



THE AGA KHAN UNIVERSITY

eCommons@AKU

Department of Anaesthesia

Medical College, Pakistan

January 2018

Pediatric critical incidents reported over 15 years at a tertiary care teaching hospital of a developing country

Shemila Abbasi

Aga Khan University, shemila.abbasi@aku.edu

Fauzia Anis Khan

Aga Khan University, fauzia.khan@aku.edu

Sobia Khan

Aga Khan University, sobia.khan@aku.edu

Follow this and additional works at: https://ecommons.aku.edu/pakistan_fhs_mc_anaesth



Part of the [Anesthesiology Commons](#)

Recommended Citation

Abbasi, S., Khan, F. A., Khan, S. (2018). Pediatric critical incidents reported over 15 years at a tertiary care teaching hospital of a developing country. *Journal of Anaesthesiology Clinical Pharmacology*, 34(1), 78-83.

Available at: https://ecommons.aku.edu/pakistan_fhs_mc_anaesth/144

Pediatric critical incidents reported over 15 years at a tertiary care teaching hospital of a developing country

Shemila Abbasi, Fauzia Anis Khan, Sobia Khan

Department of Anaesthesiology, Aga Khan University, Karachi, Pakistan

Abstract

Background and Aims: The role of critical incident (CI) reporting is well established in improving patient safety but only a limited number of available reports relate to pediatric incidents. Our aim was to analyze the reported CIs specific to pediatric patients in our database and to reevaluate the value of this program in addressing issues in pediatric anesthesia practice.

Material and Methods: Incidents related to pediatric population from neonatal period till the age of 12 years were selected. A review of all CI records collected between January 1998 and December 2012, in the Department of Anaesthesiology of Aga Khan University hospital was done. This was retrospective form review. The Department has a structured CI form in use since 1998 which is intermittently evaluated and modified if needed.

Results: A total of 451 pediatric CIs were included. Thirty-four percent of the incidents were reported in infants. Ninety-six percent of the reported incidents took place during elective surgery and 4% during emergency surgery. Equipment-related events ($n = 114$), respiratory events ($n = 112$), and drug events ($n = 110$) were equally distributed (25.6%, 25.3%, and 24.7%). Human factors accounted for 74% of reports followed by, equipment failure (10%) and patient factors (8%). Only 5% of the incidents were system errors. Failure to check (equipment/drugs/doses) was the most common cause for human factors. Poor outcome was seen in 7% of cases.

Conclusion: Medication and equipment are the clinical areas that need to be looked at more closely. We also recommend quality improvement projects in both these areas as well as training of residents and staff in managing airway-related problems in pediatric patients.

Keywords: Adverse events, anesthesia, critical incident, outcomes, pediatric, quality improvement

Introduction

A critical incident (CI) is defined as “An untoward and preventable mishap which was associated with the administration of general or regional anesthesia which led or could have led to an undesirable patient outcome.”^[1] CI reporting (CIR) systems are well established in high-income countries. Learning from these incidents has limitations, but they are of value in learning from errors, quality improvement, and comparison of data from different parts of the world.^[2]

Specialty-based CIR, for example, in pediatrics has advantages as it draws attention to problems which may get diluted in a larger data pool. In addition, it is easier to take decisions and plan necessary actions in a smaller specialty-based group. Published literature on CIR in pediatric anesthesia from even high-income countries is limited.^[3,4] but is lacking from low and middle-income countries.

Department of Anaesthesiology at the Aga Khan University Hospital has a CIR mechanism in place since 1996.^[5] By doing this audit, our aim was to analyze the reported CIs specific to pediatric patients and to see the trends of type of incidents and patient population. The secondary objective was

Address for correspondence: Dr. Shemila Abbasi,
Aga Khan University Hospital, Stadium Road, P. O. Box 3500,
Karachi 74800, Pakistan.
E-mail: shemila.abbasi@aku.edu

Access this article online

Quick Response Code:



Website:
www.joacp.org

DOI:
10.4103/joacp.JOACP_240_16

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Abbasi S, Khan FA, Khan S. Pediatric critical incidents reported over 15 years at a tertiary care teaching hospital of a developing country. *J Anaesthesiol Clin Pharmacol* 2018;34:78-83.

to re-evaluate the value of this program in highlighting issues in pediatric anesthesia practice, a need to review the reporting form, guidelines, and policies and to plan future audits and quality improvement projects.

Material and Methods

After obtaining an exemption from the Institutional Ethical Review Committee (2582-Ane-ERC-13), this retrospective audit was conducted by reviewing all available CI forms collected prospectively between 1998 until 2012. The structured CI form used in the department is given in the appendix. In addition to identify field's space for free text for contextual details is also available on the form. Empty paper forms are available in all the operating rooms of the hospital. These are filled anonymously on a voluntary basis by the medical and paramedical staff including anesthesia trainees, consultants, and technicians. At the beginning of postgraduate training year, a presentation on CIR system is part of department orientation. A dedicated locked "CI box" is kept in the recovery room where filled hard copies are dropped. Forms are collected from this box periodically, and all data variables are routinely entered in an electronic departmental database on Statistical Package of Social Sciences Version 19.0 Statistical Package of Social Sciences Version 19.0 (SPSS ver-19, Inc., Chicago, IL, USA). These forms are periodically reviewed and presented in departmental academic meetings where personal are also reminded on how to and when to fill the forms. The form is also used to standardize existing and formulate new guidelines. Our pediatric workload has not been static and changed over the years. In 1996 there was only one pediatric list per week, but now there are five lists per week with dedicated teams in dedicated operating rooms.

All forms with incidents related to pediatric population from neonatal period up to the age of 12 years were selected. Two of the authors (consultant anesthetists) independently reviewed and re-analyzed these incidents according to a predefined protocol and standardized definitions. The forms with incomplete contextual information were dealt with separately. The following data were retrieved for all cases: age, surgical procedure, grade of anesthetist who reported the incident, American Society of Anaesthesiology (ASA) status, type of anesthesia, phase of anesthesia when the incident occurred, organ system involved, type of error, outcome, and action taken. The same reviewers then identified the major contributing factor according to "what happened" into organ system involved, equipment event, circuit event, drug-related event, and monitoring event. Disagreement on contributing factor between the two reviewers was observed in 2% of the forms ($n = 10$) and a consensus decision was taken after discussion.

Events that did not fall in these were classified as miscellaneous. Factors important in incident causation were classified according to those originally filling the form into human factors, equipment fault with no human factor involved, patient factors or system at fault.

Outcome was documented as no effect, minor physiological disturbance, severe physiological disturbances, temporary sequel morbidity or mortality.

Results

A total of 151,351 anesthetics were administered during the review period, and 1997 CIs were reported, 453 (23%) of these were pediatric. Two forms had duplication of reporting, henceforth, 451 reports were included in the analysis. Thirty-five percent of incidents were reported in ASA I and 42% in ASA II patients. Ninety-six percent of the reported incidents took place during elective surgery and 4% during emergency surgery. Thirty-four percent of the incident reports were related to children < 1 year of age, 44% to more than 1 and < 6 years, and 22% to more than 6 years.

Fifty percent of the reported incidents occurred at induction of anesthesia, 38% during maintenance and 12% during emergence phase. General anesthesia (GA) was the anesthetic technique used in 342 (76%) patients, combined regional with GA in 89 (21%), and the technique was not specified in 20 (3%) of cases.

Out of 451 incidents, five incidents were related to communication error which did not fall in any event type. Out of the remaining 446 incidents, 86% were related to the respiratory, cardiovascular, or central nervous systems. The breakdown of incidents based on "what happened" is presented in Table 1. Equipment-related events ($n = 114$), respiratory events ($n = 112$), and drug events ($n = 110$) were equally distributed (25.6%, 25.3%, and 24.7%). The rest of 25% were related to monitoring, circuit, cardiac, and miscellaneous events. Respiratory events included 83 incidents of airway and 30 of pulmonary events. Laryngospasm and accidental extubation were the most common contributing factor in airway events.

Factors judged to have been most important in incident causation according to those originally filling the audit form were 74% human factors, 10% equipment failure with no human factor involved, 5% system at fault, and 8% patient factors. Analysis of the reasons for human factors revealed 39% failure to check (equipment/drugs/doses), followed by lack of judgment (22%), haste (17%), lack of knowledge/skills (14%), and fatigue in (8%).

Table 1: Classification of the incident according to type of event and phases of Anesthetic care

What happened	n (446)%	Phase of anaesthesia		
		Induction	Maintenance	Emergence
Equipment events	114 (25.6)	55	47	12
Vaporizer	19 (4.3)			
Syringes/Cannula	17 (3.8)			
Airway/ETT/Laryngoscope	13 (2.9)			
Ventilator and accessories	12 (2.7)			
Infusions	11 (2.5)			
Monitors	8 (1.8)			
K-Thermia/Temp probe	8 (1.8)			
Others	26 (5.8)			
Respiratory events	113 (25.3)			
Airway events	83 (18.6)	35	27	21
Laryngospasm	30 (6.7)			
Accidental extubation	18 (4.0)			
Inability to ventilate	11 (2.5)			
Endo-bronchial intubation	6 (1.3)			
Problems with LMA	6 (1.3)			
Obstruction of ETT	5 (1.1)			
Throat pack	3 (0.7)			
Others	4 (0.9)			
Pulmonary events	29 (6.5)	11	16	2
Hypoxemia	15 (3.4)			
Hypercapnia	6 (1.3)			
Bronchospasm/ETT obstruction	7 (1.6)			
Chest tube dislodged	1 (0.2)			
Drug events	110 (24.7)	75	24	11
Under-dosage	18 (4.0)			
Wrong (drug dilution/labeling)	31 (7.0)			
Over-dosage	25 (5.6)			
Side effect/Interaction	3 (0.7)			
Others	33 (7.4)			
Monitoring events	28 (6.3)	8	20	0
B.P./E.C.G.	7 (1.6)			
Oximetry/Capnography	4 (0.9)			
Blood loss	2 (0.4)			
Others	15 (3.4)			
Circuit events	26 (5.8)	14	11	1
Disconnection/Leak	15 (3.4)			
Over-pressure	7 (1.6)			
Others	4 (0.9)			
Cardiac events	11 (2.4)	2	7	2
Tachycardia/Bradycardia need treatment	6 (1.3)			
Atrial and ventricular arrhythmias	3 (0.7)			
Hypotension needs treatment	2 (0.4)			
Miscellaneous events	45 (10.1)	24	17	4
Hypothermia/Hyperthermia	7 (1.6)			
Others (Blood products/Documentation)	38 (8.5)			

Outcome of CI is shown in Table 2. No effect in 71% ($n = 318$), minor physiologic disturbance in 22% ($n = 98$), severe physiological disturbance in 2.8% ($n = 12$), temporary sequel in 3% ($n = 4$), morbidity in 1% ($n = 4$), and mortality 0.2% ($n = 1$).

There were four cases of major morbidity reported. An incident of severe bradycardia was reported in a 4-year-old posttrauma child who was shifted from another hospital. He suffered brain damage due to prolonged hypoxemia as a result of endobronchial intubation during transfer. Endobronchial

Table 2: Incidents classified according to outcome

Incident category	No effect	Minor physiological disturbance	Severe physiological disturbance	Temporary sequel	Morbidity	Mortality	Total (%)
Airway events	38	34	5	5	0	1	83 (18.6)
Circuit events	20	6	0	0	0	0	26 (5.8)
Equipment events	88	22	3	1	0	0	114 (25.6)
Drug events	96	12	0	1	0	1	110 (24.7)
Pulmonary events	12	12	2	2	0	1	29 (6.5)
Cardiac events	7	1	1	1	0	1	11 (2.4)
Monitoring events	24	3	0	1	0	0	28 (6.3)
Miscellaneous events	33	8	1	2	1	0	45 (10.1)

intubation was only confirmed by doing a chest X-ray on arrival. In two other reports, there were delays in recovery secondary to overdose of muscle relaxant in the first case and laryngospasm in the other. The fourth morbidity was continued desaturation up to 85% at induction in a 17 days child planned for superficial thickness skin grafting. No cardiac issue was picked up preoperatively, and surgery was postponed after starting anesthesia due to suspicion of an underlying cardiac anomaly.

This study is basically not patient centered as we only reviewed an already existing critical incident reporting forms which is filled anonymously without any name or medical record number of patients. All authors are involved in critical incident reporting group and exemption from ethical review committee was taken before starting data collection.

Discussion

This review provided data of 451 pediatric CIs in an academic institution in a middle-income country. Equipment, respiratory, and drug events made up 77% of the incidents. The majority of incidents related to equipment were unavailability, malfunction, or wrong use. Out of 113 respiratory events, 73% ($n = 83$) were pure airway events, and the rest were pulmonary. Laryngospasm (36%) and accidental extubation (22%) were majority contributors to airway events. One-third of the incidents resulted in no effect, and a single report of uncontrolled surgical bleeding resulted in death.

A national reporting system of CIs was established in the UK in 2001. MacLennan and Smith identified 606 CIs (17%) relating to pediatric anesthesia in that database (data from England and Wales) collected over a period of 3 years.^[3] In contrast, we found a very small percentage of pediatric incident reports 0.2% ($n = 451$) during our review period of 15 years.

The majority of our incidents were reported in elective surgery which is similar to the pediatric CI reported by Tay *et al.* from Singapore.^[4] This lack of reporting in emergency cases

may be due to overworked anesthetists during on-call period, lack of ownership or understanding the role of CI in quality improvement. Seventy-seven of our incidents were reported in relatively healthy ASA I and II patients which is also comparable to Tay *et al.* who reported (80%) incidents in ASA I and II patients. In contrast to Tays study, 50% of our incidents were reported at induction of anesthesia. This may be due to a large number of our incidents being related to equipment malfunction which is mostly detected at the time of induction.

One-third of the incidents (34%) related to infants. This is similar to risk profile identified in previous audits of risk assessment where it was identified that infants were at a greater risk of complications.^[2]

The frequency of equipment error was double than that reported by Morray *et al.* and Van der Walt *et al.*^[6,7] MacLennan and Smith reported a much lower incidence of equipment errors in the UK National Reporting and Learning System (15%–7%), but the nature of problems was quite similar, i.e., failure, unavailability of necessary equipment, unsuitable for the purpose and use without user training.^[3] More than half of our incidents were related to vaporizers, syringes, cannula, airways, laryngoscopes, ventilator and its accessories and infusions. The reason of this high percentage of equipment errors could be limited equipment budget, and overuse of equipment with more breakdowns compared to resource-rich nations. Only three of these incidents resulted in severe physiological disturbance but no morbidity or mortality. The availability of adequate number of sevoflurane vaporizer, pediatric oxygen saturation probes, use of transparent drapes, and availability of ultrasound machine to perform central line insertion were ensured through our CI reporting mechanism.

One-quarter of our events was respiratory (25.3%). Our numbers and nature of incidents were close to that reported by MacLennan and Smith (18.8%).^[3] The nature of incidents, i.e., laryngospasm, accidental extubation, airway obstruction, and throat pack were also similar. Tay *et al.* reported 77%

respiratory events which was three times greater than seen in our data.^[4] In their report hypoxia, laryngospasm and bronchospasm were common contributors. This high number of reported respiratory events also emphasizes the importance of pulse oximetry and capnography during anesthetic management. Although used routinely in our institution this is not mandatory requirements in our country.

Approximately, 25% of incidents were medication related with majority related to dosing (39%) followed by interaction/side effect (33%) and wrong dilution and labeling (28%) Dosage errors are common in children and children are at greater risk with errors occurring across prescribing, dispensing, or administration.^[8,9] In the UK, National Reporting and learning system unintentional additional medication doses was the most prevalent. Our results also reflect that dosing errors were common. Merry and Anderson have discussed the medication error in pediatric anesthesia in more detail and specific approaches in reducing them.^[10]

Factors judged to be the cause of the incidents (by those reporting the incidents in our database) in 74% of the cases were human factors. This was similar to that reported by Runciman *et al.* for adult patients.^[11] Staender *et al.* reported a much lower incidence in their adult data.^[12] Marcus conducted a retrospective review of pediatric incidents and identified 42.5% where human factors were involved. The most common human factor was error of judgment.^[13] Although human factors are not easily correctable but contributing factors need to be identified with continuous reinforcement for adherence with guidelines and policies, change of attitudes, and alteration of systems to ensure check and balance at different steps. Nearly, 40% of our human factor related incidents were due to failure to check. Fatigue was reported in only 8%. Elhalawani recommends dividing human errors into organization accidents or unsafe act, and further divide unsafe act into intended and unintended action to get more useful information.^[14] We intend to add this to our existing CI form.

Regarding outcome, our results demonstrated that majority of incidents resulted in no or minor harm, and only 8% incidents resulted in severe physiological disturbance or morbidity and mortality [Table 2]. This could be under-reporting as a parallel system of morbidity and mortality review exists in the department whereby all incidents leading to intermediate, major morbidity or mortality are presented in the monthly morbidity and mortality meeting with root cause analysis and action to prevent future incidents. The only morbidity reported in our database was due to massive hemorrhage. It has been identified as the most common specific cause of anesthesia-related cardiac arrests.^[2]

Any CI program requires constant reinforcement. In our experience, the number of reported incidents go up following each departmental presentation and then gradually decline. A regular feedback is crucial in engaging clinicians. This feedback or follow-up should be quick with clear messages and should be regular and detailed.^[15] Two years ago we initiated “lessons to learn” E-mails after every departmental CI meeting which was well received. Sharing of lessons to learn on E-mail after an open discussion of CIs in departmental meeting and feedbacks gives a sense of team effort rather than the activity of only a few concerned members. CIR forum has also been used by us to pick quality improvement projects, to make guidelines, and to increasing awareness. Some of the examples of such activity are drug dilution guidelines for infants and older children, color-coded drug labels, availability of pediatric oxygen saturation probes, use of transparent drapes, etc.

One limitation of our report is that CI reporting in our department is voluntary and not mandatory which may limit the value of these results. This may be the reason why the incidence of reported morbidity and mortality is low in this report. However, this type of monitoring is of value in eastern cultures where a hierarchy prevails, and people are not very forthcoming in pointing errors.^[5] Voluntary reporting needs continuous sensitization, reinforcement, workforce, and feedback. In the absence of these elements volume of reporting is difficult to maintain. However, many investigators have concluded that voluntary reporting can result in underestimation of the frequency of problems, but not necessarily the nature of problems.^[12]

Another limitation of this report is the lack of denominator in our data. The information gathering systems at our institution were not robust before 2005 and were done manually with only crude data available which did not include subspecialty breakdown. Hence, we only had the total number of anesthetics administered during the audit period.

Conclusion

Audit of our pediatric CI data has helped us to highlight areas requiring improvement, i.e., medication and equipment. It has also identified our high-risk group of children < 1 year of age. Based on this, we have recommended further quality projects to improve safety in medication and equipment for children. We have also emphasized the training of residents and staff in managing airway related problems in pediatrics within our department.

Overall, we have found the CIR program of value in raising awareness and safety initiatives and recommend establishing

CI reporting databases in other hospitals nationally as well as at regional level.

Financial support and sponsorship

The secretarial and statistical help was supported by the resources of the Department of Anaesthesiology, Aga Khan University.

Conflicts of interest

There are no conflicts of interest.

References

1. Currie M. A prospective survey of anaesthetic critical events in a teaching hospital. *Anaesth Intensive Care* 1989;17:403-11.
2. Paterson N, Waterhouse P. Risk in pediatric anesthesia. *Paediatr Anaesth* 2011;21:848-57.
3. MacLennan AI, Smith AF. An analysis of critical incidents relevant to pediatric anesthesia reported to the UK National Reporting and Learning System, 2006-2008. *Paediatr Anaesth* 2011;21:841-7.
4. Tay CL, Tan GM, Ng SB. Critical incidents in paediatric anaesthesia: An audit of 10 000 anaesthetics in Singapore. *Paediatr Anaesth* 2001;11:711-8.
5. Khan FA, Hoda MQ. A prospective survey of intra-operative critical incidents in a teaching hospital in a developing country. *Anaesthesia* 2001;56:177-82.
6. Morray JP, Geiduschek JM, Caplan RA, Posner KL, Gild WM, Cheney FW. A comparison of pediatric and adult anesthesia closed malpractice claims. *Anesthesiology* 1993;78:461-7.
7. Van der Walt JH, Sweeney DB, Runciman WB, Webb RK. The Australian Incident Monitoring Study. Paediatric incidents in anaesthesia: An analysis of 2000 incident reports. *Anaesth Intensive Care* 1993;21:655-8.
8. Miller MR, Robinson KA, Lubomski LH, Rinke ML, Pronovost PJ. Medication errors in paediatric care: A systematic review of epidemiology and an evaluation of evidence supporting reduction strategy recommendations. *Qual Saf Health Care* 2007;16:116-26.
9. Barker KN, Allan EL. Research on drug-use-system errors. *Am J Health Syst Pharm* 1995;52:400-3.
10. Merry AF, Anderson BJ. Medication errors – New approaches to prevention. *Paediatr Anaesth* 2011;21:743-53.
11. Runciman WB, Sellen A, Webb RK, Williamson JA, Currie M, Morgan C, *et al.* The Australian Incident Monitoring Study. Errors, incidents and accidents in anaesthetic practice. *Anaesth Intensive Care* 1993;21:506-19.
12. Staender S, Davies J, Helmreich B, Sexton B, Kaufmann M. The anaesthesia critical incident reporting system: An experience based database. *Int J Med Inform* 1997;47:87-90.
13. Marcus R. Human factors in pediatric anesthesia incidents. *Paediatr Anaesth* 2006;16:242-50.
14. Elhalawani I, Jenkins S, Newman N. Perioperative anesthetic documentation: Adherence to current Australian guidelines. *J Anaesthesiol Clin Pharmacol* 2013;29:211-5.
15. Mahajan RP. Critical incident reporting and learning. *Br J Anaesth* 2010;105:69-75.

Author Help: Online submission of the manuscripts

Articles can be submitted online from <http://www.journalonweb.com>. For online submission, the articles should be prepared in two files (first page file and article file). Images should be submitted separately.

1) **First Page File:**

Prepare the title page, covering letter, acknowledgement etc. using a word processor program. All information related to your identity should be included here. Use text/rtf/doc/pdf files. Do not zip the files.

2) **Article File:**

The main text of the article, beginning with the Abstract to References (including tables) should be in this file. Do not include any information (such as acknowledgement, your names in page headers etc.) in this file. Use text/rtf/doc/pdf files. Do not zip the files. Limit the file size to 1 MB. Do not incorporate images in the file. If file size is large, graphs can be submitted separately as images, without their being incorporated in the article file. This will reduce the size of the file.

3) **Images:**

Submit good quality color images. Each image should be less than 4096 kb (4 MB) in size. The size of the image can be reduced by decreasing the actual height and width of the images (keep up to about 6 inches and up to about 1800 x 1200 pixels). JPEG is the most suitable file format. The image quality should be good enough to judge the scientific value of the image. For the purpose of printing, always retain a good quality, high resolution image. This high resolution image should be sent to the editorial office at the time of sending a revised article.

4) **Legends:**

Legends for the figures/images should be included at the end of the article file.