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Original Article

Perception of Anesthesia Technologists About the Barriers to Safe Anesthetic Care

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ABSTRACT

Background: Safe anesthetic care requires appropriate preparation, functional equipment, essential medications and supplies, physiological monitoring, effective teamwork, and structured postoperative handover. Anesthesia technologists contribute directly to these processes, but their perspectives remain insufficiently explored in Pakistan. Objective: To explore anesthesia technologists' perceptions of current practices and barriers affecting safe anesthetic care in tertiary care hospitals in Lahore. Methods: A qualitative exploratory study was conducted at Mayo Hospital, Sir Ganga Ram Hospital, and the University of Lahore Teaching Hospital. Sixteen anesthesia technologists were recruited purposively. Individual semi-structured interviews lasting approximately 25–35 minutes were audio-recorded, transcribed verbatim, and analysed using Braun and Clarke's six-phase thematic analysis framework. Results: Participants had a mean age of 27.63 ± 1.41 years and mean professional experience of 3.00 ± 1.10 years; 13 were male and three were female. Six themes were identified: perioperative safety practices; workforce shortage and workload pressure; equipment, supplies, and monitoring gaps; communication, teamwork, and hierarchy; protocols, reporting, and leadership support; and suggested improvements for safe anesthetic care. Participants described staffing shortages, malfunctioning or unavailable equipment, delayed repairs, inconsistent checklist use, hierarchical communication, and limited organizational learning as barriers that reduced safety margins. Conclusion: Participants perceived safe anesthetic care as dependent on the interaction of adequate staffing, functional resources, effective communication, standardized procedures, and responsive institutional support. Keywords: Anesthesia technologists; anesthetic safety; perioperative care; thematic analysis; patient safety; equipment readiness; workforce shortage; interprofessional communication.

INTRODUCTION

Safe anesthetic care is a fundamental component of perioperative patient safety. It extends beyond the administration of anesthetic agents and encompasses preoperative assessment and preparation, availability of essential medications and supplies, verification of anesthesia equipment, appropriate physiological monitoring, timely recognition and management of complications, effective communication among members of the perioperative team, and structured postoperative handover and recovery care. Deficiencies at any stage of this pathway may increase the risk of preventable patient harm and compromise the quality of surgical care (1,2).

Although substantial advances have improved anesthesia safety worldwide, access to consistently safe anesthetic services remains uneven, particularly in low- and middle-income countries. Resource-constrained health systems frequently experience shortages of trained anesthesia personnel, inadequate monitoring capacity, unreliable equipment, interruptions in essential supplies, delayed maintenance, and

limited institutional support. International standards for safe anesthesia practice therefore emphasize not only clinical competence but also appropriately trained personnel, functioning equipment, continuous monitoring, essential medications, accurate documentation, and adequately supported post-anesthesia recovery services (1–3).

Safe anesthesia delivery also depends on effective teamwork and reliable organizational systems. Operating-room care requires coordinated interaction among anesthesia providers, anesthesia technologists, surgeons, nurses, surgical technologists, and recovery personnel. Breakdowns in communication, unclear professional roles, rigid hierarchies, inconsistent checklist implementation, and weak incident-reporting mechanisms may prevent safety concerns from being communicated or addressed promptly. These challenges can be intensified by workforce shortages and high caseloads, which may reduce the time available for equipment checks, documentation, monitoring, handover, and adherence to established safety procedures (4–7).

Anesthesia technologists contribute directly to the operational delivery of perioperative care. Their responsibilities commonly include preparing anesthesia machines and airway equipment, ensuring the availability of medications and consumable supplies, assisting with physiological monitoring, supporting anesthesia providers during procedures, maintaining documentation, and facilitating patient transfer and postoperative handover. Because they work closely with equipment, supplies, monitoring systems, and other members of the perioperative team, anesthesia technologists are well positioned to identify practical deficiencies that may not be fully visible through administrative reports or studies focused exclusively on physicians.

Despite this frontline role, the perspectives of anesthesia technologists have received comparatively limited attention in research concerning anesthetic safety, particularly within Pakistan. Existing literature has primarily emphasized workforce capacity, international safety standards, surgical checklists, teamwork, and error-reporting systems, while providing limited insight into how anesthesia technologists experience these challenges during routine clinical practice. Understanding their perspectives may help identify modifiable barriers related to preparation, staffing, equipment, monitoring, communication, professional hierarchy, protocol implementation, and organizational response.

Therefore, this study aimed to explore anesthesia technologists' perceptions of current practices and barriers affecting the provision of safe anesthetic care in tertiary care hospitals in Lahore, Pakistan.

MATERIALS AND METHODS

A qualitative exploratory design was used to examine anesthesia technologists' perceptions and experiences of practices and barriers related to safe anesthetic care. This design was considered appropriate because the study sought detailed accounts of participants' routine clinical responsibilities, workplace experiences, perceived patient-safety challenges, and proposed improvements rather than numerical estimates of the prevalence or magnitude of these barriers.

The study was conducted in perioperative clinical areas at Mayo Hospital, Sir Ganga Ram Hospital, and the University of Lahore Teaching Hospital in Lahore, Pakistan. Relevant settings included operating theatres, preoperative holding areas, post-anesthesia recovery areas, and associated staff areas. Data were collected over a four-month period, with recruitment and interviewing continuing until the research team determined that sufficient information had been obtained to address the study objective and that additional interviews were no longer generating substantively new insights.

Participants were recruited through purposive sampling. Anesthesia technologists were eligible if they held a bachelor's degree in anesthesia technology, were working in a tertiary care hospital in Lahore, had at least one year of clinical experience in an anesthesia department, and voluntarily agreed to participate.

Temporary or visiting staff and individuals who were unavailable during the data-collection period were excluded. Sixteen anesthesia technologists meeting these criteria participated in the study.

Data were collected through individual semi-structured interviews using an interview guide developed around the objectives of the study. The guide explored participants' understanding of safe anesthetic care, routine perioperative safety practices, perceived barriers to safe care, experiences of equipment and monitoring availability, staffing and workload, communication and teamwork, checklist and reporting practices, and recommendations for improvement. The semi-structured format enabled the interviewers to address the same principal areas with all participants while allowing further exploration of relevant experiences raised during the interviews.

Each interview lasted approximately 25–35 minutes. Two members of the research team were present during data collection. One researcher conducted the interview and managed the consent process, while the second observed relevant contextual, verbal, and non-verbal cues. Interviews were audio-recorded with participants' permission and transcribed verbatim. Participant identities were replaced with coded identifiers to maintain anonymity, and the interview materials and transcripts were stored securely with access restricted to the research team.

Data were analysed using the six-phase thematic analysis framework described by Braun and Clarke (8). Analysis involved repeated familiarization with the interview transcripts, generation of initial codes, examination of relationships among codes, development of candidate themes, review and refinement of themes against the coded extracts and complete dataset, definition and naming of the final themes, and preparation of the analytical narrative. Participant quotations were retained to demonstrate the connection between the interpretations and the original accounts. The analysis focused on recurring patterns concerning perioperative safety practices, staffing and workload, equipment and monitoring, communication and hierarchy, protocols and reporting, leadership response, and suggested improvements to anesthetic care.

Ethical approval was obtained from the relevant institutional review board before data collection. All participants received information about the purpose and procedures of the study and provided written informed consent before participation. Participation was voluntary, and participants were informed of their right to decline to answer any question or withdraw without penalty. Confidentiality and anonymity were maintained throughout data collection, analysis, and reporting.

RESULTS

Sixteen anesthesia technologists from Mayo Hospital, Sir Ganga Ram Hospital, and the University of Lahore Teaching Hospital participated in the study. Participants ranged in age from 26 to 30 years, with a mean age of 27.63 ± 1.41 years. Their professional experience ranged from 2 to 5 years, with a mean of 3.00 ± 1.10 years. Thirteen participants were male and three were female. Participant characteristics are presented in Table 1.

Table 1. Characteristics of the Study Participants

Participant	Age, years	Sex	Professional experience, years
AT1	27	Male	3
AT2	26	Male	2
AT3	29	Male	4
AT4	27	Male	2
AT5	28	Male	3
AT6	26	Female	2
AT7	27	Female	3
AT8	30	Male	5
AT9	29	Male	4
AT10	27	Male	2

Participant	Age, years	Sex	Professional experience, years
AT11	28	Male	3
AT12	30	Male	5
AT13	26	Male	2
AT14	29	Male	4
AT15	27	Male	2
AT16	26	Female	2

Data are presented as individual participant characteristics. Mean age was 27.63 ± 1.41 years, and mean professional experience was 3.00 ± 1.10 years.

Thematic Findings

The verbatim interview transcripts were analysed using Braun and Clarke's six-phase thematic analysis framework. The analysis generated six interrelated themes: perioperative safety practices; workforce shortage and workload pressure; equipment, supplies, and monitoring gaps; communication, teamwork, and hierarchy; protocols, reporting, and leadership support; and suggested improvements for safe anesthetic care. The themes and corresponding subthemes are summarized in Table 2.

Table 2. Themes and Subthemes Identified Through Thematic Analysis

Theme	Subthemes
Perioperative safety practices	Preoperative preparation; intraoperative monitoring and assistance; postoperative handover and recovery support
Workforce shortage and workload pressure	Staff shortages; rushed or incomplete safety tasks; continuation of cases with reduced safety margins
Equipment, supplies, and monitoring gaps	Faulty or unavailable equipment; delayed procurement and repair; essential monitoring requirements
Communication, teamwork, and hierarchy	Interprofessional coordination; limited professional voice of technologists; role clarity and professional recognition
Protocols, reporting, and leadership support	Checklist use and protocol enforcement; response to reported concerns; administrative follow-up and organizational learning
Suggested improvements for safe anesthetic care	Equipment and medication availability; improved staffing and workload control; training and communication; checklist and reporting improvements

Theme 1: Perioperative Safety Practices

Participants described safe anesthetic care as a continuous process extending from preparation before induction to intraoperative monitoring and postoperative transfer and recovery. They emphasized that patient safety depended on the readiness of anesthesia machines, airway devices, monitoring equipment, anesthetic and emergency medications, and personnel before the initiation of anesthesia.

Preoperative preparation was regarded as a central responsibility of anesthesia technologists. Participants reported that they routinely checked anesthesia machines, airway equipment, monitors, emergency medications, and anesthetic agents before procedures. One participant explained:

> *"My responsibility is to prepare and check anesthesia machine, airway, monitors, emergency drugs and anesthetic drugs." (AT16)*

Participants also considered continuous physiological monitoring essential for the early identification of patient deterioration during the perioperative period. The monitoring parameters most frequently emphasized in their accounts included oxygen saturation, blood pressure, electrocardiography, and capnography:

> *"The most essential parameters and vitals which must be monitored during pre-op, intra op and post op are Pulse oximeter, Blood pressure monitoring, Capnography and ECG." (AT11)*

Safe postoperative transfer and recovery support were viewed as integral components of anesthetic care rather than activities occurring after the technologist's primary responsibilities had ended. Participants described assisting with extubation, patient transfer, and transition from the operating theatre to postoperative care:

> *"First, in the pre-op, we will check all the equipment, and prepare the drugs; second, in the surgery we keep an eye on patients; and thirdly after surgery, after extubating, we can help in shifting from the operation theatre to the post-operative care." (AT5)*

Collectively, these accounts demonstrated that participants understood safe anesthetic care as an interconnected perioperative pathway requiring preparation, vigilance, and continuity of care.

Theme 2: Workforce Shortage and Workload Pressure

Staff shortages emerged as a major organizational barrier to safe anesthetic care. Participants reported that an insufficient number of anesthesia technologists increased individual workload, work-related stress, and time pressure. These conditions affected their ability to complete routine safety activities consistently, including equipment checks, documentation, monitoring, checklist completion, and patient handover.

One participant described the relationship between staffing levels, workload, and the quality of anesthesia care:

> *"There is a wide shortage of anesthesia technologists, as this adds to the workload and stress of the few available technologists, impacting anesthesia care." (AT16)*

Participants explained that safety-related documentation and checklists were among the activities most likely to remain incomplete when staffing was inadequate:

> *"In situations where staffing levels are inadequate, the required documentation of the patient, WHO checklist and machine checklist are not completed." (AT7)*

Participants further indicated that surgical procedures commonly continued despite staffing shortages. Consequently, cases were managed with fewer personnel and reduced capacity to complete all safety-related activities:

> *"Patient's safety is reduced due to insufficient number of staff; there is usually no postponement or delay of cases." (AT8)*

These findings indicated that staffing shortages did not simply increase workload but could progressively reduce the safety margin within which anesthesia teams operated.

Theme 3: Equipment, Supplies, and Monitoring Gaps

The availability and functionality of anesthesia equipment, consumable supplies, and physiological monitoring systems were repeatedly identified as essential determinants of safe anesthetic care. Participants reported encountering malfunctioning or unavailable equipment during routine clinical work, including defective airway devices, suction systems, and monitoring equipment.

One participant summarized commonly encountered equipment problems:

> *"Lack of equipment, malfunctioning equipment, blade dysfunction, and suction not working properly are the most common problems that we face." (AT7)*

Participants also described prolonged delays in procuring advanced equipment or replacing unavailable devices. These delays limited the ability of clinical teams to respond optimally to difficult or high-risk situations:

> *"For example, if we require a video laryngoscope, we need to wait 6 to 8 months or more until we get it." (AT1)*

Adequate monitoring was viewed as an essential early-warning mechanism during anesthesia. Participants emphasized the need for basic and advanced monitoring according to the clinical condition of the patient:

> *"The first should be the ECG, the second should be the pulse oximeter data, the third should be the non-invasive blood pressure measurement, and the fourth should be end-tidal CO2, the fifth maybe be the invasive blood pressure monitoring." (AT9)*

The accounts showed that equipment safety involved more than the initial availability of devices. It also depended on maintenance, timely repair, replacement, procurement, and reliable access to monitoring resources during patient care.

Theme 4: Communication, Teamwork, and Hierarchy

Participants regarded effective communication and teamwork as necessary for patient preparation, induction, intraoperative monitoring, emergency response, and postoperative handover. Safe anesthetic care required coordination among anesthesia technologists, anesthesia providers, surgeons, surgical technologists, nurses, and recovery personnel.

However, participants perceived communication across professional groups as inconsistent:

> *"It's really very important for good anesthesia care and for patient safety, in our work place communication and team work is a little bit lacking between anesthesia technologists, anesthetists, surgical technologists, our surgical doctors, and our nurses." (AT4)*

Professional hierarchy was reported to influence whether concerns raised by anesthesia technologists were considered during clinical decision-making. Some participants believed that their observations

were given less importance because technologists occupied a lower position within the perceived professional hierarchy:

> *"In every hospital there is a hierarchy where Anesthetists feel that they are higher in ranking compared to Anesthesia Technologists and this has affected the role of the Anesthesia Technologists opinion and some issues have been left out or neglected due to this hierarchy." (AT1)*

Despite not being responsible for independent clinical decision-making, participants considered their involvement relevant to patient-centred perioperative care:

> *"It is important to note that the anesthesia technologist can play a part in patient-centered perioperative care that is independent of that in the operating theatre, even if it does not involve making clinical decisions." (AT7)*

These accounts suggested that communication difficulties were connected not only to interpersonal coordination but also to role recognition, professional authority, and the ability of technologists to raise safety concerns.

Theme 5: Protocols, Reporting, and Leadership Support

Participants emphasized the importance of standardized protocols, safety checklists, incident-reporting systems, and timely administrative responses. They considered these systems valuable for promoting consistency in patient identification, surgical verification, equipment checks, and anesthesia preparation. However, their effectiveness depended on regular implementation, enforcement, feedback, and organizational follow-up.

One participant explained that checklists and policies were available but were not used consistently:

> *"All hospitals, including our hospital have policies, checklists: WHO surgical safety checklists, name of patient, surgical marking, checking of anesthesia machine and equipment checking. They are not being used 100% of the time, but most of the time, and each have a dedicated team of staff that work on it." (AT3)*

Some participants described positive institutional responses when equipment problems were reported. For example, one participant reported that a faulty pulse oximeter was repaired promptly:

> *"Once, I said something like that: the pulse oximeter is providing false readings; then, within 24 hours, it's fixed; I think that was a good response, I think I'm satisfied with that." (AT1)*

Nevertheless, other participants distinguished between resolving an individual equipment fault and creating organizational learning that could prevent recurrence. One participant expressed concern that the immediate problem had been corrected without corresponding revision of the relevant checklist or protocol:

> *"I reported an issue regarding a faulty oximeter, and the issue was resolved within 24 hours. But what concerns me is that there was no change in the safety checklist or protocols, and I think that can harm patient safety in the future." (AT13)*

The findings therefore demonstrated variation in institutional responsiveness. Although individual concerns could receive prompt attention, participants perceived weaknesses in feedback, protocol revision, and systematic learning from reported safety problems.

Theme 6: Suggested Improvements for Safe Anesthetic Care

Participants proposed practical improvements based on their routine experiences in perioperative clinical settings. Their recommendations focused on reliable equipment, adequate supplies and medications, appropriate staffing, manageable workloads, regular training, effective communication, consistent checklist implementation, and accessible reporting systems.

The availability of functional equipment, disposable supplies, and emergency medications before the commencement of anesthesia was repeatedly emphasized:

> *"First, there have to be effective communications because that's critical when you're under anesthesia; the second is disposable items, which would help minimize the opportunity for cross-contamination and infection; the third is having all medications, including emergency medicines in front of you." (AT3)*

Participants also identified staffing, equipment, monitoring, and checklist use as interconnected priorities:

> *"The three things I would want at the top of my list for availability when it comes to the essential monitoring and functional anesthesia equipment, staff improvement and workload, and a good checklist." (AT10)*

Training, communication, and reporting-system improvement were viewed as comparatively feasible strategies, whereas recruiting additional personnel and procuring equipment were recognized as potentially more time- and resource-intensive:

> *"There are several possible solutions, such as training staff, modifying checklists, and/or improving the reporting system, but some may be time-consuming, like getting additional staff or equipment." (AT1)*

Participants further recommended that reporting mechanisms should be simple, confidential, and safe for staff to use:

> *"A reporting system should be easy to use and anonymous." (AT16)*

Overall, participants perceived safe anesthetic care as dependent on the interaction of competent personnel, functional resources, effective teamwork, standardized procedures, and responsive institutional leadership. The findings suggested that deficiencies in one area could affect multiple stages of the perioperative pathway, particularly when staffing shortages, equipment problems, hierarchical communication, and inconsistent reporting occurred simultaneously.

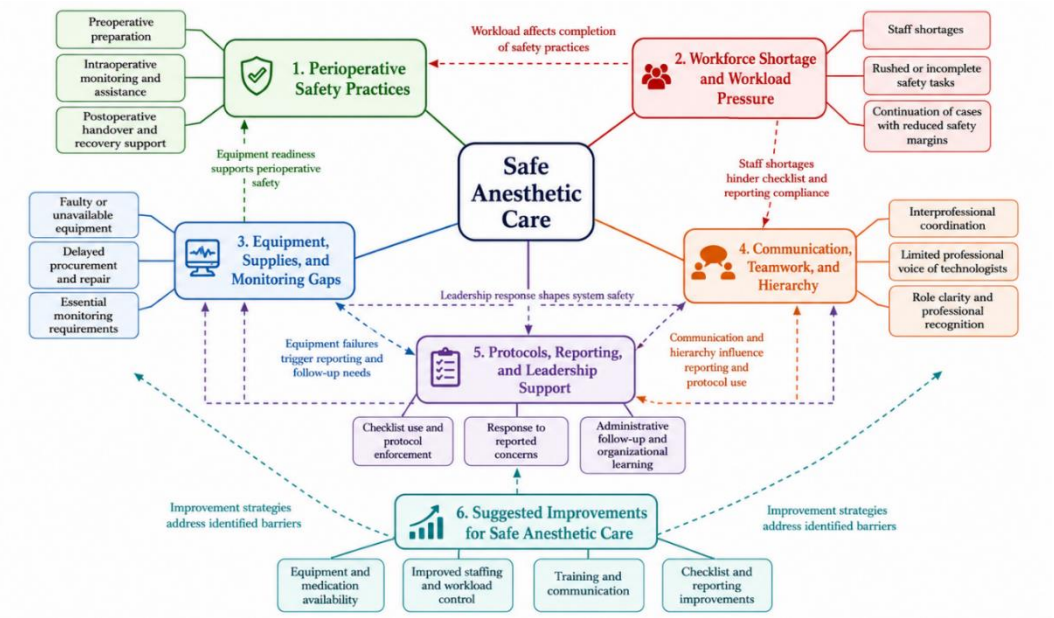

Figure 1. The thematic network illustrates safe anesthetic care as an interconnected system shaped by perioperative preparation and monitoring, workforce capacity, equipment and supply readiness, communication and professional hierarchy, and the strength of protocols, reporting, and leadership support. Staffing shortages, equipment failures, weak communication, and inconsistent checklist use can reduce safety margins, whereas improved staffing, functional equipment, training, effective communication, and accessible reporting systems may strengthen perioperative safety.

DISCUSSION

This qualitative study explored anesthesia technologists' perceptions of practices and barriers affecting safe anesthetic care in three tertiary care hospitals in Lahore. Participants understood anesthetic safety as a continuous perioperative process encompassing preparation before induction, availability and functionality of equipment and medications, intraoperative monitoring and assistance, effective interprofessional communication, and structured postoperative transfer and recovery support. Six interrelated themes were identified: perioperative safety practices; workforce shortage and workload pressure; equipment, supplies, and monitoring gaps; communication, teamwork, and hierarchy; protocols, reporting, and leadership support; and suggested improvements for safe anesthetic care. Collectively, the findings indicated that participants did not perceive patient safety as dependent on a single professional activity. Instead, they described it as the product of interactions among competent personnel, functional resources, reliable organizational procedures, and a working environment in which safety concerns could be communicated and acted upon.

Participants' emphasis on preparation, equipment readiness, essential medications, physiological monitoring, and recovery support was consistent with established international standards for safe anesthesia practice. These standards identify appropriately trained personnel, reliable anesthesia equipment, essential medications, continuous monitoring, documentation, and adequately supported recovery care as fundamental components of patient safety (1,2). The accounts in the present study extended these principles by demonstrating how anesthesia technologists contributed operationally at each stage of the perioperative pathway. Their proximity to anesthesia machines, airway devices, medications, consumable supplies, and monitoring systems placed them in a position to identify practical deficiencies before and during patient care. This frontline perspective may complement

physician-led assessments and administrative safety reports by revealing routine operational problems that are not always captured through formal institutional monitoring.

Workforce shortage and workload pressure emerged as important threats to consistent safety practices. Participants associated inadequate staffing with increased stress, rushed work, incomplete equipment checks, omissions in documentation, inconsistent checklist completion, and reduced attention to handover. Global evidence has demonstrated major inequalities in the distribution and availability of trained anesthesia personnel, particularly in resource-constrained health systems, where limited workforce capacity can restrict access to safe surgical and anesthetic care (1,3). The findings of the present study suggested that the consequences of workforce shortage extended beyond staff inconvenience or job strain. Participants perceived that inadequate staffing progressively reduced the time and attention available for routine safety processes, thereby narrowing the margin within which anesthesia care could be delivered safely.

A particularly important finding was that surgical procedures were generally perceived to continue despite inadequate staffing. This suggested that workload pressure could become normalized within routine clinical practice, with individual staff members attempting to compensate for organizational shortages. Although the present study could not determine the frequency or clinical consequences of such situations, the accounts raised concern that production demands and continuity of operating lists might take precedence over optimal staffing conditions. This interpretation should be approached cautiously because the study was based on participants' perceptions rather than direct observation or incident data. Nevertheless, the finding highlights the need for institutions to define minimum staffing expectations, escalation procedures, and circumstances in which safety concerns should lead to reassessment of whether a case can proceed.

Equipment, supplies, and monitoring gaps were also central to participants' accounts. Problems included unavailable or malfunctioning devices, defective airway equipment, unreliable suction, delayed repairs, prolonged procurement processes, and limited access to advanced monitoring. International anesthesia standards emphasize that safe care requires functional and regularly maintained equipment, appropriate monitoring, and immediate availability of essential medications and supplies (2). Participants' accounts demonstrated that nominal ownership of equipment was insufficient if devices were unavailable, non-functional, awaiting repair, or not accessible when required. These findings were also consistent with evidence from resource-limited settings in which equipment shortages, maintenance delays, workforce limitations, and restricted monitoring capacity have been identified as barriers to safe anesthesia delivery (3,9).

The monitoring requirements identified by participants reflected the importance of continuous physiological surveillance during anesthesia. Participants emphasized electrocardiography, pulse oximetry, non-invasive blood pressure monitoring, capnography, and, when clinically indicated, invasive blood pressure monitoring. Their descriptions positioned monitoring as an early-warning mechanism rather than a passive documentation requirement. This finding reinforces the importance of ensuring that monitoring devices are not only available but are functional, correctly maintained, and supported by staff who are trained to recognize and communicate abnormal findings. Equipment maintenance systems should therefore include preventive inspection, timely repair, replacement planning, and clear reporting pathways rather than relying solely on corrective action after a device has failed.

Communication and teamwork were perceived as necessary throughout preparation, induction, maintenance of anesthesia, emergency response, and postoperative handover. Previous qualitative research has shown that operating-room teamwork may be disrupted by unclear roles, professional boundaries, communication failures, competing priorities, and differences in authority among occupational groups (5,6). The present findings were consistent with this evidence but added a specific focus on anesthesia technologists, who described contributing clinically relevant observations while having limited authority over decision-making. Participants did not claim responsibility for independent

anesthetic decisions; rather, they emphasized the importance of having their equipment-related and patient-safety concerns heard by senior members of the perioperative team.

Professional hierarchy appeared to influence whether technologists felt able to contribute fully to patient safety. Some participants believed that concerns were ignored or undervalued because anesthetists occupied a higher professional rank. Hierarchical relationships are not inherently unsafe, because clearly differentiated responsibility is necessary in clinical care. However, hierarchy can become problematic when it discourages speaking up, prevents clarification, or leads team members to dismiss safety-relevant information because of the status of the person reporting it. Human-factors research has emphasized that safe surgical and anesthetic care depends on communication, shared situational awareness, role clarity, and the capacity of team members to raise concerns without fear of humiliation or retaliation (5,6). The findings therefore support the development of team cultures in which professional authority remains clear but safety-related communication is actively invited from all members of the perioperative team.

Protocols and checklists were viewed positively, but participants reported that they were not implemented consistently. Surgical safety checklists can standardize communication and verification processes, but their effectiveness depends on meaningful implementation rather than completion as a routine administrative exercise. Barriers to effective checklist use may include time pressure, poor adaptation to local workflows, limited staff engagement, inadequate leadership support, and the perception that checklist completion is secondary to clinical activity (4). In the present study, staffing shortages and workload pressure appeared to interact with inconsistent checklist use, suggesting that protocol non-adherence should not be interpreted only as individual negligence. Institutional conditions may make full compliance difficult even when staff recognize the value of the checklist.

Participants' accounts of incident reporting and administrative response revealed both positive and negative experiences. Prompt repair of a malfunctioning pulse oximeter demonstrated that reporting could lead to effective immediate action. However, another participant distinguished between correction of an individual fault and organizational learning, noting that repair was not followed by revision of the relevant checklist or protocol. This distinction is important because a safety system should not merely restore faulty equipment but should also examine why the problem occurred, whether similar risks exist elsewhere, and whether procedures require modification. Previous research has identified fear of blame, complex reporting systems, limited feedback, professional hierarchy, and weak institutional follow-up as barriers to reporting clinical errors in operating theatres and intensive care units (7). Participants' recommendation for a simple and anonymous reporting system reflected the need for psychologically safe and accessible reporting mechanisms accompanied by visible feedback and preventive action.

The six themes were closely interconnected rather than independent. Workforce shortage increased time pressure and contributed to incomplete documentation and checklist use. Equipment failures generated a need for reporting, maintenance, and leadership response. Communication and hierarchy influenced whether safety concerns reached decision-makers. Leadership support shaped staffing, procurement, protocol enforcement, and organizational learning. Suggested improvements therefore addressed both immediate clinical resources and broader institutional processes. This interconnected structure is represented in the thematic network figure, in which safe anesthetic care is positioned as the central outcome shaped by the interaction of perioperative practices, workforce capacity, equipment readiness, teamwork, protocols, reporting, and leadership.

Participants proposed several contextually relevant improvements, including adequate staffing, workload control, functional equipment, availability of essential medications and disposable supplies, regular training, improved communication, consistent checklist use, and accessible reporting systems. Some interventions, such as communication training, checklist review, reporting-system simplification, and clearer escalation pathways, may be implemented through organizational change. Others, including workforce expansion and procurement of advanced equipment, require longer-term financial and

administrative planning. The findings suggest that institutions should avoid treating these strategies as alternatives. Training cannot compensate indefinitely for inadequate staffing, and procurement alone cannot ensure safety in the absence of communication, maintenance, and accountability systems.

This study had several strengths. It focused on anesthesia technologists, a professional group whose experiences have received limited attention in perioperative safety research. It included participants from three tertiary care hospitals and used semi-structured interviews to obtain detailed accounts of practices, barriers, and proposed improvements across the perioperative pathway. The use of verbatim quotations strengthened the connection between the reported themes and participants' original accounts.

The findings should nevertheless be interpreted in view of important limitations. The sample was small and restricted to anesthesia technologists working in three tertiary care hospitals in Lahore; therefore, the findings may not reflect the experiences of technologists in smaller hospitals, private facilities, rural settings, or other regions of Pakistan. Participants may have moderated criticism because they were discussing workplace practices and professional hierarchy. The study did not include anesthesiologists, surgeons, nurses, hospital administrators, or biomedical engineering personnel, whose perspectives may have differed from those of anesthesia technologists. The findings were based on self-reported experiences and were not triangulated through direct observation, document review, equipment audits, incident reports, or patient-safety outcome data. The participant distribution across the three hospitals was not reported, limiting assessment of institutional variation. In addition, the available manuscript did not describe interview language, translation procedures, researcher reflexivity, or specific trustworthiness strategies in sufficient detail, and these methodological features should be transparently reported from the original study records.

Despite these limitations, the study demonstrated that anesthesia technologists perceived safe anesthetic care as a system-level responsibility extending from preoperative preparation to postoperative recovery. Their accounts highlighted how resource limitations, staffing pressure, communication, hierarchy, checklist implementation, and institutional responsiveness could interact to influence routine safety practices. These findings may inform locally appropriate quality-improvement initiatives and support the inclusion of anesthesia technologists in multidisciplinary discussions concerning perioperative safety.

CONCLUSION

Anesthesia technologists working in the participating tertiary care hospitals perceived safe anesthetic care as an interconnected perioperative process dependent on adequate preparation, functional equipment, essential medications and supplies, appropriate monitoring, effective teamwork, consistent protocol use, responsive reporting systems, and safe postoperative handover. Staffing shortages, workload pressure, equipment and monitoring deficiencies, communication barriers, professional hierarchy, inconsistent checklist implementation, and limited organizational follow-up were perceived to reduce the safety margin of care. The findings reflect the experiences of the participating technologists and indicate that strengthening anesthetic safety requires coordinated attention to clinical resources, workforce capacity, communication, and institutional safety systems.

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