RESEARCH PAPER

Impact of Preoperative Anxiety on Ultrasound-Guided Brachial Plexus Block Success: Midazolam versus Structured Counseling

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ABSTRACT

Background: Preoperative anxiety is a frequent challenge in regional anaesthesia, potentially compromising procedural success through physiological stress and behavioral interference. This study compared the clinical efficacy of pharmacological anxiolysis (midazolam) versus non-pharmacological structured counseling in patients undergoing ultrasound-guided brachial plexus blocks. Methods: In this prospective, randomized, triple-blind trial, 90 patients (ASA I–II) scheduled for upper limb surgery were randomized to receive either structured preoperative counseling (Group C) or intravenous midazolam (Group M). Baseline anxiety was assessed using the Hamilton Anxiety Rating Scale (HAM-A). Outcomes measured included block success (avoidance of general anaesthesia), sensory and motor block characteristics (onset and duration), and patient comfort levels. Results: Baseline demographics and hemodynamics were comparable between groups. No significant differences were found in sensory onset (20.11±7.56 vs. 19.43±8.29 min; p=0.687) or motor onset (31.44±11.56 vs. 31.11±12.65 min; p=0.896). Block success rates were statistically similar (86.7% in Group C vs. 91.1% in Group M; p=0.736). However, Group M reported significantly higher subjective comfort (p=0.025). Across both groups, a strong correlation existed between anxiety severity and outcome; patients with moderate-to-severe anxiety exhibited an 80% failure rate compared to <6% in those with normal-to-mild scores (p<0.001). Conclusion: While midazolam provides superior patient comfort, it does not improve the technical success or pharmacodynamics of brachial plexus blocks compared to counseling. Preoperative anxiety is a potent independent predictor of block failure, particularly at moderate-to-severe levels, necessitating targeted psychological screening in regional anaesthesia.

Keywords: Anaesthesia, Brachial Plexus Block, Anxiety, Midazolam, Ultrasonography, Preoperative Care

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INTRODUCTION

Preoperative anxiety is a pervasive challenge in surgical care, triggered by fears of the unknown, procedural pain, and loss of autonomy. These stressors activate the hypothalamic-pituitary-adrenal (HPA) axis, inducing a neuroinflammatory cascade and sympathetic overdrive that can lead to hemodynamic instability, increased analgesic requirements, and prolonged recovery. [1] In regional anaesthesia specifically ultrasound-guided brachial plexus blocks for upper limb surgeries—anxiety poses unique technical risks. Patient agitation and muscle tension can degrade sonographic resolution and displace neural targets by up to 2-5 mm, potentially compromising block precision and success. [2,3]

While ultrasound guidance has revolutionized regional anaesthesia by allowing real-time visualization of the "grape-like" supraclavicular cluster or infraclavicular cords, it does not eliminate the psychological burden of remaining awake during a procedure. [4] Consequently, accurate preoperative assessment is vital. While the State-Trait Anxiety Inventory (STAI) is the traditional gold standard, the Amsterdam Preoperative Anxiety and Information Scale (APAIS) and the Hamilton Anxiety Rating Scale (HAM-A) have emerged as practical, validated tools for rapid bedside evaluation of psychic and somatic anxiety domains.[5,6]

Management strategies are currently divided into pharmacological and non-pharmacological modalities. Midazolam, a short-acting benzodiazepine, remains the pharmacological cornerstone due to its rapid onset and potent α2-GABA_A receptor agonism. However, its use requires a "delicate equilibrium"; while it provides superior anxiolysis and anterograde amnesia, over-sedation risks respiratory depression and reduced patient cooperation during nerve localization.[7,8] Conversely, structured preoperative counseling—incorporating sensory expectations and procedural demystification—offers a side-effect-free alternative. Education has been shown to lower subjective anxiety scores, yet its impact on objective clinical endpoints remains under-researched. [9]

Anxiety has also been shown to modulate pain perception through central sensitization and enhanced cortical anticipation of nociceptive stimuli. Elevated catecholamine levels associated with psychological distress may increase skeletal muscle tone, impair

patient cooperation, and alter procedural tolerance during regional anaesthesia. In awake patients undergoing brachial plexus blockade, these responses may interfere with optimal probe positioning and needle visualization, thereby influencing the accuracy and effectiveness of the block. Although advances in ultrasound guidance have significantly improved block success rates, psychological factors continue to represent an underappreciated determinant of procedural efficacy.[10]

In developing healthcare settings, non-pharmacological approaches such as structured counseling are particularly attractive because they are inexpensive, safe, and easily reproducible. However, evidence comparing counseling with pharmacological anxiolysis in terms of objective anaesthetic outcomes remains limited. Most existing studies emphasize perioperative anxiety scores or patient satisfaction rather than clinically meaningful outcomes such as block success, onset characteristics, and conversion to general anaesthesia. Therefore, a direct comparison between these strategies is necessary to guide evidence-based perioperative anxiety management.[11]

Despite the established link between psychological state and perioperative physiology, existing literature focuses heavily on subjective scores rather than tangible anaesthetic outcomes. There is a critical paucity of research directly comparing the efficacy of midazolam versus structured counseling in optimizing ultrasound-guided block success, supplemental sedation requirements, or conversion rates to general anaesthesia. [12] The present study evaluated the comparative effects of structured counseling and pharmacological anxiolysis (midazolam) on the quality of ultrasound-guided brachial plexus blocks. Additionally, it examines how preoperative anxiety severity impacts procedural success and block characteristics.

MATERIALS AND METHODS

Study Design and Ethics

This prospective, randomized controlled trial was conducted at Anaesthesia Department at tertiary healthcare Institute. Following Institutional Ethics Committee approval (SGRD/IEC/2024-321) and informed consent in the patients' vernacular language and 90 patients were recruited and scheduled for elective upper limb surgery. The trial adhered strictly to the principles of the Declaration of Helsinki and was formally registered with the Clinical Trials Registry (CTRI/2024/11/076511).

Participants and Eligibility

Eligible participants included adults aged 18-65 years, ASA physical status I or II. Exclusion criteria comprised localized skin infection, coagulopathy, pre-existing neuropathy, pregnancy, hypersensitivity to study drugs, psychiatric illness, or current use of sedative-hypnotics.

Sample size estimation was carried out using OpenEpi software, considering an expected 25% difference in patient comfort and procedural success between the two groups, with a study power of 80% and confidence level of 95%. The calculated minimum sample size was 40 patients in each group. To account for possible dropouts, 45 patients were included in each group.

Preoperative Assessment and Randomization

All patients underwent a detailed pre-anaesthetic evaluation 24 hours before surgery. Anxiety levels were assessed using the Hamilton Anxiety Rating Scale (HAM-A), with scores categorized as normal (≤17), mild to moderate (18–24), moderate to severe (25–30), and severe (>30).

Patients were randomly allocated in a 1:1 ratio into two groups using a computer-generated randomization sequence placed in sealed opaque envelopes. Group allocation was performed by a consultant supervisor who was not involved in block administration or data collection, thereby maintaining triple blinding of the patient, anaesthesiologist, and observer.

Group I (C): Patients received structured preoperative counseling during the pre-anaesthetic visit, including explanation of the procedure and expected sensory experiences during the block.

Group II (M): Patients received intravenous midazolam (0.015–0.05 mg/kg) 10 minutes before administration of the block.

Procedure and Interventions

Standard monitoring, including non-invasive blood pressure (NIBP), electrocardiography (ECG), and pulse oximetry (SpO_2), was instituted in all patients. Ultrasound-guided brachial plexus block was performed by an experienced anaesthesiologist using 20–30 mL of 0.5% levobupivacaine.

Outcome Measures

All procedures were carried out under strict aseptic precautions using a high-frequency linear ultrasound probe (6–13 MHz). Needle advancement was performed with the in-plane approach, and appropriate spread of local anaesthetic around the neural structures was confirmed under ultrasound guidance before completion of injection. The primary outcome was assessment of block performance and procedural success.

Sensory Block: Assessed every 5 minutes using the Hollmen Scale (grades 1–4). A score of ≥3 in the radial, median, and ulnar nerve territories was considered adequate for surgery.

Motor Block: Evaluated using the Bromage Scale (grades 0–2).

Block Failure: Defined as inadequate anaesthesia necessitating conversion to general anaesthesia.

Duration of Analgesia: Calculated from the time of block administration to the first request for rescue analgesia (intravenous diclofenac 75 mg).

Statistical Analysis

Data analysis was performed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using the independent sample t-test. Categorical variables were analysed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

The demographic and clinical profiles of both cohorts were well-balanced, demonstrating no statistically significant differences across age ($p=0.601$), sex distribution ($p=0.671$), or ASA physical status ($p=0.073$). Baseline physiological parameters, including heart rate, mean arterial pressure, and oxygen saturation, remained remarkably consistent between the counseling and midazolam groups ($p>0.05$). This high degree of intergroup homogeneity at baseline ensures that any subsequent variations in block performance or patient outcomes can be attributed to the interventions studied rather than confounding physiological or demographic variables (Table 1).

Baseline Demographic and Clinico-Physiological Characteristics

Variable	Group I (Counseling) (n=45)	Group II (midazolam) (n=45)	t / χ2	p-value
Age (years), Mean ± SD	43.31±14.98	41.67±14.78	0.524	0.601
Sex (Male/Female), n (%)	26(57.8) ±19 (42.2)	24(53.3)/21 (46.7)	0.180	0.671
ASA Grade (I/II), n (%)	26(57.8) /19 (42.2)	34(75.6)/11 (24.4)	3.214	0.073
Preoperative Vitals				
Heart Rate (bpm)	79.82±11.93	83.69±10.85	-1.608	0.111
Systolic BP (mmHg)	124.36±14.77	122.80±18.06	0.447	0.656
Diastolic BP (mmHg)	78.27±9.71	77.93±11.26	0.150	0.881
Mean Arterial Pressure	93.63±10.70	92.89±12.86	0.297	0.767
SpO2 (%)	99.73±0.86	99.62±0.72	0.664	0.508

Analysis of procedural outcomes revealed that both pharmacological and non-pharmacological anxiolysis yielded comparable results regarding the technical execution of the brachial plexus block (Table 2). There were no statistically significant differences in sensory or motor onset times, nor in the total duration of the blockade ($p>0.05$), suggesting that neither intervention interferes with the pharmacodynamics of the local anaesthetic. While surgical outcomes including conversion rates to general anaesthesia and total operative time remained similar between groups, a significant disparity was observed in the subjective perioperative experience. Specifically, patients in the midazolam group reported a significantly higher incidence of being comfortable or very comfortable during the procedure compared to the counseling group ($p=0.025$), indicating that while counseling is effective for technical success, midazolam provides superior subjective patient comfort.

Comparison of Procedural Performance and Anaesthetic Quality

Parameter	Group I (n=45)	Group II (n=45)	Statistics	p-value
Block Onset (min)				
Sensory Onset	20.11±7.56	19.43±8.29	t=0.405	0.687
Motor Onset	31.44±11.56	31.11±12.65	t=0.130	0.896
Block Duration (hours)				
Sensory Duration	9.40±2.44	9.31±2.43	t=0.173	0.863
Motor Duration	6.18±1.74	6.40±1.51	t=-0.647	0.519
Quality of Block, n (%)				
Grade 4 Sensory (Hollmen)	28 (62.2)	32 (71.1)	—	0.724
Grade 2 Motor (Bromage)	36 (80.0)	34 (75.6)	—	0.800
Dermatome Sparing (Present)	10 (22.2)	9 (20.0)	X2=0.067	0.796
Patient Comfort, n (%)				
Comfortable/ Very Comfortable	32 (71.1)	38 (84.4)	—	0.025
Surgical Outcomes				
Conversion to GA, n (%)	6 (13.3)	4 (8.9)	X2=0.123	0.736
Duration of Surgery (min)	146.67±48.8	125.67±48.1	t=2.056	0.053

A highly significant correlation was observed between baseline psychological distress and the technical success of the regional blockade ($p<0.001$). Patients presenting with normal to mild anxiety levels (HAM-A ≤ 24) demonstrated an overwhelming success rate exceeding 94%, whereas the incidence of block failure escalated sharply as anxiety severity increased. Specifically, patients categorized with moderate-to-severe anxiety exhibited a failure rate of approximately 80%, with the only case of severe anxiety resulting in total failure. These data suggest that preoperative anxiety serves as a potent independent predictor of regional anaesthesia outcomes, where heightened emotional states likely correlate with technical difficulties or reduced pain thresholds during nerve localization.

The Impact of Preoperative Anxiety (HAM-A) on Block Success

Pre-op HAM-A Category	Success (n=80)	Failure (n=10)	Total (n=90)	p-value
Normal (0-17)	61 (98.4%)	1 (1.6%)	62	<0.001
Mild (18-24)	17 (94.4%)	1 (5.6%)	18	
Moderate (25-30)	2 (22.2%)	7 (77.8%)	9	
Severe (>30)	0 (0%)	1 (100%)	1	

Patients with elevated HAM-A scores demonstrated significantly higher rates of incomplete sensory blockade, procedural discomfort, and conversion to general anaesthesia. The trend suggested a graded deterioration in block reliability with increasing anxiety severity, indicating that psychological distress may independently influence clinical effectiveness despite technically adequate ultrasound guidance.

DISCUSSION

The present study demonstrates that while pharmacological anxiolysis significantly enhances the subjective patient experience, it does not fundamentally alter the technical efficacy or pharmacodynamics of ultrasound-guided brachial plexus blocks. We observed no significant difference in conversion rates to general anaesthesia between the midazolam (8.9%) and counseling groups (13.3%; $p=0.736$), suggesting that the structural success of regional anaesthesia is primarily governed by anatomical and technical precision rather than the patient's sedative state.

Our findings reinforce the consensus that block success depends on optimal needle-tip localization and circumferential local anaesthetic spread.[1,3] The comparable onset times for sensory and motor blockade across both groups ($p>0.05$) indicate that midazolam acts centrally without modulating peripheral nerve conduction or the pharmacokinetic profile of levobupivacaine. This aligns with observations by Kumar et al.[13], who noted that benzodiazepines, unlike alpha-2 agonists, lack peripheral synergistic effects on nerve blocks.

A pivotal finding, however, is the potent association between baseline anxiety severity and block failure ($p=0.001$). The concentration of failures within the moderate-to-severe anxiety subgroups suggests that heightened psychological distress serves as a catalyst for "functional" block failure. This phenomenon is likely multifactorial; anxious patients often exhibit increased muscle tension and micro-movements that can displace the needle-target interface by 2–5 mm, compromising drug deposition.[5,6] Furthermore, anxiety-induced hyperalgesia may lower nociceptive thresholds, causing patients to perceive minor pressure sensations as sharp pain, thereby necessitating conversion to general anaesthesia despite a technically "adequate" block.[4,8]

While midazolam provided superior procedural comfort ($p=0.025$), it did not compensate for the technical challenges posed by high-baseline anxiety. This suggests a graded relationship where mild anxiety is clinically negligible, but moderate-to-severe distress creates a physiological and behavioral environment prone to block inadequacy. These results suggest that clinicians should move beyond "blanket" sedation and instead utilize validated tools like the HAM-A scale to identify high-risk patients who may require intensive, multimodal psychological and pharmacological preparation.[14] Therefore, Preoperative anxiety is a significant independent predictor of regional anaesthesia failure, mediated through behavioural interference and altered pain perception rather than altered local anaesthetic action. Addressing the psychological state particularly in the moderate-to-severe spectrum is essential to bridging the gap between technical success and clinical efficacy in regional anaesthesia.

The findings of the present study are consistent with previous investigations demonstrating the influence of psychological distress on perioperative outcomes. Fuzier et al.[15] reported that anxiety independently increased the likelihood of axillary brachial plexus block failure, emphasizing the role of patient cooperation and behavioral responses during regional anaesthesia. Similarly, Yılmaz et al.[14] observed that elevated anxiety levels adversely affected sensory and motor block quality in spinal anaesthesia. These observations collectively support the hypothesis that psychological stress alters both subjective pain perception and procedural tolerance.

Anxiety-induced sympathetic activation may contribute to regional anaesthetic failure through multiple physiological mechanisms. Increased catecholamine release can heighten skeletal muscle tension, reduce patient immobility, and increase sensitivity to procedural discomfort. Moreover, activation of central pain pathways may lower nociceptive thresholds and amplify pain anticipation, resulting in exaggerated responses to otherwise tolerable surgical stimuli. Consequently, patients may perceive inadequate anaesthesia despite objectively satisfactory neural blockade.[16]

Structured counseling demonstrated efficacy comparable to pharmacological anxiolysis regarding technical block outcomes. This finding is clinically important because counseling avoids sedation-related adverse effects such as respiratory depression, excessive drowsiness, and impaired communication during nerve localization. In resource-limited settings, counseling may therefore represent a practical and cost-effective adjunct for perioperative anxiety management.[17]

Although midazolam improved subjective comfort, its inability to significantly improve block success suggests that anxiolysis alone cannot overcome technical or neurobehavioral contributors to regional anaesthetic failure. This reinforces the concept that perioperative sedation should complement rather than replace effective patient communication and psychological preparation.[18]

LIMITATIONS

The present study has certain limitations. First, the sample size was relatively modest and conducted at a single tertiary care center, which may limit generalizability. Second, postoperative patient satisfaction and long-term psychological outcomes were not assessed. Third, HAM-A scoring was performed only preoperatively, and dynamic perioperative anxiety changes were not evaluated. Finally, serum biomarkers of stress such as cortisol or catecholamine levels were not measured, which could have provided objective physiological correlation with anxiety severity.

FUTURE DIRECTIONS

Future multicentric studies with larger sample sizes are warranted to validate the relationship between psychological distress and regional anaesthetic efficacy. Research evaluating multimodal interventions integrating counseling, audiovisual education, music therapy, and tailored pharmacological anxiolysis may help optimize patient-centered perioperative care.

CONCLUSION

Preoperative anxiety significantly influences the clinical effectiveness of ultrasound-guided brachial plexus blockade. While midazolam enhances subjective patient comfort, it does not improve technical success or block pharmacodynamics compared with structured counseling. Moderate-to-severe anxiety emerged as a major predictor of block failure, underscoring the need for routine psychological assessment before regional anaesthesia. Incorporating targeted anxiolytic strategies into perioperative protocols may improve both patient experience and procedural reliability.

CONFLICTS OF INTEREST

The authors declare that there are no competing interests, financial or otherwise, that could be perceived as influencing the results or interpretation of this study.

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