key mechanisms that have been suggested include:

i. Referred pain

The phrenic nerve originates in the neck from the anterior branches of cervical spinal nerves C3-C5 (primarily C4) and descends to innervate the diaphragm. The supraclavicular nerve, a cutaneous branch of the cervical plexus, also arises from C3-C4 and provides sensation to the skin over the upper chest, neck, and shoulder.

During laparoscopic surgical operations, the abdomen is inflated with carbon dioxide (CO_2) gas to create an operative pneumoperitoneum. This gas gets converted to carbonic acid on the moist surfaces of the peritoneum and diaphragm, due to the action of carbonic anhydrase, resulting in reduction of peritoneal pH value. This acidic environment leads to diaphragmatic irritation. Due to the shared nerve pathways (C3-C4), the brain misinterprets the signal from diaphragm as pain perceived in the shoulder area, a phenomenon termed "referred pain" (5, 6).

ii. Residual gas and fluids

At the conclusion of the laparoscopic operation, CO□ gas is vented out before the port site closure, but some residual gas often persists. Similarly, blood clots or excess fluids may become sequestered under the diaphragm. These residual pockets of gas and fluids are believed to induce diaphragmatic irritation andthereby initiate PLSP.

Jackson et al. (7) conducted a prospective study on 20 patients undergoing laparoscopic gynaecological operations. Postoperative erect chest X-rays were performed at discharge to estimate the volume of trapped CO_2 bubbles beneath each hemidiaphragm. Telephonic interviews revealed a statistically significant correlation between the volume of residual gas bubbles on the right side and the reported pain score. Consistent with this study, Song et al. (8) evaluated 203 patients undergoing laparoscopy for benign gynaecological conditions and concluded that the volume of residual pneumoperitoneum, visible on 24-hour postoperative chest X-ray, was positively correlated with the intensity of PLSP.

iii. Tissue trauma

The passive stretch imposed by the pneumoperitoneum may cause traction on visceral ligaments, microvascular rupture in the peritoneum, nerve traction/neuropraxia, and the local release of inflammatory mediators that heighten pain sensitization (9). Specifically, Dixon et al. (10) attributed PLSP to mechanical trauma to the diaphragmatic crura during bariatric surgical procedures.

iv. Surgical Position

The positioning of the patient during surgery may contribute to PLSP by inducing strain on the shoulder muscles. Fujimoto et al. (11) investigated the correlation between the operative side and PLSP and concluded that left-sided surgery, performed in the lateral recumbent position for urologic laparoscopy, was associated with a higher incidence of PLSP. Additionally, Kojima et al. (12) suggested that arm abduction during gynaecological laparoscopy could be a contributing factor to PLSP.

v. Drains

The presence of a subdiaphragmatic drain may potentially irritate the phrenic nerve, triggering shoulder pain. Suzuki et al. (13) observed that symptoms improving in a sitting or standing position, which allows the drain to fall away from the diaphragm due to gravity, suggest a subphrenic drain as the cause of PLSP.

Pain Characteristics

The characteristics of PLSP (Table 1), as mentioned below, are influenced by factors such as the amount and pressure of CO_2 used, the nature and du-

Table 1. *Etiopathogenesis, clinical characteristics, and risk factors of post-laparoscopy shoulder pain*

Etiopathogenesis	Clinical characteristics	Risk factors
Referred pain due to phrenic nerve irritation	Sharp, dull, or throbbing shoulder-tip discomfort	Female sex
Residual intraperitoneal gas and fluids	Unilateral or bilateral shoulder involvement	Low body mass index
Tissue trauma	Mild to moderate intensity	Trendelenburg positioning
Surgical positioning	Onset within 24 h; peak at 12–24 h	Higher insufflation pressure
Use of intra-abdominal drains	Resolves within 2–3 days	
	Often less responsive to conventional analgesics	

Abbreviations: h-hours.

ration of the surgery, and the significant subjective patient variability (14).

Character: The pain is commonly described as a sharp, dull, or throbbing discomfort (14, 15).

i. Location: Patients typically localize the discomfort to the "shoulder-tip," meaning the superior aspect of the shoulder. PLSP may manifest unilaterally (right or left) or bilaterally, but right-sided pain is frequently reported, especially following gynaecological surgery. In a series of 97 patients undergoing various laparoscopic procedures for benign disorders, 58.7% felt PLSP on the right side (9), whereas Dixon et al. (10) found that PLSP following laparoscopic adjustable gastric band (LAGB) placement predominantly affected the left side.

ii. Intensity: PLSP is generally mild to moderate in intensity. A study by Panditrao et al. (16) utilized a 0–10 Numerical Visual Analog Scale (VAS) and reported an average PLSP score of 6.5.

iii. Timing: PLSP usually occurs within a few hours after laparoscopic surgery. It generally begins within a few hours following the laparoscopic operation and typically peaks between 12- and 24-hours post-surgery before gradually subsiding over the subsequent few days (17). However, some studies have noted a delayed onset. Li et al. (18) investigated 442 cases of gynaecological laparoscopic surgery and found that over 90% of patients first experienced PLSP on the first postoperative day rather than the day of surgery.

iv. Duration: For most patients, PLSP is transient, resolving within 2–3 days. Nevertheless, in some cases, it can persist for up to 5 weeks or longer, negatively affecting quality of life. In the series by Dixon et al. (10), 66% and 21% of patients reported pain at 1 and 5 weeks, respectively. At 5 weeks, however, only 7% remained concerned about the pain, and 5% still required analgesics.

v. Response to treatment: A characteristic feature of PLSP is its often-reduced responsiveness to conventional analgesics compared to incisional or visceral abdominal pain (8, 10).

Incidence of PLSP

PLSP is a very prevalent complication, with reported incidence rates varying widely, from 30% to over 90%, depending on the specific type of laparoscopic procedure (19). Kaloo et al. (20) identified PLSP in 80% of females following gynecological laparoscopic procedures. A different series by Li et al. (18) reported PLSP in 77.3% of cases undergoing laparoscopic operations for benign gynecological disorders. Conversely, Panditrao et al. (16) questioned whether the incidence is overestimated, as their series reported a lower incidence of 16.8%.

Potential risk factors

Several factors have been identified as potentially increasing the risk of developing PLSP (4):

i. Gender: Although the underlying reason is unclear, studies suggest a higher incidence of PLSP in females.

ii. Surgical position: Positions that facilitate the pooling of carbon dioxide gas beneath the diaphragm (e.g., head-up position) tend to increase the risk of PLSP.

iii. Body Mass Index (BMI): Patients with a lower BMI may be more vulnerable to developing PLSP (21, 22).

iv. Insufflation pressure: A positive correlation exists between higher insufflation pressures and both the incidence and intensity of discomfort (23).

Awareness about PLSP

The laparoscopic approach has enabled early discharge and shorter in-hospital stays. This success, however, has inadvertently contributed to a lack of familiarity with PLSP among both patients and clinicians, often resulting in missed diagnoses, inadequate evaluation, suboptimal management, and delayed recovery (19-25).

Management of PLSP

The management of PLSP constitutes a comprehensive, integrated strategy focusing on prevention through meticulous surgical technique, followed by the management of any residual pain using a multimodal approach of non-pharmacological and non-opioid pharmacological methods (Table 2).

Table 2. *Multimodal strategies for the prevention and management of post-laparoscopic shoulder pain*

Approach	Specific options and interventions
Surgical / Technical	Low-pressure pneumoperitoneum; active intraperitoneal gas aspiration; pulmonary recruitment manoeuvres; intraperitoneal saline or Ringer's lactate instillation
Pharmacological	Non-steroidal anti-inflammatory drugs (NSAIDs); Gabapentinoids; intraperitoneal local anaesthetics; opioid analgesics when required
Physical / Positioning	Early mobilization; Trendelenburg positioning during gas evacuation; local heat application to the shoulder region

Prevention of PLSP

i. Active gas aspiration: Multiple studies have confirmed a positive association between the volume of residual gas post-laparoscopy and PLSP severity (7, 8). Consequently, in addition to passive deflation at the end of the operation, surgeons are increasingly employing suction to actively evacuate as much residual gas as possible. A meta-analysis by Haneef et al. (26), including five Randomized Clinical Trials (RCTs) with 367 participants, found that active gas aspiration resulted in significantly lower residual gas volume, reduced PLSP scores at 24 hours postoperatively, and decreased overall analgesic requirements compared to passive aspiration, without a significant increase in operative time or cost.

ii. Pulmonary recruitment manoeuvre (PRM): The PRM is performed during positive pressure ventilation and involves the brief application of significantly supra-physiological positive pressure to the airways and alveoli. This maneuver increases transpulmonary pressure, leading to the re-expansion of collapsed alveoli and facilitating the expulsion of CO_2 from the peritoneal cavity. Several studies have validated its role in reducing PLSP when used alone or combined with other preventive strategies (6). Samarah et al. (27) demonstrated in a randomized controlled trial (RCT) that using a PRM (five manual inflations lasting five seconds at a maximum pressure of 25 mm Hg at the conclusion of laparoscopic cholecystectomy (LC) significantly reduced PLSP. Similar findings were reported by Kihlstedt Pasquier et al. (28) and Noh et al. (29). A meta-analysis by Deng et al. (30), including 1,504 patients, concluded that PRM is effective in alleviating PLSP. Kietpeerakool et al. (31) found that PRM using 40 pressure shows promise for reducing PLSP within 48 hours following gynecologic laparoscopic surgery.

Although most studies have not reported significant adverse effects, high airway pressure carries a theoretical risk of pulmonary barotrauma or cardiovascular complications. Ryu K et al. (32) assessed PRM efficacy and safety at maximum inspiratory pressures of 40 and 60mm Hg and concluded that both levels were equally effective in removing residual gas, supporting the safe use of PRM at 40mm Hg for PLSP reduction.

While the studies have not reported any significant negative effects due to PRM, high airway pressure can result in pulmonary barotrauma or other cardiovascular complications. Ryu K et al. (32) evaluated the efficacy and safety of a PRM for reducing PLSP, applying maximum inspiratory pressures of 40 and 60 cm H_2O. They concluded that PRM with a maximum inspiratory pressure of 40 cm H_2O can be used safely for the reduction of PLSP since they established that both pressure levels are equally effective in removing residual gas from the peritoneal cavity.

iii. Low-Pressure Pneumoperitoneum (LPP): During laparoscopic surgeries, the standard pneumoperitoneum pressure (SPP) is usually set between 12 and 16 mmHg. Given the link between PLSP and excessive diaphragm stretching, the impact of using LPP has been investigated. Barczynski et al. (33) compared LPP (7 mmHg) and SPP (12 mmHg) pneumoperitoneum during LC and reported a 2.1-fold reduced incidence of PLSP with LPP. Yasir et al. (23) found that LPP (8 mm Hg) during LC decreased the intensity of PLSP, leading to reduced analgesic requirements at 4, 8, and 24 hours. In gynecological operations, Bogani et al. (34) compared the use of LPP (8 mm Hg) vs SPP (12 mm Hg) during mini-laparoscopic hysterectomy (MLH) and concluded that LPP is safe in experienced hands and offers the benefit of less shoulder-tip pain. A combination of LPP (8 mm Hg) and deep neuromuscular blockade (NMB) was also found to significantly reduce PLSP following laparoscopic hysterectomy (35). Sarli et al. (36) reported a significant reduction in the frequency and severity of PLSP with LPP (9 mm Hg) during LC, with no observed increase in operative duration. However, a related study by Gurusamy et al. (37) found a two-minute increase in operating time. Therefore, further research is warranted to determine if the routine use of LPP is universally advisable for all laparoscopic surgeries.

iv. Phrenic Nerve Block (PNB): As PLSP is thought to be caused by irritation of the phrenic nerve, hence phrenic nerve block (PNB), which prevents phrenic neural impulses from entering the central nervous system (CNS), has been investigated as a potential treatment (6). As the irritation of the phrenic nerve is considered a major cause of PLSP, PNB has been studied as a potential intervention to prevent neural impulses from reaching the central nervous system (CNS). Yi et al. (38) conducted an RCT using ultrasound-guided PNB on patients undergoing LC and reported a substantial decrease in PLSP without any respiratory complications, despite a dramatic decrease in right-sided diaphragmatic excursion one-hour post-surgery.

v. Intraperitoneal instillation of local anesthetics: Several studies (39, 40) have demonstrated that the incidence and severity of PLSP may be decreased by administering local anesthetics (LA) into the abdomen cavity, either before the insufflation of CO_2 or at the end of the procedure. This analgesic effect is believed to result from the LAs' capacity to interrupt pain signal transmission from injured intra-abdominal tissues (40).

The most frequently used LAs for this purpose are bupivacaine, followed by lidocaine and ropivacaine. Cha et al. (41) assessed the effect of ropivacaine, administered peritrocally, intraperitoneally, or as a combination, following LC and found that intraperitoneal instillation significantly reduced visceral pain and PLSP.

Nebulization of intraperitoneal ropivacaine was also shown to significantly reduce PLSP and improve the duration of independent walking, though a higher rate of postoperative vomiting following LC was noted (42). Ingelmo et al. (43) compared preoperative and postoperative nebulization of ropivacaine (1%) to a placebo (normal saline, NS) during LC and concluded that ropivacaine nebulization, whether applied before or after surgery, reduced PLSP and morphine requirements, facilitating earlier mobility

Daghmouri et al. (44) concluded that intraperitoneal ropivacaine instillation is a valuable component of multimodal pain management, as it considerably lowers opioid consumption and enhances postoperative recovery markers. Despite these promising results, they advised that more studies are required to validate the safety and effectiveness of this management option.

vi. Intraperitoneal Dexamethasone: Given the known anti-inflammatory properties of steroids and the hypothesized inflammatory component of diaphragmatic/peritoneal irritation following laparoscopy, dexamethasone has been investigated as a therapy option. Asgari et al. (45) conducted a study wherein they administered 16 mg of intraperitoneal dexamethasone to a study group versus a placebo to a control group, and observed that dexamethasone significantly reduced the intensity of PLSP and the need for opioid analgesia.

vii. Sub-diaphragmatic irrigation with sodium bicarbonate: One theory of PLSP etiology involves diaphragmatic irritation from the acidic carbonic acid created by the pneumoperitoneum. Consequently, neutralizing the subphrenic acidic environment has been explored as a management strategy. Liu et al. (46) compared sub-diaphragmatic irrigation with a sodium bicarbonate-containing solution to standard saline irrigation during total laparoscopic hysterectomy (TLH) for benign indications and found that sodium bicarbonate safely and effectively reduced PLSP. Similarly, Saadati et al. (47) reported that peritoneal irrigation with sodium bicarbonate reduced PLSP intensity and improved early postoperative Quality of Life (QOL).

viii. Intraperitoneal saline instillation: Some evidence suggests that a subdiaphragmatic wash with intraperitoneal normal saline (NS) can significantly reduce PLSP and lower analgesic requirements in the postoperative period, thereby promoting early mobilization and discharge (48). Tsimoyiannis et al. (49) found that the benefit was greater when the saline was suctioned after pneumoperitoneum deflation. The effect was further enhanced when a subhepatic closed drain was left in place to continue suctioning fluid during the initial postoperative hours. Esmat et al. (50) found that combining low-pressure pneumoperitoneum with intraperitoneal NS infusion reduced the intensity of PLSP, though not its frequency. Ryu KH et al. (51) concluded that the prevention of PLSP and removal of residual CO_2 achieved by saline infusion alone is as effective as when combined with PRM.

ix. Warm and humidified CO_2 insufflation: Cold, dry CO_2 gas can lead to peritoneal tissue desiccation, which may result in inflammation and cellular damage. In contrast, warm, humidified prevents desiccation and could potentially reduce postoperative pain. Herrmann and De Wilde (52) conducted an RCT comparing warm, humidified to cold, dry in patients undergoing surgery for benign uterine diseases and demonstrated that the warm, humidified gas significantly reduced both PLSP and morphine demand. Kordestani et al. (53) compared warm gas insufflation to local heat application in LC and found that both interventions were effective in reducing PLSP.

x. Preoperative clonidine / Gabapentinoid: Clonidine is an antihypertensive agent acting on alpha-adrenergic and imidazoline receptors. Mirhosseini et al. (54) administered 0.2 of oral clonidine 90 minutes before anesthesia induction for LC patients. They found that while it did not decrease the incidence of PLSP, it significantly reduced its intensity. Gabapentinoids, including gabapentin and pregabalin, act as analogs of gamma-aminobutyric acid (GABA). Pre-emptive administration of these drugs can reduce PLSP and improve sleep quality on the first postoperative night (55). Valadan et al. (56) assessed the prophylactic effect of oral gabapentin (600 mg) given 30 minutes before induction in patients undergoing laparoscopic ovarian cystectomy, concluding it was a safe and effective strategy for reducing both the incidence and severity of PLSP.

Treatment of PLSP

i. Postoperative position: The Trendelenburg position facilitates the movement of residual CO_2 in the abdominal cavity away from the diaphragm and towards the pelvis, where the abundant vascularity accelerates the absorption of CO_2. This position also reduces the stretching of visceral ligaments. Zeeni et al. (24), in a study involving 108 patients, evaluated the effect of nursing the patients postoperatively in the Trendelenburg position and found that the severity of PLSP at 12 hours decreased by 76%. Nursing in an

exaggerated lithotomy position has also been found to be effective in relieving PLSP after laparoscopic cholecystectomy (25).

ii. Non-steroidal anti-inflammatory drugs: Lee et al. (9) found that Naproxen 250mg orally every 12 h post-operatively was effective in PLSP. NSAIDs can be given orally or via injection, but studies have indicated that they are significantly less effective in alleviating PLSP compared to pain at the abdominal surgical site. Lee et al. (9) reported that Naproxen 250 orally every 12 hours postoperatively was effective for PLSP management.

iii. Transcutaneous Electrical Nerve Stimulation (TENS): TENS delivers mild electrical currents to the skin, stimulating neurons to reduce pain via two mechanisms: the release of natural painkillers (endorphins) and the gate-control theory, which inhibits pain impulses in the spinal cord. The electrical pulses activate large, touch-sensing nerve fibers, blocking the transmission of pain-sensing nerve messages to the brain. Asgari Z et al. (57) compared the effect of TENS to 50 mg of fentanyl and found that TENS was not superior to fentanyl in any way. They suggested that future evaluations should focus on defining specific TENS parameters optimized for PLSP alleviation.

iv. Local anesthesia of shoulder tip: It has been demonstrated that local anesthetic (LA) administration directly to the area of referred pain, rather than the inflamed area, can successfully reduce referred pain. This analgesic effect is thought to be due to the interruption of pain signals in peripheral nociceptors. A study by Kim HY et al. (58) found that a 5% lidocaine patch applied directly to the shoulder reduced PLSP intensity at 24- and 48-hours following LC. The local patch provides the benefits of minimal systemic absorption and negligible side effects. Kim JE et al. (59) also demonstrated the analgesic effect of trigger point injection and eutectic mixture of local anaesthetics (EMLA) for PLSP after total laparoscopic hysterectomy.

v. Alternative medicine: Kreindler et al. (60) studied the impact of acupuncture in 25 patients with moderate-to-severe PLSP resistant to conventional analgesia. They observed no notable adverse effects and a significant decrease in PLSP. The study concluded that customized acupuncture, when integrated with traditional therapies, may be beneficial for PLSP. Zerkle et al. (61) explored a 25-minute single-session massage focusing on passive touch to the shoulder and diaphragm area in a 17-year-old patient with PLSP after laparoscopic abdominal surgery, which resulted in complete pain relief. Mottahedi et al. (62) compared conventional pharmacological treatment to massage plus conventional pharmacological treatment and TENS plus conventional pharmacological treatment.

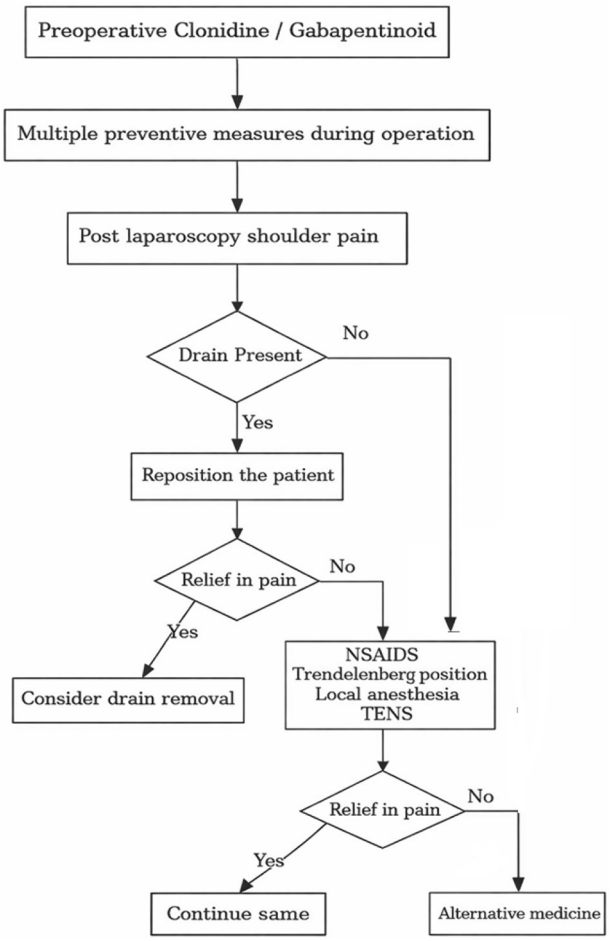

Figure 1. *Algorithm for management of post laparoscopy shoulder pain. (Image credits: Saleh AlSuwaydani - Author)*

Massage and TENS were administered three consecutive times after the patient regained consciousness in the inpatient wards, and both were found to decrease the PLSP intensity.

Based on the preceding review of the current literature, a suggested management algorithm is depicted in Figure 1. This approach emphasizes that PLSP management must be multimodal, spanning the preoperative, operative, and postoperative phases.

Limitations

This review is subject to several limitations. Firstly, the literature search was restricted to open-access databases and specific academic search engines (PubMed, Google Scholar, ResearchGate, and Web of Science), which may have led to the exclusion of other relevant publications. Secondly, bias in article selection may be present due to the varying experience and expertise of the researchers. Finally, limiting the inclusion criteria to English-language publications may have inadvertently overlooked potentially significant articles written in other languages.

CONCLUSION

Post-laparoscopic shoulder pain is a frequent complication of the laparoscopic surgical approach. It is often overlooked because it commonly manifests after the patient has been discharged from the medical facility. The etiopathogenesis remains unclear, yet a variety of management strategies have been proposed in recent years. To ensure that patients receive the benefits of the various available management options, increasing awareness of PLSP is essential.

Abbreviations

PLSP - Post-laparoscopic shoulder pain
QOL - Quality of life
NS - Normal saline
TLH - Total laparoscopic hysterectomy
SPP - Standard pneumoperitoneum pressure
LPP - Low pneumoperitoneum pressure
TENS - Transcutaneous electrical nerve stimulation
LA - Local anesthetic
PNB - Phrenic nerve block
CNS - Central nervous system
PRM - Pulmonary recruitment manoeuvre
CO_2 - Carbon dioxide

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Data Availability: References for this review were obtained from freely available open-access sources.

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Note: Artificial intelligence was not utilized as a tool in this study.

Sažetak

BOL U RAMENU NAKON LAPAROSKOPSKE OPERACIJE: PRIKAZ OVE ČESTE POSTOPERATIVNE SEKVELE

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Iako je primena laparoskopske hirurgije unapredila bezbednost, udobnost i zadovoljstvo pacijenata, kod značajnog broja pacijenata je prisutan bol u ramenu nakon laparoskopske operacije (PLSP), što može usporiti postoperativni oporavak. Pregledana je literatura na engleskom jeziku putem pretrage glavnih akademskih baza i pretraživača, uključujući PubMed, Google Scholar, ResearchGate i Web of Science, kako bi se sumiralo trenutno razumevanje etiopatogeneze, povezanih faktora rizika i strategija lečenja PLSP. Precizna etiologija još uvek nije definisana, a predložene su različite teorije koje objašnjavaju PLSP. Najšire prihvaćena teorija sugeriše da je PLSP oblik reflektovanog bola izazvan iritacijom dijafragme usled istezanja prouzrokovanog pneumoperitoneumom ili prisustvom preostalih gasova i tečnosti. Trenutno ne postoje univerzalno prihvaćeni protokoli za prevenciju ili lečenje PLSP; stoga se primenjuje širok spektar modaliteta u zavisnosti od iskustva i preferencija hirurga. Jasna je potreba za povećanjem svesti o ovom stanju kako bi se omogućila standardizacija opcija lečenja i optimizovali ishodi za pacijente.

Ključne reči: laparoskopska hirurgija, bol u ramenu, reflektovani bol, pneumoperitoneum, ugljen-dioksid, dijafragma, n.phrenicus.

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