



## Original Research Article

## A questionnaire-based survey of perioperative utilisation of ultrasound among anaesthesiology residents

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## ABSTRACT

**Background:** Ultrasonography (USG) is a resourceful tool in the perioperative period. A structured training curriculum during residency can enhance the utilisation of USG among residents.

**Aim:** This cross-sectional online survey was conducted to evaluate the utilisation of USG in the perioperative period and to assess the adequacy of current training.

**Materials and Methods:** A questionnaire was formatted consisting of 15 questions. The questionnaire was sent to the participants through email or any electronic mode of communication. This was an electronic survey conducted after obtaining informed consent from the participants.

**Results:** It was found that although the availability of USG has increased, its use in the perioperative period is limited due to various factors such as time constraints. The adequacy of training is significantly different depending on the frequency of training (p-value < 0.01). The majority of the residents (N=82, 81.2%) felt that they needed more training in the utilisation of USG.

**Conclusion:** Integration of a structured training curriculum in USG as a part of anaesthesiology residency can aid in enhancing patient care in the perioperative period.

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## 1. Introduction

The evolution of ultrasound (USG) has revolutionised the medical field with its rapid and accurate diagnosis for effective management especially during emergencies. It is portable and its availability is increasing even in low-resource settings.<sup>1</sup> The role of USG in the perioperative period is rapidly emerging. It is used for various purposes such as vascular access, administration of regional nerve blocks and echocardiographic evaluation of cardiac function.<sup>2</sup> Since anaesthesiologists frequently encounter unanticipated emergencies, USG can be a useful tool at hand, considering its easy accessibility and portability. More emphasis is being placed on including USG in routine clinical practice to improve diagnostic accuracy by

implementing USG as a fifth pillar of clinical examination.<sup>3</sup> The two important steps in the proper utilisation of USG include a clear image acquisition followed by an interpretation of the acquired image. This necessitates a structured training curriculum regarding the principles of ultrasound, a knowledge of its utilisation in the perioperative period and its role in the determination of the treatment plan during residency.

## 2. Materials and Methods

## Study design, settings and participants

A cross-sectional online survey was conducted via Google Forms among anaesthesiologists at various Tertiary care centres in India. All anaesthesiologists who were willing to fill out the forms were included. No prior sample size calculation was done.

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### 2.1. Study procedure

A questionnaire was formatted consisting of 15 questions. The questionnaire was sent to the participants through email or any electronic mode of communication. This was an electronic survey conducted after obtaining informed consent from the participants. The participants were directed to complete the self-reported questionnaire and submit the responses. The survey was conducted over one week. Each participant was allowed to submit one response only. Confidentiality of the records was maintained.

### 2.2. Questionnaire

The questionnaire consisted of 15 questions (Table 1) regarding the designation of the participant, the availability of ultrasound and the utilisation of ultrasound in the perioperative period. It was aimed at evaluating the various indications for which ultrasound was used and also to assess the adequacy of training among anaesthesiology residents pertaining to the perioperative utilisation of ultrasound. The questions were in English and distributed as Google forms with all questions requiring a response mandatorily.

### 2.3. Inclusion criteria

Anaesthesiologists at various tertiary care institutes in India who were willing to submit their responses to the questionnaire were included.

### 2.4. Exclusion criteria

Those who declined the consent for participation were excluded.

### 2.5. Statistical analysis

Data was entered in Microsoft Excel (office 365) software. Data was analysed using an online statistical analysis tool.<sup>4</sup> Fisher's exact test was used. A p value <0.05 was considered statistically significant.

## 3. Results

The google forms were distributed via email or other electronic modes. Out of the 250 forms distributed, 101 responses were recorded with a response rate of 40.4%. The data was collected for one week and the collected data was entered in Microsoft excel for analysis and graphical representation. Most of the participants were junior residents pursuing anaesthesiology residency (N=58, 57.4%) at a tertiary care centre and Senior residents, who completed three years of residency training in anaesthesiology (N=35, 34.7%). USG was available for routine use at almost all institutes (N=100, 99%). More than half the residents (N=66, 65.3%) used USG on a daily basis in the perioperative period for various indications. Less

than half the residents (N=43, 42.6%) received training in utilisation of USG regularly whereas a few residents (N=7, 6.9%) never received any formal training during residency (Figure 1). The utilisation of USG was predominantly for performing intraoperative procedures (N=85, 84.2%) such as venous and arterial cannula or administration of regional nerve blocks, with limited use in the preoperative evaluation (N=10, 9.9%) and postoperative diagnosis and treatment (N=6, 5.9%) (Figure 2). Preoperative evaluation of fluid status for prediction of intraoperative hypotension and to determine the intraoperative fluid requirements was done in specific cases only (N=81, 80.2%) and routinely in all cases by a few (N=3, 3%). The use of USG for preoperative estimation of gastric residual volume (GRV) in emergency cases for prediction of risk of aspiration (N=13, 12.9%) as well as for the assessment of anticipated difficult airway (N=20, 19.8%) was very minimal. Less than half the residents performed Deep vein thrombosis (DVT) screening preoperatively (N=46, 45.5%) in all high-risk cases such as cases of long bone fractures with prolonged immobilisation. Screening echocardiography (ECHO) for preoperative assessment of cardiac function such as evaluation of valvular function and to identify any regional wall motion abnormalities was done by many (N=73, 72.3%). When encountered with multiple failed attempts at spinal or epidural anaesthesia, the majority of the anaesthesiologists (N=86, 85.1%) opted to conduct the case under general anaesthesia rather than attempting central neuraxial blockade under USG guidance (N=15, 14.9%). The majority of the residents (N=86, 85.1%) felt that USG is being underutilised in the perioperative period and everyone felt that USG should be included as a part of the anaesthesiology curriculum during residency. Time was considered as a limiting factor for the underutilisation of USG by many (N=53, 52.5%), but it was not found to be statistically significant (p value = 0.35). Even though USG has been utilised more in recent times, the majority of the residents (N=82, 81.2%) felt that they needed more training (Figure 3).

The adequacy of training is significantly different depending on the frequency of training (p value < 0.01). The residents who have been trained regularly on a daily basis during residency felt that they have been adequately trained in the utilisation of USG in the perioperative period (Table 2). The frequency of usage of USG in the perioperative period had a significant effect on training received (p value < 0.001). More frequent usage of USG for various indications lead to enhanced training during residency (Table 3).

## 4. Discussion

This questionnaire-based survey was conducted to assess the utilisation of USG in the perioperative period. Although the availability of USG has increased in recent times,

**Table 1:** Questionnaire on perioperative utilisation of ultrasound

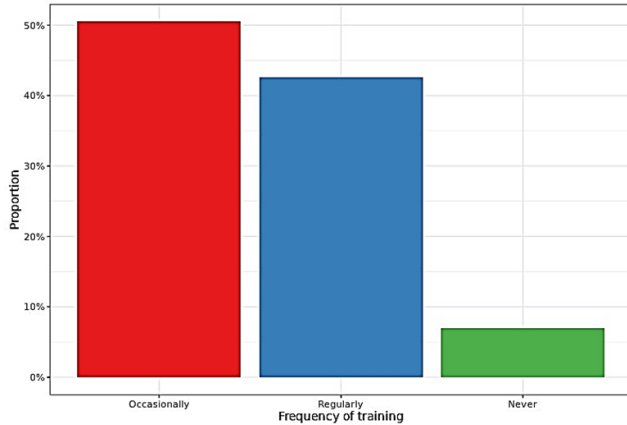
S. No.	Question	Responses
1	What are you currently pursuing?	Post graduate trainee Senior Resident Others
2	Is Ultrasonography available at your place?	Yes No
3	How often do you use USG in the perioperative period?	Frequently/daily Occasionally Never
4	How frequently have you been given training in the utilisation of USG in the perioperative period?	Regularly Occasionally Never
5	Where have you used USG more frequently in the perioperative period?	Preoperative assessment Intraoperative procedures Postoperative diagnosis and treatment
6	Have you evaluated the preoperative fluid status using USG?	Yes, routinely in all cases In specific cases Never
7	Have you assessed Gastric residual volume using USG in patients posted for emergency surgeries?	Yes No
8	Have you used USG for preoperative assessment in an anticipated difficult airway?	Yes No
9	What was your next step when you encountered multiple failed attempts at spinal/epidural?	Converted to general anaesthesia Tried under USG guidance
10	Did you include DVT screening in your preoperative evaluation of patients at high risk?	Yes No
11	Have you performed screening ECHO in any emergency/ Elective cases?	Yes No
12	Do you think USG is underutilised in the perioperative period?	Yes No
13	Do you think USG training should be a part of anaesthesia curriculum?	Yes No
14	Is the use of USG restricted by time?	Yes No
15	Do you feel you have received adequate training for using USG in the perioperative period?	Yes Need more training Not received any training

**Table 2:** Univariable analysis of the adequacy of training depending on the frequency of training by Fisher's exact test

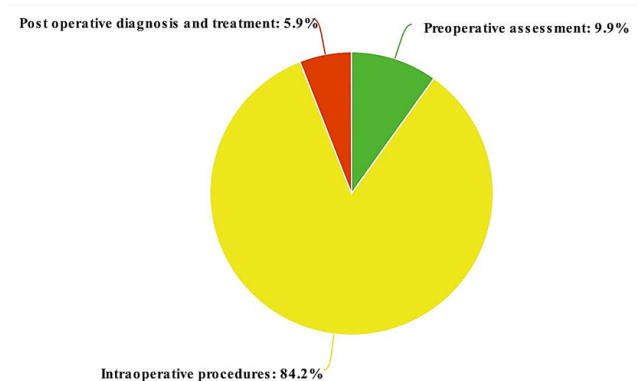
Training adequacy, n	Frequency of training			n	p
	Occasionally (n=51)	Regularly (n= 43)	Never (n= 7)		
Require more training	41 (80%)	38 (88%)	3 (43%)	82	< 0.01
Adequate training	4 (7.8%)	4 (9.3%)	0 (0%)	8	
No training received	6 (12%)	1 (2.3%)	4 (57%)	11	

**Table 3:** Univariable analysis of the frequency of training depending on the frequency of usage Fisher's exact test

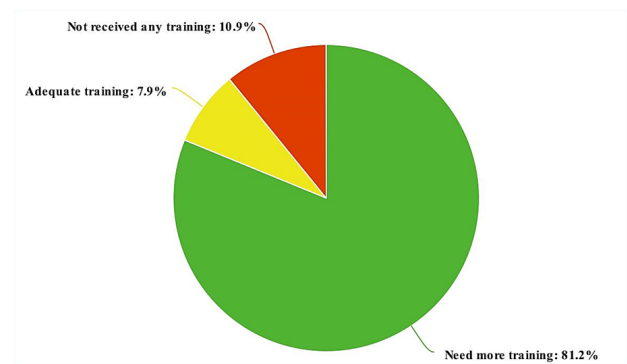
Frequency of training, n	Frequency of usage			n	p
	Frequently (n=66)	Occasionally (n= 34)	Never (n= 1)		
Occasionally	25 (38%)	26 (76%)	0 (0%)	51	< 0.001
Regularly	40 (61%)	3 (8.8%)	0 (0%)	43	
Never	1 (1.5%)	5 (15%)	1 (100%)	7	



**Figure 1:** Bar diagram showing the frequency of formal training received about utilisation of ultrasound



**Figure 2:** Pie chart showing the usage of USG in the perioperative period



**Figure 3:** Pie chart depicting the adequacy of training in USG

integration of USG as a part of the anaesthesiology curriculum during residency is still restricted due to various limiting factors such as time constrain. Though USG can be used for various indications in the perioperative period, it is mainly used for performing intraoperative procedures such as central venous cannulation, arterial cannulation and USG-guided nerve blocks. The usage of USG is limited in preoperative evaluation and postoperative diagnosis when compared to its usage in the intraoperative period.

Ramsingh D et al. assessed the impact of perioperative ultrasound training in anaesthesiology residents and concluded that a whole-body Point of care ultrasound (POCUS) curriculum can be effectively taught to anaesthesiology residents and that this training may provide clinical benefit. Clinical examinations performed in the organization after the study (n = 224) showed that point of care ultrasound affected clinical management at a rate of 76% and detected new pathology at a rate of 31%.<sup>5</sup> Ultrasound is gaining clinical importance in various areas of preoperative assessment. One such area is its role in preoperative assessment of anticipated difficult airway. It aids in the identification of airway sonoanatomy and also assists in performing procedures such as percutaneous tracheostomy.<sup>6</sup> The distance from skin to epiglottis is one of the most studied USG based index for prediction of difficult airway.<sup>7</sup>

Estimation of preoperative GRV can play a role in estimation of aspiration risk. Chaitra T. et al measured the gastric antrum in both supine and right lateral decubitus positions using USG in the immediate preoperative period, and gastric residual volume was calculated. It was found that as Body Mass Index (BMI) increased, there was a statistically significant (p-value < 0.001) increase in mean antral cross-sectional area in both supine and right lateral decubitus positions. There was a statistically significant association found between type 2 diabetes (p-value 0.045\*) with antral grade.<sup>8</sup> Ultrasound plays an important role in evaluation of lung pathology preoperatively. With adequate training, ultrasound can be a very powerful diagnostic tool in the identification of conditions such as pneumothorax, pulmonary edema and pleural effusion. It also plays a major role in the intraoperative period. It can be used for the confirmation of endotracheal tube placement, for securing vascular access, for assessing cardiac function and as a primary diagnostic modality for identifying regional wall motion abnormalities.<sup>9</sup>

Assessment of cardiac functions in the perioperative period can have significant impact on reducing perioperative morbidity and mortality, especially in geriatric and high risk patients. It can help in the detection of any underlying pathology and also in formulating a perioperative plan.<sup>10</sup> Another perioperative application of USG is detection and estimation of Deep vein thrombosis risk. Routine evaluation can aid in predicting the risk of intraoperative pulmonary

embolism.<sup>11</sup>

Advancement in technology and increasing availability of USG makes it a powerful diagnostic tool in the perioperative period. In addition to clinical examination, inclusion of routine USG examination can have a huge impact on patient outcome in the perioperative period.<sup>3</sup> The inclusion of POCUS as a part of routine preoperative assessment can help in improving the sensitivity and specificity of physical examination.<sup>12</sup> Although there is extensive literature available regarding the various indications for which ultrasound can be used, there are many limitations in the perioperative period which can adversely affect the use of ultrasound. Although availability has increased, the accessibility to USG is still a major barrier at many institutions.<sup>13</sup> Lack of adequate training remains the most important barrier to ultrasound utilisation.<sup>14</sup> With increased frequency of usage, a structured training curriculum is required during residency training to improve the efficacy of performing ultrasonography.<sup>15</sup>

### 5. Limitation

The validity of the questionnaire was not tested prior. The inclusion of more anaesthesiology residents can give a better idea of the availability and utilisation in more centres. Analytical approaches were not utilised. The results of this study cannot be generalised to all health care centres across India as it included tertiary care centres only.

### 6. Conclusion

Ultrasound has emerged as a valuable tool for anaesthesiologists for various purposes in the perioperative period. A thorough understanding of sonoanatomy and adequate training, hold significant potential to enhance patient care. Despite the increasing availability of ultrasound in numerous medical centres over recent years, its integration into perioperative procedures remains limited for diverse reasons. To address this limitation, incorporating fundamental ultrasound skills into the curriculum for anaesthesiology residents can facilitate more effective utilization of this resource. This initiative is pivotal in advancing patient-tailored care and minimizing complications during the perioperative period.

### 7. Abbreviations

USG: Ultrasonography; GRV: Gastric Residual Volume; DVT: Deep Vein Thrombosis; ECHO: Echocardiography; POCUS: Point of Care Ultrasound; BMI: Body Mass Index

### 8. Author Contributions

PN - Designing the questionnaire, conducting the survey, analysing the data and writing the manuscript. CK -

Collecting and analysing the data, writing and editing the manuscript.

### 9. Source of Funding

None.


### 10. Conflict of Interest

None.

### References

1. Stewart KA, Navarro SM, Kambala S, Tan G, Poondla R, Lederman S, et al. Trends in Ultrasound Use in Low and Middle Income Countries: A Systematic Review. *Int J MCH AIDS*. 2020;9(1):103–20.
2. Jain PN, Ranganathan P. Ultrasound in Anaesthesia. *Indian J Anaesth*. 2007;51(3):176–83.
3. Narula J, Chandrashekar Y, Braunwald E. Time to Add a Fifth Pillar to Bedside Physical Examination: Inspection, Palpation, Percussion, Auscultation, and Insonation. *JAMA Cardiol*. 2018;3(4):346–50.
4. Medistica. a Graphic User Interface to the R statistical analysis software for scientific medical publications; 2021. Available from: <https://www.pvalue.io>.
5. Ramsingh D, Rinehart J, Kain Z, Strom S, Canales C, Alexander B, et al. Impact assessment of perioperative point-of-care ultrasound training on anesthesiology residents. *Anesthesiology*. 2015;123(3):670–82.
6. Osman A, Sum KM. Role of upper airway ultrasound in airway management. *J Intensive Care*. 2016;4:52. doi:10.1186/s40560-016-0174-z.
7. Carsetti A, Sorbello M, Adrario E, Donati A, Falcetta S. Airway Ultrasound as Predictor of Difficult Direct Laryngoscopy: A Systematic Review and Meta-analysis. *Anesth Analg*. 2022;134(4):740–50.
8. Chaitra TS, Palta S, Saroa R, Jindal S, Jain A. Assessment of residual gastric volume using point-of-care ultrasonography in adult patients who underwent elective surgery. *Ultrasound J*. 2023;15(1):7.
9. Naji A, Chappidi M, Ahmed A, Monga A, Sanders J. Perioperative Point-of-Care Ultrasound Use by Anesthesiologists. *Cureus*. 2021;13(5):e15217.
10. Cowie B. Three years' experience of focused cardiovascular ultrasound in the peri-operative period. *Anaesthesia*. 2011;66(4):268–73.
11. Wang WD, Wei JP, Gao RQ, Yang QC, Chen T, Zhou HK, et al. A retrospective study of the role of preoperative ultrasonography in the detection of deep vein thrombosis in 1750 patients with gastric and colorectal cancers. *Thromb Res*. 2022;216:52–8.
12. McCormick TJ, Miller EC, Chen R, Naik VN. Acquiring and maintaining point-of-care ultrasound (POCUS) competence for anesthesiologists. L'acquisition et le maintien des compétences en échographie au chevet (POCUS) pour les anesthésiologistes. *Can J Anaesth*. 2018;65(4):427–36.
13. Chui J, Lavi R, Hegazy AF, Jones PM, Arellano R, Yang H, et al. Identifying barriers to the use of ultrasound in the perioperative period: a survey of southwestern Ontario anesthesiologists. *BMC Health Serv Res*. 2019;19:214. doi:10.1186/s12913-019-4040-2.
14. Remskar MH, Theophanous R, Bowman A, Simonson LE, Koehler J, Basrai Z, et al. Current Use, Training, and Barriers of Point-of-Care Ultrasound in Anesthesiology: A National Survey of Veterans Affairs Hospitals. *J Cardiothorac Vasc Anesth*. 2023;37(8):1390–6.
15. Marchi LD, Meineri M. POCUS in perioperative medicine: a North American perspective. *Crit Ultrasound J*. 2017;9:19. doi:10.1186/s13089-017-0075-y.

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