

Perioperative Respiratory Adverse Events in General Anesthesia Among Pediatric Surgical Patients in Comprehensive Specialized Hospitals in Northwest Ethiopia, 2020; A Cross-Sectional Follow-Up

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Perioperative respiratory adverse events in general anesthesia among pediatric surgical patients in Comprehensive Specialized Hospitals in Northwest Ethiopia, 2020; a cross-sectional follow-up

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Abstract

Introduction: Perioperative respiratory adverse events (PRAEs) are the most frequent complications in pediatrics which frequently result in morbidity and mortality. They are accountable for 75% of perioperative critical incidents and 33% of cardiac arrests. The occurrence and severity of PRAEs depends on the natures of surgery, anesthesia & patient's status.

Objective: To assess the incidence and factors associated with PRAEs in general anesthesia among pediatric surgical patients at the University of Gondar and Tibebe-Ghion Comprehensive Hospital and Specialized Hospitals, Northwest Ethiopia, 2020.

Methods: After obtaining the ethical approval, a hospital-based prospective cross-sectional follow-up study was conducted among pediatric surgical patients who underwent variety of surgical operations. A total of 225 patients were included. The associations between independent variables and the outcome variables were determined at 95% CI with the Chi-squared test, Fisher-exact test, bivariate, and multivariate logistic regression. Hosmer-Lemeshow test was used to assess the goodness of fit. Variables with a p-value < 0.05 were considered significant.

Results: The incidence of PRAEs among 210 (93.3% response rate) pediatrics surgical patients was 26.2% (95% CI: 20.5, 30.9). A total of 129 episodes of PRAEs were observed. Most of the adverse events (89 (69.0%)) were occurred postoperatively. Desaturation was found to be the predominant adverse event which was occurred 61 (47.3%) times. Age < 1 year (AOR: 3.6, 95% CI: 1.3, 10.0), ASA ≥ 3 (AOR: 5.2, 95% CI: 1.9, 22.9), upper respiratory tract infections (AOR: 7.6, 95% CI: 1.9, 30.2), presence of secretions in the upper airway (AOR: 4.8, 95% CI: 1.4, 15.9) and airway related procedures (AOR: 6.0, 95% CI: 1.5, 24.1) were significantly associated PRAEs.

Conclusions: The incidence of PRAEs among pediatric surgical patients was relatively high (26.2%). Especially, the postoperative phase is the most critical time for the occurrence of PRAEs and desaturation was the predominant adverse event. Age less than a year, presence of upper respiratory tract infections, presence of secretions in the upper airways, ASA ≥ 3 and airway related procedures were associated with PRAEs. Clinicians should carry out effective risk assessment, optimization and adequate preparation for the management of perioperative respiratory adverse events.

Keywords: Perioperative Respiratory Adverse Events, Perioperative complications, Pediatric Anesthesia General Anesthesia,

Introduction

Adverse event is defined as unexpected and undesirable response to medication and medical intervention used to facilitate anesthesia and analgesia that threaten or cause patient injury or discomfort. Respiratory adverse events are any episodes of desaturation, partial or complete airway obstruction, persistent coughing, breath holding and bronchospasm (1-3). Despite improvements in pediatrics anesthesia, respiratory adverse events remain the most frequent cause of serious morbidity and mortality in the perioperative period. The three quarters of all critical incidents and the third of all perioperative cardiac arrests in pediatric anesthesia are caused by respiratory adverse events. Preoperative identification of those children at high risk is a challenging process (4, 5).

Pediatrics are vulnerable to those respiratory adverse events because they have hyper-reactive airway secondary to frequent upper respiratory tract infections (URTIs), high oxygen demands and low oxygen reserves. The most common respiratory adverse events under anesthesia are desaturation, breath holding, laryngospasm, bronchospasm and coughing. Among those events laryngospasm, bronchospasm and persistent hypoxemia could result potentially devastating complication and death (6-8).

Respiratory adverse events are inconsistently defined in much of studies making comparison difficult and results discrepancy on magnitude of the actual events. On the other way differences in medications and airway device used to manage respiratory adverse events could influence the outcome of the patient (1). Despite introduction of new monitoring modalities, pharmacological products and new clinical practice guidelines, the incidence of respiratory adverse events remained high and increase hospital stay more than two folds and increase the cost of medical care when compared to patients who didn't develop severe respiratory events (1, 9).

The patient's age, techniques of anesthesia induction, comorbidities and airway surgery were strongly associated with occurrence of adverse events during surgery. Occurrence of respiratory adverse events differs according to timing of extubation whether awake or deep plane of anesthesia, airway device and urgency of procedures are variable across studies and its complications are uncertain (10, 11) The severity of perioperative respiratory adverse events (PRAEs) and their complications depend on nature of surgery, presence comorbidity, early detection, and prompt corrective measures. The severity of the respiratory adverse event may range from transient damage with full recovery to unanticipated morbidity and mortality (2).

Preoperative assessment and intervention are the key to successful management of the patient with upper respiratory infection, asthma and cardiac disease (12). Risk assessment in the preoperative period is recognized as very important to decrease respiratory events but still patient identification and selection is a real problem. If effective measures are not taken timely, serious respiratory complications and death would prevail (13). Critical respiratory incident recording and reporting system is poor particularly in the developing countries because fear of influence on their future carrier. Moreover, in limited resource countries electronic medical recording and reporting systems are not well established. These could have contribute for poor prevention PRAEs (31). In-contrast, in the developed world modern electronic based surveillances had significantly improved perioperative quality of care. Therefore, critical incident monitoring and reporting in anesthesia are very important for quality improvement and maintenance of high safety standards in anesthesia services (14).

The general objective of the current study was to assess the incidence and factors associated with perioperative respiratory adverse events (PRAEs) among pediatrics patients that underwent surgical operations under general anesthesia at University of Gondar and Tibebe-Ghion Comprehensive Specialized Hospitals, Northwest Ethiopia from March 1 to May 30, 2020.

Methods

A Hospital-based cross-sectional follow-up study was conducted from March 1 to May 30 2020 at the University of Gondar and Tibebe-Ghion Comprehensive Specialized Hospitals. The Hospitals are located at Gondar and Bahirdar towns respectively in the Northwest Ethiopia.

The source population was all pediatric surgical patients (0 – 12 years of age) that underwent surgical operations under general anesthesia and the study population was all pediatric surgical patients that underwent surgical operations under general anesthesia at UoGCSH and TGCSH during the study period.

All ASA I – V pediatric surgical patients of volunteer parents that underwent both emergency and elective surgical procedures were included in the study and those who had severe head injury, intubated patient, acute respiratory distress, hypoxia requiring mechanical ventilation in the preoperative period, operated for more than one time, and transferred to intensive care unit for mechanical ventilation after operation were excluded from the study.

The sample size was estimated by a single population proportion formula with 50% proportion, maximum acceptable difference (ε) = 5%, and 95% confidence interval:

$$n = \left(Z \frac{\alpha}{2} \right)^2 \times p(1-p)/\varepsilon^2$$

Where: $Z \alpha/2=1.96$ and $p = 50\% = 0.5$ and $\varepsilon = 5\% = 0.05$ will be used so the sample size will be:

$$n = (1.96)^2 \times 0.5(1 - 0.5)/0.05^2$$

$$\mathbf{n = 385}$$

By reviewing the registration log, we found out that 780 and 660 pediatrics surgical procedures performed annually at UGCSH and TGCSH respective. So we used a correction formula to determine the corrected sample size.

$$nf = \frac{n}{1 + n/N}$$

$$nf = \frac{385}{1 + 385/360}$$

$$nf = 195$$

We added **15%** for non-response rate and the final sample size was **225**.

All eligible consecutive pediatric surgical patients who received general anesthesia were included in the study till the calculated sample size reached.

The dependent variable was perioperative respiratory adverse events which was measured in terms of any episode of either hypoxemia, coughing, breath holding, laryngospasm, or bronchospasm in the perioperative period. The independent variables were Patient factors (history of prematurity, age, ASA classification, family history of asthma, respiratory infections, and other comorbidities), anesthetic factors (techniques of anesthetic induction, type of airway device, number of intubation attempts, muscle relaxant, depth of anesthesia, perioperative opioid use, and experience of the anesthesia providers), and surgical factors (site of surgery, duration, and urgency of surgery).

Perioperative respiratory adverse event was measured as the occurrence of any episode of one or a combination of hypoxemia, coughing, breath holding, laryngospasm and bronchospasm in the perioperative period (2, 3, 15, 16, 17, 18-21). Operational definitions were prepared accordingly.

Laryngospasm: complete airway obstruction associated with muscle rigidity of the abdominal and chest walls and it need requirement of positive pressure ventilation or administration of succinylcholine (1).

Bronchospasm: increased respiratory effort, particularly during expiration and wheeze on auscultation or requires bronchodilators (7, 15).

Desaturation or hypoxemia: peripheral arterial oxyhemoglobin saturation (SpO_2) < 95% more than 30 seconds measured by pulse oximetry regardless administrations of 100% Oxygen or SpO_2 < 90% in atmospheric air. The Oxygen saturation was recorded when the pulse oximetry showed consistent readings with no artifacts (2, 7).

Partial upper airway obstruction: the presence of airway obstruction in the combination with a snoring noise, an inspiratory stridor or respiratory efforts or paradoxical abdominal movement or both that can be effectively relieved by simple airway maneuvers (2).

Coughing: a series of pronounced, persistent coughs lasting more than 5 seconds (7).

Breath holding or apnea: if the patient had apnea more than 15 seconds or irregular breathing or if the apnea is associated with bradycardia or cyanosis (15).

Multiple intubation attempts: if required multiple intubation attempts more than 2 times (22).

Active or current URTIs: the present of a minimum of two URTIs symptoms (rhinorrhea, sore or scratchy throat, sneezing, nasal congestion, malaise, cough, or fever, T > 38°C) at the time of surgery together with a confirmation by a parent (15).

Recent URTIs: the history of URTIs within 4 weeks before surgery but resolved at the time of surgery (15).

Acute respiratory distress: the presence of tachypnea, intercostal and subcostal retractions, nasal flaring, grunting, and cyanosis in room air and requires high flow Oxygen (23).

Light anesthesia: the presence of patient's movement with increased heart rate, blood pressure and respiratory rate change by more than 30% from baseline (24).

Oropharyngeal secretions: the presence of secretion that requires suctioning of more than once (25).

Pulmonary aspiration: a known or suspected inhalation of foreign material such as gastric contents into the respiratory tract associated with new or worsening respiratory signs such as hypoxia (26).

Airway related surgery: the surgical procedures involving the airway which includes ENT and maxillofacial procedures such as adenotonsilectomy, cleft palate repair, direct laryngoscopy, and bronchoscopy (25, 27, 28).

Each complication was scored according to its severity from 1 (no complication) to 4 (most serious complication). For patients who received anesthesia with endotracheal tubes or laryngeal mask airways, scores were multiplied by a constant factor of five, and for those with face-masks scores were multiplied by a constant factor of three. Depending on the airway device used, patients therefore received a composite score of 5 – 20 for ETT or LMA and 3 – 12 face-mask for each adverse event. The scoring system for complications is based on a previously published scale and is described [Table 1] (25).

Respiratory adverse events were recorded starting from induction to the first postoperative hour. A patient experiencing PRAEs was counted just once independent of the numbers of events in perioperative period. Data was collected by using a pre-tested structured questionnaire. The questionnaire was primarily prepared in English language and translated to Amharic language. Training for data collectors and supervisors was provided by the principal investigator. A pilot was conducted on 20 (8%) patients who were not included in the main study. Then necessary corrections were made accordingly to the questionnaire for the main study. The data collectors and supervisors were closely mentored by the principal investigator throughout the study period. The data collectors directly observed the children and reviewed their charts to collect the necessary data. The collected data was checked for the completeness and clarity.

After completion of data collection, the variables were coded and cleaned. The data was entered into the Epi-data software (version 4.2) for cleaning for errors and was analyzed by SPSS version 20 (IBM Corporate). The normality of the data was tested by using Shapiro-Wilk normality test. Descriptive statistic was done and presented with frequency, percentage, mean, standard deviation, median and inter-quartile range (IQR). The relationships of nominal data with postoperative pain were analyzed by cross-tabulations using the Chi-squared or Fisher's exact tests as appropriate. Hosmer-Lemeshow test was used to assess the goodness of fit. The variance inflation factors and tolerance were used to diagnose multicollinearity. The associations between the independent variables and outcome variable were determined at 95% confidence interval with chi-squared test, bivariate and multivariate binary logistic regression. The cut-point of statistical significance was $p < 0.2$ for bivariate and < 0.05 for multivariate regression. The crude and adjusted Odds Ratio were used to see the strength of the association for bivariate and multivariate logistic regression respectively.

Result

A total of 210 pediatric surgical patients who received general anesthesia were included in this study with a 93.3% response rate. The remaining data from 15 patients was excluded due to incompleteness. The majority of the patients 115 (54.8%) were males. The median age of the participants was 4.0 (1.1 – 8.0) years [Table 2]. The majority of the patients were classified under ASA 1 and 2 which were 189 (90%) patients while the rest were ASA 3 and above. The 23 (11%) patients had URTIs. Eighty-nine (42.4%) patients had low hemoglobin levels (< 11 g/dl) preoperative. The mean duration of surgery was 82 ± 41.5 minutes [Table 3].

The overall incidence of PRAEs among pediatric surgical patients who underwent surgery under general anesthesia at UOGCSH and TGCSH was found to be 55 (26.2%, 95% CI: 20.5%, 30.9%). We have observed a total of 129 episodes of PRAEs. Desaturation was found to be the predominant adverse event which occurred 61 (47.3%) times; followed by partial upper airway obstruction 21 (16.3%), breath holding 17 (13.2%), persistent coughing 15 (11.6%), laryngospasm 11 (8.5%) and bronchospasm 2 (1.6%). Most of the adverse events 89 (69.0%) were occurred during the postoperative period while 23 (17.8) were occurred during induction of anesthesia, and 17 (13.2%) during the maintenance phase [Figure 1].

Regarding severity of PRAEs, 10 (4.8%) patients had serious desaturation ($\text{SpO}_2 < 80\%$) and 1 (0.5%) patient had continuous coughing, 3 (1.4%) patients had complete airway obstruction which required muscle relaxant, and 9 (4.3%) patients had laryngospasm which was effectively managed by the applications of simple airway maneuvers and positive airway pressure [Table 5].

Among four pediatric surgical patients who had family history of asthma, bronchospasm was occurred in the two patients. One was during induction and the other was after extubation. Fisher-exact test has showed the significant association between family history of asthma and perioperative bronchospasm. The relations of independent variables with outcome variables in Pearson's Chi-squared and Fisher-exact tests are presented [Table 4]. In the bivariate binary logistic regression analysis, comorbidity, emergency surgery, multiple attempts of tracheal intubation (≥ 3 attempts), light anesthesia, perioperative opioid use and duration of surgery ≥ 60 minutes were found associated with PRAEs. The final analysis model (multivariate binary logistic regression) demonstrated that age less than a year, presence URTIs (recent or active), presence of secretions in the upper airways, ASA ≥ 3 and airway related procedures were associated with PRAEs.

Among pediatric surgical patients, those who had URTIs were more than 7 times likely to develop PRAEs (AOR: 7.6, 95% CI: 1.9, 30.2, p: 0.004). The likelihood of PRAEs to occur in infants was 3.6 times than older pediatric surgical patients (AOR: 3.6, 95% CI: 1.3, 10.0, p: 0.012). Interestingly, repeated attempts of tracheal intubation were noticed among infants (66.6% vs. 33.3%, p: 0.008). ASA physical status of 3 and above increases the occurrence of PRAEs by more than 5 folds (AOR: 5.2, 95% CI: 1.9, 22.9, p: 0.029). Pediatric surgical patients who underwent airway related procedures had developed PRAEs more frequently compared to their counterparts (AOR: 6.0, 95% CI: 1.5, 24.1, p: 0.012). Having moderate to copious oropharyngeal secretions was found associated with the occurrence of PRAEs (AOR: 4.8, 95% CI: 1.4, 15.9, p: 0.011). The results of this study claimed that prematurity, premedication, induction agents, types of airway devices and experiences of the anesthetists were not associated with PRAEs [**Table 6**].

Discussion

Perioperative respiratory adverse events (PRAEs) are the most common critical incidents encountered in the practice of pediatric anesthesia. In this study, PRAEs were defined in terms of perioperative occurrence of one or more episodes of desaturation, breathe holding, persistent coughing, partial or complete upper airway obstruction, laryngospasm and bronchospasm (1, 2, 29).

The overall incidence of PRAEs among pediatric surgical patients who underwent surgery under general anesthesia at UOGCSH and TGCSH was 26.2%. This result was congruent with a study done by Mamie et al, in which, it was 21% (1). A systematic review also has revealed that the incidence of PRAEs was in the ranges of 8% to 21% (2). Our finding was relatively lower compared to the results presented by Ramgolam et al. which was 26% – 43% (7). The differences can be explained by the inclusion of pediatric surgical patients with high risk of developing PRAEs only in the previous study. Whereas, it was relatively higher when compared to an Australian study; in which, the overall incidence was 15% (17). The variations might be due to that in the current study infants were included. We have found that there was an increased risk of developing PRAEs in infants compared to older children (42.3 % vs. 20.9%, AOR: 3.6, 95 % CI: 1.3, 10.0, p: 0.012). Our study has demonstrated that there was higher incidence of PRAEs compared to other studies; in which, PRAEs were occurred only among 2.8%, 5.7% and 17.8% pediatric surgical patients (30-32). Higher incidence in our study might be due to the inclusion of patients with higher ASA physical status (≥ 3). A retrospective multicenter study done in Thailand among 25,098 patients showed that the incidence of PRAEs was 4.6%. The discrepancies might be explained by the incorporation of a large numbers of emergency patients in our study (54.3% vs. 27.4%) (13). In-addition, the differences in the study design and definitions of PRAEs might explain it.

Oxygen desaturation was found in 50 (23.8%) patients which was the most common PRAEs. We found that desaturation was associated with most of patients who had URTIs and secretions. This was similar with multicenter study done in Thailand in terms of the overall occurrence but it was more frequent in the intraoperative period and lesser in the emergence phase of anesthesia (13). In this study, desaturation was found predominantly after tracheal extubation. This finding was supported by a Serbian study. Anesthetic agents are known for diminishing respiratory drive that can results in hypoxemia in the postoperative period (30).

Persistent coughing and upper airway obstruction were occurred 15 (7.1%) and 21 (10%) respectively. A systematic review pointed out the incidence of upper airway obstruction in the ranges between 3.6% and

9% (2). However, Budic and D. Simic have reported that persistent coughing was occurred only in 3 out of 682 patients. The differences in definitions of persistent coughing might cause the inconsistencies of results. In the current study, persistent coughing was defined as coughing that sustained for 5 seconds; however, others have defined it as coughing that sustained for 5 – 10 seconds (33, 34).

In 16 (7.6%) patients, breathe holding was found and it was higher compared to a study done by Tait et al (25). A large numbers of infant patients (52 (24.8%)) was included in our study. Younger children have a tidal volume that occurs at the same volume as a closing volume; therefore, the terminal bronchioles close easily causing apnea and desaturation (30). Neuromuscular blocking agents were used extensively in 120 (57.1%) patients. In our study areas, there was no a qualitative monitoring of residual neuromuscular blockade. This might contribute for higher incidence of breath holding among our patients (35).

The incidence of laryngospasm was found in 12 (5.7%). It was congruent with a systematic review done by Regli et al, which claimed that the incidence of laryngospasm could ranges from 0.1% to 16%. Particularly in general pediatrics population, it was 4% (2). The commonest time of occurrence was the extubation period. In current study laryngospasm was associated with presence of secretions and URTIs. This result was similar with the previous studies conducted in Ethiopia (24, 36). The presence of family history of asthma was associated with an increased risk of bronchospasm in the perioperative period. This is compatible with the study done by Jackson and colleagues. The phenomenon can be explained by a genetically heightened bronchial hyper-responsiveness in children born from parents having asthma (37).

Among patient presented with URTIs, the incidence of PRAEs was 17 (73.9%). In high-risk patients, the incidence could be as high as 50% (2, 15, 38). The reason for higher occurrence in our study might be the use of invasive airway devices (endotracheal tubes) in the majority of patients 15 (65.2%) who had URTIs (2, 28, 31). Our results tend to demonstrate the advantages of LMA (17.4) and FM (25) over ETT (29.4%) among but no statistically significant associations obtained. Similarly with a study done in Serbia and Montenegro, the patients that presented with recent or current sign and symptoms of URTIs were found to have increased risk of developing PRAEs (AOR: 7.6, 95% CI: 1.9, 30.2, p: 0.004). The higher risk of PRAEs during URTIs can be justified by the morphologic damage to the respiratory epithelium and mucosa after infections and sensitize the airway to potentially irritant anesthetic gases and secretions that results in activations of irritant receptors and contractions of smooth muscle of the airway (30). A study has showed that there was increased incidence of PRAEs in patients with an active URTIs than those who had recent URTIs (2 – 4 weeks before the procedure) (39). The effects of URTIs on the airway by the infections could last for several weeks (3). In

our study there was no significant difference in the occurrence of PRAEs whether the URTI is recent or active (84.6% vs. 60%, p: 0.34). The incidence of PRAEs was significantly higher immediately after tracheal extubation than during induction of anesthesia and the intraoperative phase (30).

Harmoniously with other studies, infants were more vulnerable to develop PRAEs than older patients (AOR: 3.6, 95% CI: 1.3, 10.0, p: 0.012) (8, 20). Desaturation occurs more frequently in infants and it was supported by Nigerian and Australian studies (5, 40). Infants have higher oxygen demand and low oxygen reserves which make them risky to PRAEs. In-addition, breath holding was common in this group of patients due to immature the respiratory center in the central nervous system. We have noticed that multiple attempts of tracheal intubation in infants than older patients (66.7% vs. 33.3%, p: 0.008). A study done in Thailand concluded that multiple intubation attempts were associated with PRAEs (22).

Among patients with higher ASA physical status (≥ 3), higher rates of PRAEs compared to those with lower ASA physical status (AOR: 5.2, 95% CI: 1.2, 22.9, p: 0.029). Previous studies also have showed the strong association between higher ASA physical status and PRAEs (4, 13). In developing countries, anesthetists frequently encounter poorly treated comorbidities which could lead to the occurrence of PRAEs (4, 5, 41). The majority of the patients in our study have undergone emergency surgical operations 114 (54%); therefore, poor optimization and limited availability of preoperative investigation modalities might contribute for higher incidence of PRAEs (41). We have observed that patients who had low levels of hemoglobin had similar incidence of PRAEs compared to normal hemoglobin levels.

The risk of developing PRAEs was increased by 6-folds when a surgical procedure involves the airway (AOR: 6.0, 95% CI: 1.5, 24.1, p: 0.012). Airway related procedures were associated with frequent desaturation and upper airway obstruction. Our finding was supported by previous multicenter prospective studies conducted in Europe and USA (3, 5, 42). Children who come for airway related procedures commonly have chronic airway inflammation and bronchial hypersensitivity that could result in PRAEs more frequently. Direct surgical instrumentation and manipulation of the airway can lead to laryngeal reflex response (2).

The presence of moderate to copious oropharyngeal secretions was found associated with PRAEs, particularly with desaturation and partial upper airway obstruction. Pediatrics surgical patients who had oropharyngeal secretions that required suctioning more than once were nearly 5 times more likely to sustain PRAEs (AOR: 4.8, 95% CI: 1.4, 15.9, p: 0.011). Soiling of the airway which necessitate repeated suctioning can potentiate airway hyper-reactivity (25).

Strengths and limitations

The study was the first for its type in the study areas and the country at large. It can be used as a cornerstone for future studies in the field. However, the study did not measure hypoventilation and residual neuromuscular blockade due to the lack of the devices in the post-anesthesia care units of the hospitals. As a cross-sectional study, it cannot determine cause and effect relations.

Conclusions

The overall incidence of perioperative respiratory adverse events (PRAEs) among pediatric surgical patients was relatively high (26.2%). Especially, the postoperative phase is the most critical time for the occurrence of PRAEs and desaturation was the leading adverse event. Age less than a year, presence URTIs (recent or active), presence of secretions in the upper airways, ASA ≥ 3 and airway related procedures were associated with PRAEs. Clinicians should carry out effective risk assessment, optimization and adequate preparation for the management of perioperative respiratory adverse events.

Declarations

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Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to security and confidentiality issues but are available from the corresponding author on reasonable request.

Authors' contributions

DMW and YBW have conceptualized the study and objectives. DMW has developed the proposal. YBW, WBC, HA and MMW have criticized the proposal. All the authors had participated in the data and statistical analyses. DMW and YBW have led the manuscript preparation. All the authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical clearance to conduct the research was obtained from the Ethical Review Board of School of Medicine, College of Medicine and Health Sciences, University of Gondar. Written informed consent forms in Amharic and English languages were presented. Informed consent was taken from a legal care-giver of each patient after brief explanation. Every participant was allowed to discontinue participation if did not want to finish it. Also the participants were assured that their treatment and other benefits they can gain from the hospitals will not be interrupted due to their withdrawal. Confidentiality was ensured by removing identifiers and locking the questionnaires after data collection in a secured area. Additionally, when the patients found experiencing clinically significant perioperative respiratory adverse events, the data collectors had reported for the corresponding clinicians (Anesthetist, Surgeon or Nurse) to provide the appropriate management. All methods were carried out in accordance with relevant guidelines and regulations in the Ethical Declaration.

Consent for publication

Not applicable; this article does not include any personal or clinical details of any participant.

Competing interests

The authors declared that they have no competing interests.

List of Acronyms and Abbreviations

AOR	Adjusted Odds Ratio
ASA	American Society of Anesthesiologist
GA	General Anesthesia
LMA	Laryngeal Mask Airways
PRAEs	Perioperative Respiratory Adverse Events
RCTs	Randomized Control Trials
SPO2	Peripheral Oxygen Saturation
SPSS	Statistical Package for Social Science
TGCSH	Tibebe-Ghion Comprehensive Specialized Hospital
UOGCSH	University of Gondar Comprehensive and Specialized Hospital
URTIs	Upper Respiratory Tract Infections

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Figures

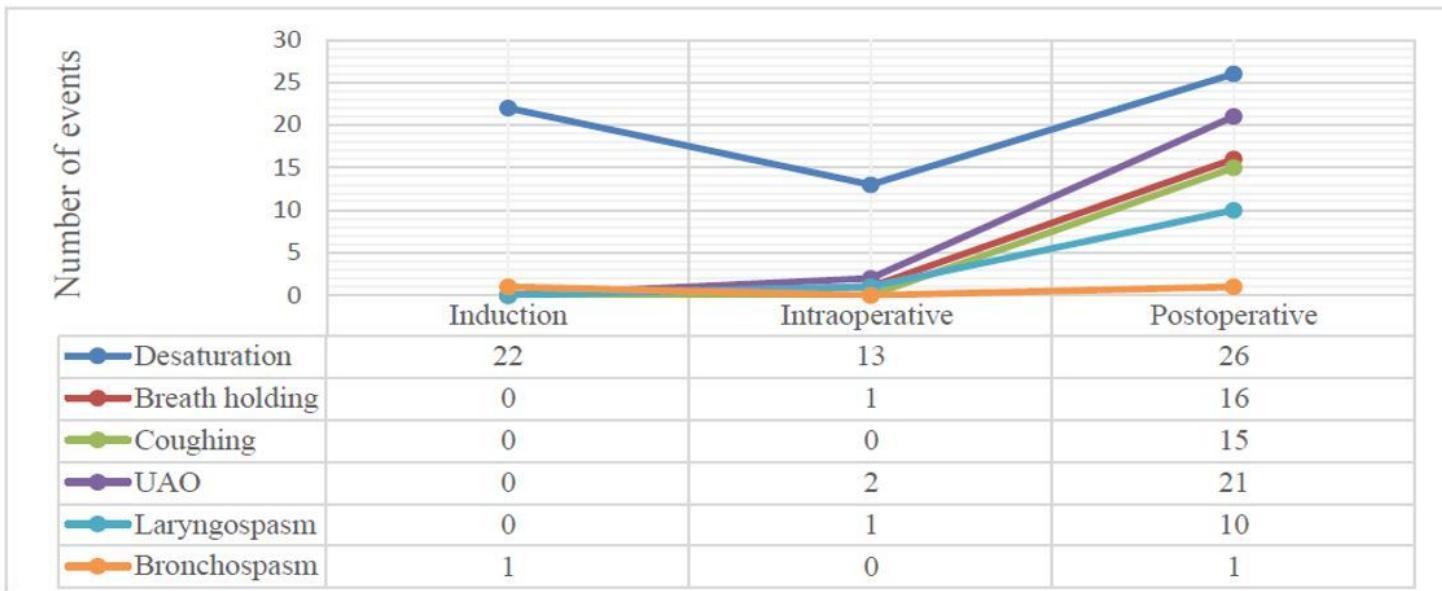


Figure 1

Line graphs showing the occurrences of perioperative respiratory adverse events among pediatrics surgical patients at UoGCSH and TGCSH, Northwest Ethiopia; March 1 – May 30, 2020 (N = 210).