

Assessment of the Availability of the Anaesthesia Safety Checklist and the Compliance of the Anaesthesia Residents to use This Checklist

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ABSTRACT

Background: Safety checklists help prevent human errors in complex, high-intensity working environments. Using perioperative checklists was shown to reduce mortality and complication rates, improve communication and perception of safety in human hospital anesthesia teams, and reduce the incidence and severity of complications in veterinary settings.

The checklist employs tactics to improve efficiency in the operating theatre and inculcates teamwork and good communication among the operational staff, all working together to make the surgical environment safe for the patient.

Aim of The Study: To determine the availability of the safety checklist and the compliance of the anaesthesia resident to use this checklist.

Patients and Methods: A simple random sampling technique was used to select 100 anaesthesia residents working at Baghdad Teaching Hospital and Ghazy Al Hariri Hospital for Surgical Specialities, where general or spinal anaesthesia surgeries were done.

Results: Preoperative assessment compliance score was 79.63%. The anaesthesia machine checklist compliance score was 30.56%. The ventilator function checklist compliance score was 13.89%. The equipment checklist compliance score was 83.33%.

Conclusions: The overall compliance score could have been better. Plus, there was a difference in the compliance score between the different parts of the questionnaire.

KEYWORDS: Anaesthesia, assessments, checklist, compliance, safety.

ARTICLE DETAILS

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INTRODUCTION

Anesthesia safety varies from country to country, depending mainly on economic background. It is highly safe in developed countries but needs to catch up in other parts of the world. Professional standards, guidelines, and protocols have been developed with the sole aim of making anesthesia safer. Application of current standards of anesthesia care is likely to prevent nearly 43% of operation theatre adverse events. The practice of these standards in the developed world

is not disputable, but it is uncertain in developing countries due to complex problems requiring frequent assessment and reporting. ⁽¹⁾

Mortality associated with anesthesia in the developed world has been reduced significantly during the last 25 years. Although anesthetic-related deaths have declined overall, there has been an increase in reports of mortality arising from institutional and organizational problems such as poor supervision and rostering. ⁽²⁾

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Studies in developed countries have shown a perioperative death rate from inpatient surgery of 0.4%–0.8% and a rate of significant complications of 3%–17%. These rates are likely to be much higher in developing countries. Thus, surgical care and its associated complications represent a substantial global burden public consideration community. ^(3, 4)

Anesthesia risks were the subject of numerous investigations, editorials, and journal correspondences from when the first anesthesia-related death was reported in 1848. In 1985, the Anesthesia Patient Safety Foundation (APSF) was established to ensure “that no patient is harmed by anesthesia.” ⁽⁵⁾

Massive resources are now being devoted to patient safety issues, owing to a report by the Institute of Medicine (IOM) in 1999. The World Federation of Societies of Anesthesiologists (WFSA) first approved International Standards for the Safe Practice of Anesthesia in 1992. ⁽⁶⁾

In 2008, to improve surgical safety, the World Health Organization (WHO) released a safety checklist identifying multiple recommended practices to ensure the safety of surgical patients. Using this checklist in eight hospitals showed a reduction of about 4% in significant complications, and the list was then launched in many developed countries. Most hospital staff use it in the operating room. ⁽⁷⁾

While the best-known perioperative list, the WHO Surgical Safety Checklist, contains a few critical anesthesia items (e.g., pulse oximeter checks), the call for more specific cognitive aids has led to various anesthesia-specific checklists. These checklists include those developed for the routine phases of anesthesia care, critical events potentially complicating a surgical procedure, and provider hand-offs. Though the WHO Surgical Safety Checklist has been widely accepted and implemented, there still needs to be guidelines regarding anesthesia-specific checklists. ⁽⁵⁾

Safety checklists help prevent human errors in complex, high-intensity working environments. Using perioperative

checklists was shown to reduce mortality and complication rates, improve communication and perception of safety in human hospital anesthesia teams, and reduce the incidence and severity of complications in veterinary settings. ⁽⁸⁾

The checklist employs tactics to improve efficiency in the operating theatre and inculcates teamwork and good communication among the operational staff, all working together to make the surgical environment safe for the patient. Implementing the surgical safety checklist has decreased operative morbidity and mortality, fostered a patient safety culture, and enhanced communication. ⁽⁹⁾

Appropriate checklist use and sustainable practice can be a result of practical implementation. In addition, barriers to implementation are multifactorial. They encompass cultural and structural levels, including communication gaps, perceived benefit by the provider, lack of procedural understanding, and perceived ambiguity of the process. ⁽¹⁰⁾

Health care is continually changing, and anesthesiologists must identify trends that could lead to reduced patient safety and develop corrective actions. ⁽¹¹⁾

WHO surgical safety checklist is not intended to be concise. Fitting local practice by additions and modifications is encouraged. It is branched initially into three domains (Sign In, Time Out and Sign Out)”. It comprises 19 items that must be checked at three points during surgery. ⁽¹²⁾

The sign-in, carried out by the anesthesiologist, the anesthesia nurse, and the patient, consists of a check on the patient’s identity, the procedure to be performed and the side it is to be performed on, and other points relating to the anesthesia. In the time-out, the patient’s identity is rechecked, the name and roles of all team members are stated, and all essential aspects of the operation, including its expected duration and the expected blood loss, are communicated. Finally, major concluding points are checked in the sign-out, e.g., the correctness of the final sponge count and the completion of the postoperative orders, as shown in table 1. ⁽¹³⁾

Table 1: World Health Organization Surgical Safety Checklist

Before induction of anaesthesia	Before skin incision	Before the patient leaves the operating room
(With at least a nurse & anaesthetist)	(With nurse, anaesthetist, and surgeon)	(With nurse, anaesthetist, and surgeon)
Has the patient confirmed their identity, site, procedure, and consent? ☐ Yes	☐ Confirm all team members have introduced themselves by name and role	Nurse verbally confirms: ☐ The name of the procedure ☐ Completions of instruments, sponge, and needle counts ☐ Specimen labelling (read specimen labels aloud, including patient name) ☐ Whether there are any equipment problems to be addressed

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Is the site marked? ☐ Yes ☐ No	☐ Confirm the patient's name, procedure, and where the incision will be made	To surgeons, anaesthetists, and nurses: ☐ What are the key concerns for the recovery and management of this patient?
Are the anaesthesia machine and medication check complete? ☐ Yes ☐ No	Has antibiotic prophylaxis been given within the last 60 minutes? ☐ Yes ☐ Not applicable	
Is the pulse oximeter on the patient and functioning? ☐ Yes	Anticipated Critical Events To surgeon: ☐ What are the critical or non-routine steps? ☐ How long will the case take? ☐ What is the anticipated blood loss? To anaesthetist: ☐ Are there any patient specific-concerns? To the nursing team: ☐ Has sterility (including indicator results) been confirmed? ☐ Are there equipment issues or any concerns?	
Does the patient have a: Known allergy? ☐ Yes ☐ No Difficult airway or aspiration risk? ☐ No ☐ Yes, and equipment/assistance is available Risk of > 500 ml blood loss (7ml/kg in children)? ☐ No ☐ Yes, and two IVs/central access and fluids planned	Is essential imaging displayed? ☐ Yes ☐ Not applicable	

As operating teams become familiar with the checklist steps, they can integrate the checks into their regular work patterns and verbalize their completion of each step without the direct intervention of the Checklist coordinator. Each team should seek to incorporate the checklist into its work with maximum efficiency and minimum disruption while aiming to accomplish the steps effectively. ⁽¹⁴⁾

Many international standards exist for anesthesia machines (or workstations as they are called), specifying the required safety features and those relative/desirable. Various national associations of anesthesiologists have recommended the minimum safety features for machines used in their countries or by their members. Safety features can be divided into the following categories ⁽¹⁵⁾:

- Gas supplies: From the central pipeline to the machine and cylinders.

- Flow meters.
- Vaporizers.
- Fresh gas delivery: Breathing systems and ventilators.
- Scavenging.
- Monitoring.

Aim of The Study

To determine the availability of the safety checklist and the compliance of the anesthesia resident to use this checklist.

Patients and Methods

Scientific approval for the study was obtained from the Iraqi Board Council, and permission from Baghdad Teaching Hospital and Ghazi Al Hariri Hospital for Surgical Specialities was obtained.

A cross-sectional study was conducted to determine the availability of the safety checklist and the compliance of the

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anaesthesia residents to use this checklist. The study was conducted from 1st June 2022 - 1st November 2022.

A simple random sampling technique selected 100 anaesthesia residents at Baghdad Teaching Hospital and Ghazi Al Hariri Hospital for Surgical Specialities.

All anaesthesia residents from the Iraqi or Arab Board Council attended the OR in Baghdad Teaching Hospital or Ghazi Al Hariri Hospital for Surgical Specialities, where general or spinal anaesthesia surgeries were done.

Structured safety checklists were developed based on the WHO Surgical Safety Checklist. This checklist targeted the anaesthesia residents who work in the OR where general or spinal anaesthesia surgeries were done. The researcher filled

out the list through direct observation of the anaesthesia residents while they worked in the OR. Anaesthesia residents were not informed about the checklist's subject to reduce bias. The researcher chose only the surgeries that were the first on the list of surgeries in the operating room, so the anaesthesia equipment was still not checked by anyone. The researcher stands away from the residents but in space enough to observe them. The researcher did not interact with the resident during the check.

The checklist consists of two parts. The first part covers the pre-operative assessment, as shown in Table 2. Each variable was given a value of one as checked and zero as not.

Table 2: Pre-operative assessment.

Pre-operative assessment	Checked	Not checked
Patient history includes patient ID, type of operation, general hx, drug hx, allergy hx, PMH (HTN, DM, IHD, Asthma, Epilepsy), PSH, Family history, and Social hx.		
Investigations include CBC, FBS, RFT, LFT, coagulation profile, virology, ECG, CXR, and others.		
General examination		
Mallampati test		
HR		
BP		
ECG monitor		
IV cannula		
Fasting status		

The second part consists of an anaesthesia checklist with three subdivisions: anaesthesia machine checklist, ventilator function check, and equipment check.

The anaesthesia machine checklist is shown in Table 3.

Table 3: Anesthesia machine checklist.

Anesthesia Machine Checklist	Checked	Not checked
Adjust flow on Scavenger		
Check Ambu-bag (Including backup Oxygen Source)		
Fill vaporisers		
Check CO2 Absorbent.		
Remove the oxygen analyser fuel cell from the breathing circuit.		
Turn on the anaesthesia machine and monitors.		
Check pressure in O2 cylinder(s) (>1000 psi).		
Connect central gas supply hose for O2.		
Confirm central supply gas pressures of $\pm$ 50 psi		

The ventilator function checklist is shown in Table 4.

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Table 4: Ventilator function checklist.

Ventilator function checklist	Checked	Not checked
Connect the reservoir bag to the Y-piece of the breathing circuit.		
Position the selector valve to the ventilator (auto)		
Turn on the ventilator; set at an appropriate: Tidal Volume, Rate, I: E ratio, and Pressure Limit.		
Check the unidirectional valve function.		
Remove/Replace reservoir bag and occlude outlet at Y-piece.		
Fill bellows and perform a high-pressure check.		
Turn off ventilator		
Confirm the Ventilator Disconnect Alarm		
Check APL valve (With APL valve open and Y-connector occluded, press the O2 flush valve and confirm pressure of < 14 cmH2O)		

The equipment checklist is shown in Table 5.

Table 5: Equipment checklist.

Equipment checklist	Checked	Not checked
An experienced and trained assistant is available to help with induction.		
The patient is on a table that can be rapidly tilted into a head-down position in case of sudden hypotension or vomiting.		
Check Laryngoscope		
Check the different types of blades.		
Check tracheal tubes.		
Check the different sizes of tubes.		
The suction apparatus is ready and clean.		
Needles and syringes are sterile.		
Drugs are drawn up into labelled syringes.		
Emergency drugs are present in the room if needed.		

Statistical Package for Social Sciences (SPSS version 28) was used for data entry and analysis, and Microsoft Excel to generate graphs. Variables were expressed as a mean $\pm$ standard deviation (SD) or frequency and percentages.

RESULTS

A total of 100 anesthesia residents working at Baghdad Teaching Hospital and Ghazi Al Hariri Hospital for Surgical Specialties were enrolled in this study to determine the availability of the safety checklist and the compliance of the

anesthesia residents to use this checklist. The response rate was 100%.

Pre-operative assessment

One hundred anesthesia residents (100%) checked patients history patients', investigations, HR, BP, patients' fasting status, and availability of IV cannula and did a general examination. The overall score of compliance was 79.63%. At the same time, zero anesthesia residents did the Mallampati test, as shown in Figure 1.

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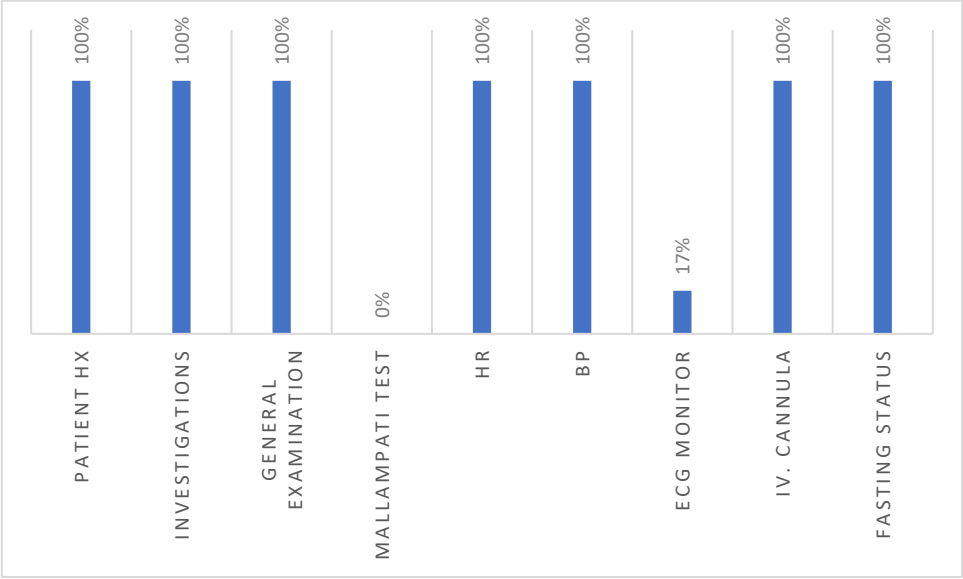


Figure 1: Pre-operative Assessment Checklist.

Anesthesia machine checklist

While 75 anesthesia residents (75%) and 100 (100%) turned on the anesthesia machine and monitor, and connected the central gas supply for O₂, respectively, as shown in Figure 2. The overall score of compliance was 30.56%. None of the

anesthesia residents adjusted the flow on the scavenger, checked the CO₂ absorbent, removed the oxygen analyzer fuel cell, nor confirmed the central supply gas pressures of $\pm$ 50 psi.

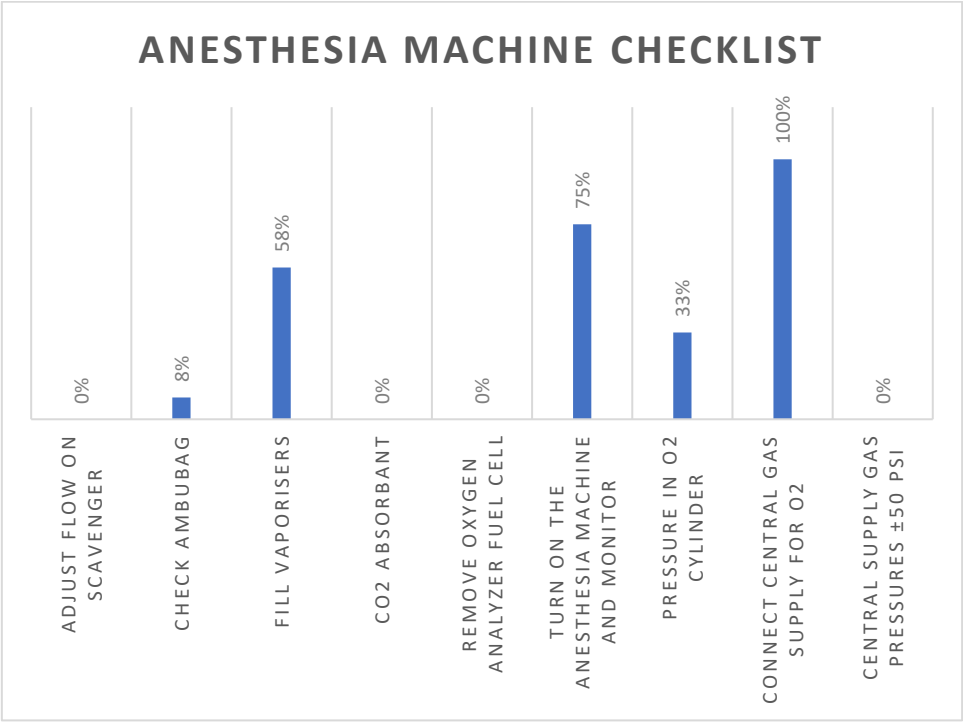


Figure 2: Anesthesia Machine Checklist.

Ventilator function checklist

None of the anaesthesia residents connected the reservoir bag to the Y-piece of the breathing circuit, positioned the selector valve to the ventilator, checked the unidirectional valve function, removed/replaced the reservoir bag, occluded a Y-

piece, nor turned off the ventilator. At the same time, 100 anaesthesia residents (100%) turned on the ventilator and set it at an appropriate tidal volume rate, I: E ratio, and pressure limit, as shown in Figure 3. The overall score of compliance was 13.89%.

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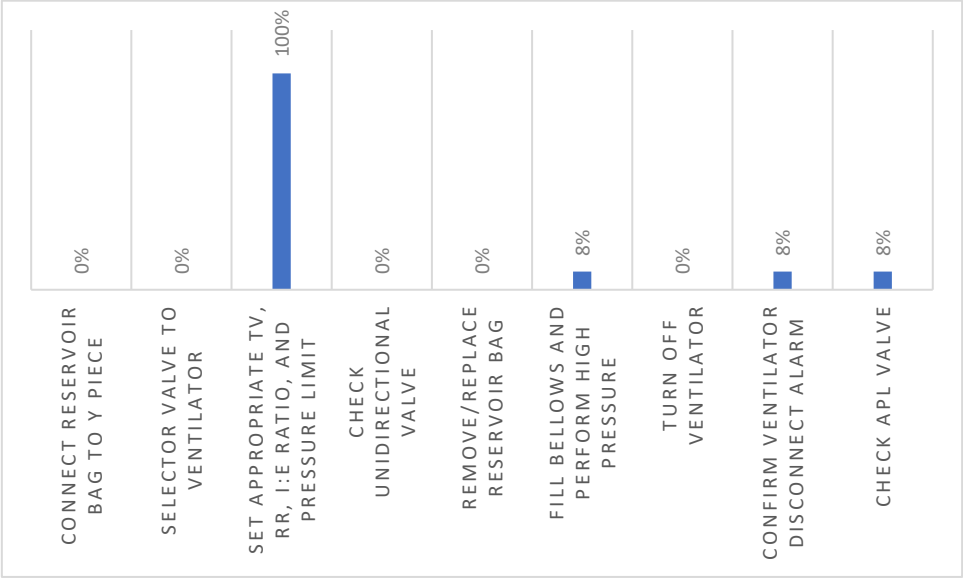


Figure 3: Ventilator Function Checklist

Equipment Checklist

The overall score of compliance was 83.33%. All of the 100 anaesthesia residents (100%) checked if an experienced and trained assistant was available to help them with the induction, checked tracheal tubes availability,

checked if the needles and syringes were sterile, the drugs were drawn into labelled syringes, and if the emergency drugs were available in the room if needed. While only 42 anaesthesia residents (42%) checked the availability of different types of blades, as shown in Figure 4.

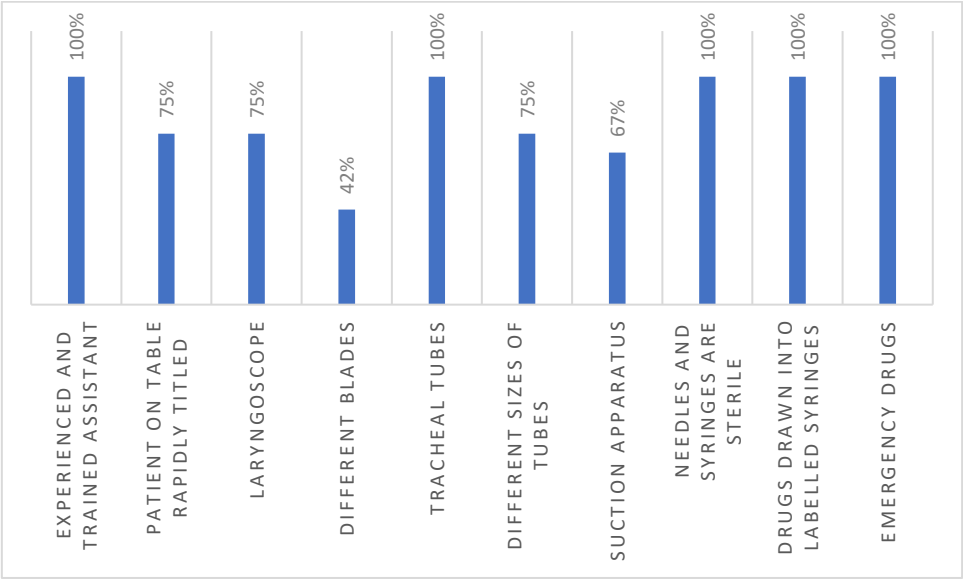


Figure 4: Equipment Checklist

DISCUSSION

This study was conducted to determine the availability of the safety checklist and the compliance of the anaesthesia resident to use this checklist. Pre-operative assessment is crucial to the patient’s anaesthesia care to improve patient outcomes from surgeries. In this study, the anaesthesia residents did almost all pre-operative patient assessments. Many studies have shown that pre-operative assessments focusing on general history, examination, pre-existing conditions, and anaesthesia history can help address modifiable risk factors preoperatively,

shorten the patient’s stay, and reduce anaesthesia complications.⁽¹⁶⁾ In a review where 25 articles were selected to investigate the effect of surgical safety checklists on the prevention of perioperative complications and errors, it was revealed that 93% of the studies assessed the implementation of anaesthesia-specific checklists had a reduction in intraoperative complications, human error, and intraoperative quality of care.⁽⁵⁾ While none of the anaesthesia residents did the Mallampati score test, the modified Mallampati score alone is inadequate

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to test difficult laryngoscopy or tracheal intubation. Still, it is a good part of a multivariate model for predicting difficult tracheal intubation, as shown in a Meta-analysis of 55 studies involving 177 088 patients (two studies account for 149 096 patients).⁽¹⁷⁾

Regarding pre-operatively monitoring, less than a quarter of the anesthesia residents checked the ECG monitor when this practice was considered a requirement in the USA. However, there was agreement at the Adelaide 1987 meeting on “Monitoring and Patient Safety” that “the use of an ECG monitor on every healthy child and young adult the disadvantages may outweigh the slender advantages.”. Because ECG provides a false sense of security, ECG electrodes consume more funds than other disposable items. It is used in a manner unlikely to detect ischemia. Therefore, later studies agreed that a pulse oximeter or stethoscope would detect any dysrhythmias for regular anesthesia in a healthy young patient then an ECG monitor is used to define its type.^(18, 19)

While the anesthesia machine most often had been linked to equipment morbidity, the results in this study showed that the total compliance score of the machine checklist was 30.56% which is way less than the score found in an institutional-based prospective observational study conducted at the University of Gondar comprehensive specialized hospital, where 90 anesthetists were included. The overall compliance rate was 87%.^(20, 21)

One of the crucial aspects of the anesthesia machine checklist is adjusting the flow on the scavenger because prolonged exposure to trace anesthetic gases may affect anesthesiologists to develop various organ system disorders. However, this study showed that non-anesthesia residents adjusted the scavenger flow because the scavenger system was not available in the first place.⁽²²⁾

Also, none of the anesthesia residents checked the CO₂ absorbent. However, CO₂ absorbent may contribute to ventilator problems due to water condensation and the production of dangerous substances such as compound A and may lead to rebreathing and hypercarbia.⁽²²⁾

Although one of the main problems of the anesthesia machine is related to insufficient ventilation and hypoxic gas delivery, none of the anesthesia residents checked the central supply gas pressures of ± 50 psi.⁽²²⁾

The overall ventilator function compliance score was 13.89%, and almost all the functions were not checked. This result needs to be performed more than an institutional-based prospective observational study conducted at the University of Gondar comprehensive specialized hospital.⁽²⁰⁾

A ventilator function check must be performed even if the automatic function test is done successfully because this check is among the anesthesia management factors associated with a decreased risk of death or coma. Therefore the anesthesiologist must be prepared for any sudden ventilator malfunctions.⁽²³⁾

The equipment's overall compliance score of 83.33% was the highest in this study. It was similar to a study conducted in Debre Berhan Comprehensive Specialized Hospital, North Shewa, Ethiopia, in 2020, where complex airway equipment preparation compliance was 85.2%. It is essential to check the anesthetic equipment daily and before every use because studies showed that 31% of equipment problems are related to under-checking before use.⁽²⁴⁾

This study showed that 100% of the anesthesia residents checked the presence of an experienced and trained assistant. Studies have shown that two persons compared to one person during anesthesia induction were associated with a decreased risk of mortality and morbidity.⁽²⁵⁾

The study's limitation was not exploring the main barriers affecting compliance with the safety checklist. The checklist was filled based on the researcher's observation of the residents, which may lead to information bias.

CONCLUSION

1. The overall anesthesia residents' compliance with the anesthesia safety checklist was poor.
2. There was a difference in the compliance score between the different parts of the questionnaire. For instance, preoperative assessment and equipment checklist overall scores are considered good. In contrast, anesthesia machines and ventilator function checklists are considered poor. This needs further evaluation.

RECOMMENDATIONS

1. Further analysis and studies are needed to explore the barriers affecting the anesthesia residents' compliance with the anesthesia safety checklist.
2. Activation of the curriculum of the anesthesia residents regarding implementing the anesthesia safety checklists.
3. Anesthesia specialists might consider the assessment of the anesthesia residents' compliance with the anesthesia safety checklist routinely at least once daily.

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