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BRIEF COMUNICATION

Results of ultrasound-guided supraclavicular brachial plexus block in orthopedic surgery

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ABSTRACT

Introduction: peripheral nerve blocks are widely used in upper limb surgery, and ultrasound-guided supraclavicular block is a standard and preferred technique for anesthesia, providing control and safety that are not possible with other techniques.
Objectives: to describe the results of ultrasound-guided supraclavicular block in orthopedic surgery of the upper limb.
Methods: an observational, descriptive and retrospective study was conducted on 50 patients aged 14 to 82 years with upper limb orthopedic injuries, in which the supraclavicular approach to the brachial plexus was used as an anesthetic method, during the period from January to September 2025 at the Jazzolino Hospital in Italy.
Results: the main orthopedic injuries treated with ultrasound-guided supraclavicular block were forearm injuries, with 84 % of patients classified as ASA II. The average procedure time was 6,3 minutes. The complication, adverse effect and side effect rate was 0,05 per 1000 patients, with hematoma observed as a complication in only one patient. The technique demonstrated 98 % effectiveness and 99 % safety. The main advantages of ultrasound-guided supraclavicular brachial block were the short procedure time with guaranteed hemodynamic stability, the absence of adjuvant medications, and the prolonged postoperative analgesic effect.
Conclusions: the main results of ultrasound-guided supraclavicular brachial plexus block were its high efficacy and safety for orthopedic surgery.

Keywords: Anesthesia, Conduction; Nerve Block; Brachial Plexus; Ultrasonography.

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INTRODUCTION

The history of regional anesthesia is as old as the history of anesthesia itself. The supraclavicular block (SCB) of the brachial plexus has a history spanning decades, evolving significantly with the introduction and widespread adoption of ultrasound guidance. Ultrasound-guided SCB, performed at the level of the trunks and divisions of the brachial plexus, is indicated for surgeries of the distal region of the upper limb up to the shoulder.[1]

The classic supraclavicular approach was originally described by the German military surgeon August Bier in the early 20th century and popularized by Georg Kulenkampff in 1911.[2] This technique relied on anatomical landmarks (the pulse of the subclavian artery above the clavicle) and did not use imaging or nerve stimulation, which entailed a considerable risk of complications, such as pneumothorax, due to the proximity of the pleura.[2]

The true revolution in regional anesthesia, and specifically for the supraclavicular approach, occurred with the introduction of ultrasound (echography) in the early 2000s. Ultrasound guidance allowed real-time visualization of anatomical structures, the needle, and the spread of local anesthetic, transforming the technique. Anesthesiologists such as Dr. Admir Hadzic and the team at the New York School of Regional Anesthesia were key figures in the standardization and teaching of ultrasound-guided regional anesthesia techniques, including the supraclavicular approach. Direct visualization of the brachial plexus (the superior, middle, and inferior trunks) above the clavicle and lateral to the subclavian artery, known as the "grape cluster" view, became the gold standard.[3]

Ultrasound guidance has drastically improved the safety and efficacy profile of SCB. Visualization of the pleural dome and the ability to avoid it have reduced the incidence of pneumothorax to less than 1 %. It also allows for more precise placement of local anesthetic, which often results in a faster onset of block and, in some cases, the use of smaller volumes of anesthetic.[2]

Today, ultrasound-guided SCB is a standard and preferred technique for upper limb anesthesia, providing control and safety that were not possible with techniques based solely on anatomical landmarks and nerve stimulation. Adequate knowledge of brachial plexus anatomy and osteomuscular innervation allows for optimal planning of the block according to the surgery and patient characteristics.[4]

During the authors' international collaboration in the region of Italy, this technique became the first choice in the protocols of Jazzolino Hospital. The present research fulfills the objective of showing the results of ultrasound-guided supraclavicular block in upper limb orthopedic surgery.

METHODS

An observational, descriptive, and retrospective study was conducted on a universe of 50 patients with upper limb orthopedic injuries who underwent elective upper limb orthopedic surgery using the ultrasound-guided supraclavicular brachial plexus block as the anesthetic method at "G. Jazzolino" Hospital during the period from January to September 2025.

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Patients meeting the American Society of Anesthesiologists (ASA) I-II criteria were included, following informed consent. Patients under 14 years and over 82 years of age, those with coagulation disorders or receiving anticoagulant and antiplatelet therapy, patients with a reported prior brachial plexus injury, those with psychiatric and/or neurodegenerative diseases, and those reporting a history of allergic reaction to local anesthetics were excluded.

To assess the efficacy of the technique, six variables were considered; the technique was deemed ineffective in the presence of the following: persistence of motor function after 20 minutes of block performance, presence of pain upon a painful stimulus in the blocked area, an increase of more than 15 % in vital parameters, need for a second block, requirement for narcotic doses, or conversion of the technique to general anesthesia.

Complications of the technique were categorized as: vascular puncture with systemic toxicity, pneumothorax, vasovagal syncope, nerve injury, brachial plexus inflammation, infection, Horner's syndrome (ptosis and miosis), recurrent laryngeal nerve block, pain at the puncture site, and hematomas.

RESULTS

During the study period, data from 50 patients were collected, with ages ranging from 14 to 82 years (mean age 50,8 years); 72 % were male and 28 % female.

The main orthopedic injuries treated with ultrasound-guided SCB, by frequency, were forearm injuries (76 %), arm injuries (18 %), and hand injuries (6 %). Forearm fractures included compound ulnar fractures (45 %) and multifragmentary radial fractures (30 %). According to clinical status, 84 % corresponded to ASA II and 16 % to ASA I. The average procedure duration in patients was 6,3 minutes (95 % CI 5,4–7,1).

The complication rate was 0,05 per 1000 patients. No patients reported vascular puncture with systemic toxicity, pneumothorax, or vasovagal syncope. Other complications such as nerve injury, brachial plexus inflammation, infection, Horner's syndrome, recurrent laryngeal nerve block, or pain at the puncture site were not observed. In one patient (2 %), a hematoma was identified following the use of the technique. A 99 % safety rate was achieved with this technique.

In all patients, the procedure was completed within eight minutes, with stable vital parameters, effective motor block, and no need for co-adjuvant anesthetic agents such as narcotics. In 48 of them, the onset time of the anesthetic (latency period) was less than or equal to 20 minutes, while in two patients, the onset occurred later. The applied technique showed 98 % efficacy; Table 1 shows the percentages for each indicator.

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Table 1. Behavior of effectiveness indicators in patients with ultrasound-guided supraclavicular brachial plexus block.

Effectiveness indicators	No.	%
Procedure duration < 8 minutes	50	100
Anesthetic onset time ≤ 20 minutes	48	98
Increase in vital parameters not exceeding 15 %	50	100
No need for additional narcotic dose	50	100
No requirement for a second block	50	100
No need for conversion to general anesthesia	50	100

DISCUSSION

Upper limb trauma accounts for 10 % to 40 % of emergency department visits in North America and Europe, causing significant temporary or permanent disability.[5] Upper limb trauma in Italy is predominantly the result of traffic and occupational accidents. In 2023, traumatic injuries from these causes increased, with Calabria (where the study was conducted) being among the Italian regions with the highest rate.[6] Furthermore, according to the Italian National Institute for Insurance against Occupational Accidents, fractures account for more than 50 % of the most frequent work-related injuries.[7] This explains the case mix and types of injuries most frequently observed in the patients selected for the study.

When comparing our results with two Colombian studies, the predominance of forearm injuries coincides with reports from Barranquilla, although at a lower percentage than ours, but differs from the injury locations reported in Medellín, where trauma occurred more frequently in hands and fingers.[5,8] The predominance of forearm injuries in our patients is explained by the fact that hand and finger injuries are managed as minor surgery under local anesthesia at our institution.

Peripheral nerve blocks are widely used in upper limb surgery since, when properly performed, they can provide surgical anesthesia beyond just postoperative analgesia, which can be complemented with varying degrees of sedation, thereby avoiding general anesthesia and its complications. These blocks are ideal for outpatient surgery, as they enable earlier discharge, better pain control, and fewer complications, demonstrating their efficacy and safety.

In experienced hands, ultrasound allows the practitioner to visualize nerves and adjacent structures, as well as the needle tip and the spread of local anesthetic in real time, minimizing the risk of adverse effects and complications.

The incidence of complications observed in our patients was lower than the 2,81:1000 reported in a sample of 5,000 subjects at the regional anesthesia unit in Zaragoza, Spain.[9] It was also lower than that reported in a sample of 2,012 patients included in 25 controlled clinical trials, in which the main complications reported were vascular puncture, transient neurological injury, symptomatic phrenic nerve palsy, and pneumothorax. The same study found no differences in associated complications.[9] The low incidence of complications and the anesthetic success observed in our patients are similar to those reported with other ultrasound-guided anesthetic techniques.

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Phrenic nerve palsy following ultrasound-guided SCB is a complication with a notably lower frequency compared to the 50 % observed with nerve stimulation technique, which occurs mainly in patients with pre-existing pulmonary compromise and may also be related to the volume of anesthetic used.[10] For this reason, we do not recommend the concurrent use of nerve stimulation to improve SCB efficacy.

In a series of 510 cases of ultrasound-guided SCB in patients without respiratory dysfunction, symptomatic hemidiaphragmatic paresis occurred in 1 % of cases.[11] It would be beneficial to prevent this complication during SCB by considering patients with potential intolerance to the loss of contribution from the ipsilateral diaphragm.

Hemidiaphragmatic paresis was not observed in our study subjects, as the selected patients met inclusion criteria and the procedure was performed by experienced hands, in accordance with the aforementioned recommendation.

No patient presented pneumothorax as a complication, consistent with recent studies estimating a very low risk (0,1 %) of pneumothorax associated with ultrasound-guided SCB.[11]

Although the reported incidence of Horner's syndrome is around 1 %, and that of vascular puncture and transient sensory deficit up to 0,4 % in cases undergoing SCB, these rare complications were not observed in our patients.[12]

Some authors recommend a double interscalene-supraclavicular block when surgery involves both the head and diaphysis of the humerus, but we lack evidence to support this, as we did not use this technique due to the absence of patients with this type of compound injury.[13]

Although hematoma is a rare complication and is more common with continuous catheter use than with the single-injection technique used in our patients, we consider that in the single case where it occurred, it was likely due to puncture of a small blood vessel, possibly favored by antiplatelet use—an antecedent omitted by the patient during pre-anesthetic consultation.

The average time required to perform the block in this study was similar to that obtained in the series by Higuera et al., but 1,7 minutes longer than the clinical trial published, which reported an average time of 4,3 minutes for performance with no significant differences between nerve stimulator and ultrasound use.[8] In the present investigation, the result coincides with other studies evaluating the performance of this type of anesthesia. Therefore, we consider the block performance time in this study to be appropriate.

The effectiveness of ultrasound-guided supraclavicular brachial plexus block in our series was 1,4 % lower than the 99,4 % reported by Higuera et al., but unlike that study, no patient required conversion to general anesthesia, and we achieved a similar safety percentage.[8] The low complication rate in both studies allows us to confirm the safety of the procedure described in other investigations.

The results of the present study in terms of efficacy and safety are as high as the 99,6 % success rate and absence of complications reported in 283 pediatric patients and in patients undergoing forearm osteosynthesis.[14,15]

In anesthetic practice, although bilateral brachial plexus block has scarce indications, it has also proven successful in cases of bilateral upper limb surgery, where surgery has proceeded without incidents or major complications, providing better comfort in the immediate postoperative period, according to the reports we have accessed.[16]

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Supraclavicular and infraclavicular approaches for brachial plexus block in upper limb trauma surgery have been compared, with no significant differences found in terms of effectiveness and safety.[17]

The supraclavicular route was chosen for our patients, despite the fact that other techniques for brachial plexus blockade have also demonstrated low incidence of complications and medium- to long-term sequelae, with none being superior in reducing complications and all being highly successful when performed with ultrasound visualization.[18,19]

CONCLUSIONS

Ultrasound-guided supraclavicular brachial plexus block was established in this study as a reference technique for upper limb orthopedic surgery, demonstrating high efficacy and safety, a high success rate, minimal complication incidence, and no need for conversion to general anesthesia. Its rapid execution, achieved hemodynamic stability, absence of co-adjuvant drug requirements, and prolonged postoperative analgesic effect confirm its utility as a first-choice option in regional anesthesia protocols, providing additional benefits in patient recovery and comfort and supporting its systematic incorporation into clinical practice.

Declaration of conflict of interests
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RVG: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing.
LLP: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing.
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