



## Adverse Events in Children Receiving General Anaesthesia with Laryngeal Mask Airway Insertion

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### ABSTRACT

**Introduction:** Perioperative adverse events are more common in children compared to adult population. Reporting an adverse event proves effective in identifying problems and helps in prevention and early management. Our objective was to identify the types, incidence, and the time of occurrence of perioperative adverse event. We also aimed to find out whether the occurrence of the types of adverse events differs in children below and above five years.

**Methods:** This was a prospective study in 242, ASA Physical Status I and II children aged day one to 14 years, receiving general anesthesia with laryngeal mask airway for various elective surgeries. Adverse events observed in the perioperative period were recorded.

**Results:** Adverse events related to respiratory system (n=26, 55%) were the most common followed by cardiovascular system (n= 14, 30%). Adverse events were observed in 24(10%) children in the operating room and in 20 (8%) children in the post anaesthesia care unit. In the operating room, majority (14 of 27, 52%) of the events occurred immediately after removal of laryngeal mask airway. Respiratory events were more common in children below five years (p=0.007), whereas cardiac events were more common in children above five years (p=0.02).

**Conclusions:** The commonest adverse event in children is related to respiratory system. Adverse events occur more frequently in the operating room, mostly immediately after removal of laryngeal mask airway. Respiratory events are more frequent in children below five years whereas cardiac events are more frequent in children above five years.

**Keywords:** *adverse events; children; laryngeal mask airway; laryngospasm; perioperative.*

### INTRODUCTION

Perioperative adverse events are more common in children compared to adult population.<sup>1-3</sup> Unique anatomic, physiologic and pharmacologic characteristics make general anaesthesia in a child potentially more challenging when compared to an adult.<sup>4</sup> Although, anaesthesia related mortality and morbidity in children has declined over the past two decades, it is still a problem.<sup>5-7</sup>

Reporting an adverse event proves effective in identifying problems and improving anaesthetic care, leading to a better outcome.<sup>3,8</sup> Laryngeal mask airway (LMA) offers a safe alternative to endotracheal tube for airway maintenance and is frequently used in children.<sup>9</sup>

Perioperative adverse event particularly with LMA insertion in children is little investigated.

This study was therefore conducted to find out the type, frequency and the timing of occurrence of perioperative adverse events in children scheduled for general anaesthesia with LMA for various elective surgeries. We also aimed to find out whether the occurrence of the types of adverse events differs in children below and above five years.

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## METHODS

This was a prospective, observational study conducted in a community based tertiary care hospital in eastern Nepal from August 2013 to October 2013. Approval from the Institutional Ethical Review Board and informed consent from the parent of each child was obtained. Two hundred forty-two consecutive children with ASA physical status I and II, aged day one to 14 years, scheduled for general anaesthesia with LMA insertion for various elective surgeries were included. Children with ASA physical status >II, cardiac disease, pulmonary disease, respiratory tract infection, risk of aspiration with LMA use, undergoing surgeries involving the airway and surgeries that were anticipated to require > 120 min were excluded.

Each patient underwent preoperative evaluation by a resident anaesthesiologist in the inpatient unit, a day before surgery and by a consultant anaesthesiologist just before the anaesthesia. Patient's age, sex, weight, and detailed past and present medical history were noted. Children six months to five years were premedicated with syrup Promethazine hydrochloride, 0.5mg/kg and children above five years with tab. diazepam (2.5mg for <25 kg and 5mg for >25kg) at the night prior to surgery and in the morning of the day of surgery. On arrival to operation theatre, electrocardiogram, pulse oximeter, and non-invasive blood pressure were monitored. In children up to five years, intravenous access was secured after induction of anaesthesia with halothane in oxygen. In most of the children older than five years, an intravenous access was secured before induction. Anaesthesia was induced in these children with inj. 2% propofol, 2-3mg/kg. For prevention of propofol induced pain, inj. lignocaine 2mg was mixed with each ml of propofol. All the children received inj. fentanyl 1.5µg/kg for analgesia. A bolus of 0.2µg/kg of inj. fentanyl was added according to the discretion of the attending anaesthesiologist thereafter. Appropriate sized LMA according to weight of the child was inserted after achieving adequate depth of anaesthesia, which was confirmed by loss of jaw tone. Anaesthesia was maintained with halothane 2% in oxygen while the patient spontaneously breathed through Ayres T piece. Heart rate, blood pressure, oxygen saturation, electrocardiogram and end tidal CO<sub>2</sub> were monitored at every five minutes. After completion of surgery, the head end of the operating table was lowered, approximately 15° to the horizontal and LMA was removed when the patient was still in a deeper plane of anaesthesia. Spontaneously breathing patient with stable vital signs was transferred to postanesthesia care unit (PACU) in the lateral position. In the PACU oxygen was supplemented by face mask. The duration of stay of the child in the PACU was recorded.

Types and the frequency of the adverse events that occurred in the operating room (OR) and in PACU were documented. According to the time of occurrence, the operating room adverse events were divided in to three groups: during induction of anesthesia, during maintenance and after removal of LMA. Tachycardia, bradycardia, hypertension and hypotension were defined as change in HR or BP of > or < 30% of the baseline. Fever was defined as temperature ≥ 38°C. Respiratory adverse events were defined as following<sup>10</sup>

**Laryngospasm:** complete airway obstruction associated with muscle rigidity of abdominal wall, chest wall, unrelieved by manoeuvres to relieve soft tissue obstruction.

**Airway obstruction:** partial airway obstruction with snoring noise and respiratory efforts without deep desaturation. This was relieved easily by jaw-thrust manoeuvre, application of positive airway pressure and/or a Guedel's airway.

**Bronchospasm:** an increase in respiratory effort, especially expiration, associated with hypercapnoea and oxygen desaturation, wheeze on auscultation, capnography changes with increase in the slope of the plateau, and increase in airway peak pressure.

Oxygen desaturation: fall in SpO<sub>2</sub> < 95%.

The collected data was entered in Microsoft excel 2007 and exported to Statistical Package for Social Science software version 11.5 for windows for analysis. Values are presented as frequency, percentage and mean ± SD. Children were divided into two groups according to age: children less than five years and children more than five years. The type of adverse event among age groups was compared using chi-square test using actual number of patients.

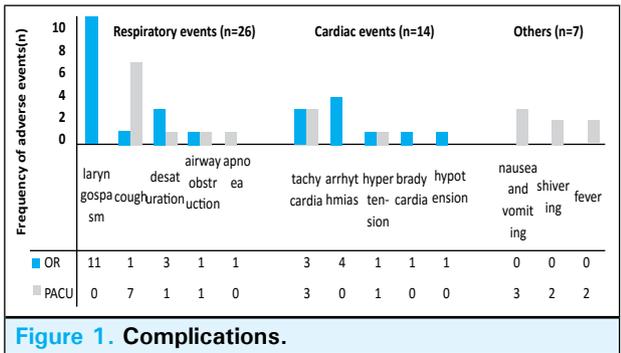
## RESULTS

Of the 242 children studied, 149 underwent general surgical procedures (Table 1). The age of the children ranged from day one to 14 years, 107 children were below five years and 135 children were above five years.

Forty-seven adverse events were observed in 40 children. Two children had triple events and three children had double events which were related to respiratory system. The commonest adverse event in the perioperative period was related to respiratory system (26 events, 55%) followed by cardiovascular system (14 events, 30%)(Fig 1).

**Table 1. Demography.**

Parameters	Observations (no. or mean ± SD)
<b>Surgical procedures:</b>	
General surgery: Ophthalmic:	149: 43: 41: 9
Orthopaedic: Ear nose and throat	
Male: Female	157:85
Children < 5 years: > 5 years	107:135
Age (years)	6.59 ± 3.97
Weight (kg)	21.71 ± 9.57
Duration of anaesthesia (min)	51.29 ± 13.8
Length of stay in PACU(min)	46.84 ± 17.65

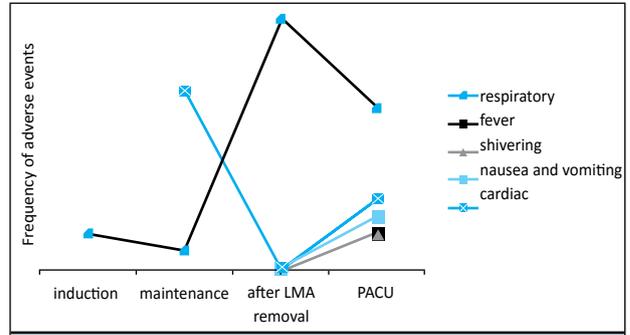


Laryngospasm accounted for 42% (11) of all the respiratory adverse events and it occurred only in the operating room. Two of our children developed laryngospasm at the time of induction of anaesthesia. Laryngospasm in nine children was observed immediately after removal of LMA and three of them desaturated. Laryngospasm in one child required administration of iv Succinylcholine 0.5mg/kg whereas, in other ten children, it resolved after application of positive pressure ventilation manually. Cough was the second most common respiratory event and occurred mostly in PACU. One child developed cough after LMA removal and in seven children it developed in the PACU. Four children developing cough in PACU had also developed other respiratory events in the OR. Children developing cough, apnoea, airway obstruction and desaturation were manually ventilated and did not require any pharmacological intervention.

Tachycardia occurred in six children and was the commonest cardiac adverse event followed by arrhythmias. All the episodes of tachycardia and hypertension was resolved either after administration of inj. fentanyl or after increasing the depth of anaesthesia. Premature ventricular contraction in one child required administration of intravenous lignocaine and in the other three children, it was spontaneously reverted. Hypotension and bradycardia were the other cardiac events observed and did not require pharmacological intervention. Nausea and vomiting, shivering, and fever

occurred only in the PACU and were observed in three, two and two children respectively.

Adverse events were observed in 10% (24) of the children in the operating room and 8% (20) in the PACU. Among the OR events, majority (14 events, 52%) occurred immediately after removal of LMA (Fig2). All the events that occurred after removing LMA were related to the respiratory system.



**Figure 2. Frequency of adverse events.**

When the children were grouped according to age, respiratory events were observed more frequently in children below five years (p=0.007) whereas cardiac events were observed more frequently in children above five years (p=0.02)(Table2).

**Table 2. Adverse events in different age groups.**

Types of adverse events	Children < 5y (n = 107)	Children > 5y (n = 135)
Respiratory*	14	5
Cardiac*	2	12
Nausea and vomiting	0	3
Shivering	1	1
Fever	1	1

\*P<0.05

**DISCUSSION**

The commonest adverse event in the perioperative period was related to respiratory system followed by cardiovascular system in our study. Laryngospasm was the most frequent respiratory event observed. Adverse events occurred more frequently in the operating room when compared to PACU. In the operating room, most of the adverse events were observed immediately after removal of LMA. When the types of adverse events were compared according to the child’s age, respiratory events were more frequent in children below five years whereas cardiac events were more frequent in children above five years.

Our finding, respiratory as the most common perioperative adverse event in children is similar to the findings of previous studies.<sup>5,6,11</sup> Similarly, earlier studies have also reported laryngospasm as the most

frequent respiratory adverse event in children.<sup>6,11</sup> In contrast, the most frequently observed respiratory event was hypoxemia/hypoventilation in a study of de Graff et al.<sup>5</sup> The commonest perioperative respiratory adverse event was recurrent cough in a study of Mamie et al.<sup>10</sup> In our patients, cough was the second most common respiratory event and was mostly observed in PACU. Most of our children developing cough in PACU had also developed other respiratory events in the OR. From our observation, children developing an adverse events in OR are at risk for developing an event later and therefore these children should be monitored cautiously in the postoperative period.

Cardiovascular event was the second most common adverse event in our study. This finding is similar to the earlier studies, where hypotension and arrhythmia were the most frequently occurring cardiac events.<sup>5,6,11</sup> Tachycardia was the commonest cardiac event in our study followed by other rhythm abnormalities. Episodes of tachycardia and hypertension were resolved in our patient either after fentanyl administration or after increasing the depth of anaesthesia. Inadequate dosing of analgesics and under management of postoperative pain in children still remains a problem.<sup>12-14</sup> Fear of respiratory depression in the postoperative period can result in under dosing of opioids in the intraoperative period. However, it has been recognized that infant and children do perceive pain as an adult and hence, pain in this population should be recognized and treated adequately.<sup>14</sup>

Premature ventricular contractions and bradycardia were observed only during the intraoperative period in our patients. Bradycardia reverted spontaneously and was observed during cataract surgery in one child. Bradycardia due to oculocardiac reflex is a common complication during ophthalmic surgery.<sup>15</sup> Bradycardia and arrhythmias are also common during halothane anaesthesia.<sup>16,17</sup> The incidence of arrhythmias during halothane anaesthesia in 50 children who were spontaneously ventilated with LMA was 15% in a study of Walker et al.<sup>18</sup> In spite of halothane use, the overall incidence of arrhythmias including bradycardia was only two percent in our patients. Similar incidence of dysrhythmias as ours was reported by Tay et al.<sup>6</sup> However, they had excluded bradycardia resulting from most cases of hypoxia and used sevoflurane instead of halothane.

Nausea and vomiting, shivering and fever were observed only in the PACU in our patients. Two developed retching and one vomited. We did not administer prophylactic antiemetic drug. Nausea and vomiting is a common complication in older children in the postoperative period,<sup>1,7,19</sup> the incidence increases with duration of surgery and anaesthesia.<sup>20</sup> The incidence of nausea

and vomiting in our study was 1.2%, which is less as compared to six percent in a study of Mural et al.<sup>7</sup> Its incidence in 94 children in the first 24 h postoperatively was 7%.<sup>19</sup>

Shivering was observed in two (0.8%) children in our study. Shivering in the postoperative period is probably the result of intra-operative heat loss because of exposure to low ambient temperatures, vasodilation due to anaesthetic drugs and infusions of cold fluids.<sup>21</sup> Its incidence was 3.4% in 1507 children in a study of Akin et al,<sup>22</sup> and was 14.4% in 376 children in a study of Lyons et al.<sup>21</sup>

Two (0.8%) children developed fever in our study. Temperature  $\geq 38^{\circ}\text{C}$  was observed in 30% of the 100 children in the first 24 h in a study of Anand et al,<sup>23</sup> and in 28.5% of 256 children in the early postoperative period in a study of Yeung et al.<sup>24</sup> It has been suggested that postoperative fever in children is likely to be the inflammatory response to the trauma of surgery but not caused by infection.<sup>24</sup> Both of our febrile patients did not show any other features of infection during their stay in the inpatient unit.

The incidence of arrhythmias,<sup>18</sup> nausea and vomiting,<sup>7,19</sup> shivering,<sup>21,22</sup> and fever,<sup>23,24</sup> was less in our study as compared to earlier studies. This could be because our patients were healthier and were scheduled for elective surgeries. Increased ASA physical status and emergency procedures are known to be the risk for developing perioperative complications.<sup>5,25</sup> Lower incidence could also be due to differences in the duration of the study period as we observed our patients only for a shorter time.

Adverse events occurred in 10% children in the operating room and in 8% of the children in PACU in our study. Adverse events were recorded in 8.5% of children in the intraoperative period and in 12% of children in the PACU in a study of Cohen et al.<sup>1</sup> The events were not divided in to intraoperative and postoperative period and were recorded in 2.8% of children anaesthetized in a study of Tay et al,<sup>6</sup> and in 3.4% of children in the study of de Graff et al.<sup>5</sup> Differences in the incidence of adverse events between our study and these studies could be due to the variability in the type of patients included and the anaesthetic technique used. In addition to inclusion of children getting regional anaesthesia and tracheal intubation, children receiving general anaesthesia for emergency surgeries were also included in these studies. Adverse events were relatively more common in OR compared to PACU in our patients. Similarly, only minority of perioperative adverse event originated in PACU in a study of de Graff et al.<sup>5</sup> In contrast to our finding, most of the perioperative complications in children were reported in PACU in a study of Murat et

al.<sup>7</sup> Differences in the definition of the adverse events could be one of the reason for this finding, adverse events relating to the use of drugs and equipment failure were also included by Mural et al.<sup>7</sup>

When we recorded the time of occurrence of adverse events in OR, majority of the event, occurred immediately after removal of LMA. All the events that occurred after removing LMA were related to respiratory system, and laryngospasm was the commonest. Lighter plane of anesthesia and presence of secretion in the pharynx during removal of LMA can precipitate laryngospasm.<sup>26</sup> Although, we removed LMA when our patients were still in a deeper plane of anesthesia, their pharynx was not suctioned. Similar to our finding, the incidence of laryngospasm, cough, breath holding and desaturation were more after LMA removal than during insertion and maintenance of anaesthesia in a study of Ates et al.<sup>19</sup>

The more frequently occurring perioperative adverse event in children below five years was respiratory and in children above five years was cardiac in our study. Young age particularly less than one is known to have the highest risk of developing perioperative respiratory adverse events.<sup>1,5,6,7,25</sup> The relatively narrow airway together with high incidence of respiratory tract infection is the reason for this observation.<sup>7</sup> Mamie et al. found an 8% decreased risk of perioperative respiratory adverse event with each increasing year of age in children aged 1-14 years.<sup>10</sup> Although, adverse events involving the cardiovascular system are reported more common in adult compared to children,<sup>5</sup> we

could not find any study reporting the occurrence of cardiac events more frequently in older children as ours. Greater incidence of arrhythmia in children 1-10 years as compared to children below one year was found by Cohen et al.<sup>1</sup> Although all the children developing nausea or vomiting in our study were older than five years, its occurrence was not statistically influenced by the age factor. Occurrence of postoperative nausea and vomiting more frequently in children above five years has been reported.<sup>1,25</sup>

All the events observed in our study were easily managed and none of the children required admission in intensive care unit. Small number and selection of heterogeneous group of patients are our main limitations. Further studies of larger patient population may be helpful to determine the trend of perioperative event in children receiving general anaesthesia with LMA use.

## CONCLUSIONS

The commonest adverse event in children receiving general anaesthesia with LMA insertion in the perioperative period is related to respiratory system followed by cardiovascular system. Of all the respiratory events, laryngospasm is the commonest. Adverse events are observed more frequently in the operating room as compared to PACU. In OR, adverse events occur mostly immediately after removal of LMA. Respiratory events are more frequent in children below five years whereas cardiac events are more frequent in children above five years.

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