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Frequency of Ultrasound Guidance for Vascular Access Placement and Nerve Blocks by Anesthesiologists

Fahad¹, Kashif Naeem¹, Mahendar Wanwari¹, Adeel ur Rehman¹, Tarique Aziz¹, Asif Hassan¹¹Department of Anesthesia, Indus Hospital, Karachi, Sindh, Pakistan.

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Corresponding Author: Adeel ur Rehman
Department of Anesthesia, Indus Hospital,
Karachi, Sindh, Pakistan.
Email: adeelurrehman.1979@gmail.com

Declaration

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ABSTRACT

Objective: To determine the frequency at which anesthesiologists utilize ultrasound guidance for the placement of vascular access and nerve blocks.

Background: Within the field of anesthesia, anesthesiologists perform vital procedures referred to as perioperative vascular access placement and nerve blocks. Vascular access is crucial for the delivery of fluids and medications required for surgical procedures, whereas nerve blocks offer precise pain control with little systemic effects. **Method:** A cross-sectional study conducted in tertiary hospitals in Karachi. The study had a duration of six months, commencing on May 29 and concluding on November 29, 2022, following the approval of the Institutional Review Board. The study was conducted with the cooperation of anesthesiology residents and practicing anesthesiologists. The principal researcher sent an email to the anesthesiologists. If there was no response, an additional SMS was sent. If there was no answer, we reached out to the next eligible candidate. Participants who willingly choose to take part answered an online questionnaire. The research proforma was filled out online.

Findings: The study comprised 193 participants, which further comprises 47.7% of FCPS consultants, 22.8% of MCPS consultants, 15.5% of FCPS trainees, and 14.0% of MCPS trainees. Ultrasonography guidance was utilized by 49.7% of individuals with 2-13 years of experience and 25.4% of individuals with more than 13 years of experience. The disparity may lack statistical significance.

Conclusion: The primary obstacles were the absence of ultrasound equipment, apprehensions over inadequate training, and a propensity to rely on clinical judgement rather than utilizing ultrasonography.

INTRODUCTION

Ultrasound is a secure and portable device that is relatively affordable, requires a moderate level of expertise to become proficient in its use, and offers a readily available method for obtaining images. This imaging modality has made significant progress in terms of innovation and continues to see ongoing expansion. Enhancements have been made in terms of improved visual clarity, resolution, portability, and equipment size [1]. These qualities render it a very useful monitoring and diagnostic tool. Anesthesiologists encounter

several new situations and could benefit from a technology that offers real-time imaging and monitoring capabilities [2]. Ultrasonography enables the detection of brain structures and adjacent anatomical structures, as well as the identification of anatomical variations. The objective of this study is to assess the current usage of ultrasound by anesthesiologists and ascertain their inclination towards utilizing this tool as an aid in their procedures [3].



ultrasonography guidance is essential in the field of anesthesia to improve patient safety, comfort, and the effectiveness of procedures. It also helps in assessing patients, including the use of gastric and lung ultrasonography [4]. Anesthesiologists frequently meet emergencies and heavily depend on accurate and efficient diagnostic technologies to properly manage these situations. Ultrasound (US) has become a widely accessible and reliable imaging technique. To achieve optimal ultrasound images and effectively interpret them, it is imperative to receive appropriate knowledge and training, as is required for other diagnostic devices [5]. Proficiency in needle visualization is a fundamental skill necessary for the successful execution of ultrasound-guided therapies [6]. Anesthesiology now utilizes ultrasound (US) for a variety of purposes, with the possibility for many more uses in the future. These encompass regional anesthesia, spinal cord nerve procedures, chronic pain management, blood vessel access, airway evaluation, lung examination, stomach assessment, ultrasound-based nervous system monitoring, focused transthoracic echo (TTE) procedures, trans esophageal echo (TEE) procedures, and the use of Doppler technology. The introduction of ultrasound guidance in anesthesia has significantly reduced the rates of failure and iatrogenic complications associated with the placement of central venous catheters (CVC) and regional blocks [79]. Ultrasound guidance has shown to be a valuable and effective technique for conducting peripheral nerve blocks. In 2018, doctors used a combination of ultrasound-guided femoral and sciatic nerve blocks in patients at high risk for lower limb amputation. This approach provided effective pain relief, and the surgeries were performed without any complications while the patients maintained stable blood pressure and heart rate [10]. Compared to landmark based techniques, it reduces the time required to conduct the block, the amount of local anesthetics used, and the risk of intravascular injection [11].

The utilization of ultrasound guidance should not be regarded as a substitute for, but rather as a supplement to a thorough comprehension of anatomy. Several clinical practice guidelines, such as those from the National Institute for Health and Care Excellence (NICE) in the UK and the

Canadian Anesthesiologists' Society, strongly recommend the regular use of ultrasound guidance during invasive procedures. These guidelines also emphasize the need for anesthesiologists to have access to ultrasound equipment. Notwithstanding these suggestions, anesthesiologists have not traditionally embraced the regular utilization of US advice [12]. A survey was conducted in Ontario, Canada, targeting 266 anesthesiologists currently employed in southern Ontario. The participants were given a questionnaire to complete. A total of 66 complete questionnaires were collected, resulting in a response rate of 25%. Regarding institutional characteristics, the majority (>80%) reported that the utilization of ultrasound (US) was a widespread practice for the insertion of central venous catheters (CVC) and regional blocks in their hospitals or institutes. The findings indicated that the utilization of ultrasound (US) for the placement of arterial lines was a prevalent procedure in over 50% of the participating facilities. Nevertheless, a significant majority of participants indicated that their access to US machines was restricted. Specifically, 9% of participants did not have access to any US machine, while 27% had access to only one machine. Additionally, 24% had access to two machines, and 17% had access to three machines. 9% of the participants did not have access to US equipment in their institutes. Just half of the participants had ready access to a US machine whenever it was required. Despite the clear benefits of using ultrasonography (US) for regional anesthesia, more than half of the participants did not consistently use US for doing regional blocks. A minuscule proportion of the participants (18%) indicated that they never employ ultrasound (US) for regional nerve blocks. Only a few (15%) of the individuals regularly or rarely used ultrasound (US) for neuraxial anesthesia. No participant often used US for neuraxial blocks. Thirteen percent of the participants indicated that they rarely or never utilized the United States (US) for evaluating cardiac and pulmonary issues. Obstacles to the utilization of ultrasound (US) in the institute were determined to be the absence or limited availability of US machines, inadequate training on US usage, a perceived lack of necessity for US, insufficient support from clinical leadership to use US, time limitations in the operating theatre that impeded the use of US, and the belief that US was unnecessary

for the safe and effective insertion of central line catheters or arterial lines.

The utilization of ultrasound guidance in anesthesiology has proven to be a valuable asset, significantly improving the accuracy and safety of procedures including vascular access placement and nerve blocks. Although the advantages of it are well-known, the frequency and method of its utilization can significantly change among various regions and healthcare environments. In Pakistan, there is a lack of data regarding the frequency at which anesthesiologists use ultrasound guidance for these treatments. The aim of this study is to comprehensively evaluate the prevalence of ultrasound-guided vascular access placements and nerve blocks carried out by anesthesiologists in Pakistan. By addressing current knowledge gaps, this will enhance clinical procedures and raise the quality of patient care.

METHODS

An investigation conducted using a cross-sectional study design. Karachi's tertiary care hospitals. The study was conducted between May 28, 2022, and November 27, 2022.

The sample size was determined using the Open-Epi software, based on the following assumptions. The confidence interval is set at 95%. Desired accuracy = 7% Based on the ultrasound practices of anesthesiologists:

S. No	US practices of anesthesiologist for the following procedure (14)	Sample Size
1	Proportion of anesthesiologist who always and frequently use US for CVP (82)	116
2	Proportion of anesthesiologist who always use US for performing regional block (57)	193
3	Proportion of anesthesiologist who frequently use US for A-Line (24)	143
4	Proportion of anesthesiologist who frequently use US for assessing heart and lungs (11)	77

Required sample size =193

There were approximately 200 to 250 anaesthesiologists in Karachi. We included only those fulfilling the eligibility criteria.

Following table showed approximate distribution of residents and consultants/specialists in the hospitals included in this study. Please note that the numbers were approximate and may differ.

S. No	Hospital	Total anaesthesiology residents (2 nd , 3 rd and 4 th) and Consultants/Specialists)	Sample Size Allocation
1.	AKUH	55	51
2.	Indus Hospital	31	29
3.	Civil Hospital	29	27
4.	SIUT	22	20
5.	Abbasi Shaheed	22	20
6.	Ziauddin Hospital	12	12
7.	PNS Shifa	11	11
8.	LNH	24	23
	TOTAL	206	193

The sample technique used was non-probability, namely consecutive sampling. The inclusion criteria comprised of consultants and specialists who were engaged at a tertiary and secondary care hospital. Residents in their second, third, and final year of the FCPS and MCPS program, irrespective of gender. The age range is from 23 to 75 years. The exclusion criteria encompassed anesthesiologists who refused to provide consent. The study employed a cross-sectional design and encompassed both active anesthesiologists and anesthesiology residents. After receiving permission for the survey, the participants proceeded to answer the questionnaire based on their individual experiences. The questions assessed the current perioperative practice of using ultrasonography to position vascular access devices, such as arterial lines, central venous pressure (CVP) lines, and for regional blocks. A study was conducted via a meticulously designed questionnaire that involved acquiring participant consent. The purpose of the questionnaire was to collect the viewpoints of anesthesiologists regarding the challenges they face while utilizing ultrasound (US).

A study was done following the clearance of the Indus Hospital's Institutional Review Board (IRB). Before commencing the research, the primary investigator (PI) individually reached out to anesthesiologists who satisfied the inclusion criteria, largely through email communication. If the anesthesiologist who fulfilled the requirements did not respond to the email, they were later

contacted a second time by a text message. If no response was received, the next suitable candidate was contacted. Anesthesiologists who met the eligibility criteria were provided with a clear explanation of the objective of the research survey, and they responded positively. Authorization was obtained. Participants who expressed consent were supplied with an online self-administered questionnaire to complete. The anesthesiologists targeted were individuals who were currently working at the mentioned facilities. The data was entered and analyzed using SPSS version 26.0. The mean $\pm$ standard deviation (SD) was determined for all quantitative variables, including age, years of experience, number of operation rooms, and number of ultrasound (US) equipment, at your institute. Frequency and percentage were computed for all categorical variables, such as gender, type of institute, highest qualification, availability of US machine when required, utilization of US for central line placement, regional block, arterial line placement, spinal and epidural block, and assessment of lung and heart. In addition, we calculated the frequency and percentage to determine the appropriateness of training in the United States, as well as the barriers related to the unavailability or insufficient number of ultrasound machines and the absence of training in ultrasound-guided care.

The impact modifier was managed by stratifying the data according to age group, gender, qualification, and years of experience. Following the process of stratification, the Chi-square test was employed in appropriate cases. A P-value below 0.05 was considered to have statistical significance.

RESULTS

This study enrolled a cohort of 193 patients to achieve two main objectives: firstly, to determine the frequency at which anesthesiologists use ultrasound (US) guidance for vascular access placement and nerve blocks during surgery; and secondly, to identify the obstacles that prevent anesthesiologists from adopting the use of ultrasound. The data were thoroughly examined to shed light on the present practices and issues related to the. The mean age was 39.80 ± 15.96 with a standard deviation. The mean $\pm$ standard deviation for years of experience was 13.05 ± 11.32 ,

with a confidence interval of 11.44 to 14.66, as seen in table 1.

The mean $\pm$ standard deviation for the number of operating rooms in your institute was 5.93 ± 2.13 . The mean $\pm$ standard deviation for the number of ultrasound machines in your institute was 2.12 ± 1.71 as displayed in table 1.

Regarding the gender distribution, 135 individuals (69.9%) were identified as male, whereas 58 individuals (30.1%) were identified as female. According to the distribution of institute types, 127 (65.8%) were classified as private institutes, whereas 66 (34.2%) were categorized as government institutes. The surveyed persons can be categorized as follows: 47.7% are FCPS consultants, 22.8% are MCPS consultants, 15.5% are in their FCPS trainee year, and 14.0% are in their MCPS trainee year, as indicated in table 2. Among the participants, 69.4% indicated that the ultrasound (U/S) machine is accessible when required, whereas 30.6% claimed that it is unavailable when needed, as demonstrated in table 2.

Among the entire group of participants, 78.2% said that they utilize ultrasound (U/S) for the installation of central lines, whereas 7.8% explicitly mentioned that they do not employ ultrasound for this specific reason. In table 2, 14.0% of respondents expressed uncertainty or lack of knowledge on the use of ultrasound for central line placement. Out of the participants, 81.9% indicated that they utilize ultrasonography (U/S) for regional block, however 13.4% mentioned that they do not employ ultrasound for this specific reason. In addition, 4.7% of respondents expressed uncertainty or lack of knowledge regarding the use of ultrasound for regional block, as depicted in table 2. Out of the participants, 60.1% indicated that they utilize ultrasonography (U/S) for placing arterial lines, however 27.4% mentioned that they do not employ ultrasound for this specific task. In TABLE 3, it was shown that 12.5% of respondents were uncertain or unaware of whether ultrasonography is utilized for arterial line placement. According to table 2, none of the respondents consistently used ultrasound (U/S) guidance for spinal and epidural block placement. 2.6% reported frequent use, 8.3% reported occasional use, 26.4% reported infrequent use,

58.6% reported never using it, and 4.1% reported using it only when clinically necessary.

Out of the participants, 9.9% stated that they consistently utilize ultrasonography (U/S) advice for evaluating the lungs and heart. The data from table 2 indicates that 12.0% of individuals reported using it regularly, 18.1% reported using it sometimes, 23.3% reported using it seldom, 30.5% reported never using it, and 6.2% reported using it as clinically required. Out of the participants, 20.5% indicated that the lack or inadequacy of ultrasonography (U/S) devices is consistently worrisome. In addition, 13.3% of respondents indicated that it is a common issue, and 24.7% reported that it occurs occasionally. 11.3% of the participants indicated that it happens infrequently, whilst 16.4% stated that it never occurs. Ultimately, 13.8% of respondents stated that the availability of the resource is contingent upon the therapeutic indication, as illustrated in table 2.

Out of the participants, 25.3% consistently reported a lack of training in the utilization of ultrasonography (U/S), whereas 26.5% indicated that it occurs frequently. In addition, 30.6% of respondents stated that it occurs occasionally, 14.0% highlighted that it happens infrequently, 2.6% revealed that it never happens, and 1.0% indicated that it depends on the therapeutic indication, as displayed in table 2.

None of the respondents reported consistently or regularly feeling a lack of necessity in the use of ultrasonography (U/S). However, a small proportion of 2.6% indicated occasional occurrence, while 14.0% reported infrequent occurrence, and 24.4% affirmed that it never occurs. 59.0% of the participants stated that the use of ultrasound is contingent upon the clinical indication, as presented in table 2.

Out of the participants, 20.7% indicated that clinical leadership consistently discourages the use of ultrasonography (U/S), while 24.9% revealed that it often discourages its use. In addition, 32.6% of respondents indicated that clinical leadership occasionally fails to promote it, while 2.6% reported that it seldom happens, and 11.4% claimed that it never occurs. In addition, 7.8% of respondents stated that the decision to utilise ultrasonography is contingent upon the clinical indication, as illustrated in table 2.

The research shows that the use of ultrasonography (U/S) guidance varies among different medical degrees. Among FCPS consultants, 35.8% reported utilizing ultrasound (U/S) guidance. The percentages were lower for other categories, with 17.6% for MCPS consultants, 11.4% for FCPS trainee year, and 10.4% for MCPS trainee year. The statistical analysis showed that the P value was non-significant ($P=0.981$), indicating no significant difference between the groups. This information is presented in Table 4.

The data indicates that those with 2-13 years of experience had a greater rate of using ultrasound (U/S) guidance (49.7%) compared to those with more than 13 years of experience (25.4%). Nevertheless, the disparity found may not possess statistical significance, as indicated by the p-value of 0.554 presented in table 3.

Table 1
Descriptive Statistics

Variable	n	Mean	SD	Maximum	Minimum
Age (years)	193	39.80	15.96	75	25
Experience(years)	193	13.05	11.32	36	2
Number of operating rooms	193	5.93	2.13	9	1
Number of u/s machines	193	2.12	1.71	6	0

Table 2
Frequency of Qualification N=193

Qualification	Frequency	Percentage
FCPS Consultant	92	47.7%
MCPS Consultant	44	22.8%
FCPS Trainee Year	30	15.5%
MCPS Trainee Year	27	14.0%
Availability of u/s machine when needed	Frequency	Percentage
Yes	134	69.4%
No	59	30.6%
Using u/s for central line placement	Frequency	Percentage
Yes	151	78.2%
No	15	7.8%
Don't Know	27	14.0%
Use u/s guidance for spinal & epidural blocks placement	Frequency	Percentage
Always	0	0.0%
Frequently	5	2.6%
Sometimes	16	8.3%

Seldom	51	26.4%
Never	113	58.6%
As Clinically Indicated	8	4.1%
Use u/s guidance for the assessment of lung and heart	Frequency	Percentage
Always	19	9.9%
Frequently	23	12.0%
Sometimes	35	18.1%
Seldom	45	23.3%
Never	59	30.5%
As Clinically Indicated	12	6.2%
Unavailability or enough u/s machines	Frequency	Percentage
Always	40	20.5%
Frequently	26	13.3%
Sometimes	48	24.7%
Seldom	22	11.3%
Never	32	16.4%
As Clinically Indicated	25	13.8%
Lack of training regarding use of u/s	Frequency	Percentage
Always	49	25.3%
Frequently	51	26.5%
Sometimes	59	30.6%
Seldom	27	14.0%
Never	5	2.6%
As Clinically Indicated	2	1.0%
Lack of perceived need in the use of u/s	Frequency	Percentage
Always	0	0.0%
Frequently	0	0.0%
Sometimes	5	2.6%
Seldom	27	14.0%
Never	47	24.4%
As Clinically Indicated	114	59.0%
Clinical leadership not encouraging u/s use	Frequency	Percentage
Always	40	20.7%
Frequently	48	24.9%
Sometimes	63	32.6%
Seldom	5	2.6%
Never	22	11.4%
As clinically indicated	15	7.8%
Using u/s for arterial line placement	Frequency	Percentage
Yes	116	60.1%
No	53	27.4%
Don't Know	24	12.5%

Table 3
Stratification of Qualification/Years of Experience with Ultrasound Guidance N=193

Qualification	Ultrasound guidance		P-value
	Yes	No	
FCPS Consultant	69 (35.8%)	23 (11.9%)	0.981
MCPS Consultant	34 (17.6%)	10 (5.2%)	
FCPS Trainee Year	22 (11.4%)	8 (4.1%)	
MCPS Trainee Year	20 (10.4%)	7 (3.6%)	

Years of experience	Ultrasound guidance		P-value
	Yes	No	
2 – 13	96 (49.7%)	34 (17.6%)	0.554
>13	49 (25.4%)	14 (7.3%)	

DISCUSSION

In the field of contemporary anaesthesia practice, the perioperative period is a crucial phase where careful preparation and execution are essential to guaranteeing patient safety, comfort, and the best possible surgical results [13]. Anaesthesiologists have a crucial role in this phase, using different procedures and interventions to control pain, enable surgical access, and ensure physiological stability.

Anesthesiologists commonly conduct vascular access placement and nerve blocks as essential components of perioperative anaesthesia care [14]. These procedures have different but complimentary objectives in the perioperative care continuum. Vascular access placement entails the insertion of intravenous catheters or central lines to ease the delivery of drugs, fluids, and blood products necessary for maintaining stable blood flow and supporting the proper functioning of key organs during surgical procedures. Moreover, vascular access plays a crucial role in perioperative anaesthesia practice by allowing for the swift administration of life-saving measures during emergency scenarios. It is considered a fundamental aspect of this technique [15].

Nerve blocks involve the precise delivery of local anaesthetic drugs near peripheral nerves to induce regional anaesthesia and pain relief during surgical procedures. Nerve blocks provide excellent pain relief by stopping the transmission of pain signals along specific neural pathways. This strategy minimises the systemic side effects that are commonly associated with standard systemic analgesic methods. Anaesthesiologists use evidence-based guidelines, institutional policies, and their clinical knowledge to choose, perform, and manage vascular access placement and nerve blocks in the perioperative context. This is done to assure the best patient outcomes and procedural effectiveness. These guidelines cover various aspects including patient variables, procedure techniques, equipment selection, drug

administration, monitoring parameters, and post-procedural care. This helps to establish a standardised practice and reduce the risk of problems [16]. Anaesthesiologists maintain the highest levels of patient-centred care and safety during the perioperative journey by following established criteria and utilising advancements in anaesthesia technology and pharmacology. When discussing the installation of vascular access and nerve blocks during the perioperative period by anaesthesiologists in the United States, several important points arise regarding their clinical importance, difficulties, and Repercussions for providing medical treatment to patients.

First and foremost, the significance of placing vascular access cannot be exaggerated throughout the perioperative period. Ensuring prompt and reliable vascular access is crucial for delivering anaesthesia agents, intravenous fluids, blood products, and drugs required to maintain stable blood flow and support the proper functioning of key organs during surgical procedures. However, establishing and sustaining vascular access might be difficult in specific patient populations, such as those with challenging venous access or underlying diseases that make them more prone to vascular problems.

In addition, nerve blocks are essential in managing pain during surgery, providing precise pain relief while minimising the negative effects on the entire body, as opposed to using painkillers that affect the entire system [17]. Nevertheless, the effectiveness of nerve blocks relies on precise identification of anatomical location, correct methodology, and patient-specific factors that affect nerve distribution and sensitivity.

Moreover, the topic covers aspects of patient safety, procedure efficiency, and resource utilisation. It is crucial for anaesthesia practitioners to address strategies for reducing complications related to vascular access placement and nerve blocks, including infection, bleeding, nerve injury, and local anesthetic toxicity.

Out of the total number of anesthesiologists, 145 (75.1%) were seen to use ultrasonography guidance in this investigation. The respondents reported varying levels of availability or sufficiency of ultrasound machines: always (20.5%), frequently (13.3%), sometimes (24.7%), seldom (11.3%), never (16.4%), and clinical

indication (13.8%). In terms of training, the respondents experienced a lack of it as follows: always (25.3%), frequently (26.5%), sometimes (30.6%), seldom (14%), never (2.6%), and clinical indication (1%). Some respondents perceived a lack of need in using ultrasound: always (0%), sometimes (2.6%), frequently (0%), seldom (14%), never (24.4%), and clinical indication (59%). When it came to clinical leadership encouragement for ultrasound use, the responses were as follows: always (20.7%), frequently (24.9%), sometimes (32.6%), seldom (2.6%), never (11.4%), and clinical indication (7.8%). Finally, the respondents' agreement on the importance of ultrasound was as follows: strongly agreed (76.7%), agreed (14.5%), somewhat agreed (7.8%), somewhat disagreed (1%), and disagreed or strongly disagreed (0%). Chui J, et al. conducted a study on the availability and adequacy of ultrasound machines. The results showed that the unavailability or insufficiency of ultrasound machines was reported as follows: always (21%), frequently (14%), sometimes (24%), seldom (11%), never (17%), and clinical indication (14%). Regarding the lack of training, participants reported experiencing it as follows: always (26%), frequently (26%), sometimes (30%), seldom (14%), never (3%), and clinical indication (2%). Participants also reported perceiving a lack of need in the use of ultrasound as follows: always (0%), frequently (0%), sometimes (3%), seldom (14%), never (23%), and clinical indication (61%). In terms of clinical leadership encouragement for the use of ultrasound, participants reported it as follows: always (21%), frequently (23%), sometimes (30%), seldom (5%), never (11%), and clinical indication (11%). Lastly, participants' agreement on the importance of ultrasound was as follows: strongly agreed (76%), agreed (15%), somewhat agreed (8%), somewhat disagreed (2%), and disagreed or strongly disagreed (0%).

Furthermore, continuous research and quality improvement efforts focused on improving procedural techniques, optimising medication selection and dosing, enhancing perioperative monitoring, and standardising practice guidelines are contributing to the advancement of perioperative anaesthesia care and improving patient outcomes.

The conversation about placing vascular access and nerve blocks before surgery emphasises the complex nature of anaesthesia practice. It emphasises the significance of making decisions based on evidence, collaborating across disciplines, and continuously improving quality to enhance safety, effectiveness, and patient satisfaction in the perioperative environment. The limitation of the study may entail a restricted cohort of anesthesiologists, thus impacting the universality of the results. Lack of follow-up data to evaluate the temporal trends in ultrasound utilization and the effects of any treatments.

CONCLUSION

It can be inferred that a substantial majority of anesthesiologists employ ultrasound guidance during the perioperative period for the placement of vascular access and nerve blocks. The primary obstacles encountered were restricted availability of ultrasound machines, apprehensions regarding inadequate training, and a propensity to prioritise clinical judgement over regular utilization of ultrasonography. Enhancing equipment accessibility and training can greatly enhance patient care by promoting consistent and successful utilization of ultrasonography in various procedures, hence overcoming existing restrictions.

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