Pain Management after Shoulder Surgeries

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Abstract

Background: The shoulder and its joint are very important parts of the human body. The shoulder is very important for a vertical body position and cosmetic appearance particularly in women. The shoulder joint has the largest motion range of all joints in the human body. There are some shoulder surgery procedures such as diagnostic arthroscopy, subacromial disorders (impingement syndrome, rotator cuff defects and ruptures, periarthritis humeroscapularis, tendinopathy) and arthroscopic subacromial decompression). All of these shoulder procedures need anesthesia and analgesia. Adequate pain relief after the surgical procedures of shoulder is necessary both for the comfort of the patients and for an early use of rehabilitation exercises. The management of acute postoperative pain after shoulder surgery has been performed using conventional nonsteroidal anti-inflammatory drugs (NSAIDs), local injection of analgesics, i.v. patient-controlled analgesia (PCA), continuous intrabursal infusion of analgesics, and patient-controlled interscalene or subacromial analgesia. ISO (infraclavicular-subomohyoid) block, subscapularis subomohyoid block block a recent techniques used to block BP cords and the suprascapular nerve, was also described to provide adequate shoulder analgesia while reducing phrenic nerve injury incidence.

Keywords: shoulder surgeries, pain management.

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1- INTRODUCTION:

Phrenic nerve injury is a common complication with regional anesthesia for shoulder surgeries. Its often temporary with Transient Phrenic Nerve Palsy leading to hemidiaphragmatic paresis after interscalene block or other injections of local anesthetic in the neck **(1).**

Although studies of interscalene blocks have shown a reduction in the incidence in hemidiaphragmatic paralysis with low-volume interscalene block, the risk of phrenic paralysis is not completely eliminated **(2).**

To bypass this complication, distal block of the shoulder innervation was recommended such as subomohyoid infraclavicular and subomohyoid subscapularis blocks **(3).**

Anatomy of the shoulder:

The shoulder is one of the largest and most complex joints in the body. The shoulder joint is formed where the humerus (upper arm bone) fits into the scapula (shoulder blade), like a ball and socket. Other important bones in the shoulder include**:** The acromion. 2-The clavicle 3- The coracoid process **(4).**

Muscles of the shoulder:

The primary muscle group that supports the shoulder joint is the rotator cuff muscles. The four rotator cuff muscles are the supraspinatus, infraspinatus, teres minor, and subscapularis. Together the rotator cuff muscles form a

musculotendinous cuff as they insert on the proximal humerus. The rotator cuff muscles attach to the proximal humerus anteriorly at the greater tuberosity. The rotator cuff muscles provide considerable structural support to the glenohumeral joint and keep the humeral head in a firm position by articulating with the scapula within the glenoid cavity. The muscles of the chest also provide structural support to the shoulder joint **(5).**

The origin of the supraspinatus is from the supraspinatus fossa above the spine of the scapula crossing the shoulder joint, passing under the coracoacromial arch, and above the glenohumeral joint where it inserts at the greater tubercle of the humerus. The supraspinatus muscle functions by abduction of the humerus up to 30 degrees and stabilizing the glenohumeral joint.

The infraspinatus muscle originates from the infraspinatus fossa below the spine of the scapula and inserts on the greater tubercle of the proximal humerus below the supraspinatus tendon. The infraspinatus muscle functions by externally rotating the humerus. The teres minor muscle is positioned immediately inferior to infraspinatus, originating at the inferior aspect of the dorsal scapula at the lateral border of the scapula. The teres minor inserts on the greater tubercle of the humerus below the infraspinatus. The Teres minor acts to externally rotate the humerus and assists with abduction of the humerus. The subscapularis originates from the subscapular fossa of the scapula and inserts on the lesser tubercle of the humerus as well as a portion of the anterior capsule of the shoulder joint. A large bursa separates the muscle from the neck of the scapula. The subscapularis functions by internally rotating and abducting the humerus **(6).**

The rhomboid minor originates from the nuchal ligament and spinous processes of C7-T1. The rhomboid major originates from the spinous processes of T2-T5. The rhomboid muscles insert on the medial border of the scapula and work in combination with the levator scapulae muscles to elevate the medial border of the scapula. The only muscle which acts to depress the shoulder is the lower trapezius, which is assisted by gravity in the upright position. The trapezius is a large triangularshaped muscle that overlies the shoulder posteriorly. The trapezius originates from the superior aspect of the nuchal line in the occipital, cervical, and upper thoracic region and inserts at the lateral aspect of the clavicle, the acromion, and spine of the scapula. The function of the trapezius muscle is both elevation and depression of the shoulder depending on whether the upper or lower muscle fibers are activated.When the entire trapezius muscle contracts, the fibers are geometrically opposed, and the forces are balanced, resulting in no shoulder movement **(7).**

The deltoid muscle overlies the shoulder superficially and functions to abduct the humerus. The deltoid muscle has three origins; the body of the clavicle, the spine of the scapula, and the acromion. The deltoid muscle has its insertion on the deltoid tuberosity of the humerus. The function of the deltoid muscle is variable depending on which muscle fibers are activated. The anterior deltoid flexes and medially rotations the humerus, the middle deltoid abducts the humerus, and the posterior deltoid performs the actions of extension and external rotation of the humerus **(8).**

The short head of the biceps brachii originates from the coracoid process, and the long head originates from the supraglenoid tubercle, passing through the intertubercular groove of the proximal humerus. The biceps brachii is not actually considered a shoulder muscle, but the tendon of its long head originates on the superior lip of the glenoid labrum **(6).**

Types of shoulder surgeries:

Procedures can range from minimally invasive arthroscopic procedures, where instruments are inserted through keyhole-size incisions in the shoulder, to more traditional open surgeries that involve incisions and sutures.

The most common shoulder surgeries include:

1-Rotator Cuff Repairs:

The most common surgery on the shoulder is a rotator cuff repair. Individuals may need this surgery if they experienced an injury, had a fall, or have inflammation or a tear that isn't getting any better with noninvasive treatment options. The goal of the surgery is to identify the damaged part of the rotator cuff and to clean and reattach any torn or damaged tendons **(9).**

2-Arthroscopy for Impingement Syndrome:

Also called rotator cuff tendonitis or bursitis, impingement syndrome occurs when the tendons of the rotator cuff are trapped and compressed during movement. The arthroscopic procedure used to correct impingement is known as a subacromial decompression. The aim of the surgery is to increase the space between the rotator

cuff and the top of the shoulder, known as the acromion **(10).**

3-Arthroscopic SLAP Repair:

A superior labrum anterior and posterior (SLAP) tear is an injury to the rim of cartilage that encircles the shoulder socket known as the labrum.

This can occur from an injury, repeated trauma, or wear-and-tear arthritis. Arthroscopic surgery may be used to restore the labrum back to its position at the rim of the shoulder socket. Once repositioned, sutures, or stitches, are used to secure the bone to the cartilage **(11).**

4- Arthroscopy for Shoulder Dislocation:

A shoulder dislocation injury occurs when the ball of the shoulder joint comes out of the socket. In young athletes, the damage most commonly occurs at the labrum. To stabilize the shoulder after dislocation, a type of surgery known as a Bankart repair can attach the labrum to the joint capsule to hold the ball in place **(12).**

5-Arthroscopy for Frozen Shoulder:

Frozen shoulder is the second most common cause of shoulder injury next to a rotator cuff tear. When a frozen shoulder occurs, the capsule surrounding the shoulder joint becomes tight and contracted. The goal of surgery is to loosen the contracted tissue to allow the shoulder to move more freely. This is done by cutting the capsule all the way around the ball of the shoulder **(13).**

Acute postoperative shoulder pain:

Acute pain occurs following tissue injury associated with surgery and should resolve during the healing process. This normally takes up to 3 months, after which pain is considered to be chronic or persistent **(14).**

Pain is a multidimensional experience, personalized to each patient. Differences in pain experience are influenced by biological response, psychological state and traits, and social context **(15).**

Pathophysiology of postoperative shoulder pain:

Postoperative shoulder pain is considered a form of acute pain due to surgical trauma with an inflammatory reaction and initiation of an afferent neuronal barrage. It is a combined constellation of several unpleasant sensory, emotional and mental experience precipitated by the surgical trauma and associated with autonomic, endocrine-metabolic, physiological and behavioral responses. Although pain decreases over the first few days after surgery in the majority of patients, some experience a static or ascending trajectory in pain and analgesic requirements **(16).**

Postoperative pain can be divided into acute pain and chronic pain. Acute pain is experienced immediately after surgery (up to 7 days) and pain which lasts more than 3 months after the injury is considered to be chronic pain. Acute and chronic pain can arise from cutaneous, deep somatic or visceral structures.

Acute pain plays some useful positive role such as to provide a warming of tissue damage and inducing immobilization to allow appropriate healing. But, pain has some short term negative effects such as sleep disturbance, cardiovascular side effects, increase oxygen consumption, impaired bowel movement, delays mobilization and promotes thromboembolism. Management of post postoperative pain has generally been shown to be inadequate **(17).**

Pathways of pain: Pain impulses were seen as leaving three components:-

- A first order neurone (cell body in dorsal root ganglion) which transmits pain from a peripheral receptor to a second-order neurone.
- A second-order neurone in the dorsal horn of the spinal cord, uheicle axon crosses the midline to ascend in the spinothalamic tract to the thalamus where a third neurone.
- A third-order neurone projects to the postcentral gyros (via the internal capsule)**(18).**

Response to pain:

Systemic effects of pain are numerous and include augmentation of the catabolic surgical stress response with hormonal changes (including increases in cortisol), and greater sympathetic activity, resulting in increased heart rate and blood pressure, reduced skin blood flow, and sweating .This normal, self-limiting response to surgery is the same as to other injuries, and serves to protect us by alerting us to avoid further harm and to allow for restitution **(19).**

Management of pain after shoulder surgeries:

1. Multimodal analgesia:

Multimodal' analgesia is a concept that has grown in popularity as an approach to post-operative pain management. When compared with opioid based analgesia, it often provides superior pain control with the added benefit of reducing the requirements of opioids and their adverse effects **(20).**

The technique involves using analgesics of differing classes that have varying target sites, but that also work synergistically to achieve optimal pain control. This is often defined as the use of two or more analgesics whose mechanism of action are distinct from one another. Owing to the marked reductions in pain scores when using synergistic analgesia, this technique is a recommended for optimising pain control post-operatively like opioids with NSAID, paracetamol, gapabentine, dexamethasone or ketolac.

Ketorolac :

Ketorolac is a medication used in the management and treatment of acute moderate to severe pain. It is in the nonsteroidal anti-inflammatory drug class. Ketorolac is versatile, as it is available in multiple-dose forms: oral, nasal spray, IV, or IM. It is commonly used postoperatively for pain management. In combination with opioids, ketorolac results in a significant decrease in opioid requirement and lowers the incidence of adverse effects such as vomiting and decreased gastrointestinal motility **(21).**

Pharmacokinetics:

It is used by mouth, by nose, by injection into a vein or muscle, and as eye drops. Effects begin within an hour and last for up to eight hours. Metabolized by the liver and excreted by the kidney **(22).**

Mechanism of action:

It blocks cyclooxygenases (COX), which are enzymes that convert arachidonic acid into prostaglandins, prostacyclin, and thromboxane. The inhibition of these substances decreases pain, fever, and inflammation.

Ketorolac does so by inhibiting both cyclooxygenase-1 and cyclooxygenase-2. It has higher demonstrated potency than most other NSAIDs. It had high bleeding risk when compared with opioids **(23).**

Dose:

IV and IM dosing for adults are recommended at 30 mg single dose or 30 mg every 6 hours, not exceeding 120 mg in 24 hours. The recommended oral dosing in adults is a 20 mg single dose after IV or IM therapy, then 10 mg every 4 to 6 hours, not exceeding 40 mg in 24 hours.

Half-life: 5.6 hours for a single 30 mg IM or single 10 mg oral dose **(24).**

Adverse Effects:

Adverse effects of ketorolac increase significantly when used in higher doses, for durations over five days, and in patients who are over 75 years old. Like other NSAIDs, ketorolac shows correlations with significant gastrointestinal (GI), renal, and cardiovascular risks. In the GI system, it can cause peptic ulcers and/or perforations of the stomach or intestines. In an extensive pooled data set, all NSAIDs, including COX2 inhibitors, were shown to increase the relative risk for peptic ulcers. Because of its antiplatelet properties, ketorolac increases the risk of GI bleeding. Ketorolac can cause an increased risk of cardiovascular thrombotic events, myocardial infarctions, and hemorrhagic stroke. Lastly, ketorolac can cause renal damage and failure **(25).**

Paracetamol :

Paracetamol (acetaminophen[a] or para-hydroxyacetanilide) is a nonopioid analgesic and antipyretic agent used to treat fever and mild to moderate pain.

Pharmacokinetics:

After being taken by mouth, paracetamol is rapidly absorbed from the small intestine, while absorption from the stomach is negligible. Thus, the rate of absorption depends on stomach emptying. Food slows the stomach emptying and absorption, but the total amount absorbed stays the same. In the same subjects, the peak plasma concentration of paracetamol was reached after 20 minutes when fasting versus 90 minutes when fed. Its plasma terminal elimination half-life is 1.9–2.5 hours. Paracetamol is metabolized primarily in the liver, mainly by glucuronidation and sulfation, and the products are then eliminated in the urine **(26).**

Pharmacodynamics:

aracetamol appears to exert its effects through two mechanisms: the inhibition of cyclooxygenase and actions of its metabolite N-arachidonoylphenolamine (AM404) **(27)**.

Dose:

It's taken in a dose of 15 mg/kg over 15 minutes (Bucak et al., 2020).

The recommended maximum daily dose for an adult is three to four grams.

Higher doses may lead to toxicity, including liver failure.

Side effects from paracetamol are rare but can include:

An allergic reaction, which can cause a rash and swelling, flushing, low blood pressure and a fast heartbeat.

Blood disorders, such as thrombocytopenia (low number of platelet cells) and leukopenia (low number of white blood cells) - Liver and kidney damage with high doses **(28).**

2. Systemic opioids:

Opioids are the mainstay of postoperative analgesia for many surgeries. While they are effective for moderate to severe pain, their usage is limited by dose-related postoperative adverse effects, including postoperative nausea and vomiting (PONV), urinary retention, ileus, pruritus, and most dangerously, respiratory depression. These side effects have led to an increasing emphasis on multimodal analgesic regimens that reduce opioid demand, with opioids used as rescue analgesics when nonopioid medications are inadequate for pain control **(29).**

3. Local infiltration of long-acting local anesthetics:

Long-acting local anesthetics include liposomal bupivacaine for single-dose local infiltration at the surgical site. This formulation aims to sustain safe therapeutic levels of bupivacaine for up to 72 hr after administration, allowing prolonged analgesia and thus early hospital discharge **(30).**

4- Regional block.

A-- Interscalene brachial plexus blockade:

Interscalene block targets roots of brachial plexus sparing ulnar nerve (c8-t1). It is a great block for distal clavicle, shoulder and proximal humerous procedures **(31**).
Dose of local anesthetics:

Different volumes of local anesthetics can be used. Recently it is recommended to start with low volume of local anesthetics to decrease the incidence of phrenic nerve block incidence by 50% compared with standard block using 20 ml. It can start from 5 ml up to 25 ml of local anesthetics **(31).**

Side Effects:

A misguided needle placement can result in pneumothorax, nerve damage, epidural or intrathecal placement, and

spinal cord trauma.

B-Infraclavicular Subomohyoid block:

The infraclavicular approach targets the posterior and lateral cords, thus anesthetizing the axillary nerve (which supplies the anterior and posterior shoulder joint. whereas the suprascapular nerve block done by blocking subomohyoid muscle anesthetizes the posterior shoulder **(32).**

C-Subomohyoid Subscapularis block:

Subscapularis is done before subomohyoid block. Subscapularis block target subscapular nerve which arise from posterior cord and present on ventral surface of subscapularis muscle **(33).**

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