International Journal of Multiphysics
Volume 18, No. 3, 2024
ISSN: 1750-9548

Pericapsular Nerve Group Block and Multimodal Analgesia in Shoulder Arthroscopy: A Review of Current Evidence

Neveen Mahmoud El Aasar , Hossam Abd El Baki Mahmoud , Mustafa Ahmed Ahmed Amer, Ahmed Bahgat Mohamed

Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author:** Mustafa Ahmed Ahmed Amer ,

Abstract

Background : Shoulder arthroscopy is the second most common minimally invasive orthopedic procedure that involves the insertion of a small camera and instruments through tiny incisions in the shoulder joint. Postoperative pain in the first 24 hours after shoulder arthroscopy is commonly intense as the effects of anesthesia and nerve blocks wear off. The pain is often sharp, aching, or throbbing, especially with any movement of the shoulder, which leads to substantial utilization of opioids or nonsteroidal anti-inflammatory drugs resulting in prolonged recovery periods, and an elevated susceptibility to bleeding at the surgical site.

Aim: The aim of this review is to discuss the role of Pericapsular Nerve Group block versus multimodal analgesia in postoperative pain relief and quality of recovery after shoulder arthroscopy.

Conclusion : The shoulder PENG block aims to target the articular branches through a single, ultrasound-guided injection into the fascial plane between the deltoid muscle and the subscapularis tendon in the region of the coracoid process. By depositing local anesthetic in this anatomical location, the block produces selective analgesia of the shoulder without affecting the more proximal origins of the brachial plexus. Therefore, PENG block may represent an important technique for postoperative pain relief and quality of recovery after shoulder arthroscopy.

Keywords: Shoulder arthroscopy; Postoperative pain; Pericapsular Nerve Group block; PENG block; Multimodal analgesia; Regional analgesia; Quality of recovery; Pain relief.

Introduction

Shoulder arthroscopy is the second most common minimally invasive orthopedic procedure that involves the insertion of a small camera and instruments through tiny incisions in the shoulder joint[(1)].

Postoperative pain in the first 24 hours after shoulder arthroscopy is commonly intense as the effects of anesthesia and nerve blocks wear off. The pain is often sharp, aching, or throbbing, especially with any movement of the shoulder, which leads to substantial utilization of opioids or nonsteroidal anti-inflammatory drugs resulting in prolonged recovery periods, and an elevated susceptibility to bleeding at the surgical site[(2)].

Various multimodal analgesia methods have been developed to treat the pain following shoulder arthroscopy, which is achieved by combining different analgesics that act by different mechanisms, such as opioids, nonsteroidal anti-inflammatory drugs, and local anesthetics, resulting in additive or synergistic analgesia, lower total doses of analgesics, and fewer side effects[(3)].

Many regional anesthesia procedures provide pain relief during shoulder surgery. These techniques include the interscalene brachial plexus block, suprascapular, and supraclavicular nerve blocks[(4)].

Researchers have extensively studied the pericapsular nerve group block in hip surgeries. However, it is a new method used in shoulder surgeries[5].

Postoperative Shoulder Pain

Shoulder arthroscopy is one of the most common procedures in orthopedic surgery. With the advances in both surgical and anesthetic techniques, it is increasingly common for shoulder arthroscopy to be performed in ambulatory major surgery units, allowing early patient discharge, faster postoperative recovery and a decrease in costs related to hospital admission. However, the management of postoperative pain is a genuine challenge for the surgical team, not only because of its impact upon the patient but also because it is known to influence the final outcome of the procedure[6].

Postoperative pain is categorized into two categories: acute pain and persistent pain. Acute pain occurs immediately after post-surgery, while pain persists beyond 3 months after the injury is classified as chronic pain. Acute and chronic pain may originate from cutaneous, deep somatic, or visceral tissues.

Acute pain serves as a beneficial function by signaling tissue injury and promoting immobility to facilitate proper recovery. However, pain has several immediate adverse effects, including sleep disturbances, cardiovascular adverse effects, elevated oxygen consumption, decreased bowel function, delayed mobility, and an increased risk of thrombosis[7].

The pathophysiology of postoperative shoulder pain involves immediate pain resulting from surgical damage, accompanied by an inflammatory response and the activation of an afferent neuronal barrage. It is a composite of various adverse sensory, emotional, and cognitive changes triggered by surgical trauma, accompanied by autonomic, endocrine-metabolic, physiological, and behavioral reactions[8].

While pain diminishes in most patients during the initial days post-surgery, others exhibit a stable or increasing pattern in pain and analgesic needs[6].

Postoperative Pain Management

Postoperative pain control aims to reduce the negative consequences of acute post-surgical pain and help the patient transition smoothly back to normal function. Various treatments exist for postoperative pain, encompassing systemic analgesics, both opioid and non-opioid, and regional analgesic strategies, including neuraxial and peripheral methods. The clinician can enhance the postoperative analgesic protocol for each patient[9].

Systemic Analgesic Methodologies

Commonly used medications for postoperative pain control include opioids, nonsteroidal anti-inflammatory drugs, acetaminophen, steroids, gabapentin or pregabalin, IV ketamine, and IV lidocaine. Intramuscular medications are discouraged. Oral administration of opioid medication is preferable over the intravenous route[10].

Gabapentin or pregabalin are recommended for administration preoperatively, especially in opioid-tolerant patients, as they have been shown to reduce opioid requirements. Due to its extensive side effect profile, ketamine is only for major surgeries in highly opioid-tolerant or opioid-intolerant patients.

Intraoperative IV lidocaine infusions have associations with a shorter duration of ileus and better analgesic control compared to placebo[10].

Regional Analgesic Methodologies

A local anesthetic with or without the addition of IV opioid medication is an option for a site-specific regional anesthetic injection. An anesthesiologist typically performs these techniques under ultrasound guidance.

Long-acting local anesthetics encompass liposomal bupivacaine for single-dose local infiltration at the surgical site. This formulation seeks to maintain safe therapeutic concentrations of bupivacaine for up to 72 hours

post-administration, facilitating extended analgesia, and enabling early hospital departure and use of these techniques may even reduce morbidity and mortality[11].

The predominant regional anesthetic intervention for this anatomical site is the Pericapsular Nerve Group block. This procedure is a novel, ultrasound-guided regional anesthesia technique, primarily indicated for hip fracture analgesia and major hip arthroplasty[12].

Role of Ultrasound in Regional Analgesia

The sound spectrum is a representation of a sound signal in terms of the amount of vibration at each individual frequency. The sound spectrum is categorized into three segments: audible noises, which are detectable by the human ear and range from 20 hertz to 20,000 hertz; infrasound; and ultrasound [13].

A sound wave is transmitted through liquids as a longitudinal wave, in which the movements of particles in a medium are parallel to the direction of propagation of the sound wave (Shriki, 2014). Sound waves transmit their energy mechanically, through pressure variations on the particles. Regions of high pressure and density are called compressions while regions of low pressure and density are called rarefactions [14].

The frequency of the sound waves used in medical ultrasound is in the range of millions of cycles per second. Ultrasound guidance helps regional anesthetic techniques by allowing visualization of anatomical structures and improving the accuracy of local anesthetic injection.

The Pericapsular Nerve Group Block

While the interscalene brachial plexus block has long been considered the gold standard for postoperative shoulder analgesia, its use is frequently limited by well-recognized adverse effects, most notably phrenic nerve palsy and hemi diaphragmatic dysfunction. These limitations have become increasingly important in clinical practice, particularly among patients with compromised pulmonary reserve, obesity, obstructive sleep apnea, or preexisting respiratory disease[15].

As perioperative medicine shifts toward safer, motor-sparing, diaphragm-sparing alternatives, regional anesthesia techniques such as the PENG block have attracted growing attention.

The concept of the Pericapsular Nerve Group block was initially introduced for hip analgesia Casas Reza et al. [5], but more recently, its principles have been adapted to the shoulder region[16]. The theoretical foundation of using a PENG-type block for the shoulder lies in the detailed understanding of the glenohumeral joint's sensory innervation and the articular branches involved in shoulder pain [4, 17].

The shoulder joint receives contributions from several major nerves. The suprascapular nerve, arising from the upper trunk of the brachial plexus, provides the majority of the sensory supply to the posterior capsule and plays a key role in transmitting pain from arthroscopic manipulation of the supraspinatus and infraspinatus regions.

The axillary nerve, which courses near the surgical field during arthroscopic procedures, innervates the anterior, anteroinferior, and posteroinferior aspects of the joint capsule and often contributes to the pain associated with rotator cuff tears or capsular traction.

The lateral pectoral nerve supplies the anterosuperior capsule and is involved particularly in procedures affecting the biceps tendon or subscapularis. Together, these articular branches form the primary pain pathways involved in postoperative discomfort after shoulder arthroscopy[18].

The shoulder PENG block aims to target these articular branches through a single, ultrasound-guided injection into the fascial plane between the deltoid muscle and the subscapularis tendon in the region of the coracoid process. This plane serves as a conduit through which the sensory branches of the suprascapular, axillary, and lateral pectoral nerves course toward the anterior and superior aspects of the glenohumeral joint. By depositing local anesthetic in this anatomical location, the block produces selective analgesia of the shoulder without affecting the more proximal origins of the brachial plexus[19].

PENG Block Versus Multimodal Analgesia

Multimodal analgesia methods have been developed to treat the pain following shoulder arthroscopy by combining different analgesics that act by different mechanisms. This method results in additive or synergistic analgesia, lower total doses of analgesics, and fewer side effects[3].

On the other hand, the PENG block is a regional analgesic technique that aims to provide selective analgesia by targeting the articular sensory branches involved in shoulder pain. The PENG block is performed under ultrasound guidance and focuses on the fascial plane between the deltoid muscle and the subscapularis tendon[19].

The main advantage of multimodal analgesia is that it combines systemic medications and local anesthetics to reduce pain from different pathways. However, it may still require the use of opioids or nonsteroidal anti-inflammatory drugs, which may be associated with side effects and prolonged recovery[2,20,21].

The main advantage of the PENG block is that it targets the primary pain pathways involved in postoperative discomfort after shoulder arthroscopy. It may also provide a motor-sparing and diaphragm-sparing alternative to interscalene brachial plexus block, especially in patients with compromised pulmonary reserve, obesity, obstructive sleep apnea, or preexisting respiratory disease[15].

Quality of Recovery

Quality of recovery after shoulder arthroscopy is affected by the degree of postoperative pain, opioid consumption, early mobility, sleep quality, emotional response, and patient satisfaction. Effective postoperative pain management helps the patient transition smoothly back to normal function[9,22].

Regional anesthesia and multimodal analgesia both aim to improve postoperative recovery by reducing pain intensity, decreasing analgesic requirements, and facilitating early discharge. The PENG block may improve quality of recovery through selective analgesia of the shoulder without affecting the more proximal origins of the brachial plexus[23,24].

Conclusion

Shoulder arthroscopy is one of the most common procedures in orthopedic surgery, and postoperative pain management remains a genuine challenge for the surgical team. Postoperative pain in the first 24 hours after shoulder arthroscopy is commonly intense and may lead to substantial utilization of opioids or nonsteroidal anti-inflammatory drugs.

Various multimodal analgesia methods have been developed to treat the pain following shoulder arthroscopy. These methods combine different analgesics that act by different mechanisms, resulting in additive or synergistic analgesia, lower total doses of analgesics, and fewer side effects.

The Pericapsular Nerve Group block is a novel, ultrasound-guided regional anesthesia technique. The shoulder PENG block aims to target the articular branches through a single injection into the fascial plane between the deltoid muscle and the subscapularis tendon in the region of the coracoid process. By depositing local anesthetic in this anatomical location, the block produces selective analgesia of the shoulder without affecting the more proximal origins of the brachial plexus.

Therefore, PENG block may represent a promising regional analgesic technique for pain relief and improvement of quality of recovery after shoulder arthroscopy, either as an alternative or as part of postoperative pain management strategies.

References

1- Crimmins, I. M., Mulcahey, M. K., & O'Brien, M. J. (2019). Diagnostic Shoulder Arthroscopy: Surgical Technique. Arthroscopy Techniques, 8(5), e443-e449.

2- Ardon, Alberto, E., Steven, B., et al. (2023). "Shoulder arthroscopy." Regional Anesthesia and Acute Pain Medicine: A Problem-Based Learning Approach (2023): 247.

3- Hurley, E. T., Maye, A. B., Thompson, K., Anil, U., Resad, S., Virk, M., et al. (2021). Pain control after shoulder arthroscopy: a systematic review of randomized controlled trials with a network meta-analysis. American Journal of Sports Medicine, 49(8), 2262-2271.

4- Patel, M. S., Abboud, J. A., & Sethi, P. M. (2020). Perioperative pain management for shoulder surgery: evolving techniques. Journal of Shoulder and Elbow Surgery, 29(11), 416-433.

5- Casas, R.P., Dieguez, G.P., Gestal, V.M., Sampayo, R.L., & Lopez, A.S. (2020). Pericapsular nerve group block for hip surgery. Minerva Anestesiol., 86, pp. 463-465.

6- De Soto, P. C. M., Cáceres, A. G., Aznar, I. D. R., Moreno, M. M., & Heredia, J. D. (2022). Perioperative pain management in arthroscopic surgery of the shoulder. Revista Española de Artroscopia y Cirugía Articular, 29(2), 87-97.

7- Liu, Y., Xiao, S., Yang, H., Lv, X., Hou, A., Ma, Y., & Zhang, T. (2023). Postoperative pain-related outcomes and perioperative pain management in China: a population-based study. The Lancet Regional Health–Western Pacific, 39.

8- Sun, Y., Li, T., Wang, N., Yun, Y., & Han, R. (2020). Regional anesthesia and postoperative recovery outcomes: a systematic review. Pain Physician, 23(2), E161-E174.

9- Park, S. Y. (2024). Multimodal analgesia for postoperative pain: pursuing liberation from pain, not redemption. Annals of Coloproctology, 40(3), 189.

10- Govil, N., Arora, P., Parag, K., Tripathi, M., Garg, P. K., & Goyal, T. (2023). Postoperative acute pain management with duloxetine as compared to placebo: A systematic review with meta-analysis of randomized clinical trials. Pain Practice, 23(7), 818-837.

11- Jogie, J., & Jogie, J. A. (2023). A comprehensive review on the efficacy of nerve blocks in reducing postoperative anesthetic and analgesic requirements. Cureus, 15(5).

12- Kim, R., & Tsui, B. C. (2022). Toward precision regional anesthesia: is the PENG block appropriate for all hip fracture surgeries? Regional Anesthesia and Pain Medicine, 47(1), 76-77.

13- Uddin, S. M., Komatsu, D. E., Motyka, T., & Petterson, S. (2021). Low-intensity continuous ultrasound therapies—a systematic review of current state-of-the-art and future perspectives. Journal of Clinical Medicine, 10(12), 2698.

14- Rossing, T. D., Moore, F. R., & Wheeler, P. A. (2002). The science of sound (3rd ed., pp. 25–27). Addison-Wesley.

15- Ferré, F.; Pommier, M.; Laumonerie, P.; Ferrier, A.; Menut, R.; Bosch, L.; Balech, V.; Bonnevialle, N.; Minville, V. Hemidiaphragmatic paralysis following ultrasound-guided anterior vs. posterior suprascapular nerve block: A double-blind, randomised control trial. Anaesthesia **2020**, 75, 499–508.

16- Ramadurai, R., Bhoi, D., Nagarajappa, A., & Amar, P. (2021). Pericapsular nerve group block (PENG) at neutral position for shoulder manipulation: A feasible approach for a new indication. Journal of Clinical Anesthesia, 75, 110541. doi:10.1016/j.jclinane.2021.110541.

17- Altinpulluk, E. Y., Teles, A. S., Galluccio, F., Simón, D. G., Olea, M. S., Salazar, C., & Perez, M. F. (2020). Pericapsular nerve group block for postoperative shoulder pain: a cadaveric radiological evaluation. Journal of Clinical Anesthesia, 67, 110058.

18- EARLY, I. T. O. (2022). Session 1: Rotator cuff and frozen shoulder.

19- Mohanty, C. R., Radhakrishnan, R. V., Konikkara, P. S., Behera, S., & Anulakshmi, T. V. (2026). Ultrasound-guided suprascapular and axillary nerve block for management of bilateral shoulder pain due to sickle cell vaso-occlusive crisis: A case report. *JCA Advances*, 100212.

20- Kaye, A. D., Cornett, E. M., Helander, E. M., Liu, H., Urman, R. D., & Vadivelu, N. (2020). An update on multimodal analgesia for orthopedic surgery. Current Pain and Headache Reports, 24(9), 62–74.

21- Peden, C. J., Stephens, T., & Martin, G. (2020). Enhanced recovery and multimodal analgesia: A review of current practice and future directions. Anaesthesia, 75(1), 64–73.

22- Stark, P. A., Myles, P. S., & Burke, J. A. (2013). Development and psychometric evaluation of a postoperative quality of recovery score: the QoR-15. Anesthesiology, 118(6), 1332-1340.