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Preanesthetic Evaluation and Preparation for Neurosurgical Procedures: An Indian Perspective

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Abstract

Background A questionnaire-based survey was conducted to determine the preanesthetic evaluation (PAE) practices among the members of the Indian Society of Neuroanesthesiology and Critical Care (ISNACC). The survey aimed to assess the current clinical practice of PAE and optimization of neurosurgical patients in India.

Methods An online questionnaire was designed by the working group of ISNACC and circulated among its active members. Response to individual questions was considered significant if 50% or more respondents concurred. The survey questions to which less than 50% of respondents concurred were identified as inconclusive results.

Results Out of 438 active ISNACC members, 218 responded. Responses were obtained from various parts of the country. The majority of participants were practicing neuroanesthesiology. Questions asked were regarding clinical assessment, preoperative optimization, prognostication, and airway management in neurosurgery. More than 50% of practitioners acceded to most of the questions; however, the percentage of responses varied across different questions (50–100%). The questions related to preoperative duplex scanning in chronically immobilized patients,

Keywords
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preoperative cognitive testing, and risk stratification during neurosurgical procedures received an inconclusive response (< 50%).

Conclusion The survey highlights the variable PAE practices perused by ISNACC members across the country. A guideline for uniform PAE practices may help to enhance research and improve perioperative care.

Introduction

Preanesthetic evaluation (PAE) is the assessment of a patient from multiple sources that may include the patient's interview, medical records, physical examination, and findings from medical tests and evaluations before conducting anesthesia.[1] A thorough PAE is essential for the safe administration of anesthesia and mitigation of perioperative risk. Presently, there are no standardized PAE recommendations for neurosurgical procedures in India. The PAE practice is variable across the country and is influenced by the type of surgery, individual preferences, and hospital infrastructure.

Due to the lack of uniformity in PAE practices, the Indian Society of Neuroanesthesiology and Critical Care (ISNACC) embarked on conducting a questionnaire-based survey. The survey's primary objective was to identify the PAE practices perused by more than 50% of the respondents. The secondary objective was to identify questions on which less than 50% of respondents concurred. These questions where less than 50% of respondents concurred were identified as inconclusive (areas for further evaluation).

Methods

A working group (WG) was appointed by ISNACC to develop a questionnaire, conduct a survey among ISNACC members, and compile and interpret the survey results. WG consisted of 12 senior neuroanesthesiologist from different parts of the country who were ISNACC members. Five online meetings were conducted over 6 months to frame a structured questionnaire consisting of five sections: general information, clinical assessment, preoperative optimization, prognostication, and airway in neurosurgical patients (►**Supplementary Material**, available in the online version). The survey focused on knowing best practices followed by ISNACC members for PAE. The questions were framed keeping in mind PAE for standard neurosurgical procedures. Answering all questions was mandatory, and choosing more than one option was allowed for specific questions. The final questionnaire was prepared on Google forms. This online questionnaire was standardized by two senior expert members of ISNACC and two overseas field experts who were not part of the WG. Suggestions received were incorporated into the questionnaire. The final online Google form (►**Supplementary Material**, available in the online version) was circulated to the members of ISNACC via email and social media (WhatsApp Inc [Facebook, Inc.], 2020]). Reminders were sent to participants every week for 4 weeks. Participants were labeled nonresponder if no response was obtained. The survey was closed after 1 month. This was followed by result compilation, interpretation, and writing. Ethical clearance was obtained from the Institute Ethics Committee, All India Institute of Medical Sciences, New Delhi, India.

Sample size: Considering an overall 50% response on a set of opinions, with a 7% margin of error and a 95% confidence level, 196 responses were required. Expecting a 10% nonresponse rate, we were required to study 218 respondents. Response from these 218 respondents was evaluated. Response to individual questions was considered significant if more than 50% of participating respondents concurred.

Results

General Information

Out of 438 active life ISNACC members, a total of 218 responses were obtained. Of these, 66.5% of respondents had > 5 years' experience in neuroanesthesia practice. A total of 65.5% had formal training in neuroanesthesia, which included postdoctoral fellowship or a doctorate in neuroanesthesia (►**Fig. S1A–S1E**, available in the online version).

Clinical Assessment

We included questions about PAE of most commonly performed neurosurgical procedures, including intracranial space-occupying lesions (ICSOLs), aneurysmal subarachnoid hemorrhage (aSAH), traumatic brain injury (TBI), and spinal cord injury (SCI). The response for minimum neurological examination and minimum preoperative investigations to be performed during PAE are elucidated in ►**Table 1**. Additionally, the indication for liver function test, pulmonary function test (PFT), echocardiography (ECHO), and serum albumin in specific patient scenarios are depicted in ►**Table 2**. ►**Fig. 1** shows the results for investigations asked during PAE of a pediatric patient presenting for elective neurosurgery.

Around 76% of the responders would ask for a preoperative ECHO for detecting patent foramen ovale (PFO) before posting patients for sitting craniotomy. Around 23% of the responders would ask for a preoperative ECHO only in the presence of cardiac comorbidity (►**Fig. S2G, S2H**, available in the online version). PAE considerations while posting a young patient with aSAH for aneurysmal clipping are depicted in ►**Table 2**. No statistically significant response was obtained regarding the need for preoperative deep venous thrombosis (DVT) screening in chronically immobilized patients (> 4 weeks). ►**Table 3** summarizes responses received pertinent to perioperative transfusion practices in neurosurgical patients.

Table 1 Summary of significant responses obtained regarding the minimum neurological examination and minimum preoperative investigations asked during neurosurgical PAE

	Intracranial surgery[a]	Spinal surgery
Minimum neurological examination	● GCS ● Ability to comprehend and understand procedures ● Pupil size and reaction to light ● Cranial nerve function with emphasis on lower cranial nerves ● Power in all four limbs ● Evaluation of reflexes with emphasis on checking cough and gag reflex ● Lateralizing signs (like decreased power in one limb as compared with other, unequal pupil, unilateral hypo/hypertonia) ● Cerebellar and brainstem functions	● GCS ● Ability to comprehend and understand procedures ● Power in all four limbs ● Sensory evaluation ● Evaluation of type of weakness: lower motor neuron (flaccid) or upper motor neuron (spastic) ● American Spinal Injury Association (ASIA) impairment scale
Minimum preoperative investigations	● CBC (Hb, TLC, DLC, platelet count) ● PT, INR ● APTT ● Serum urea and creatinine ● Serum sodium and potassium ● Blood glucose ● ECG ● Chest X-ray	

Abbreviations: APTT, activated partial thromboplastin time; CBC, complete blood count; DLC, differential leucocyte count; ECG, electrocardiography; GCS, Glasgow Coma Score; Hb, hemoglobin; INR, international normalized ratio; PAE, preanesthetic evaluation; PT, prothrombin time; TLC, total leucocyte count.
[a]Intracranial space-occupying lesion, aneurysmal subarachnoid hemorrhage, and traumatic brain injury.

Preoperative Optimization

More than 70% of the respondents opined that an international normalized ratio (INR) in the range of 1.0 to 1.5 and platelet count $\geq$ 100,000/µL is mandatory before elective intracranial and spinal surgeries. The most preferred preoperative anemia correction strategy was preoperative oral iron supplements (61%), followed by autologous blood transfusion (33%) and intravenous iron therapy (26%).

Questions addressing concerns like preoperative upper respiratory infections (URIs) and sedation during pediatric

Table 2 Summary of significant responses obtained regarding additional investigations during neurosurgical PAE

Indications for LFT in neurosurgical patients (other than history of a known liver disease) ● Patients on long term antiepileptic therapy ● Patients on antitubercular therapy ● History of alcohol intake
Indications of asking preoperative albumin levels in neurosurgical patients ● Patients with prolonged immobilization
Indications for PFT in neurosurgical patients ● Spinal deformities for corrective surgery (scoliosis correction surgery with Cobb's angle $>$ 50) ● Chronic smoker with signs of COPD, off and on bronchodilators use ● Thoracic spinal surgery for one-lung ventilation
Indications of preoperative ECHO in the neurosurgical population ● Cases with known cardiac morbidity ● Geriatric cases where the functional status cannot be assessed ● Patients with ECG abnormalities with a normal functional status posted for high-risk surgeries ● Syndromic children with craniosynostosis ● Congenital spinal cord malformations ● Surgeries requiring sitting craniotomy
The response to additional investigation required in a 45-year-old female patient presenting to the emergency department with the worst holocranial headache of her life, and with a PR of 110/min, BP 178/100 mm Hg, RR 18/min. Her ECG shows sinus tachycardia with nonspecific ST-segment depression and T wave inversion. On CT angiography, a ruptured ACOM aneurysm is seen. She is posted for surgical clipping. Her routine blood investigations and Chest X-ray are normal ● As it is a surgical emergency, proceed with the case despite an abnormal 2D-ECHO, and elevated troponin values after explaining the risk–benefit ratio to the patient

Abbreviations: 2D, two-dimensional; ACOM, anterior communicating artery; BP, blood pressure; COPD, chronic obstructive pulmonary disease; CT, computed tomography; ECG, electrocardiogram; ECHO, echocardiogram; LFT, liver function test; PAE, preanesthetic evaluation; PFT, pulmonary function test; PR, pulse rate; RR, respiratory rate.

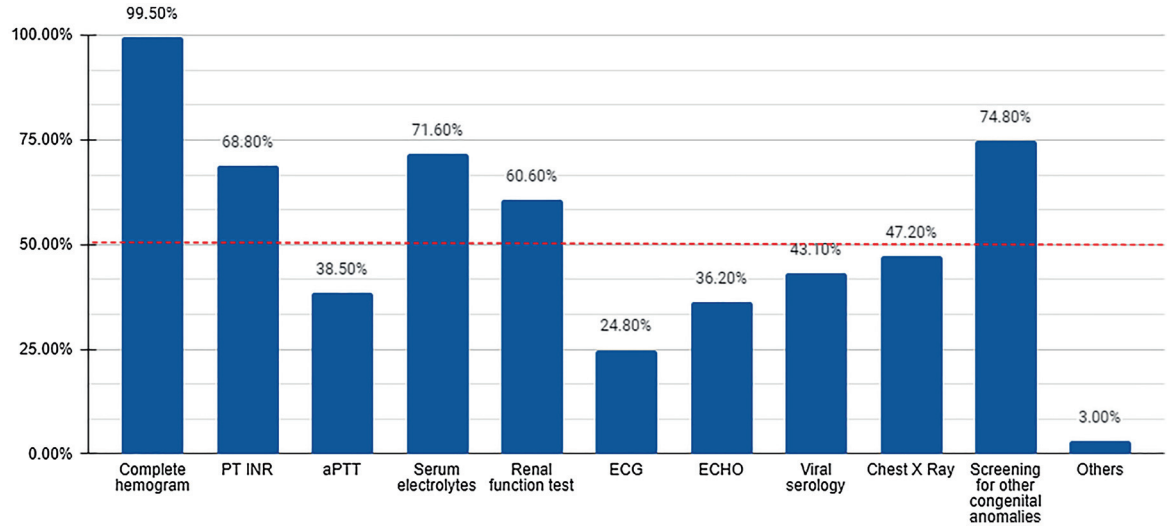

Fig. 1 A 2-year-old child posted for the repair of meningomyelocele under general anesthesia, which of the following investigations do you advise in your clinical setup during PAE.

PAE can be accessed (►**Supplementary Fig. 3D, S3E**, available in the online version). Most of our respondents favored case cancellation in children with URI only if the child has a fever and leukocytosis (66%), or significant chest finding (60%). Most of the respondents will give sedative premedication under strict vigilance in children with ICSOLs having separation anxiety.

About 70% of respondents did PAE at the time of the patient's initial visit, followed by evaluation on the day or day before surgery. ►**Fig. 2** deals with responses obtained regarding the PAE infrastructure and the utility of telemedicine for PAE.

Prognostication

Our survey shows that currently no cognitive tests or perioperative risk stratification tools are widely practiced. Around 82% of the respondents felt that preoperative neurocognitive testing would be helpful in neuroprognostication following elective craniotomies. According to the survey, the groups of patients who will benefit from preoperative cognitive testing are listed in ►**Table 4**. There was no conclusive reply for the type of preoperative risk stratification tool in use. Only 44 (20.2%) respondents use some perioperative risk calculator like American Society of Anesthesiology (ASA), Acute Physiology and Chronic Health Evaluation 2, Glasgow Coma Score, National Surgical Quality Improvement Program, etc. Currently, tools like Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity (POSSUM) and Portsmouth-POSSUM, are used only in research settings. ►**Table 4** describes the response to indications of obtaining consent for postoperative elective ventilation.

Airway in Neurosurgery

In this section, clinicians were asked about their airway management strategy in patients with difficult airways such as acromegalics, difficult pediatric airways (like syndromic craniosynostosis, significant hydrocephalus, giant occipital encephalocele, etc.), and in cases with a previous history of tracheostomy (►**Table 5**).

Responses where less than 50% of respondents concurred upon: The questions with an insignificant response (< 50%) are the practice of preoperative screening for DVT in chronically immobilized patients (> 4 weeks), role of preoperative cognitive testing in elective neurosurgery, and preoperative risk stratification in neurosurgery.

The survey questionnaire along with responses obtained is available as ►**Supplementary Material** (available in the online version).

Discussion

The purpose of the survey was to find current practices followed for the conduct of neurosurgical PAE in the Indian context. The significant advantage of surveying ISNACC members is that the majority are practicing neuroanesthesiologists, and their response can be considered as an expert opinion. The questionnaire was constructed in a format to get responses that can assist decision-making during PAE. More than 50% of practitioners acceded to most of the questions; however, the percentage of responses varied across different questions (50–100%). The current article only provides information on the existing practices of PAE in India and is by no means the standard of practice advocated by the authors or the journal.

Clinical Assessment

Preanesthetic history and physical examination are recommended for assessing anesthetic risks associated with a patient's physical status, medical condition, and ongoing treatment.[1] Neurosurgical patient presenting for surgery has variable neurological status and neurological deficits that are likely to change perioperatively. Besides obtaining a relevant neurological history, a neurological examination is paramount to PAE. There are no clinical trials to see the impact of neurological examination on the patient outcome,

Table 3 Summary of response to indications for blood grouping and cross-matching in various neurosurgical conditions

	Intracranial surgeries	Spine surgeries	Functional neurosurgeries	Pediatric neurosurgeries	Vascular surgeries
Indications for preoperative blood grouping and cross-matching	Meningiomas (> 3 cm) High-grade supratentorial gliomas Clival chordomas (skull base lesions) Cerebellopontine angle Acoustic schwannoma Metastatic lesions Craniopharyngioma	Deformity correction surgeries Multilevel lumbar fusion Spinal cord tumors	Functional hemispherectomy for epilepsy Temporal lobectomy for epilepsy surgery	Traumatic brain injury Supratentorial SOL Infratentorial space-occupying lesions Encephalocele - Meningomyelocele Craniosynostosis reconstructive surgery	aSAH for clipping Arteriovenous malformation excision Superficial temporal artery and middle cerebral artery bypass for Moyamoya disease

Abbreviations: aSAH, aneurysmal subarachnoid hemorrhage; SOL, space-occupying lesion.

but neurological assessment guides perioperative management. While a complete and thorough neurological examination is desirable, anesthesiologists may not need the same. However, documentation of a few significant positive neurological findings during the PAE has important implications for the anesthesiologist. The minimum neurological examination suggested by respondents during PAE in different neurosurgical conditions is described in our survey (►**Table 1**).

The ASA practice advisory does not support routine preoperative investigations, but rather advocates tests based on the type of procedure and the accompanying comorbidities.[1] However, there are no guidelines available for preoperative investigations to be performed before neurosurgical procedures. Besides preexisting comorbidities and neurosurgical ailments, drugs to treat neurosurgical conditions are known to cause cardiorespiratory disturbances, coagulation abnormalities, and other metabolic derangements.[2] In the Indian scenario, there is a lack of routine health screening, and many patients present to the anesthesiologist for the first time with chronic illness. Our survey enquired and enlists the minimum perioperative laboratory and radiological investigations sought by most of the anesthesiologist for neurosurgical procedures (►**Table 2**).

Pulmonary complications contribute significantly to perioperative morbidity and mortality.[3] Patients presenting for neurosurgical procedures are predisposed to pulmonary complications, ranging from atelectasis, exacerbation of the underlying chronic obstructive pulmonary disease (COPD), nosocomial pneumonia, and aspiration pneumonia. This may be attributed to decreased mental function, lower cranial nerve palsies, neurogenic pulmonary edema, and pulmonary thromboembolism in this cohort. Most of our respondents (around 90%) would ask for a preoperative chest X-ray to note significant lung pathology. The utility of preoperative PFT to predict postoperative pulmonary complications has been questioned.[4] Though not a crystal ball for predicting postoperative pulmonary complications, more than 50% of respondents felt the need for preoperative PFTs in patients who are chronic smokers with signs of COPD and on bronchodilator therapy or patients presenting for corrective spine surgeries (scoliosis correction surgery with Cobb's angle > 50). Additionally, PFT was mandated in patients planned for thoracic spine surgery requiring one-lung ventilation (►**Table 2**).

Patients undergoing neurosurgery may have perioperative cardiac dysfunction either due to associated cardiovascular comorbidities or secondary to the systemic effect of neurological diseases such as raised intracranial pressure (ICP), space-occupying lesion, SAH, TBI, or SCI. In addition, autonomic dysfunction associated with cervical myelopathy and brainstem lesions may increase perioperative cardiac morbidity. The American College of Cardiology/American Heart Association guidelines[5,6] made recommendations about preoperative ECHO in patients with cardiac disease posted for noncardiac surgery. Our survey reflected a similar opinion regarding neurosurgical patients (►**Table 2**). However, indications for ECHO in patients with

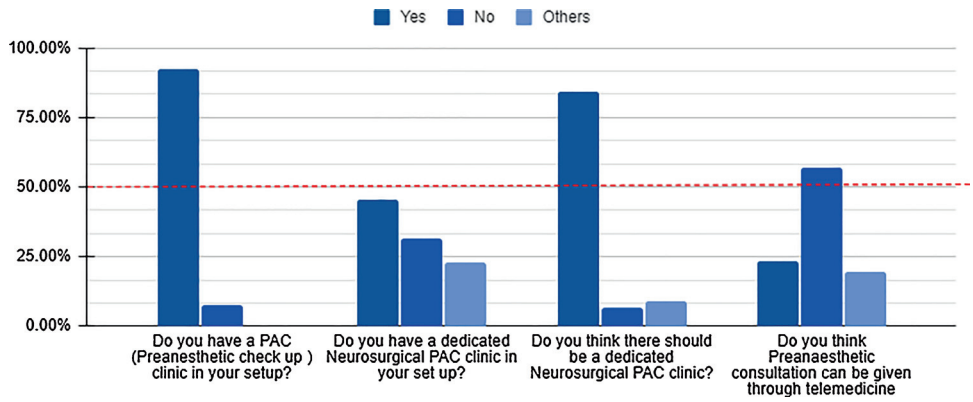

Fig. 2 Response obtained regarding preanesthetic evaluation (PAE) setup of the respondents.

Table 4 Summary of responses obtained regarding prognostication in neurosurgery

In which group of neurosurgical procedures do you think preoperative cognitive testing would be most useful ● Intracranial space-occupying lesions ● Epilepsy surgery ● Awake craniotomy ● Geriatric patients
In which of the following cases consent for postoperative elective ventilation should be taken ● Patients with upper cervical spine surgery ● Patients with large intracranial tumors with risk of massive intraoperative blood loss ● Patients with preoperative lower cranial nerve palsy ● Patients with poor-grade aSAH ● Patients with low GCS preoperatively ● Metabolic derangements ● Anticipated long intraoperative period ● Prolonged surgeries especially in the prone position ● Preoperative respiratory insufficiency ● Presence of obstructive sleep apnea ● Patients with difficult airway

Abbreviations: aSAH, aneurysmal subarachnoid hemorrhage; GCS, Glasgow Coma Score.

Table 5 Airway in neurosurgery: summary of response obtained regarding difficult airway evaluation in neurosurgical patients

	Acromegaly	Pediatric airway	Previous history of tracheostomy
Common airway tests employed in neurosurgical difficult airways	History and routine airway examination Modified Mallampati test Upper lip bite test	History and a routine airway examination Looking for facial deformity	History and routine airway examination X-ray neck anterior-posterior and lateral views

electrocardiographic (ECG) abnormalities with normal effort tolerance may be debated and depend upon the type of ECG abnormalities seen.

The sitting position is associated with a high risk of venous air embolism and a coexistent PFO further increases the risk of paradoxical air embolism. Preoperative screening for PFO in patients planned for a sitting position has been suggested in literature mainly based on observational cohort studies.[7] There are no outcome studies to implement PFO screening protocols preoperatively. Our survey findings support the use of preoperative ECHO to know the presence of PFO in patients planned for neurosurgery in a sitting position.

Cardiovascular manifestations ranging from benign ECG changes to myocardial ischemia, neurogenic stunned myocardium (NSM), cardiac failure, and arrhythmias are common in patients with aSAH.[8,9] Differentiating myocardial ischemia from NSM is challenging. Lack of preexisting heart disease, cardiac dysfunction of recent onset with ejection fraction $< 40\%$, wall motion abnormalities matching ECG changes, and low troponin levels favor NSM.[10] Not enough literature is available regarding levels of cardiac enzymes required to differentiate between NSM and myocardial ischemia. Our survey reflected a similar opinion of the respondents pertaining to preoperative assessment of cardiac

enzymes in such patients. Moreover, our respondents did not favor delaying surgery for evaluating nonspecific ST-segment depression and T wave inversion using preoperative ECHO in a young patient with aSAH (►**Table 2**). Assessing the risk–benefit ratio before postponing surgery in patients with abnormal ECG/ECHO findings is required. According to the survey, preoperative cardiac markers do not have much role in managing these patients and hence are not advised on an urgent basis. Only 26% of respondents would seek cardiac troponin levels to differentiate between cardiac and neurological causes of ECG changes.

Prolonged immobilization is a risk factor for developing venous thromboembolism, a major cause of morbidity and mortality in the neurosurgical population.[11] Preoperative DVT screening protocol helps in reducing pulmonary embolism rates and improving patient outcomes in the neurosurgical population.[12] However, currently, there are no recommendations for preoperative DVT screening in this population. Our survey response depicts that most respondents are not considering preoperative DVT screening. Outcome-based studies in this area are required to guide preoperative DVT screening.

Adult and pediatric neurosurgeries cause significant intraoperative blood loss. The reported incidence of blood transfusion during intracranial neurosurgery ranges from 10 to 95%.[13] TBI, aSAH, pediatric intracranial and cranial vault reconstruction surgeries, and large tumors are known risk factors for intraoperative blood loss.[13–15] It is rational to arrange blood preoperatively for surgeries with anticipated blood loss. The amount of blood reserved (cross-matched) and the actual percentage of the blood transfused is known as crossmatch–transfusion ratio (CT ratio). A higher CT ratio means reserving blood but not utilizing it. This results in an additional burden on the blood banks. Therefore, we sought the opinion of ISNACC members regarding their preoperative blood arrangement practices for various neurosurgical procedures (►**Table 3**). Among the pediatric neurosurgical procedures, craniosynostosis correction surgery causes significant blood loss. However, we found an insignificant response for blood transfusion requirements during craniosynostosis surgery. This may be due to the small number of participants providing anesthesia for this specialized surgery (►**Table 3**). In centers regularly performing craniosynostosis repair surgeries, blood would be reserved in most cases. Studies show a transfusion rate of approximately 90% in open craniosynostosis surgeries, with an average blood loss of around 77% of blood volume.[16] Anterior medial temporal lobe resections for management of surgical epilepsy are not associated with significant blood loss.[17] According to our survey respondents will arrange blood for this surgery. Again, it may be due to the smaller number of centers undertaking this surgery.

Preoperative Optimization

The values for preoperative platelet count and INR acceptable for brain and spine surgery reported by the survey are similar to the existing literature (►**Table 4**). Anemia is one of the most common preoperative problems affecting perioperative outcomes.[18] Incidence of moderate to severe anemia (hematocrit $< 30\%$) in elective cranial surgery is around 2.7%.[12] Preoperative anemia in the neurosurgical population can be multifactorial and results in poor outcome, prolonged hospitalization, and excessive resource utilization.[19,20] It should be detected and corrected before elective surgery. Common modalities for treatment include oral or intravenous iron therapy and preoperative blood transfusion. There is no evidence on the best treatment modality, and the management is individualized to the patient and clinical settings. Oral iron is the preferred treatment due to its effectiveness and low cost. In our survey, oral iron supplementation seemed the most favored preoperative anemia correction strategy before elective neurosurgery. However, treatment with oral iron takes a long time to replenish iron stores. Intravenous iron corrects anemia in approximately 4 weeks. Around 30% of respondents opted for intravenous iron (►**Fig. S3C**, available in the online version). Other modalities like erythropoietin can be used in patients without nutritional deficiencies.[21] However, its use is limited to a few clinical indications; therefore, we did not include the use of erythropoietin in our survey. More studies are required to inform the benefit of different modalities to correct preoperative anemia in the neurosurgical population.

Blanket cancellation of elective surgeries for children with URI is a thing of the past. However, such children continue to pose airway challenges in the perioperative period.[22] (Most of our respondents favored case cancellation in children with U RI only if the child has a fever, leukocytosis, or significant chest finding.) Sedative premedication in children with ICSOLs is controversial. It may be deleterious in patients with raised ICP. However, anxious children can be equally challenging to manage. Few clinical trials have addressed this issue. Carefully titrated sedative premedication has been successfully practised.[23,24] Our survey respondents will prefer to use sedative premedication under strict vigilance in these children.

The timing of PAE is reflected in our survey. Nearly 70% of respondents examine the patients at the initial visit to the hospital followed by reevaluation a day before surgery, reflecting the time and opportunity to optimize the patients (►**Fig. S3C**, available in the online version). The majority of the participants had a PAE clinic; however, our survey shows a need for a dedicated neurosurgical PAE clinic as perceived by the respondents (►**Fig. 2**). In this era of respiratory pandemic, teleconsultations are rampant. Though the virtual screen cannot replace physical examination and personal visits, telemedicine has been reported to effectively deliver treatment/assessment in far-flung places. It has been widely used during the COVID-19 pandemic.[25] However, most respondents of the survey were not in favor of PAE via telemedicine (►**Fig. 2**). Few believed that a follow-up consultation could be given through telemedicine.

Prognostication

The majority of the respondents believed that preoperative neurocognitive tests would be helpful in neuroprognostication (►**Fig. S4A**, available in the online version). However,

neurocognitive tests were not commonly used by respondents. This could occur due to the questionable predictability and lack of knowledge resources in the Indian scenario, these tests are used mainly in research settings. Similarly, preoperative risk calculators to predict perioperative mortality and morbidity in elective neurosurgical patients were not popular for routine patient care.[26]

Airway in Neurosurgery

A thorough airway examination is an essential part of PAE, especially when a difficult airway is predicted. Despite limitations, bedside airway examination is the most commonly employed procedure for preoperative airway assessment. The response obtained on the list of common airway assessment tests employed for difficult neurosurgical airways is enlisted (►**Table 5**). Modified Mallampati test and upper lip bite test were the most commonly used airway tests in acromegalics, and are widely described in the literature.[27–29] Despite the increasing role of ultrasonography (USG) in airway assessment,[30,31] very few respondents used it for airway assessment. More research in this field may be helpful for the inclusion of USG in routine airway assessment in these scenarios. The airway assessment in presence of stereotactic frames, cervical spine pathology, and cervical trauma are a few other challenging airway situations we did not include in our survey.

Limitations

Our online questionnaire was validated by four field experts, and our primary objective was to identify PAE practices, which are followed by $\geq$ 50% of respondents. Besides the inherent drawbacks of a survey like inflexible design, and the possible inappropriateness of questions, our questionnaire was lengthy. The detailed questionnaire and responses obtained are included in the ►**Supplementary Material** (available in the online version) due to limitation of word and figure count. The most appropriate questions and response options as decided by the WG were provided in the questionnaire. We missed many other questions and options pertinent to PAE, like risk categorization for different neurosurgical procedures, the role of tranexamic acid, preoperative autologous blood donation, endocrine abnormalities associated with neurosurgical procedures, etc.

Conclusion

The survey highlights the PAE practices among ISNACC members. These findings should help all those practicing neuroanesthesia. More than 50% of practitioners concurred upon most of the questions; however, the percentage of responses varied (50–100%). The areas with inconclusive responses were preoperative duplex scanning for prolonged immobilization, preoperative cognitive testing, and perioperative risk stratification. There is a need to develop uniform guidelines for PAE practices across the country. Consistent practice will facilitate research and enhance standard of perioperative care.

Conflict of Interest
None declared.

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