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Supraclavicular Block in Regional Anesthesia: A Comprehensive Overview and Role of Nursing Interventions

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Abstract:

Background: The supraclavicular block is a regional anesthesia technique frequently used for upper extremity surgeries. Its resurgence in popularity is attributed to the integration of ultrasound guidance, which enhances procedural safety and efficacy. This block offers rapid onset and effective anesthesia due to the compact arrangement of the brachial plexus nerves at the targeted site.

Aim: This article provides a comprehensive overview of the supraclavicular block, its clinical significance, associated risks, and the critical role of nursing interventions in ensuring procedural success and patient safety.

Methods:
A review of the supraclavicular block was conducted, focusing on its anatomy, indications, contraindications, procedural techniques, and complications. The article also highlights advancements in ultrasound guidance and its impact on procedural outcomes. Case studies and recent clinical findings were reviewed to underscore the block's efficacy and safety.

Results: The integration of ultrasound guidance has significantly improved the safety of the supraclavicular block by reducing complications such as pneumothorax and vascular injury. Studies demonstrate an average procedure duration of 4 minutes, with postoperative analgesia lasting approximately 437 minutes. The block's efficacy extends to a wide range of upper extremity surgeries with minimal risks when

performed by trained professionals. Nursing staff play a pivotal role in patient preparation, equipment management, and postoperative monitoring, contributing to the overall success of the procedure.

Conclusion: The supraclavicular block is a reliable and efficient regional anesthesia technique, particularly when enhanced by ultrasound guidance. It provides excellent anesthetic coverage with minimal risks, making it a preferred choice for upper extremity surgeries. Nursing interventions are integral to optimizing patient outcomes, emphasizing the need for interprofessional collaboration and continuous training.

Keywords: Supraclavicular block, regional anesthesia, ultrasound guidance, brachial plexus, nursing interventions, upper extremity surgeries.

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Introduction:

The supraclavicular block is a widely utilized regional anesthetic technique, serving either as an alternative or an adjunct to general anesthesia or as an effective method for postoperative pain management during upper extremity surgeries, particularly from the mid-humerus to the hand. Initially introduced in 1911 by Kulenkampff using a landmark-based approach, this technique saw a decline in popularity due to the significant risk of pneumothorax. [1] With the introduction of ultrasonography, La Grange pioneered the use of Doppler probes to identify arteries in 1978. [2] Subsequently, Kapral and colleagues advocated for the dynamic application of ultrasound for needle guidance in the supraclavicular region. [3] Often referred to as the "spinal of the arm," this block is particularly advantageous due to the compact arrangement of the brachial plexus nerves, which facilitates a rapid onset of anesthesia. However, because of this close anatomical relationship, it is essential to use minimal volumes of local anesthetic to prevent compression ischemia.

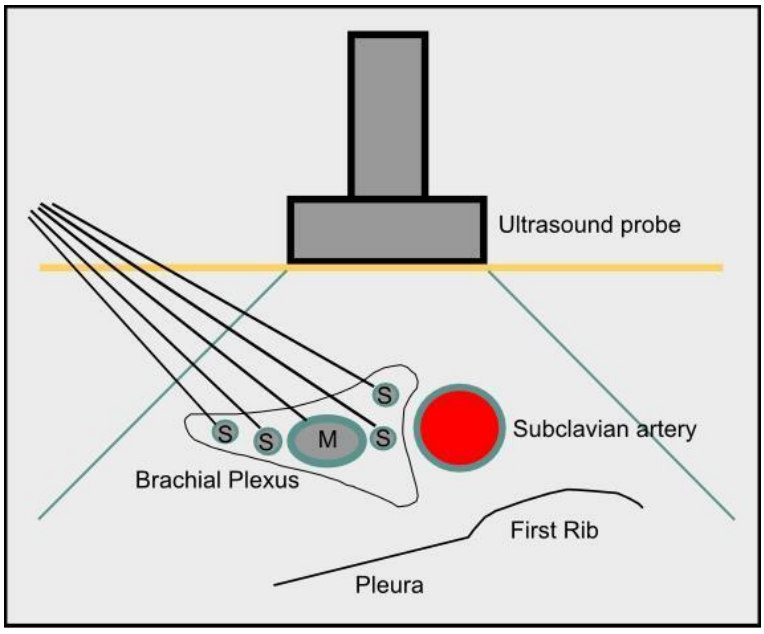

Figure 1: Brachial Plexus Block.

Anatomy and Physiology:

The brachial plexus arises from the anterior rami of the C5 to T1 spinal nerves. These rami exit the cervical spine and coalesce to form the superior, middle, and inferior trunks, which traverse between the anterior and middle scalene muscles. Each trunk subsequently divides into anterior and posterior branches, which rejoin to form the lateral, posterior, and medial cords as they progress distally beneath the clavicle. The supraclavicular block targets the brachial plexus at the divisions, encompassing the distal trunks and proximal cords. [4]

Indications:

The supraclavicular block is primarily indicated for regional anesthesia during surgical procedures or for postoperative pain control in the distal two-thirds of the upper extremity, spanning from the mid-humerus to the fingertips. Despite its efficacy, occasional sparing of distal branches, particularly the ulnar nerve, may occur. [5]

Contraindications:

Contraindications to supraclavicular block align with general exclusions for peripheral nerve blockades, including patient refusal, hypersensitivity to local anesthetics, infection or malignancy at the injection site, and coagulopathy. As per the guidelines from the American Society for Regional Anesthesia and Pain Medicine (ASRA), the supraclavicular block is considered a noncompressible or "deep block" and should be cautiously approached in anticoagulated patients. A more superficial brachial plexus block is often preferred for such cases. Additional vigilance is required for patients with severe pulmonary conditions, as the spread of local anesthetic may cause diaphragmatic paresis, and although rare with ultrasound guidance, pneumothorax remains a potential risk. Moreover, the block is contraindicated in patients with preexisting neural deficits within the targeted distribution. [6]

Equipment and Personnel:

The necessary equipment for performing a supraclavicular block includes antiseptic solutions such as chlorhexidine gluconate or povidone iodine, a high-frequency ultrasound probe with a sterile cover and gel, and optional nerve stimulators. Local anesthetics such as 1% lidocaine are typically employed for superficial infiltration, while regional block solutions like 0.5% bupivacaine or 0.5% ropivacaine are utilized for postoperative analgesia. A 10 to 20 mL syringe with extension tubing and a short-beveled needle (10 cm, 18-gauge for catheter insertion or 22-gauge for single injections) are also required. Ideally, an anesthesiologist with expertise in ultrasound-guided regional anesthesia should perform the procedure, supported by a trained healthcare team, including nursing staff skilled in sedation techniques.

Preparation:

Before the procedure, informed consent must be obtained, and a pre-procedure pause should be conducted. The patient is positioned supine with their arms resting by their sides and the head turned toward the opposite side of the block. Elevating the head of the bed by approximately 30 degrees and using a towel roll under the ipsilateral shoulder can enhance access to the supraclavicular space. Sedation may be administered intravenously with 1 to 2 mg of midazolam and 50 to 100 mcg of fentanyl if required. Aseptic techniques must be strictly followed, including the application of antiseptic solutions and the use of sterile ultrasound probe covers and gel.

Technique and Treatment:

To perform the block, the ultrasound probe is placed in the supraclavicular fossa, parallel to the clavicle, with its orientation aimed inferiorly toward the ipsilateral thorax. The brachial plexus and subclavian artery are visualized, along with the first rib, which appears hyperechoic with the pleura below. Using an in-plane technique, the needle is advanced laterally to medially towards the brachial plexus. After confirming the absence of vascular puncture through negative aspiration, approximately 10 mL of local anesthetic is administered, followed by smaller aliquots near surrounding neural clusters. Injection should cease if the patient reports paresthesia or pain. Alternatively, the "corner pocket technique," described by Soares and colleagues in 2007, involves directing the needle toward the deeper portion of the brachial plexus to elevate it off the first rib with the local anesthetic. Subsequently, the needle is adjusted to a shallower angle to target the superficial plexus, ensuring proper anesthetic deposition. [8][9] Although effective, this technique carries a heightened risk of pleural puncture. Nerve stimulation can complement ultrasound guidance. If employed, the nerve stimulator is connected prior to the injection of local anesthetic. A current below 0.4 mA eliciting contractions of the arm, forearm, or wrist suggests potential intraneural positioning, necessitating needle withdrawal and redirection. Pressure monitoring during

proximal brachial plexus blocks has also been recommended, as injection pressures exceeding 15 psi are associated with increased risks of intraneural injection and nerve injury. [10][11]

Complications:

Supraclavicular blocks, like other peripheral nerve blockades, carry potential risks such as infection, bleeding, and neuropathy. However, advancements in ultrasonography enable continuous visualization of critical structures, including the needle tip, first rib, and pleura, significantly reducing the likelihood of pneumothorax. Common transient effects include hoarseness caused by ipsilateral laryngeal nerve involvement, Horner syndrome due to stellate ganglion blockade, and hemidiaphragmatic paresis resulting from phrenic nerve blockade [12]. Local anesthetic systemic toxicity remains a possibility, and due to the close proximity of the transverse cervical and dorsal scapular arteries to the brachial plexus, the application of color Doppler is highly recommended to enhance safety.

Clinical Significance:

The ultrasound-guided supraclavicular block is generally executed at the level of the distal trunks or proximal divisions of the brachial plexus. While definitive evidence is lacking, the compact anatomical arrangement at this site is thought to contribute to the block's reputation for rapid onset and robust sensory and motor anesthesia. Although primarily used for surgeries involving the upper extremity, it can also be applied for shoulder surgeries with additional supplementation to cover proximal cervical nerves, such as the supraclavicular nerve (C3 to C4) and suprascapular nerve (C5 to C6), to achieve comprehensive coverage of the shoulder region. The improved safety profile provided by ultrasound visualization, particularly of the pleura, has been a pivotal factor in the resurgence of supraclavicular block utilization [13]. Research by Gamo et al. highlighted that ultrasound-guided supraclavicular blocks are associated with a brief procedure duration (average of 4 minutes), optimal intraoperative conditions (mean surgery time of 75.2 minutes, ranging from 6 to 232 minutes), and an extended mean postoperative analgesia duration of 437 minutes [14]. Furthermore, studies have demonstrated reduced risks of pneumothorax and vascular injury alongside improved block success rates.

Ultrasound guidance has rendered peripheral nerve stimulation largely unnecessary, as it does not significantly enhance block success rates and is associated with a high false-negative rate. Consequently, these blocks are typically effective without eliciting motor responses [15]. The selection of a specific brachial plexus blockade approach—supraclavicular, infraclavicular, interscalene, or axillary—depends on numerous factors, including the desired area of anesthetic coverage, operator expertise, anatomical variations, coagulopathy considerations (favoring compressible sites), local infection, and patient positioning. Moreover, the intended objective, whether for primary anesthesia or postoperative analgesia, also influences the decision. Stav et al. conducted a randomized study comparing supraclavicular, infraclavicular, and axillary blocks in 101 patients and found that all three methods provided comparable surgical anesthesia quality for procedures below the shoulder [16]. Similarly, a meta-analysis by Guo et al. revealed no significant differences between supraclavicular and interscalene blocks for shoulder surgery concerning procedural time, rescue analgesia requirements, and dyspnea rates, though supraclavicular blocks were associated with a statistically lower incidence of hoarseness and Horner syndrome [17].

Enhancing Healthcare Team Outcomes:

The supraclavicular block procedure is generally performed by an anesthesiologist or an anesthesia nurse, supported by a nursing team. Nurses play a vital role in maintaining sterile technique, preparing medications, and ensuring the availability of necessary equipment during the procedure. Postoperatively, nurses monitor patients in the recovery room, remaining vigilant for complications and promptly notifying the operative team if issues arise. It is crucial for all involved healthcare professionals to possess comprehensive knowledge of the adverse effects associated with anesthetics used in regional blocks. While most patients experience no complications, some may develop temporary brachial plexus paralysis. Due to the rarity of these complications, complacency can occur; thus, regular re-education and continuous interprofessional training are imperative. Optimal patient outcomes are achieved through an

interprofessional team approach, where effective communication and collaboration are maintained to address any challenges encountered during the procedure.

Ultrasound-Guided Supraclavicular Brachial Plexus Block-Case Study:

The effectiveness of brachial plexus blocks hinges on precise nerve localization, accurate needle placement, and the optimal administration of local anesthetics. Current standard techniques, unfortunately, are reliant on "blind" methods [1–3], which use surface anatomical landmarks for needle insertion and depend on eliciting paresthesia or nerve-stimulated muscle contractions post-insertion. These approaches often require multiple trial-and-error needle attempts, potentially causing procedural discomfort and complications [4]. The supraclavicular approach, in particular, carries an elevated risk of pneumothorax [1].

The Role of Ultrasound Guidance in Brachial Plexus Blocks

Ultrasound imaging has emerged as a promising tool to enhance the success and reduce complications of brachial plexus blocks [5–8]. This study hypothesized that ultrasound imaging facilitates precise localization of the brachial plexus and aids in guiding the needle to the target nerves. The investigation evaluates the efficacy and clinical utility of advanced ultrasound technology for performing supraclavicular brachial plexus blocks.

Following ethics committee approval and obtaining written informed consent, 40 healthy outpatients undergoing elective upper-limb surgery were administered ultrasound-guided supraclavicular brachial plexus blocks. Exclusion criteria included upper-limb neurological deficits or contraindications for the procedure. Initially, 29 patients were scanned using the Toshiba Core Vision Pro unit (Toshiba Corp., Tokyo, Japan) with an 8-MHz linear probe. The remaining 11 patients were evaluated using the Philips ATL HDI 5000 SonoCT unit (Philips Medical Systems, Bothell, WA) equipped with a linear 5–12 MHz probe, color Doppler, and compound imaging capabilities. Patients, positioned supine with their heads turned 45° contralaterally, underwent scanning of the brachial plexus and surrounding structures. The ultrasound probe was aligned in the coronal oblique plane within the supraclavicular fossa to visualize the subclavian artery and the brachial plexus in the transverse sectional view. The brachial plexus, identified as hypoechoic nodules, was generally located lateral to the subclavian artery and above the first rib, which appeared hyperechoic. Skin sterilization and local anesthesia preceded the insertion of a 22-gauge, 50-mm insulated needle (Stimuplex; Braun Medical). The needle was advanced along the ultrasound beam's axis under real-time guidance until it reached the nerve cluster. Nerve stimulation was initiated with currents between 0.5–1.5 mA to elicit muscle twitches, and any occurrence of paresthesia was recorded. Subsequently, 20 mL of lidocaine 2% with epinephrine (1:200,000) and 20 mL of bupivacaine 0.5% were injected incrementally while observing local anesthetic spread. If incomplete coverage was noted, the needle was repositioned to achieve complete anesthetic dispersion.

The study encompassed 40 patients (26 males, 14 females) with a mean age of 45 ± 15 years, mean height of 170 ± 11 cm, and mean weight of 77 ± 15 kg (BMI: 26 ± 5 kg/m^2). The surgical procedures included forearm, wrist, and hand or finger surgeries, with an average operative duration of 77.9 ± 40.4 minutes. Ultrasound consistently revealed the brachial plexus as hypoechoic nodules lateral, posterior, and cephalad to the subclavian artery. The procedure achieved a 95% success rate (38 out of 40 cases) across five anesthesiologists with varying levels of ultrasound expertise. The block required 9.0 ± 4.4 minutes on average and was completed after one needle attempt in most cases. Sensory and motor block onset occurred within 5.4 ± 1.8 minutes, achieving full effect within 16.7 ± 5.5 minutes, and lasted 11.4 ± 4.2 hours. Patients reported low postoperative pain scores (<0.3/10), with high satisfaction levels (median: 9/10). Two block failures were noted: one due to subcutaneous injection, which exhibited atypical anesthetic spread patterns, and the other due to partial intravascular injection, which resolved by the end of surgery. Complications were minimal, including one case of Horner's syndrome and one transient paresthesia lasting less than 48 hours. No pneumothorax incidents were reported.

The findings suggest that ultrasound guidance significantly enhances the precision of nerve localization for supraclavicular brachial plexus blocks, reducing needle attempts and improving outcomes.

This study confirmed nerve localization using ultrasound and electrical stimulation, although further research is needed to assess the efficacy of ultrasound as a standalone technique. By visualizing anatomical structures in real-time, ultrasound provides critical information on the size, depth, and position of the brachial plexus, aiding in optimal needle placement and minimizing risks of vascular or pleural injury. The described needle insertion technique, involving lateral-to-medial advancement under real-time ultrasound guidance, diverges from conventional approaches and offers distinct advantages. This method aligns with anatomical constraints and ensures consistent visualization of the needle shaft and tip, thereby reducing the risk of pneumothorax. Two observed patterns of local anesthetic dispersion—circumferential and asymmetrical—highlight the importance of meticulous technique to ensure complete nerve blockade. While double injection was employed in asymmetrical cases, the necessity of this practice remains uncertain.

Role of Nursing Interventions:

The supraclavicular block is a widely utilized regional anesthesia technique that requires precise planning and execution to ensure patient safety and effective outcomes. Nursing interventions are integral to this process, encompassing patient education, procedural support, and postoperative monitoring. The following sections delineate evidence-based nursing interventions that optimize patient care during and after supraclavicular block procedures.

Preoperative Nursing Interventions

1. **Patient Education and Consent**: Nurses play a pivotal role in educating patients about the procedure, potential risks, and expected outcomes. This involves providing clear and concise explanations of the supraclavicular block, its advantages for pain management, and associated complications such as diaphragmatic paresis or transient brachial plexus paralysis. Education ensures informed consent and reduces patient anxiety. Additionally, patients with contraindications, such as hypersensitivity to local anesthetics or severe pulmonary conditions, should be identified through thorough nursing assessments.
2. **Preparation for the Procedure**: Preoperative nursing care involves preparing the patient and the surgical environment. Patients should be positioned supine with their arms at their sides and the head turned away from the procedural site. Ensuring optimal positioning is essential to facilitate access to the supraclavicular fossa and reduce procedural complications. Nurses must also assist with aseptic preparation by applying antiseptic solutions and arranging sterile drapes to maintain infection control standards.
3. **Monitoring Baseline Parameters**: Baseline monitoring of vital signs, oxygen saturation, and patient comfort is critical before administering sedation or local anesthetics. This step provides a reference for detecting perioperative changes and potential adverse reactions. Nurses must ensure that emergency resuscitation equipment is readily available to address complications such as local anesthetic systemic toxicity (LAST).

Intraoperative Nursing Interventions

1. **Assisting with Ultrasound-Guided Technique**: During the procedure, nurses assist the anesthesiologist by handling equipment such as ultrasound probes, sterile covers, and syringes. Their expertise in managing the ultrasound setup ensures clear visualization of anatomical structures, including the brachial plexus, subclavian artery, and pleura. Effective coordination minimizes risks such as pleural puncture and pneumothorax.
2. **Ensuring Patient Safety and Comfort**: Administering sedation, typically with midazolam or fentanyl, may be necessary to alleviate patient discomfort. Nurses monitor patient responses to sedation and intervene promptly if adverse effects such as respiratory depression occur. Additionally, they should remain vigilant for signs of intraneural injection, such as paresthesia or severe pain during the administration of local anesthetic and alert the anesthesiologist immediately.

3. **Documentation and Communication**: Accurate documentation of the procedure, including the anesthetic used, dosage, and patient responses, is essential for continuity of care. Nurses must maintain open communication with the surgical team to address any procedural challenges and ensure a seamless workflow.

Postoperative Nursing Interventions

1. **Monitoring for Complications**: After the block, patients are monitored closely in the recovery area for potential complications such as infection, neuropathy, or systemic toxicity. Vital signs, neurological status, and respiratory function should be assessed frequently. Transient effects like Horner syndrome or hemidiaphragmatic paresis must be documented and communicated to the medical team.
2. **Pain Management and Patient Comfort**: Nurses play a crucial role in assessing the effectiveness of the block in providing postoperative analgesia. They should address residual pain using prescribed analgesics and provide non-pharmacological comfort measures, such as positioning and reassurance.
3. **Patient Education for Discharge**: Before discharge, patients should receive instructions on recognizing signs of complications, such as increasing pain, swelling, or difficulty breathing. Nurses should educate patients and caregivers on postoperative care, including activity restrictions and follow-up appointments, to ensure a smooth recovery.

Interprofessional Collaboration

Effective nursing interventions rely on seamless interprofessional collaboration. Nurses must work closely with anesthesiologists, surgeons, and recovery room staff to address patient needs and optimize outcomes. Regular training sessions on the latest advancements in ultrasound-guided techniques and complication management further enhance the team's efficiency and safety protocols. Nursing interventions in the context of supraclavicular blocks encompass a spectrum of responsibilities, from preoperative education and preparation to intraoperative support and postoperative monitoring. By adopting a patient-centered approach, nurses contribute significantly to the safety and success of the procedure. Their vigilance and expertise not only mitigate risks but also enhance patient comfort and satisfaction, underscoring the critical role of nursing in regional anesthesia care.

Conclusion:

The supraclavicular block, often referred to as the "spinal of the arm," is a cornerstone in regional anesthesia for upper extremity surgeries, offering rapid onset and robust sensory and motor blockade. Its evolution, from landmark-based techniques to ultrasound-guided procedures, underscores significant advancements in anesthesia practices. Ultrasound guidance has revolutionized the supraclavicular block by enabling precise visualization of the brachial plexus and adjacent structures, thereby minimizing risks such as pneumothorax and vascular injury while enhancing procedural success rates. The clinical utility of this block extends beyond primary anesthesia to effective postoperative pain management. Evidence highlights its efficacy, with minimal procedural discomfort, reduced complication rates, and prolonged postoperative analgesia. Comparative studies have shown its effectiveness relative to other brachial plexus blocks, with fewer adverse effects such as hoarseness and Horner syndrome. Nursing interventions are indispensable throughout the procedure. From pre-procedural preparations, including informed consent and equipment management, to intraoperative support and vigilant postoperative monitoring, nurses ensure the seamless execution of this technique. Their role in identifying and addressing potential complications, such as local anesthetic toxicity or transient nerve effects, is critical. Interprofessional collaboration is pivotal in achieving optimal patient outcomes. Regular training and re-education for all team members, including nurses and anesthesiologists, foster an environment of safety and efficiency. Moreover, continuous advancements in ultrasound technology and procedural techniques demand ongoing professional development to maintain competency and confidence. In conclusion, the supraclavicular block exemplifies a blend of clinical efficacy and innovation in regional anesthesia. Its success hinges on the synergy between advanced technology and skilled healthcare professionals. By embracing interprofessional teamwork and

prioritizing patient-centered care, this technique continues to set a benchmark in anesthesia practices for upper extremity surgeries.

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اغلاق فوق الترقوة في التخدير المنطقي: نظرة شاملة ودور التدخلات التمريضية

الملخص:

الخلفية:

تُعتبر طريقة اغلاق فوق الترقوة تقنية تخدير مناطقي تُستخدم بشكل شائع في جراحات الطرف العلوي. ويُعزى تجدد شعبيتها إلى دمج التوجيه بالموجات فوق الصوتية، مما يُعزز من سلامة وكفاءة الإجراء. توفر هذه التقنية بداية سريعة للتخدير وفعالية عالية نظرًا لترتيب أعصاب الضفيرة العضدية بشكل مضغوط في الموقع المستهدف.

الهدف: يقدم هذا المقال نظرة شاملة حول اغلاق فوق الترقوة، أهميتها السريرية، المخاطر المرتبطة بها، والدور الحاسم للتدخلات التمريضية في ضمان نجاح الإجراء وسلامة المريض.

المنهجية: تمت مراجعة اغلاق فوق الترقوة مع التركيز على تشريحها، مؤشرات استخدامها، موانعها، تقنيات الإجراء، والمضاعفات المحتملة. كما يسلط المقال الضوء على التطورات في التوجيه بالموجات فوق الصوتية وتأثيرها على نتائج الإجراء. وتمت مراجعة دراسات الحالة والنتائج السريرية الحديثة لتوضيح فعالية وأمان هذه التقنية.

النتائج: أدى دمج التوجيه بالموجات فوق الصوتية إلى تحسين كبير في سلامة اغلاق فوق الترقوة من خلال تقليل المضاعفات مثل استرواح الصدر وإصابة الأوعية الدموية. تُظهر الدراسات أن متوسط مدة الإجراء يبلغ 4 دقائق، مع توفير تسكين بعد العملية يستمر لمدة حوالي 437 دقيقة. تمتد فعالية تخدير فوق الترقوة إلى مجموعة واسعة من جراحات الطرف العلوي مع مخاطر ضئيلة عند تنفيذها من قبل محترفين مدربين. يلعب طاقم التمريض دورًا محوريًا في تحضير المريض، وإدارة المعدات، والمراقبة بعد العملية، مما يساهم في نجاح الإجراء بشكل عام.

الخلاصة: تُعد طريقة اغلاق فوق الترقوة تقنية تخدير مناطقي موثوقة وفعّالة، خاصةً عند تعزيزها بالتوجيه بالموجات فوق الصوتية. توفر تغطية تخديريه ممتازة مع مخاطر قليلة، مما يجعلها خيارًا مفضلًا لجراحات الطرف العلوي. تُعتبر التدخلات التمريضية جزءًا لا يتجزأ من تحسين نتائج المرضى، مما يؤكد على أهمية التعاون بين التخصصات والتدريب المستمر.

الكلمات المفتاحية: اغلاق فوق الترقوة، التخدير المناطقي، التوجيه بالموجات فوق الصوتية، الضفيرة العضدية، التدخلات التمريضية، جراحات الطرف العلوي.