CRITICAL ANAESTHETIC INCIDENTS CAUSES AND ANALYSIS

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ABSTRACT

Objective: To improve the standard operating procedures (SOPs) for perioperative anesthesia management and reduction of complications where human error is involved.

Study Design: Retrospective observational descriptive study.

Place and Duration of Study: Department of Anesthesiam, Combined Military Hospital (CMH) Lahore, from Jun 2017 to Jun 2018.

Material and Methods: Anesthesia related critical incidents were reported voluntarily in a proforma in this study. Results were then analyzed and audited for human errors, equipment malfunction, drug mishaps, patient factors, and nature of surgeries. Averages and percentage were calculated for these occurrences.

Results: During one year 159 critical incidents (1.56%) were reported in 10181 patients. Airway and pulmonary incidents (49%), cardiovascular (42.1%) drug related (5%) and rare causes were (3.9%). Most incidents occurred during maintenance phase (40.88%), followed by emergence (25.16%), induction (23.27%) and post-operative period (10.69%). General anesthesia (1.56%), regional anesthesia (1.78%) and local anesthesia under monitored care (0.56%) were responsible for these adverse events. Analysis for reasons of these incidents suggested human errors (47.16%), patient's comorbids (28.30%), nature of surgical procedures (24.52%) and combined factors were (71%). Anesthesia related mortality in our study was 5 deaths per 10000 anesthetics.

Conclusion: Critical incidents do occur even in the hands of highly qualified and skilled anesthesiologists but can be minimized by continuous efforts through reporting and analysis of these events and hence formulating safety protocols.

Keywords: Analysis, Critical incident reporting, Safety protocols.

INTRODUCTION

A critical incident in anesthesia is generally defined as any untoward and preventable mishap associated with administration of general anesthesia, regional anesthesia or during monitored anesthesia care which leads to, or could have led to undesirable patient outcome. A near miss is an event under anesthesia care which has the potential to lead to these events[1]. However question of how to define critical anesthesia event and how to differentiate it from accident is a continuous debate[2]. Usually an analogy is drawn between anesthesia and air flight safety system. In aviation the incidents are differentiated from accidents simply on the basis of not doing any harm to the personnel and only minor damage to the equipment. A model adopted from aviation and oil industry can help to define critical incident.

Every unusual occurrence can have its origin in process from the faulty technique, the environment factors, and human errors or a combination of these factors. This event can either return to normal operations if the primary defenses such as standard operating procedures (SOPs) are in place and function sufficiently, when these defenses fail critical event is triggered[3]. If the process of a critical event is not halted an accident will happen.

Anesthesia related mortality has been on the decline in the past three decades due to several measures that have been adopted to improve patient safety[4]. Among these is review of critical incidents and near misses occurring during

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anesthesia as well as factors contributing to these incidents[5].

Incident reporting is a tool for quality improvement[6]. It has proven beneficial in numerous disciplines such as aviation and petroleum industry[7]. Every system is as safe as involved structures, technique and processes are[8]. Incident reporting system can help in improving the complex process of care in anesthesiology and other domains in health care[9].

Audit of critical incidents enables anesthesia department to minimize adverse events and ascertain factors which contribute to such happenings[10]. If an unusual situation that nobody has ever considered develops with no guideline or SOP's in place, a rigid system will fail[11]. Incident reporting acts like a window to the system revealing weakness of the system involved[12]. This is especially true in so called non linear systems with complex couplings. At its best, reported incidents are used to improve the system because repeated events or near misses of the same kind happening again and again result in system failure[13]. The purpose of this study is to improve standard operating procedures (SOPs) for preoperative anesthesia management and reduction of complications where human error is involved.

PATIENTS AND METHODS

This prospective descriptive observational study was carried out in Combined Military Hospital (CMH) Lahore a tertiary care from Jun 2017 to Jun 2018, 1000 bedded Pak Emirates Military Hospital. Surgical procedures belonging to various surgical subspecialties are being performed here in 11 operating rooms.

Study population included demographically patients of either sex and of all ages belonging to ASA class I-IV. All types of anesthesia modalities like general anesthesia, regional anesthesia and monitored anesthesia care were included in the study and by adopting non probability convenience sampling technique. Since it was observational study consent of patients was not required.

The study protocol was approved by the hospital ethical committee. The study team included four consultants and eight post graduate residents. A critical incident proforma was designed. Anesthesiologists were regularly reminded to report critical incidents on anonymous and voluntary basis and care was taken to have complete confidentiality. During weekly meeting of anesthesia team these critical events were discussed and analyzed.

In faculty meeting of the department it was decided to implement critical incident reporting as the quality assurance measure and anesthesiologists were asked to report 24 hour perioperative incidents occurring in patients subjected to anesthesia. A critical event was defined as "An event under anesthesia care which had the potential to lead to substantial negative outcome (ranging from increased length of hospital stay to death or permanent disability or cancelled operative procedure) if not addressed in time".

A systematic method for the investigation of anesthetic incident was adopted. Performa was having two parts, a descriptive part and analytical part was used. Descriptive part was filled by the anesthesiologists who handled the case initially. Analytical part was filled by the consultants after investigations.

Anesthetic analysis protocol was structured a framework for investigation of five separate elements of the total system. These were the patient, the operation, the incident, equipment, environment, and personnel. Each of these areas was subdivided, for patient history, physical examination and laboratory investigations and autopsy in case of death.

The following were recorded in the critical incident reporting form:

- Age, sex, ASA class of the patient, timing of the surgery, anesthetic technique, and elective or emergency surgery.
- Phase of critical incident

- Critical incident categories: Airway and ventilator problems, cardiovascular problems, blood transfusions, drug errors etc.
- Probable causes of critical incidents which could be human error, surgical factor or pharmacological factor.

Following definitions were employed for the respective events:

- Difficult intubation if more than three attempts required.
- Bradycardia/tachycardia if more than 30% deviation from the accepted normal for age.
- Hypotension/ hypertension if more than 30% deviation from the baseline blood pressure.
- Desaturation if SPO_2 <90%

The descriptive data of the following variables was analyzed by using number and percentages with help of Microsoft Excel for the following:

a. Percentage of critical incidents in different specialties.
b. Number and percentages of critical incidents according to various systems involved.
c. Number and percentages of on table deaths and deaths within 24 hours of surgery.

Furthermore frequencies and percentages of critical incidents were calculated for emergency and elective surgeries.

Various factors contributing towards occurrence of critical incidents were also calculated interms of total number and percentages.

RESULTS

During one year period 159 (15.6%) critical anesthesia related incidents occurred among 10181 patients who were operated upon in CMH Lahore.

Highest number of patients operated were of gynecology and obstetrics 32.41%, followed by ophthalmology 22.65% and general surgery 14.34% (figure).

Table-I: Distribution of critical incidents according to system involved for n=159.

System Involved	Event Description	No of Cases	Percentage
Airway & Pulmonary Problems	Laryngospasm	40	51.3
	Hypoventilation	17	21.8
	LMA malfunction	05	6.4
	Pulmonary edema	04	5.1
	Pulmonary Embolism	03	3.8
	Failed Intubation	02	2.56
	Anesthesia Machine Malfunction		3.8
	Accidental Extubation	01	1.3
	Esophageal Intubation	01	1.3
	Circuit disconnection	02	2.56
	Total	78	49
Drugs Related Mishaps		07	4.4
Cardiovascular events	Bradycardia	30	44.78
	Dysrythmia	07	10.45
	Hypotension	27	40.3
	Cardiac Arrest Revival in OT	03	4.4
Total		67	42.14
Death	Cardiac arrest leading to death in OT	02	28.6
Total	Death within 24 Hours	05	71.4
		07	4.4
Grand total	159		

Mean age of the patients operated was 46 ± 4 out of which 624 (61.3%) were females and 3940 (38.7%) males.

However, mean age of patients who had critical anesthesia related incidents n=159 was 32 ± 3 out of which 114 (71.4) were females and 45 (28.6) were males.

Airway and pulmonary problems were the most frequent (49%), followed by cardiovascular and hemodynamic problems (42.14%). Wrongly administered drugs were responsible for 4.4% of the cases. Laryngospasm and hypoventilation were most commonly identified problems in respiratory system where as bradycardia and significant hypotension were the commonest problems regarding cardiovascular and hemodynamic (table-I).

Highest critical incidents occurred in general surgery & obstetrics and gynecological surgery because these were the most frequently performed operations. However the percentage of these anesthesia related adverse events was highest in vascular (12.18%), urology (1.19%) pediatric (8.9 %) and thoracic surgery (5.26%) table-II.

Most of the critical incidents occurred during maintenance phase of anesthesia (40.88%) followed by emergence (25.16%), induction (23.27%) and post-operative recovery periods (10.69%).

Table-II: Distribution of critical incidents according to sub specialty involved.

Serial Number	Surgical Specialty	Total Cases	Percentage
Gynecology & Obstetrical	3300	45	1.36
General Surgery	1460	35	2.39
Pediatric Surgery	190	13	6.84
Otorhinolaryngology	793	13	1.64
Thoracic Surgery	209	11	5.26
Urology	757	9	1.19
EYE	2307	5	0.22
Orthopedic	759	7	0.92
Vascular	156	19	12.18
Neuro	250	2	0.8
Total	10181	159	

Table-III: Rate of critical Incidents based on techniques of anesthesia.

Types	Total Cases	Critical Incidents	Percentage
General Anesthesia	4594	83	1.8
Spinal Anesthesia/Epidural Aesthesia	3638	65	1.78
Local Anesthesia /Monitored Anesthesia	1949	11	0.56
Overall Cases	10181	159	1.56

Table- IV: Analysis for reasons of critical incidents for (n=159).

Factors Implicated	Critical Incidents	Percentage
Anesthetist (Human Errors)	75	47.16
Patient's Comorbids	45	28.30
High risk surgical procedure	39	24.52
Combined Factors	113	71

Rate of complications in general anesthesia (1.8%) was almost equal to regional anesthesia (1.78%). However rate of complications in local anesthesia performed under monitored anesthesia care (0.56%) was significantly less (table-III).

Factors which were implicated contributing to occurrence of these events were analyzed. Human error (judgment, late identification of a complication, and lack of prompt response on the part of anesthetists) was commonest (47.16%). Patient's comorbids (28.30%) and high risk

surgical procedures (24.52%) were also significant. Seventy one percent affected patients had multiple contributing factors (table-IV).

Rate of critical incidences was higher (2.16%) in emergency surgery as compared to elective surgery (1.14%).

DISCUSSION

Critical incident reporting and audit are imperative to improve the standards of safety protocols in anesthesia practice[14]. Critical incidents sharing and discussing at various levels educate the young evolving anesthesiologists[15].

Anesthesia related morbidity and mortality has markedly decreased in last three decades

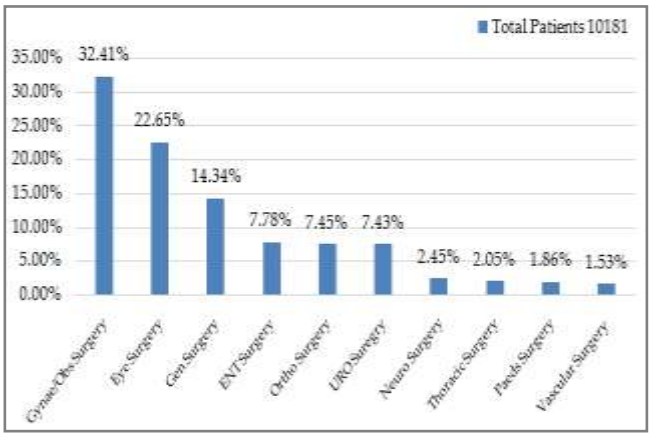

Figure: Operation performed in CMH lahore during the study period.

with advent of modern monitoring techniques even in developing countries, but still there is lot to be desired to get to the standards of modern world[16].

The ASA has recommended standards of monitoring for the safe delivery of anesthesia. Standard I was the continuous presence of qualified personnel during any general anesthesia, regional anesthesia and monitored anesthesia care[17]. Standard II is that during all anesthetics the patient's oxygenation, ventilation, circulation and temperature shall be continually monitored[18].

In our set up for eleven operating theaters only four consultants are available who administer anesthesia to the patients and supervise eight resident fellowship trainees. Because of the paucity of qualified anesthesiologists in spite of sufficient monitoring equipments it becomes hard to meet ASA standards of minimum monitoring during anesthesia and hence operating environment becomes quite vulnerable for anesthesia related mishaps[19].

CMH Lahore is a tertiary care hospital where sick patients for complicated surgeries are referred from different places. In prospective study such as this the reporting avoids the problems of inaccurate recall and allows a warning and advice to be issued if necessary soon after the occurrence.

Frequency of critical incidents was 1.56% which was attributable to anesthesia. There was probably under reporting by resident anesthetists in spite of assurance and motivation, especially when working during evening and night shifts. This might be for the fear of punishment or egoistic issues.

The frequency of critical incidents has varied in different institutions in the world. Desalu and Kushimo in a study of 1717 patients reported critical incident rate of 6.6%[7]. Higher incidences up to (12.1%) and (10.6%) have been reported in some studies. Siato *et al*[20] reported much less incidence (0.8%). Varying incidences however have been reported worldwide, <1% to as high as 22%. The vast difference in these figures is due to the fact that interpretation of critically ill in anesthesia varies according to the individual perception of an incident and to an ambiguity in how that is applied in practice[20]. There is reluctance to report minor incident while some major events go unreported for the fear of retribution, lack of motivation and lack of acceptance of the fact that it could be beneficial as educational tool[21].

Airway and pulmonary problems were commonest (49%) followed by cardiovascular issues (42.14%) in our study. Laryngospasm and hypoventilation were the most frequent respiratory and airway problems. Endotracheal tube was wrongly placed in esophagus in one patient,

two other patients could not be intubated because of difficult airways and surgery had to be postponed. Among cardiovascular problems hypotension and bradycardia were the most frequent problems as also cited in some international studies[22].

Operating rooms were the most vulnerable places because majority of incidents occurred during maintenance (40.88%), emergence (25.16%) and induction phase (23.37%) followed by recovery period. Induction and emergence periods are always potentially eventful regarding physiological parameters.

Critical incident rate was higher (2.1%) during emergency surgery as compared to elective surgical procedures (1.6%).

Vascular, Urological, thoracic, ENT and pediatric surgery cases were more vulnerable for incidents and accidents.

In our study human error has been implicated as major cause of anesthesia related incidents. Lack of experience, skills, judgment and failure to have proper check list review before anesthesia were the most frequently cited reasons for this. Because pattern of human errors are identifiable and correctable majority of these accidents were timely picked and rectified before adverse outcome.

Mortality associated with anesthesia has been defined as death under, as a result of, or within 24 hour of an anesthetic[23]. Anesthesia related mortality in developed countries ranges from 0.12% to 1.4%/10000 anesthetics[24]. We had an exclusive anesthesia related mortality of 05 deaths/10181 anesthetics. Although actual mortality was higher where other factors combined with anesthesia contributed to outcome.

CONCLUSION

Critical incident may be due to human error, equipment malfunction, pharmacological factors, patient co-morbidities or nature of surgery. Critical incidences can occur even in the hands of highly skilled and qualified anesthesiologists in the presence of all modern monitoring gadgets. It is a common saying "To not be allowed to err is not to be allowed to learn". (G.I. Rochin)[25]. Majority of these mishaps are preventable. Reporting and audit of critical incidents should be introduced in all anesthesia departments to reduce the anesthesia related morbidity and mortality.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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