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Postoperative Pain Management after Shoulder Surgery: Current Regional Anesthesia Techniques and Multimodal Analgesia

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Abstract:

Postoperative pain following shoulder surgery can be moderate to severe, particularly during the first 24–48 hours, and may delay rehabilitation, restrict shoulder movement, and increase the risk of joint stiffness and chronic postoperative pain. Pain originates from the rich sensory innervation of the anterior and posterior glenohumeral capsule through branches of the axillary, subscapular, lateral pectoral, and suprascapular nerves. Therefore, effective perioperative analgesia is essential to improve patient comfort, facilitate early physiotherapy, and enhance functional recovery. Current management is based on a multimodal approach that combines systemic opioids, non-opioid analgesics, local anesthetic infiltration, and regional anesthesia techniques. Although opioids remain useful for moderate-to-severe pain, their adverse effects encourage opioid-sparing strategies. Interscalene brachial plexus block is considered the standard regional technique because of its excellent analgesic efficacy; however, its use may be limited by phrenic nerve palsy and hemidiaphragmatic paralysis. Consequently, several diaphragm-sparing alternatives have been developed, including superior trunk, infraclavicular–subomohyoid, subomohyoid–subscapularis, suprascapular, and axillary nerve blocks. Newer fascial plane techniques, such as the pericapsular nerve group and shoulder anterior capsule blocks, selectively target terminal articular branches supplying the shoulder capsule. These techniques may provide effective analgesia while preserving motor function and reducing respiratory complications associated with interscalene block.

Keywords: Postoperative shoulder pain; Shoulder surgery; Multimodal analgesia; Interscalene block; Regional anesthesia; Pericapsular nerve group block; Shoulder anterior capsule block.

Introduction:

The shoulder joint is essential for upper-limb mobility, posture, and cosmetic appearance. It has the widest range of motion in the human body **(1)**. Shoulder surgeries may be arthroscopic (minimally invasive) or open procedures, depending on the pathology.

Common shoulder surgeries include:

- Rotator cuff repair: reattachment of torn rotator cuff tendons to the humeral head **(2).**
- Arthroscopic subacromial decompression: performed for impingement syndrome to increase the space

between the rotator cuff and acromion **(3).**

- Arthroscopic SLAP repair: restoration of the superior labrum to the glenoid rim using sutures or anchors **(4).**
- Bankart repair for shoulder dislocation: reattachment of the labrum to stabilize the glenohumeral joint **(5).**
- Arthroscopic capsular release for frozen shoulder: division of the contracted joint capsule to restore shoulder mobility **(6).**

Postoperative pain after shoulder surgery is commonly classified as mild, moderate, or severe based on its intensity and its impact on function. Mild pain causes minimal discomfort and is generally well controlled with simple analgesics. Moderate pain interferes with daily activities and rehabilitation exercises and often requires multimodal analgesia. Severe pain is most common during the first 24–48 hours after surgery, particularly following major procedures such as rotator cuff repair or shoulder arthroplasty, and usually requires regional anesthesia techniques and opioid-based analgesia in addition to non-opioid medications. **(7).**

Pain arising from the shoulder joint capsule is closely related to the rich sensory innervation of both the anterior and posterior capsule. The anterior capsule is primarily innervated by branches of the axillary, subscapular and lateral pectoral nerves, whereas the posterior capsule receives sensory fibers mainly from suprascapular nerves. Surgical manipulation, capsular stretching, or inflammation activates nociceptors within these capsular tissues, making both the anterior and posterior capsule significant sources of postoperative shoulder pain, particularly during joint movement and rehabilitation **(8).**

Effective postoperative pain management is essential for enhancing recovery after shoulder surgery and facilitating early physiotherapy. Adequate analgesia improves patient comfort, enables earlier participation in rehabilitation exercises, increases shoulder range of motion, and reduces the risk of complications such as joint stiffness and chronic postoperative pain **(9).**

Analgesic management of shoulder surgeries

1. **Systemic opioids:**

Opioids remain a cornerstone of postoperative analgesia, particularly for moderate to severe pain. However, their use is often limited by dose-dependent adverse effects such as postoperative nausea and vomiting (PONV), urinary retention, ileus, pruritus, and respiratory depression. Consequently, current analgesic strategies emphasize multimodal approaches to minimize opioid requirements, reserving opioids mainly as rescue analgesics when non-opioid medications fail to provide adequate pain relief **(10).**

2. **Multimodal analgesia:**

Multimodal analgesia has become an increasingly adopted strategy for postoperative pain management. Compared with opioid-based regimens alone, it often provides better pain control while reducing opioid consumption and their associated adverse effects **(11).** This approach involves the combined use of analgesic agents from different pharmacological classes that act through distinct mechanisms but produce synergistic effects. Typically, it includes two or more analgesics with different sites of action, such as opioids combined with NSAIDs, paracetamol, gabapentin, dexamethasone, or ketorolac, to enhance postoperative pain control **(12).**

3. **Local infiltration of long-acting local anesthetics:**

Local infiltration with long-acting local anesthetics is another strategy for postoperative pain control. Liposomal bupivacaine is commonly used for single-dose infiltration at the surgical site, providing sustained release of bupivacaine for up to 72 hours. This prolonged analgesic effect can improve postoperative pain management and facilitate earlier hospital discharge **(13).**

4- Different regional blocks for pain management after shoulder surgeries:

- **Interscalene brachial plexus block (ISB):**

The interscalene block is considered the gold standard for analgesia after shoulder surgery. It anesthetizes the roots of the brachial plexus (C5–C7), providing excellent pain relief for procedures involving the shoulder joint **(14).** Although the interscalene brachial plexus block (ISB) remains the most frequently used regional anesthetic technique for analgesia after shoulder surgery, several alternative blocks have been developed to reduce complications such as phrenic nerve palsy and hemi diaphragmatic paralysis.

- **Superior trunk block (STB):**

The C5 and C6 nerve roots converge within the interscalene groove to form the superior trunk of the brachial plexus, which provides major sensory innervation to the shoulder joint. The suprascapular nerve originates from this trunk and courses laterally beneath the omohyoid muscle. Therefore, the block is performed proximal to the origin of the suprascapular nerve. Using an ultrasound-guided in-plane approach from posterolateral to anteromedial, the superior trunk is surrounded with approximately 10–15 mL of local anesthetic. Due to the variable course of nearby vessels such as the suprascapular and transverse cervical arteries, careful ultrasound identification of these structures is recommended before needle insertion **(15).**

- **Infraclavicular–subomohyoid block:**

The infraclavicular approach primarily targets the posterior and lateral cords of the brachial plexus, thereby anesthetizing the axillary nerve, which contributes to both anterior and posterior shoulder joint innervation. When combined with a subomohyoid suprascapular nerve block, which anesthetizes the posterior shoulder, this technique can provide effective postoperative analgesia for shoulder surgery **(16).**

- **Subomohyoid–subscapularis block:**

The subscapularis block is typically performed before the subomohyoid block. It targets the subscapular nerve. Blocking this nerve contributes to analgesia of the anterior shoulder region. when combined with a subomohyoid suprascapular nerve block, which anesthetizes the posterior shoulder, this technique can provide effective postoperative analgesia for shoulder surgery **(17).**

- **Distal peripheral nerve blocks:**

Selective distal nerve blocks may also be used as part of a multimodal regional anesthesia strategy, including:

  - **Axillary nerve block**, which provides analgesia to the anterior and inferior aspects of the shoulder **(18).**
  - **Suprascapular nerve block**, which supplies the majority of the sensory innervation of the shoulder joint **(19).**

- **New fascial plane block for pain management:**

  - **Pericapsular Nerve Group block (PENG)**, which targets the anterior capsule and terminal articular branches of the suprascapular, axillary, and subscapular nerves **(20).**
  - **Shoulder Anterior Capsule block (SHAC)**, which targets the anterior shoulder capsule and the terminal articular branches of the axillary, subscapular, lateral pectoral, and musculocutaneous nerves **(21).**

These alternative techniques can provide effective analgesia while potentially minimizing the respiratory complications associated with interscalene block.

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