

Artificial intelligence enhanced Chatbot boom: A single center observational study to evaluate assistance in clinical anesthesiology

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Abstract

Background and Aims: The field of anaesthesiology and perioperative medicine has explored advancements in science and technology, ensuring precision and personalized anesthesia plans. The surge in the usage of chat-generative pretrained transformer (Chat GPT) in medicine has evoked interest among anesthesiologists to assess its performance in the operating room. However, there is concern about accuracy, patient privacy and ethics. Our objective in this study assess whether Chat GPT can provide assistance in clinical decisions and compare them with those of resident anesthesiologists.

Material and Methods: In this cross-sectional study conducted at a teaching hospital, a set of 30 hypothetical clinical scenarios in the operating room were presented to resident anesthesiologists and Chat-GPT 4. The first five scenarios out of 30 were typed with three additional prompts in the same chat to determine if there was any detailing of answers. The responses were labeled and assessed by three reviewers not involved in the study.

Results: The interclass coefficient (ICC) values show variation in the level of agreement between Chat GPT and anesthesiologists. For instance, the ICC of 0.41 between A1 and Chat GPT indicates a moderate level of agreement, whereas the ICC of 0.06 between A2 and Chat GPT suggests a comparatively weaker level of agreement.

Conclusions: In this study, it was found that there were variations in the level of agreement between Chat GPT and resident anesthesiologists' response in terms of accuracy and comprehensiveness of responses in solving intraoperative scenarios. The use of prompts improved the agreement of Chat GPT with anesthesiologists.

Keywords: Anesthesia, artificial intelligence, decision support systems, deep learning, ethics, machine learning, perioperative care

Introduction

Anesthesiology is a unique speciality of medicine that requires skill, expertise, and focus in a complex dynamic environment with a demand to multitask efficiently. It is paramount to augment information of practising anesthesiologists with varying viewpoints. This enables them to concentrate

on crucial decision-making and delivering personalized, efficient patient care. With advancements in machine learning, neural network, and deep learning, artificial intelligence (AI) has empowered machines to simulate human intelligence.^[1] This brings about a technology-driven paradigm shift in healthcare leading to enhanced patient outcomes.

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AI has immense potential in the operating room including data management, monitoring, optimizing anesthesia management, mitigating drug errors, ultrasound image delineation and interpretation, facilitating education and research, and providing clinical decision support.^[2-4] It has been suggested that chatbots can be integrated into clinical practice as an assisting tool.^[5-7] Safe and successful integration of chatbots into health care needs rigorous research, validation, and regulation. Chat-generative pretrained transformer (Chat GPT), an AI-powered chatbot, released in November 2022 and developed by OPEN AI, has kindled curiosity and excitement but also scepticism and resistance in varying measures among anesthesiologists.^[8,9]

We envisaged this study to evaluate the ability of Chat GPT to manage perioperative clinical scenarios. The objective of the study was to assess the performance of Chat GPT and to determine the level of agreement between responses provided by Chat GPT and those of resident anesthesiologists when managing perioperative clinical scenarios both being evaluated by experienced anesthesiologists. The secondary objective was to find if there was any improvement in agreement with prompts.

Material and Methods

This was a cross-sectional pilot study conducted at a tertiary care teaching hospital in the Department of Anaesthesiology. There were no patients involved in the study. Ethical committee approval was taken, and The Clinical Trial Registration was done. After obtaining informed consent to participate in the study, a total of 14 anesthesiologists (10 third-year postgraduate trainees and four resident anesthesiologists after completing their masters in anesthesiology) who were willing to participate in the study were recruited. All the recruits answered the scenarios, but only three postgraduates and two residents completed all the answers within the stipulated time. As the objective was to find agreement between the answers, five responses with completed answers were included in the study.

Formulation of case scenarios

A collection of 30 hypothetical clinical scenarios were devised by the first three authors conducting the study. The scenarios encompassed a diverse array of cases and disorders of subspecialties in anesthesiology. These competency-based (easy and difficult) were designed to simulate real-life perioperative conditions and possible complications that the anesthesiologist encounters in clinical practice. They were planned to test the clinical expertise, critical thinking, and problem-solving skills of the participants. The curriculum broadly followed was the syllabus of MD anesthesiology as

specified by the National Medical Council. [The scenarios are shared in the supplemental material.] The answer key was prepared by the first three authors and provided as a guide for evaluation. Both the questions and the key were validated by two anesthesiologists with more than 6 years of experience who were not part of the study team.

Acquisition of anesthesiologist responses

The anesthesiologists participating in the study were given 10 scenarios each day for 3 days to be answered in 3 hours to complete a total of 30 scenarios. The handwritten responses of the anesthesiologists were typed in Microsoft Word (MS Word) format by an office assistant.

Acquisition of AI responses

The latest iteration of Chat GPT 4 was used to generate AI responses. Each scenario was typed in a new chat session to prevent any conversational recall. The first five scenarios out of 30 were typed again with three additional prompts in the same chat to determine if there was any further detailing of answers. The Chat GPT responses for the scenarios were saved for analysis. To ensure unbiased evaluation, five responses from anesthesiologists and Chat GPT responses with and without prompts (5 + 1 + 1) were blinded and randomly labeled as responses 1-7 of 30 scenarios each. There were six responses for 30 scenarios and 7th responses for the first five scenarios given with prompts.

Evaluation of the responses

Three reviewer anesthesiologists with over 10 years of clinical experience were assigned responses of 10 scenarios each for evaluation. An answer key was provided to the three reviewers as a guide including the definition of accuracy, factuality, and comprehensiveness of answers and model answers. Accuracy was defined as the degree of correctness of answers to the scenarios. Factuality was defined as the quality of evidence-based facts. Comprehensiveness was defined as the measure of completeness of the answer to the scenarios.

Assessment of accuracy and factuality

The responses were assessed using a 3-point Likert Scale for accuracy and factuality. The scale ratings were translated into 1-3 according to the level of accuracy and factuality as wrong, partially correct, and correct.

Assessment of comprehensiveness of responses

For assessing the comprehensiveness of the responses, three key parameters were considered: conceptual correctness, coherence of argument with reasoning, and inclusion of the latest evidence and guidelines. Each parameter was then assigned a numerical score of 1-10.

This manuscript adheres to the applicable CONSORT guidelines.

The methodology is shown in the consort table in Figure 1.

Statistical methods

Collected data were entered in Excel software and analyzed using R-software version 4.0.2. To calculate agreement, intraclass correlation/Kappa statistics were used. Collected data were entered in Excel software and analyzed using R-software version 4.0.2. The intraclass correlation coefficient (ICC) was used to evaluate the agreement between the experts (two-way random effects, absolute agreement, multiple raters average, ICC (2, k)).^[10] An ICC < 0.5 was considered as poor, ≥ 0.5 and < 0.75 as moderate, ≥ 0.75 and < 0.9 as good, and ≥ 0.9 as excellent agreement. $P < 0.05$ (two-sided) was considered statistically significant.

Results

This study involved three postgraduates in anesthesiology possessing more than 2 years of experience and two resident anesthesiologists with more than 3 years of clinical experience. The word count of anesthesiologists' responses was between 75-250 and that of Chat GPT was 170-350 on MS Word.

To assess the extent of agreement between the responses provided by anesthesiologists and that of Chat GPT, the ICC was used. Table 1 displays the ICC for accuracy measured on a Likert scale ranging from 1 to 3, indicating the level of agreement

between Chat GPT and different anesthesiologists (A1, A2, A3, A4, A5). For example A3 vs. CHAT GPT with prompts: ICC = 0.45 (95% confidence interval, CI: 0.00, 0.72), A2 vs. CHAT GPT: ICC = 0.21 (95% CI: 0.00, 0.62).

The results of the correlation regarding the comprehensiveness of responses in terms of conceptual correctness, coherence of argument, and inclusion of the latest guidelines are depicted in Tables 2-4. ICC values comparing conceptual correctness between Chat GPT vs. anesthesiologists (A1 to A5) range from 0.08 to 0.75. Similarly, the ICC values for AI versus anesthesiologists (A1 to A5) in terms of coherence of argument and incorporation of the latest evidence and guidelines vary from 0.04 to 0.60 and 0.04 to 0.55, respectively.

Discussion

It is imperative to rigorously test Chat GPT's performance in analyzing and reasoning medical queries before Chat GPT can be considered relevant and beneficial in clinical settings. This study provides an early insight into the reliability of Chat GPT in providing accurate and comprehensive information about clinical anesthesiology. The proficiency of Chat GPT was assessed in solving intraoperative case scenarios of the operating room which demand a combination of logical reasoning, coherence, situational awareness, and involve higher-level thinking due to the complexity of the problems.

Accuracy of responses: It was found that the level of agreement between the chatbot and anesthesiologists varied

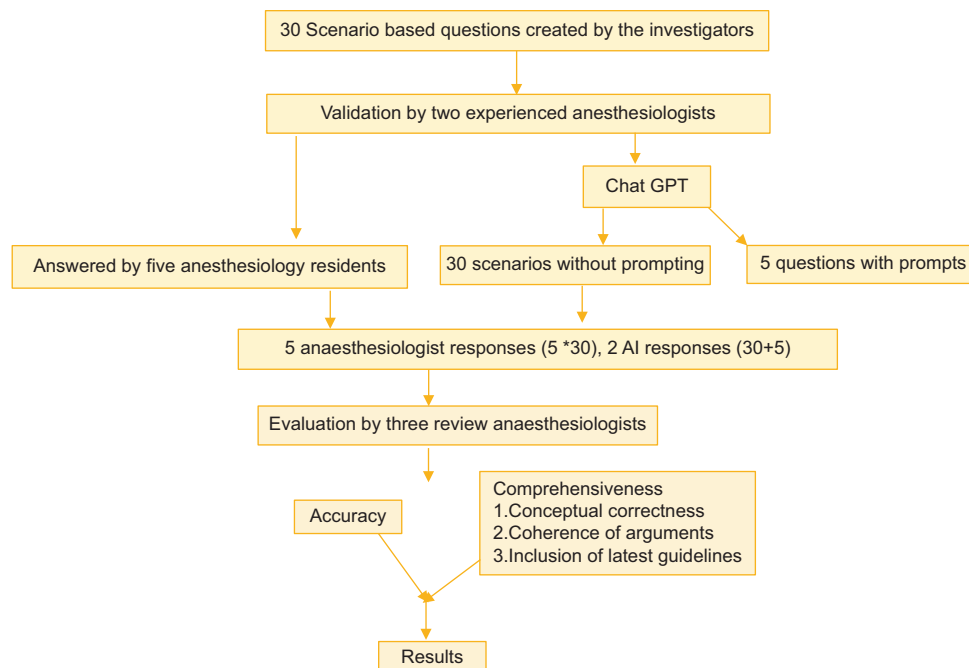


Figure 1: Consort flow diagram

Table 1: Intraclass correlation values with 95% confidence interval for accuracy, rated on a Likert scale ranging from 1 to 3

	CHAT GPT	A1	A2	A3	A4	A5
A1	0.15 (0.00, 0.59)					
A2	0.21 (0.00, 0.62)	0.60 (0.15, 0.81)				
A3	0.13 (0.01, 0.32)	0.11 (0.00, 0.31)	0.21 (0.00, 0.42)			
A4	0.14 (0.02, 0.38)	0.19 (0.00, 0.40)	0.07 (0.00, 0.33)	0.09 (0.00, 0.32)		
A5	0.09 (0.00, 0.21)	0.32 (0.02, 0.51)	0.08 (0.00, 0.35)	0.08 (0.00, 0.36)	0.12 (0.00, 0.38)	
CHAT GPT WITH Prompt	0.41 (0.00, 0.72)	0.06 (0.00, 0.32)	0.05 (0.00, 0.42)	0.45 (0.00, 0.75)	0.72 (0.23, 0.92)	0.05 (0.00, 0.41)

A- Anesthesiologist A1-A5 responses of five anesthesiologists

Table 2: Interclass correlation values with the 95% confidence interval for conceptual correctness of responses

	Chat GPT	A1	A2	A3	A4	A5
A1	0.18 (0.00, 0.58)					
A2	0.20 (0.00, 0.52)	0.61 (0.17, 0.80)				
A3	0.21 (0.01, 0.49)	0.29 (0.00, 0.41)	0.41 (0.00, 0.68)			
A4	0.11 (0.03, 0.28)	0.19 (0.00, 0.30)	0.06 (0.00, 0.32)	0.04 (0.00, 0.22)		
A5	0.08 (0.00, 0.23)	0.02 (0.02, 0.41)	0.07 (0.00, 0.29)	0.07 (0.00, 0.30)	0.32 (0.00, 0.42)	
Chat GPT with prompt	0.75 (0.00, 0.92)	0.72 (0.00, 0.87)	0.39 (0.00, 0.52)	0.07 (0.00, 0.35)	0.06 (0.00, 0.33)	0.05 (0.00, 0.39)

A- Anesthesiologist A1-A5 responses of five anesthesiologists

Table 3: Interclass correlation values with 95% confidence interval for the coherence of argument with the reasoning of responses

	Chat GPT	A1	A2	A3	A4	A5
A1	0.10 (0.00, 0.42)					
A2	0.22 (0.00, 0.54)	0.54 (0.14, 0.80)				
A3	0.22 (0.00, 0.49)	0.05 (0.00, 0.31)	0.26 (0.00, 0.44)			
A4	0.08 (0.00, 0.29)	0.06 (0.00, 0.28)	0.07 (0.00, 0.29)	0.15 (0.00, 0.29)		
A5	0.04 (0.00, 0.23)	0.18 (0.01, 0.42)	0.06 (0.00, 0.26)	0.07 (0.00, 0.27)	0.11 (0.02, 0.41)	
Chat GPT with prompts	0.60 (0.00, 0.89)	0.41 (0.01, 0.77)	0.05 (0.00, 0.22)	0.05 (0.00, 0.24)	0.05 (0.00, 0.21)	0.16 (0.00, 0.36)

A- Anesthesiologist A1-A5 responses of five anesthesiologists

Table 4: Interclass correlation values with 95% confidence interval for inclusion of latest evidence and guidelines in responses

	Chat GPT	A1	A2	A3	A4	A5
A1	0.04 (0.00, 0.48)					
A2	0.05 (0.00, 0.32)	0.54 (0.17, 0.78)				
A3	0.17 (0.01, 0.40)	0.25 (0.00, 0.41)	0.28 (0.00, 0.58)			
A4	0.11 (0.03, 0.27)	0.16 (0.00, 0.29)	0.07 (0.00, 0.29)	0.05 (0.00, 0.21)		
A5	0.13 (0.00, 0.33)	0.40 (0.02, 0.71)	0.26 (0.00, 0.49)	0.10 (0.00, 0.32)	0.20 (0.00, 0.45)	
Chat GPT with prompt	0.55 (0.00, 0.88)	0.05 (0.00, 0.27)	0.06 (0.00, 0.32)	0.04 (0.00, 0.19)	0.05 (0.00, 0.25)	0.62 (0.00, 0.91)

A- Anesthesiologist A1-A5 responses of five anesthesiologists

in terms of the accuracy of responses to clinical scenarios. The level of agreement could have been varied due to the clinical acumen and experience of the anesthesiologist.

The comprehensiveness of responses

Conceptual correctness of responses: It was found that there were varying levels of agreement between Chat GPT and individual anesthesiologists, with some pairs demonstrating moderate agreement (e.g., Anesthesiologist 1 and 2 with Chat GPT), while others exhibited weaker alignment (e.g., Anesthesiologist 5 and Chat GPT). Coherence of

argument with reasoning and inclusion of the latest evidence and guidelines also showed similar degrees of agreement.

Interestingly, when Chat GPT was provided with prompts, the agreement with anesthesiologists was substantially augmented. In a study done by Abdelhady and colleagues,^[11] the feasibility and effectiveness of employing the chat generative pretrained transformer (Chat GPT), as a supporting and educational tool for plastic surgeons, was evaluated. They found that the Chat GPT generated operative notes faster with better user satisfaction. They also found that carefully crafted prompts

generated more accurate and detailed operative notes, similar to our study.

Several other studies^[4,11] have used AI for improved documentation and in the refinement of medical devices but in our study we evaluated the usefulness of Chat GPT in the perioperative period. A recent study was done to determine if Chat GPT can generate suggestions for improving clinical decision support compared to human-generated suggestions. The suggestions generated by AI were found to provide unique viewpoints and were scored as understandable and relevant, with moderate usefulness, bias, and low acceptance.^[12]

In another study, physicians generated 284 medical questions with varying levels of difficulty. Although the questions were subjective with no validation mechanism to verify the accuracy of answers, it was found that the AI-generated answers scored high for accuracy and completeness.^[13]

In the present study, Chat GPT with prompt showed better agreement with the collective assessment of anesthesiologists responses. It follows that to elicit a detailed and complete response the clinician should be conversant with the language the chatbot understands. The number of prompts required to get the desired response remains unknown and can also be variable.^[14] As with any other language model, Chat GPT is susceptible to the inherent problem of GIGO (garbage in and garbage out) wherein the quality of output is dependent on the quality of input.^[15] Accordingly, a person not familiar with AI may not be able to extract specific answers.

An experienced anesthesiologist can anticipate and predict other related problems and react to them, unlike Chat GPT. Chat GPT was trained on large web pages and corpus before September 2021, resulting in the knowledge being cut off from then. Consequently, the latest evidence and guidelines released after this are not included beyond that date. The introduction of a newer version with browsing capability could address this problem. Inevitably, AI is likely to create inroads in perioperative practice. Still, widespread adoption is far from reality. Realistic expectations and extensive testing could foster favorable outcomes. Eventually, human intelligence is required to drive AI.

Limitations of the study

In our study, we used hypothetical scenarios for evaluating Chat GPT because real-life events could not be used due to ethical concerns. Anesthesiologists participating in the study had less than five years of experience. The level of agreement could have been different if senior anesthesiologists were involved.

The discrepancy in the level of agreement in our study could be due to multiple factors. While using Chat GPT without prompts, in easy and straightforward scenarios, the level of agreement was stronger while elaborate scenarios showed weaker agreement. It was found that responses by Chat GPT were verbose and detailed. The anesthesiologists had to adhere to time while answering the scenarios whereas Chat GPT could generate answers in seconds. Although responses were blinded, the lengthy and structured responses of Chat GPT after prompts in comparison to the concise responses of anesthesiologists might have led to some degree of bias in the evaluation. Third, though the answer key was provided to the experts, scoring might have been varied due to the subjective nature of the questions.

This was a pilot study and only five anesthesiologists completed all the answers within the stipulated time. Further studies are required involving more anesthesiologists and with diverse experiences for the generalizability of the results to a larger population.

Conclusion

In conclusion, this study revealed the varied performance of Chat GPT in solving clinical case scenarios with variations in the level of agreement from low to moderate between Chat GPT and resident anesthesiologists' responses. The study also found that the use of prompts improved the agreement of Chat GPT with anesthesiologists. Further refinements of the model could ensure better performance and improved agreement with experienced anesthesiologists.

However, replacing a perioperative physician in anesthetizing a patient with myriad problems, health complexities, and dynamically evolving changes is unrealistic and impractical because these situations demand refined clinical judgment. Complete automation of clinical duties in the foreseeable future despite technological developments is unethical. Nevertheless after rigorous testing, further refinements of the AI model, thorough validation, and provision of browsing access, Chat GPT could be integrated into clinical practice as an aid in the decision-making process.

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Conflicts of interest

There are no conflicts of interest.

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Scenarios

1. A 60-year-old female patient is posted for posterior instrumentation for intervertebral disc prolapse. She had covid 19 infection 2 years back for which she was treated symptomatically. She has no other comorbidities. Her investigations are normal. 12 lead ECG and 2D echocardiography are normal. Patient was accepted under ASAPS I for surgery. Patient was administered general anaesthesia with endotracheal intubation with volume-controlled ventilation. Patient was maintained on oxygen, nitrous oxide and isoflurane (1 MAC). One hour into the procedure she developed bradycardia with high peak airway pressure for which atropine was administered. She develops pink frothy secretions and develops cardiopulmonary arrest. Patient was turned supine and CPR was initiated.
What was the cause of cardiac arrest? How do you manage this case?
Prompts – What could be the cause of cardiac arrest? What are the investigations that should be done? Is covid history relevant?
2. A 22-year-old primigravida with grade 4 placenta previa reaches the hospital with bleeding per vagina. She has consumed soft diet one hour back. She is posted for an emergency caesarean section. What is the anaesthetic plan?
Prompts for ChatGPT - What are the investigations to be done? How to optimize this patient? What is the choice of anaesthesia?
3. A 70-year-old male patient is posted for transurethral resection of prostate. He is a known case of ischemic heart disease with pacemaker in situ. His effort tolerance is moderate. 2D echo shows reduced left ventricular function 35%. His preoperative sodium is 132 meq/l. How do you proceed with the case?
Prompts for ChatGPT- How do you evaluate pacemaker? What are the investigations to be done? What are the concerns?
4. A 65-year-old diabetic patient is brought to the ER with necrotizing fasciitis of the left lower limb. His random blood sugar is 500 mg/dl. his breathing is hurried. Urine ketone bodies are positive. ABG shows pH of 7.1, HCO₃ 12meQ/L with pCO₂ of 22mmHg. Patient has cold, clammy skin. What is the plan of anaesthetic management?
Prompts for Chat GPT- What is the diagnosis? What is the volume of fluids to be administered? What dose of insulin has to be administered? Can we accept this case for emergency debridement?
5. A 6-year-old patient, with a previous history of upper respiratory tract infection 2 weeks back is posted for herniotomy. His upper respiratory symptoms have subsided. On examination there were no adventitious sounds. Intraoperatively patient is stable. During extubation patient developed stridor, respiratory distress with drop in saturation. How do you proceed with the case?
Prompts for Chat GPT-What are the concerns? What is the probable cause? How do you treat the above condition?
6. A 40-year-old patient is scheduled for fibroadenoma excision. Her pre anaesthetic evaluation is non-contributory. After induction, patient is intubated using Macintosh laryngoscope with 7.0 size endotracheal tube. At the end of surgery, it is found that the bulb of the laryngoscope is missing. What is the further course of action?
7. Why does Desflurane require a special type of vaporizers when compared to other inhalational agents?
8. A 22-year-old patient is posted for hemithyroidectomy for goitre. She has symptoms of hyperthyroidism. Her thyroid hormone levels are above normal. What would be the choice of inducing agent?
9. In a postoperative case of bilateral knee replacement on injection enoxaparin 40mg twice a day, epidural catheter has to be removed. When can it be removed? Answer with justification with supporting guidelines.
10. 10. When choosing an intravenous cannula, we choose a larger bore in order to increase the radius of the cannula thereby increasing the flow. What is the law that is applied in this phenomenon?
11. Mention the Latest All India Difficult Airway Association guidelines (AIDAA) for unanticipated difficult airway.
12. 7. A 22-year-old female patient admitted with complaints of headache 1 day, history of preeclampsia. the patient is receiving 20mg labetalol tablet BD for the last 15 days. The patient complains of headache since one day. She is being treated with magnesium sulphate injection 4g infusion over 20 min and 5g on alternate buttocks every 4 hours. After 3 hours patient goes into labour and an epidural analgesia is requested. On evaluations patient's face appears puffy, BP is found to be 140/90mmHg. Patient is started on Ringer's lactate preloading 500ml. Epidural catheter is secured and test dose injection lidocaine 2% with adrenaline 3ml given through epidural catheter . There is no tachycardia or hypertension. In the meantime, the patient becomes tachypnoeic and saturation drops to 85%. Auscultation reveals coarse crepitations. Staff nurse has started 3rd pint of Ringer's lactate. What is the diagnosis and management?
13. 8. A 26-year-old woman G2P1L1 is scheduled for an emergency caesarean section under spinal anaesthesia for the indication of cephalopelvic disproportion (CPD). Spinal anaesthesia with bupivacaine 12.5mg heavy was administered at L3/L4 space, with a sensory block level of T4, the foetus delivered uneventfully. In the meantime, mother complained

of difficulty breathing, developed hypotension, bradycardia, hypoxia, and loss of consciousness. Immediate maternal resuscitation was done with vasopressor support, endotracheal intubation, and mechanical ventilation. What is the diagnosis?

14. 9. A 23-year-old male patient was scheduled for sebaceous cyst excision over nape of the neck under general anaesthesia. He did not have history of any other medical illness, no history of allergy; no history of previous surgery under anaesthesia; clinical examination and laboratory investigations were essentially normal. Patient was pre medicated and pre oxygenated, induced with propofol, injection succinylcholine was administered for endotracheal intubation. Three minutes later, 15 mg intravenous atracurium was administered. 30 seconds after injection, the patient developed rashes, tachycardia of 140-160/min, BP unrecordable and a peak airway pressure of 50 cm H₂O with a SpO₂ of 92% was seen. Auscultation revealed a silent chest. What is the diagnosis and management?
15. 10. A 77-year-old female patient, known case of hypertension and chronic kidney disease since 10 years on T. Amlodipine 5mg and on regular haemodialysis was taken up for D J stent exchange on an emergency basis. Patient's pre operative investigations revealed HB 8.5g/dL, TC 23000, Serum potassium 6mg/dl, serum creatinine 2.5mg/dl, ECG showed LVH pattern with tall T waves, 2 D echo showed concentric LVH with no regional motion abnormalities. Procedure was started under low dose SAB. Few minutes into the procedure, the patient complained of difficulty in breathing, ECG showed ST depression, and the patient went into cardiac asystole. CPR was initiated immediately, ETT secured and patient shifted to SICU for further management. What could be the diagnosis?
16. A 36-year-old female with morbid obesity and a known case of bronchial asthma was scheduled for right ear CSOM repair. Patient had been compliant with her medications and her last attack of asthma was 6 months back. Chest was found to be clear on auscultation during pre-anaesthetic check-up and on the day of surgery all investigations were within normal limits. Case was accepted for proposed surgery under ASA PS II after explaining the potential risk. Pre operative orders including pre-op nebulisation with levolin/ Budecort and Injection Hydrocortisone 100mg IV were followed. Pt was administered GA and tracheal intubation was performed. After intubation, chest auscultation revealed a complete absence of B/L breath sounds. As an oesophageal intubation was suspected, the patient was immediately extubated and mask ventilation was attempted. Mask ventilation was difficult to perform. Rapid arterial oxygen desaturation followed by hypotension associated tachycardia occurred. What is the diagnosis and management of this patient?
17. A 1 year old child weighing 10 kg presented to the operating room for bilateral syndactyly repair. Pre anaesthetic check-up revealed nothing significant and the case was accepted for proposed surgery under ASAPS II. After induction of general anaesthesia, plastic surgery resident infiltrated the left hand, right hand and right groin with lignocaine 1% with a total of 16ml(160mg). Fifteen minutes later, the attending plastic surgeon infiltrated the right hand with another 7ml lignocaine 1% with epinephrine for a total of 23ml. 10min into the procedure, the child developed bradycardia. The procedure was stopped, CPR was initiated. What is the diagnosis and management of this patient?
18. A 32 year old male patient, with a known case of seizure disorder on medications with last episode of seizure 6 yrs. back. Patient had undergone two surgeries under general anaesthesia 4yrs and 2yrs back, both of which were uneventful. Pt was currently scheduled for septoplasty and turbinoplasty under general anaesthesia. Case was accepted for proposed surgery under ASA II. Anaesthesia induction was performed with Injection Midazolam, Propofol and Remifentanyl in appropriate doses. Neuromuscular relaxation was performed with succinylcholine (100mg) and rocuronium (50mg) and hypnosis with Desflurane. The surgery was uneventful, and the patient was afebrile. Towards the end of the surgery, a rapidly progressive rise of EtCO₂, tachycardia and axillary hyperthermia(39.5) was observed. What is the diagnosis and treatment?
19. A 15 year old child was posted for nasal polyp surgery under ASA 1. The child was pre- medicated, induced with IV induction agents, intubated and surgery was started. Surgery was uneventful and at the end of procedure, a nasal endoscopy was performed which revealed hyperplastic adenoids and surgeons decided not to resect it. The patient was extubated after responding to commands but had obstructed breathing soon after. Vigorous suctioning revealed copious blood in the airway. Patient developed oxygen desaturation up to 58%. Suspecting laryngospasm, CPAP was applied for 3 minutes to break the spasm. Pt was then shifted to PICU. One hour later the patient again became tachypnoeic and saturation fell to 80%. What is the diagnosis and treatment?
20. A 45-year-old male patient posted for L4-L5 discectomy, with no known comorbidities was accepted for the surgery under ASA1. Patient was pre-medicated, pre-oxygenated and induced with intravenous induction agents. Vecuronium was administered for neuromuscular relaxation. Intubation was attempted by a third year anaesthesiology resident and was found to be an unanticipated difficult airway. Intubation was then taken over by senior resident and bougie intubation was attempted which was again unsuccessful. The intubation was subsequently accomplished by an experienced senior anaesthesiologist using a bougie. Capnograph confirmed the position of the tube in the trachea and patient was put in

prone position for the surgery. Half an hour into the surgery, peak airway pressure started increasing and the patient desaturated up to 80%. What is the diagnosis and treatment?

21. A 41-year-old female patient was scheduled for Diagnostic hystero-laparoscopy (DHL) with septal resection. Pt had no comorbidities and the case was accepted for proposed surgery under ASA 1. Pt was administered general anaesthesia using laryngeal mask airway. After DHL was performed surgeons found that there was a submucous uterine myoma and decided to resect that as well. 50 min into the procedure, EtCO₂ dropped from 35 to 25 mmHg and saturation was found to be 90%. Crackles were heard at the base of the lungs on auscultation. A review of the volume of irrigation fluid used revealed that 9000ml of irrigation fluid was used during the procedure. The procedure was abandoned and LMA was exchanged with 6.5 ETT followed by the patient being shifted to ICU for further management. Blood investigations sent from ICU showed severe metabolic acidosis (pH 7.09) with severe hypokalemia and hypocalcemia. What is the diagnosis and management?
22. A 36-year-old female patient with toxic multinodular goitre, treated and controlled with antithyroid drugs, was scheduled for total thyroidectomy. General anaesthesia with endotracheal intubation under standard monitoring was administered with intravenous fentanyl (200µg), propofol (150 mg), and vecuronium (8 mg), and maintained with morphine (8 mg), isoflurane, and N₂O in O₂, and controlled ventilation. In the 3rd hour during skin closure, his heart rate increased from 80 bpm to 120 bpm, blood pressure raised from 110/70 to 170/108 mmHg, temperature (36.2–39.3°C), and ET-CO₂ was found to be 65 mmHg. The CO₂ absorber was warm to the touch. There was sweating with skin mottling and skeletal muscle rigidity. An arterial blood gas analysis revealed respiratory and metabolic acidosis. What is the diagnosis and management?
23. A 55kg, 48-year-old male patient scheduled for laparoscopic cholecystectomy had no medical comorbidities. Airway examination revealed mouth opening of 4 cm, thyromental distance of 7 cm, full range of neck movements, and Mallampati grade was III. After premedication and pre oxygenation, the patient was induced with propofol and paralysis with succinylcholine (100mg). Laryngoscopy was attempted with MacIntosh size 3 blade. First intubation attempt with size 8.0 tube failed. Cormack and Lehane grade IIIb was observed. A second attempt was made inserting a malleable stylet in the endotracheal tube, but the tube could not be passed below the epiglottis. After 3 failed attempts at intubation, the patient was found to desaturate and was mask ventilated for 3min. Laryngeal mask airway was then inserted and the airway was secured. What are the guidelines and protocol in such a situation?
24. A 35-year-old female patient undergoing laparoscopic cholecystectomy under general anaesthesia was intubated with ETT 7.5 size and fixed at 20 cm after bilateral air entry was confirmed. Pt was then handed over to the surgeons and the patient was put in Trendelenburg position. 10min later it was noticed that the peak airway pressure raised to 40 mmHg. What do we suspect in such cases? How can we avoid these situations?
25. A patient categorised under ASA2 with fasting blood glucose level of 300 mg/dl receives general anaesthesia for four hours for repair of tendon laceration. How do you manage this patient's blood glucose level intra operatively?
26. A 60-year-old patient with chronic kidney disease with maintenance haemodialysis is scheduled for arteriovenous fistula on the right arm. What are the various techniques of anaesthesia that can be used for this patient?
27. A 36-year-old patient is brought to the casualty with a history of road traffic accident. On evaluation he is diagnosed to have left 3rd to 6th rib fractures. He complains of pain during breathing with pain VAS score of 7. What are the modalities of pain management?
28. A 40-year-old patient with a diagnosis of foramen magnum meningioma was taken up for surgery. Patient was administered general anaesthesia and was maintained with total intravenous anaesthesia. Patient was being operated in sitting position. 30min into the surgery, the patient developed bradycardia with desaturation. What are the concerns of general anaesthesia in sitting position?
29. A 10-year-old female presents to the emergency room with a history of coughing blood-tinged secretions for 2 days and vomiting blood for the last 12 hours. The patient had an adenotonsillectomy done 8 days back. On examination, the patient is sitting in bed, anxious, with bloody sputum. Vitals: HR 120/min; BP 100/50; respiratory rate 24/min. What is the plan for anaesthetic management in this patient?
30. A 26-year-old patient presented to casualty three hours after sustaining burns injury over the face and neck while working in a factory. The is awake and alert. On examination, there was darkened oral and/or nasal mucosa, burns on the face, lips and nares and the presence of carbon or soot in the mouth or throat. What is the initial line of management in this patient? What is the plan for fluid resuscitation? What is the plan of anaesthesia when this patient is being taken up for debridement and skin grafting?