

Original article

Awareness, Knowledge, and Barriers to the Practice of Ultrasound-Guided Regional Anaesthesia Among Anaesthesia Residents: A Cross-Sectional Study

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Abstract

Background: Ultrasound-guided regional anaesthesia (USG-RA) has become an important component of contemporary anaesthetic practice by facilitating real-time visualization of neural structures, adjacent anatomy, needle advancement, and local anaesthetic spread. Despite its advantages, competency among anaesthesia residents may be influenced by differences in formal training, supervision, confidence, and access to equipment.

Objectives: To assess awareness, knowledge, clinical exposure, confidence, and perceived barriers regarding USG-RA among anaesthesia residents and to determine their perceived training requirements.

Materials and Methods: This observational cross-sectional study was conducted in the Department of Anaesthesiology and Critical Care at Pravara Rural Hospital, Loni. A structured self-administered questionnaire assessed residency level, perceived knowledge, previous training, frequency of USG-RA practice, basic technical knowledge, confidence, barriers, ultrasound availability, and preferred future training. Although the protocol described a planned sample of 27 residents, 26 completed responses were available in the questionnaire dataset and were therefore analysed. Descriptive statistics were expressed as frequencies and percentages.

Results: Among 26 respondents, 38.5% were first-year residents. Overall USG-RA knowledge was rated good by 46.2%, while 19.2% considered their knowledge poor. Departmental teaching was the principal source of formal exposure (61.5%). Frequent performance of ultrasound-guided blocks was reported by 76.9%. Correct understanding of the principal advantage of ultrasound guidance and the preferred probe for superficial blocks was demonstrated by 92.3% and 84.6%, respectively. Only 3.8% were very confident in identifying nerves and anatomical structures. Lack of adequate training/supervision (53.8%) was the predominant barrier, followed by lack of confidence/technical skills (30.8%). Regular supervised clinical training was preferred by 57.7%, and 96.2% expressed definite interest in additional USG-RA training.

Conclusion: Residents demonstrated substantial exposure and satisfactory basic knowledge of USG-RA; however, confidence and structured training remained important gaps. Competency-based supervised clinical training supplemented by workshops and simulation may improve resident proficiency.

Keywords: Ultrasound-guided regional anaesthesia; regional anaesthesia

Introduction

Regional anaesthesia is an integral component of modern perioperative care, providing effective surgical anaesthesia and postoperative analgesia while potentially reducing systemic opioid requirements. Traditionally, peripheral nerve blocks were performed using anatomical landmarks, elicitation of paraesthesia, or peripheral nerve stimulation. The incorporation of ultrasound has substantially changed regional anaesthesia by allowing direct visualization of nerves, fascial planes, surrounding structures, the needle, and local anaesthetic spread. Evidence indicates that ultrasound guidance can improve several aspects of block performance and may decrease vascular puncture and other procedural complications.[1,2]

Ultrasound-guided regional anaesthesia (USG-RA), however, is a technically demanding skill requiring knowledge of anatomy and sonoanatomy, image acquisition and optimization, hand-eye coordination, needle visualization, and safe injection techniques.[3,4] Consequently, simply providing an ultrasound machine does not ensure proficiency. Residents require structured teaching, deliberate practice, appropriate supervision, and sufficient clinical exposure.

International recommendations emphasize both didactic and experiential components in USG-RA training.[5] Nevertheless, training opportunities and competence can vary considerably between residency programmes. Lack of trained supervisors, limited equipment, insufficient protected training time, and low procedural confidence have all been described as barriers.[6,7] Assessment of residents' current knowledge and perceived educational needs is therefore essential for designing locally appropriate training programmes.

The present study assessed awareness, knowledge, utilization, confidence, perceived barriers, and training preferences regarding USG-RA among anaesthesia residents at a tertiary-care teaching institution.

Aim and Objectives

The primary aim was to evaluate awareness, knowledge, and barriers related to the practice of ultrasound-guided regional anaesthesia among anaesthesia residents. Specific objectives were to assess residents' self-perceived knowledge, previous USG-RA training, frequency of clinical use, understanding of basic ultrasound principles, confidence in identifying anatomical structures, major barriers to greater utilization, availability of ultrasound equipment, and preferences for additional training.

Materials and Methods

An observational, cross-sectional questionnaire-based study was conducted in the Department of Anaesthesiology and Critical Care, Pravara Rural Hospital, Loni. The source protocol describes recruitment of postgraduate anaesthesia residents from different levels of training.

Study population and sample size

The protocol proposed inclusion of 27 postgraduate anaesthesia residents. However, the charts contained 26 completed questionnaire responses; consequently, the present analysis is based on the 26 evaluable respondents rather than imputing a response for the missing participant. This distinction is important because the percentages shown in the source charts correspond to a denominator of 26.

Residents at different levels of postgraduate training were eligible. Residents providing informed consent were included. Those unwilling to participate and questionnaires with incomplete information were excluded, consistent with the source protocol.

Study tool

Data were obtained using a structured, self-administered questionnaire. For the present USG-RA analysis, questionnaire domains included residency year, overall knowledge of USG-RA, previous teaching or training, frequency of ultrasound use for regional nerve blocks, understanding of the principal advantage of ultrasound guidance, appropriate probe selection, confidence in recognizing nerves and surrounding structures, perceived barriers, equipment availability, preferred mode of training, and willingness to undergo additional training.

Data collection

Residents completed the questionnaire independently. Participation was voluntary, and confidentiality and anonymity were maintained. The questionnaire results were compiled electronically and summarized using response charts.

Outcome variables

The principal outcomes were self-reported knowledge and confidence, exposure to USG-RA, frequency of use, correct responses to basic technical questions, barriers to practice, perceived adequacy of ultrasound availability, and demand for further training.

Statistical analysis

Data were analysed descriptively. Categorical variables are presented as frequency (n) and percentage (%). Percentages were calculated using 26 completed responses as the denominator. Because the dataset was small and primarily consisted of aggregate questionnaire responses, the analysis focused on descriptive interpretation rather than unsupported inferential comparisons.

Results

Twenty-six complete responses were available. Residents represented different levels of anaesthesia training, with first-year residents forming the largest group.

Table 1. Residency profile, perceived knowledge and previous USG-RA training (n=26)

Variable	Category	n	%
Residency status	First year	10	38.5
	Second year	7	26.9
	Third year	5	19.2
	Senior resident/faculty*	4	15.4
Overall knowledge of USG-RA	Excellent	3	11.5
	Good	12	46.2
	Fair	6	23.1
	Poor	5	19.2
Previous training	Formal course/workshop	1	3.8
	Departmental teaching	16	61.5
	Informal/self-learning	7	26.9

	No training	2	7.7
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*Category reproduced according to the response chart.

Almost three-fifths (57.7%) rated their knowledge as either good or excellent. Nevertheless, 42.3% rated it as fair or poor, demonstrating a meaningful perceived knowledge gap. Departmental teaching represented the predominant training route, while only one respondent reported a formal course/workshop. The questionnaire specifically evaluated formal USG-RA teaching and frequency of use.

Table 2. Clinical utilization, technical knowledge and confidence regarding USG-RA (n=26)

Variable	Response	n	%
Frequency of USG regional blocks	Frequently (>5 blocks/month)	20	76.9
	Occasionally (1-5/month)	4	15.4
	Rarely (<1/month)	1	3.8
	Never	1	3.8
Most important advantage of USG-RA	Direct visualization of nerves/surrounding structures	24	92.3
	Other response	2	7.7
Probe for superficial peripheral nerve blocks	High-frequency linear probe	22	84.6
	Other response	4	15.4
Confidence identifying nerves/anatomy	Very confident	1	3.8
	Moderately confident	13	50.0
	Slightly confident	9	34.6
	Not confident	3	11.5

Frequent clinical exposure was reported by 76.9% of residents. Knowledge of fundamental ultrasound concepts was relatively strong: 92.3% identified direct visualization of nerves and surrounding structures as the major advantage of USG-RA, while 84.6% selected the high-frequency linear probe for superficial peripheral nerve blocks. These questions are explicitly included in the study questionnaire.

Despite this knowledge, confidence was substantially lower. Only one respondent was very confident, whereas 46.1% were either slightly confident or not confident. Thus, theoretical familiarity did not uniformly translate into perceived procedural competence.

Table 3. Barriers, ultrasound availability and future training preferences (n=26)

Variable	Response	n	%
Major barrier to performing more USG blocks	Lack of adequate training/supervision	14	53.8
	Lack of confidence/technical skills	8	30.8
	Lack of time/workload	2	7.7
	Lack of ultrasound machine availability	2	7.7
Availability of ultrasound machine	Easily available	10	38.5
	Usually available	16	61.5
Preferred training method	Regular supervised clinical training	15	57.7
	Hands-on workshops	9	34.6
	Simulation-based training	2	7.7
	Online/video-based learning	0	0
Interest in additional training	Definitely yes	25	96.2
	Probably yes	1	3.8
	Probably/definitely no	0	0

The principal barrier was **lack of adequate training and supervision (53.8%)**, followed by lack of confidence or technical skills (30.8%). Importantly, ultrasound equipment itself appeared to be comparatively accessible, with all respondents describing machines as either easily or usually available. Regular supervised clinical training was the most preferred educational intervention (57.7%), followed by hands-on workshops (34.6%). Almost all respondents (96.2%) definitely wanted further USG-RA training. These findings correspond to the questionnaire's specific assessment of machine availability and preferred training strategy.

Discussion

The present study demonstrates a noteworthy combination of **high clinical exposure and basic awareness but comparatively limited procedural confidence** among anaesthesia residents. Most respondents regularly used ultrasound for regional nerve blocks, and fundamental knowledge concerning the advantages of ultrasound and probe selection was satisfactory. Nevertheless, lack of adequate training/supervision was the most frequently reported barrier, and almost half of respondents were only slightly confident or not confident in identifying nerves and relevant anatomical structures.

The growing adoption of USG-RA has changed regional anaesthesia education. Ultrasound provides dynamic visualization of anatomy and enables the anaesthesiologist to monitor needle advancement and local anaesthetic distribution. Earlier systematic evidence suggested that ultrasound-guided blocks provide at least comparable success to alternative nerve-localization techniques while potentially improving block quality and onset and reducing vascular puncture.[1] The updated Cochrane review similarly supported clinically important advantages associated with ultrasound guidance.[2]

In our study, **92.3% correctly identified direct visualization of nerves and surrounding structures as the principal advantage of ultrasound guidance**. This finding suggests that residents possess a sound conceptual understanding of why ultrasound is used. Furthermore, 84.6% correctly identified the

high-frequency linear probe as generally appropriate for superficial peripheral nerve blocks. Basic cognitive knowledge therefore does not appear to be the primary educational deficiency.

A more important finding was the discrepancy between knowledge and confidence. Although 57.7% rated their overall knowledge as good or excellent, only 3.8% considered themselves very confident in identifying nerves and relevant anatomical structures. Approximately one-third were only slightly confident and 11.5% were not confident. USG-RA requires integration of several competencies: knowledge of anatomy, recognition of sonoanatomy, ultrasound image optimization, needle-probe alignment, hand-eye coordination, continuous needle-tip visualization, and recognition of local anaesthetic spread.[3,4] Knowledge acquired through lectures alone may therefore be insufficient to generate procedural confidence.

ASRA and ESRA recommendations emphasize that UGRA education should incorporate both cognitive and experiential training rather than relying solely on procedural numbers.[5] Competence should develop through structured teaching, supervised practice, feedback, and progressive independence. Contemporary educational approaches similarly emphasize competency-based progression rather than the traditional "see one, do one, teach one" model.[4]

The pattern of training observed in our respondents is particularly relevant. Departmental teaching was reported by 61.5%, whereas only 3.8% had received training through a formal course or workshop. Informal or self-directed learning accounted for another 26.9%. Helwani et al., in their survey of US anaesthesia residency programmes, found extensive incorporation of ultrasound into regional anaesthesia teaching but also identified lack of training and equipment accessibility among barriers to implementation.[6] Our findings suggest that equipment availability is less problematic locally; the greater need is structured training and supervision.

The frequency of clinical utilization was relatively high, with **76.9% performing more than five ultrasound-guided blocks per month**. Only 3.8% reported never using ultrasound. Clinical exposure alone, however, should not be equated with competence. Residents may repeatedly perform components of procedures without achieving mastery if opportunities for deliberate practice and high-quality feedback are limited. Competency-based curricula are therefore preferable to purely volume-based approaches.[3,8]

Lack of adequate training or supervision was reported by 53.8% as the major barrier. Lack of confidence and technical skills was the second most common barrier at 30.8%. Together, these categories accounted for more than four-fifths of responses, indicating that the dominant barriers were educational rather than technological. Similar observations have been reported elsewhere. Wilson et al. identified considerable variability in USG-RA education and highlighted faculty training as a major barrier to implementation.[7] Point-of-care ultrasound surveys among anaesthesia trainees have likewise demonstrated variation in educational organization and access to dedicated teaching.[9]

The present findings also offer a practical solution because residents clearly indicated their preferred educational strategy. **Regular supervised clinical training was selected by 57.7%, and hands-on workshops by 34.6%**. No respondent selected online/video-based education as the preferred primary

approach. This reinforces the procedural nature of USG-RA: residents want direct practice, immediate feedback, and expert supervision.

Simulation may complement bedside education. Udani et al. emphasized the usefulness of simulation for developing cognitive and psychomotor UGRA skills.[3] More recent Canadian data have demonstrated substantial use of live-model scanning and phantom-based training, although barriers including faculty availability and funding remain.[10] Simulation provides an environment in which residents can repeatedly practise image acquisition, probe manipulation, needle visualization, and coordination without exposing patients to unnecessary procedural risk.

Workshop-based training also has evidence supporting its educational utility. Structured anatomy and ultrasonography workshops incorporating didactics, scanning, and anatomical learning can improve residents' knowledge and confidence.[1] Similarly, simulation-based UGRA courses have been associated with subsequent increases in ultrasound-guided block utilization among practising anaesthesiologists.[7] These findings support a blended training programme consisting of foundational teaching, hands-on simulation, supervised patient procedures, and objective competency assessment.

A particularly encouraging observation was that **96.2% of residents definitely wanted additional training**, with the remaining respondent also indicating probable interest. There was therefore essentially universal willingness to improve USG-RA competency. This creates an opportunity for departments to establish structured longitudinal curricula rather than isolated teaching sessions.

A feasible departmental curriculum could begin with ultrasound physics, machine controls, image optimization and sonoanatomy, followed by scanning sessions on volunteers or models. Needle visualization could then be practised using phantoms before residents progress to supervised blocks in patients. Logbooks and competency checklists could document progression. Recent consensus work has also sought to define core USG-RA techniques that should form part of standardized resident education.[8]

Conclusion

Anaesthesia residents demonstrated good overall awareness and frequent clinical exposure to ultrasound-guided regional anaesthesia, with most respondents correctly understanding the major advantage of ultrasound guidance and appropriate probe selection. However, procedural confidence remained substantially lower than basic theoretical knowledge. Lack of adequate training and supervision was the principal barrier, rather than lack of ultrasound equipment.

The near-universal demand for additional training indicates a strong educational opportunity. A structured competency-based programme incorporating regular supervised clinical practice, hands-on workshops, simulation, deliberate practice, and objective assessment should be integrated into anaesthesia residency training. Such an approach may help bridge the gap between knowledge and practical confidence and promote safer and more consistent application of ultrasound-guided regional anaesthesia.

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