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Original Research Article

A Prospective Randomized Comparative Study of Oxiport Laryngoscope Blade versus Miller Laryngoscope Blade for Intubation in Neonates and Infants during General Anesthesia

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Abstract

Aim: To compare oxiport laryngoscope blade and miller laryngoscope blade for neonatal and infant intubations.

Methodology: This controlled interventional study conducted in the Department of Anesthesiology, IGIMS, Bihar for one year in which 120 neonates/infants in groups of 60 each posted for surgery in paediatric operation theatre over a period of 6 months were included in the study. Patients posted for elective surgery were assessed during the pre-anaesthetic check a day prior whereas those taken up for emergency procedures were assessed on the day of surgery. Full-term neonates and infants up to 6 months of age of either sex requiring general anaesthesia with endotracheal intubation for elective as well as emergency surgery were included in the study. This comprised three groups: thoracic, abdominal and miscellaneous surgeries. Monitoring used included electrocardiogram and pulse rate on cardioscope, pulse oximetry, capnometry, noninvasive BP, nasopharyngeal and skin temperature. For the purpose of this study to quantify desaturation data, it was graded as mild desaturation (lowest SpO2 up to 90%), moderate desaturation (lowest SpO2 between 85% and 89%) and severe desaturation (lowest SpO2< 0.05 was considered as statistically significant.

Results: The mean lowest level of saturation attained in Group O was 98.37% ± 2.28% as compared to 97.38% ± 3.83% in Group M and p value was <0.001 which was statistically significant. The incidence of mild desaturation (SpO2 up to 90%) was 87.24% in Miller group and 93.75% in Oxiport group. The incidence of moderate desaturation (SpO2 between 85% and 92.5%) was 3.26% in Miller group and 6.25% in Oxiport group. Incidence of severe desaturation (SpO2 <85%) was 9.5% in Miller group and 0% in Oxiport group (Chi-square test P = 0.028). Both groups were comparable with respect to the type of surgery (abdominal, thoracic, miscellaneous). Abdominal surgeries were associated with a higher number of severe desaturations (80%) compared to thoracic (10%) and miscellaneous (10%) surgeries.

Conclusion: Apneic laryngeal oxygen insufflation with Oxiport laryngoscope blade decreases the incidence and rate of desaturation with a better hemodynamic stability as compared to Miller blade while intubating neonates and infants.

Keywords: Miller, Oxiport, Haemodynamic, Laryngoscope.

Introduction

One of the most essential skills to master as an anesthetist is the skill of airway management. Despite the development of new pediatric airway techniques and devices (including video monitors), tracheal intubation in infants and neonates using direct laryngoscopy (DL) remains the 'gold standard' for anesthesiologists and pediatricians [1]. Endotracheal intubation is essential for the maintenance of airway and to ensure adequate ventilation during various surgical procedures. Endotracheal intubation involves laryngoscopy, for which Macintosh/Miller laryngoscope is the gold standard.

A failed intubation can contribute up to 21% of respiratory complications in pediatric-aged patients. In addition, higher oxygen consumption (7 ml/kg/minute) and an immature pulmonary apparatus make them prone to rapid and early desaturation. This is more likely in pre-term babies who have limited respiratory reserve, prolonged as well as recurrent apnoea or difficult laryngoscopies [2].

Pre-oxygenation is intended to prevent or delay onset of hypoxia during subsequent apnoea. The theory of apnoeic oxygenation is based on absorption of oxygen into the bloodstream, with the absorbed pulmonary volume being replaced by fresh oxygen pulled from the larynx through the trachea into the lungs. Pharyngeal insufflation of oxygen has been shown to delay the onset of desaturation and hypoxaemia during apnoea by enhancing the safe apnoea duration [3]. This technique supplements pre- oxygenation and provides apnoeic diffusion oxygenation during laryngoscopy, significantly delaying the desaturation during subsequent apnoea [4].

Many techniques have been developed in the past for pharyngeal insufflation of oxygen, by fitting a feeding tube to the laryngoscope blade to provide oxygen flow [5] or incorporating a channel along the side of laryngoscope blade[6]. Neonatal intubations are routinely performed with a Miller blade which has no provision for oxygenation. The Oxiport Miller is a modified Miller blade. It consists of a metallic tube incorporated into the blade that has an attachment through which oxygen can be connected and insufflated during laryngoscopy.

The blade has been commercially available since 1980's and is used in infants and neonates. Deep laryngeal oxygen insufflation is a method which delivers oxygen closer to the larynx. This can be done with the Oxiport laryngoscope blade through the integrated oxygen delivery channel. Hence, compared to nasal prongs where the inspired oxygen concentration may be variable, oxygen insufflation closer to the larynx provides higher inspired oxygen concentration [7]. We tested the hypothesis that deep laryngeal oxygenation with Oxiport blade delays the onset as well as severity of desaturation as compared with laryngoscopy without oxygen insufflations (Miller Blade). Our aim was to compare these two blades for neonatal and infant intubations.

Methodology

This controlled interventional study conducted in the Department of Anesthesiology, IGIMS, Patna,Bihar, India for one year in which 120 neonates/infants in groups of 60 each posted for surgery in paediatric operation theatre over a period of 6 months were included in the study. Patients posted for elective surgery were assessed during the pre-anaesthetic check a day prior whereas those taken up for emergency procedures were assessed on the day of surgery. Full-term neonates and infants up to 6 months of age of either sex requiring general anaesthesia with endotracheal intubation for elective as well

as emergency surgery were included in the study.

This comprised three groups: thoracic, abdominal and miscellaneous surgeries. Thoracic surgeries included tracheoesophageal fistula repair, congenital diaphragmatic hernia repair, and lobectomies for pulmonary sequestration and congenital lobar emphysema. Abdominal surgeries included intestinal obstruction, duodenal atresia, ileal atresia, colostomy, laparoscopic and open pyloromyotomy, gastroschisis, omphalocele and Kasai procedure for biliary atresia. Miscellaneous surgeries included sacrococcygeal teratoma excision, meningomyelocele repair, and ventriculoperitoneal shunt for hydrocephalus, cystoscopy and posterior urethral valve fulguration. Babies having desaturation before the induction of anaesthesia (SpO2 <94%), known congenital heart disease, hypotension (systolic blood pressure [BP] <60 mmHg), obvious congenital syndromes, anticipated difficult airway and anaemia (haemoglobin <12 g %) were excluded from the study.

After obtaining parental consent for the study and confirming fasting status, babies were wheeled into OT in a cradle covered with warm cotton rolls, along with their maintenance fluid. Monitoring used included electrocardiogram and pulse rate on cardioscope, pulse oximetry, capnometry, noninvasive BP, nasopharyngeal and skin temperature. Pulse oximeter probe was used in all participants and attached on each participant's toe. This was connected to Mindray DPM6 monitor. Only waveforms generating a good plethysmographic trace were used for recording SpO2 data. Ringer's lactate was started through an infusion pump at a rate according to the expected losses based on the surgery. Neonates/infants were then randomized into two groups, Miller group or Oxiport group by computer-generated tables. This randomization was enclosed in opaque sealed envelope, and then, the randomization was activated by the co-investigators.

The babies were then pre-oxygenated with 100% oxygen at a flow rate of 4 L/min for 3 min on spontaneous ventilation with Jackson–Rees circuit using GE Datex Ohmeda Aestiva®/5 Anaesthesia Machine. Injection fentanyl 2 μg/kg intravenous (IV) was administered, and anaesthesia was induced with incremental sevoflurane up to 8%. Neuromuscular blockade was achieved with injection rocuronium 1 mg/kg IV. Baseline SpO2 was noted at this point. This was followed by direct laryngoscopy with the designated blade by an anesthesiology resident (trainee) or a consultant. Laryngoscopy was performed with 0 number blade of Miller laryngoscope in Miller group and 0 number blade of Oxiport® Miller laryngoscope in Oxiport group followed by endotracheal intubation.

In Oxiport group, oxygen insufflation was instituted with oxygen tubing attached to Oxiport blade at a flow rate of 2 L/min (to provide low-flow oxygen during laryngoscopy)4 through an auxiliary oxygen port. Successful intubation was confirmed by end-tidal carbon dioxide tracing on capnometer and auscultation of bilateral equal air entry on both sides of the chest. This constituted the end-point of the study. The observations noted were intubation time in seconds (interval from the insertion of blade into mouth until successful confirmation of intubation), lowest saturation attained, anaesthesiologist performing laryngoscopy (trainee or consultant) and haemodynamic parameters such as heart rate and systolic BP. For the purpose of this study to quantify desaturation data, it was graded as mild desaturation (lowest SpO2 up to 90%), moderate desaturation (lowest SpO2 between 85% and 89%) and severe desaturation (lowest SpO2< 0.05 was considered as statistically significant.

Results

Out of the 120 patients, 60 patients in Miller group and 60 patients in Oxiport group were included. Both groups were comparable with respect to age, sex, weight, mean time to intubation (P = 0.56) and anaesthesiologist performing the laryngoscopy (P = 0.62).

Table 1: Comparison of demographic profile, intubation time, and heart rate between the study groups

Parameters	Miller group (n=25)	Oxiport group (n=25)
Age (in days)	146.24±110.44	138.82±92.86
Sex (Male/Female)	33/27	36/24
Weight (in Kg)	5.62±1.24	5.03±1.72
Intubation time (in sec)	21.72±19.72	22.96±22.66
Heart rate (beats/min)	126±30	134±34
Mean lowest SpO2	97.38% ± 3.83%	98.37% ± 2.28%

The mean lowest level of saturation attained in Group O was 98.37% ± 2.28% as compared to 97.38% ± 3.83% in Group M and p value was <0.001 which was statistically significant. The incidence of mild desaturation (SpO2 up to 90%) was 87.24% in Miller group and 93.75% in Oxiport group. The incidence of moderate desaturation (SpO2 between 85% and 92.5%) was 3.26% in Miller group and 6.25% in Oxiport group. Incidence of severe desaturation (SpO2 <85%) was 9.5% in Miller group and 0% in Oxiport group (Chi-square test P = 0.028). Correlation between time to intubation and SpO2 in Miller group was statistically not significant at P = 0.42. Correlation between time to intubation and SpO2 in Oxiport group was statistically significant at P = 0.001.

Table 2: Incidence of desaturation

Incidence of desaturation	Miller group (n=60)	Oxiport group (n=60)
Mild (SpO2 up to 90%)	87.24%	93.75%
Moderate (SpO2 between 85% and 92.5%)	3.26%	6.25%
Severe (SpO2 <85%)	9.5%	0%

Both groups were comparable with respect to the type of surgery (abdominal, thoracic, miscellaneous) (P = 0.68). Abdominal surgeries were associated with a higher number of severe desaturations (80%) compared to thoracic (10%) and miscellaneous (10%) surgeries.

Discussion

Pediatric patients, because of their anatomical differences in airway compared to adults pose many challenges during endotracheal intubation. In neonates, the highly compliant chest wall with a lower functional residual capacity (FRC) and high closing volume results in increased tendency to close at end-expiration [8]. In addition, higher oxygen consumption (7 ml/kg/minute) and an immature pulmonary apparatus make them prone to rapid and early desaturation. This is more likely in pre-term babies who have limited respiratory reserve, prolonged as well as recurrent apnoea or difficult laryngoscopies [7].

Babies in the Oxiport group had significantly higher saturations compared with those in the Miller group. With Oxiport® laryngoscope, saturation never fell below 85% during the entire period of apnoea. These results confirmed our hypothesis. Oxygen insufflations closer to the larynx maintains higher SpO2 in neonates and infants by maintaining higher lung oxygen partial pressure and thus delays desaturation. Fresh oxygen

continuously replaces the absorbed pulmonary volume by passive diffusion from larynx through the trachea into the lungs. The method increases safe apnoea time by maintaining SpO2 closer to the inflection point of haemoglobin oxygen dissociation curve. Our findings may be extrapolated to use of the Oxiport blade in very sick babies or in emergency situations in the intensive care set up where pre- oxygenation may not be feasible before intubation.

Steiner et al. who did a similar study on the passive laryngeal oxygen insufflations in the age group of 1-17 years also came to the same result. He studied 3 different groups: -direct laryngoscopy, laryngoscopy with TruView video laryngoscopy and laryngoscopy with an oxygen cannula attached to the side of a standard laryngoscope. They concluded that laryngeal oxygen insufflation increases the time to 1% desaturation and reduces the overall rate of desaturation during laryngoscopy in children. 2

Dias R et al [8] also concluded in her study that apnoeic laryngeal oxygen insufflation with Oxiport Miller laryngoscope blade decreases incidence of severe desaturation during neonatal and infant intubations. Montanes M et al [9] concluded in their study that use of high flow nasal cannula reduced the rate and severity of desaturation during intubation in critically ill patients in ICU with mild to moderate hypoxemia. This study's results can be extrapolated to use in paediatric patients who are likely to desaturate faster. [10

Although not statistically significant, abdominal surgeries had a higher incidence of severe desaturation. Our finding may be attributed to the abdominal distension further reducing FRC and affecting pulmonary compliance. Similar results have been reported by a recent British study [2] on the use of deep laryngeal oxygen insufflation during laryngoscopy in children between 1 and 17 years of age. The authors measured the time to a 1% decrease in SpO2 from baseline which they considered a harbinger of a more rapid desaturation to come.

Conclusion

Apneic laryngeal oxygen insufflation with Oxiport laryngoscope blade decreases the incidence and rate of desaturation with a better hemodynamic stability as compared to Miller blade while intubating neonates and infants.

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