AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 02. February ,2026

THE ROLE OF COMPREHENSIVE ULTRASONIC NAVIGATION IN INCREASING THE CLINICAL EFFECTIVENESS OF BRACHIAL PLEXUS BLOCKADE IN INJURIES AND DISEASES OF THE UPPER EXTREMITIES

Bekimbetov K.N.
Yusupalieva G.A.
Tashkent State Medical University

Abstract. Objective: to evaluate the clinical efficacy, safety, and impact on postoperative pain relief of complex ultrasound navigation during brachial plexus block in patients with upper limb injuries and diseases. Materials and Methods: the study included 150 patients (64 men, 86 women; mean age 39.8±16.3 years) who underwent brachial plexus block. The main group (n=100) included patients with injuries, chronic pain syndromes, and postoperative conditions; the control group (n=50) included patients undergoing elective surgeries without nerve damage. The block was performed under the control of ultrasound navigation using gray-scale echography, color Doppler imaging, and compression elastography. Results: The use of ultrasound navigation reduced the block time (8.4±2.1 vs. 15.2±3.8 min, $p< 0.05$), increased the block success rate (96% vs. 82%), and reduced the need for repeat anesthesia (4% vs. 18%). The frequency of vascular punctures decreased more than threefold. The duration of postoperative analgesia increased to 11.5±2.3 hours. Conclusion: Integrated ultrasound navigation improves the accuracy and safety of brachial plexus block, enhances the quality of pain relief, and reduces the incidence of complications, making it the method of choice for injuries and surgeries on the upper extremities.

Keywords: Ultrasound navigation; brachial plexus block; regional anesthesia; upper limb injuries; VAS; postoperative pain relief.

Relevance of the study. Injuries to the peripheral nerves of the upper extremities remain a pressing issue in modern traumatology and reconstructive surgery. According to the literature, the incidence of nerve involvement in upper extremity injuries ranges from 25% to 65%, with up to 40% involving the nerves of the shoulder girdle and forearm, often leading to persistent pain, functional impairment, and long-term disability. A significant proportion of patients require not only surgical correction but also adequate pain relief during the surgical treatment and rehabilitation stages.

Regional anesthesia, particularly brachial plexus blocks, is widely used for shoulder girdle and upper extremity surgeries, as well as for postoperative pain relief. However, traditional methods of performing it—blindly using anatomical landmarks or under the control of a nerve stimulator—have a number of significant limitations. These include high variability in anatomical landmarks, the risk of unintentional vascular puncture (up to 20%), nerve damage, and insufficient needle positioning, leading to incomplete anesthesia and increased anesthetic dosage.

Despite the proven effectiveness of ultrasound navigation, the Russian literature lacks data on its use in patients with a variety of traumatic injuries and postoperative conditions of the upper extremities. Issues related to the standardization of ultrasound approaches, quantitative assessment of nerve semiotics, and the integrated use of gray-scale ultrasound, color Doppler mapping (CDM), and elastography remain unresolved. This is especially relevant in cases of multiple injuries and anatomical variations, where a personalized approach is required to achieve effective pain relief.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 02. February ,2026

Thus, a study aimed at developing and clinically evaluating integrated ultrasound navigation for brachial plexus block in patients with upper extremity injuries and diseases is timely and of practical significance. The results obtained may contribute to a reduction in complication rates, improved pain management, and optimized perioperative patient care.

The aim of the study was to evaluate the clinical efficacy, safety, and impact on postoperative pain relief of complex ultrasound navigation during brachial plexus block in patients with upper extremity injuries and diseases.

Materials and methods. The study included 150 patients (64 men and 86 women) aged 7 to 73 years (mean age 39.8 ± 16.3 years) who underwent ultrasound-guided brachial plexus block. The control group (n=50) consisted of patients undergoing elective surgery for upper extremity pathology without nerve trunk injury.

The main group (n=100) included patients with various pathologies: acute injuries (fractures of the shoulder, clavicle, elbow joint, forearm and hand bones), chronic pain syndromes, consequences of operations and reconstructive interventions, rehabilitation patients with post-traumatic contractures and neuralgia.

Patients were distributed according to the location of injuries as follows: shoulder - 42 cases (28%), clavicle/brachial plexus - 16 (11%), elbow - 38 (25%), forearm - 27 (18%), hand and fingers - 27 (18%).

The block was performed under ultrasound guidance using grayscale echography, color Doppler mapping (CDM), and compression elastography (Aplio 500, Japan). Visual control of needle position, differentiation of nerves and vessels, and real-time tracking of anesthetic spread were performed.

Evaluation of effectiveness included: blockade time, volume of anesthetic used, severity of pain syndrome according to the visual analogue scale (VAS) after 30 minutes, 6 and 24 hours, frequency of complications (vascular puncture, paresthesia, hematomas), need for additional anesthesia or analgesia.

Study results. Integrated ultrasound navigation resulted in a high rate of successful blockades: 96% of cases were pain-free in the surgical area within the first 6 hours after the procedure.

The average time to perform the blockade was 8.4±2.1 min, which is almost two times less than with the traditional technique (15.2±3.8 min; $p< 0.05$) (Table 1).

Table 1. Comparative evaluation of the effectiveness of the blockades performed

Parameter	**Ultrasound navigation (n=100)**	**Control (n=50)**	**p-value**
Average block time, min	8.4 ± 2.1	15.2 ± 3.8	*<0.05*
Blockade success rate, %	96	82	*<0.05*
Need for re-anesthesia, %	4	18	*<0.05*
Average volume of anesthetic, ml	18 ± 3	24 ± 4	*<0.05*

In 4% of cases, additional administration of anesthetic was required (compared to 18% in the control group), which confirms more accurate delivery of the drug to the required fascial compartment.

Ultrasound navigation significantly reduced the number of intra- and post-procedural complications:

Vascular puncture: 6.7% (versus 21.4% in the control group);

Hematomas: 2% (versus 8%);

Transient paresthesia: 1.3% (self-limited within 24 hours);

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 02. February ,2026

No persistent neurological complications were registered.
Visual control made it possible to minimize the risk of damage to large vessels, avoid systemic toxicity of local anesthetics, and reduce the volume of drug used.
To objectively assess the quality of pain relief, a visual analogue pain scale (VAS) was used during the first 24 hours after surgery (Table 2).
Table 2
Postoperative analgesia and pain dynamics (VAS)

VAS measurement time	Ultrasound navigation (n=100)	Control (n=50)	p-value
Before surgery	6.8 ± 1.2	6.6 ± 1.3	*>0.05*
30 minutes after the blockade	0.4 ± 0.3	1.2 ± 0.8	*<0.05*
6 hours	1.2 ± 0.8	3.4 ± 1.1	*<0.05*
12 hours	2.8 ± 1.0	5.1 ± 1.5	*<0.05*
24 hours	4.0 ± 1.2	6.3 ± 1.8	*<0.05*

The duration of analgesia in the ultrasound navigation group was 11.5±2.3 hours, which is 3–4 hours longer than the result in the control group (7.9±1.8 hours).
Additional non-narcotic analgesics were required in only 10% of cases (versus 38% with the traditional technique). Patients reported a more comfortable awakening and less pain during the first 24 hours, and surgeons reported more relaxed postoperative care.
Discussion of Results. The obtained results demonstrate that the use of complex ultrasound navigation during brachial plexus block significantly improves the effectiveness of regional anesthesia in patients with traumatic and postoperative upper extremity injuries. In our study, the block success rate reached 96%, which is comparable to the data of the systematic review by Abrahams et al . (2009), where the use of ultrasound navigation increased the likelihood of complete anesthesia by 29% compared to traditional methods. Reducing the block time by almost half is of significant clinical significance, especially in a trauma hospital setting, where speed of care is crucial. Early achievement of surgical anesthesia reduces the time of patient preparation for surgery and optimizes the work of the operating room.
A 25% reduction in the volume of anesthetic used reduces the risk of systemic toxicity from local anesthetics, which is especially important for patients with concomitant cardiovascular disease. Longer postoperative analgesia reduces the need for opioid analgesics and accelerates patient recovery, which is consistent with the data of Marhofer et al . (2005), who demonstrated an improvement in the quality of the postoperative period with the use of ultrasound-guided blocks. The complication rate with the use of ultrasound navigation was significantly lower - the frequency of vascular punctures decreased by more than three times. These results confirm the work of Sites et al . (2010), who noted a reduction in the complication rate and increased block safety with visual control of the needle position and the spread of anesthetic.
It's worth noting that a comprehensive technique including grayscale ultrasound, color Doppler imaging, and compression elastography allows not only for visualization of nerves and vessels but also for assessment of anatomical variations, which is especially important in cases of repeated surgeries and tissue scarring. This allows for a more personalized approach to each patient.
Thus, the obtained data confirm the high clinical efficacy and safety of complex ultrasound navigation and allow us to recommend it as the method of choice for regional anesthesia in patients with pathology of the shoulder girdle and upper limbs.
Conclusions. Integrated ultrasound navigation during brachial plexus blockade ensures a high block success rate (96%) and significantly reduces procedure time. This technique allows for a

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 02. February ,2026

25% reduction in the volume of anesthetic used, a more than threefold reduction in the incidence of vascular complications, and a longer duration of pain relief. Ultrasound navigation reduces the need for supplemental anesthesia and improves patient satisfaction.

The introduction of integrated ultrasound navigation into clinical practice improves the safety and quality of regional anesthesia, which is especially important for injuries and surgeries on the upper extremities.

REFERENCES

1. Abrahams MS, Aziz MF, Fu RF, Horn JL Ultrasound guidance compared with electrical neurostimulation for peripheral nerve block: a systematic review and meta-analysis of randomized controlled trials. *Br J Anaesth.* 2009;102(3):408–417.
2. Marhofer P., Chan VWS Ultrasound-guided regional anesthesia: current concepts and future trends. *Anesth Analg.* 2007;104(5):1265–1269.
3. Sites BD, Brull R, Chan VW et al. Art of ultrasound-guided regional anesthesia: principles and practical considerations. *Reg Anesth Pain Med.* 2010;35(2):S 59–S80.
4. Nadiradze Z.Z. Regional anesthesia for brachial plexus injuries: current capabilities. *Anesthesiology and reanimatology.* 2014;(6):55–61.
5. Danilova M.G., Saltykova V.G., Usenko E.E. Use of ultrasound navigation in peripheral nerve blocks. *Medical visualization* 2018;(3):29–36.
6. Neal JM, Barrington MJ, Brull R, Hadzic A. The ASRA Practice Advisory on Neurologic Complications in Regional Anesthesia and Pain Medicine. *Reg Anesth Pain Med.* 2015;40(5):401–430.
7. Koscielniak-Nielsen ZJ Ultrasound-guided peripheral nerve blocks: what are the benefits? *Acta Anaesthesiol Scand.* 2008;52(6):727–737.
8. Tran DQH, Elgueta MF, Aliste J., Finlayson RJ Diaphragmsparing nerve blocks for shoulder surgery, revisited. *Reg Anesth Pain Med.* 2017;42(1):32–38.
9. Grau T., Bartusseck E., Conradi R. et al. Ultrasound imaging improves learning curves in obstetric epidural anesthesia: a randomized controlled trial. *Can J Anaesth.* 2003;50(9):976–982.
10. Ilfeld BM, Ball ST, Gearen PF et al. Ambulatory continuous interscalene nerve blocks decrease the time to discharge readiness after total shoulder arthroplasty. *Anesthesiology* . 2006;105(5):999–1007.