A controlled Interventional Comparative Assessment of Oxiport Laryngoscope Blade Versus Miller Laryngoscope Blade for Intubation in Neonates and Infants During General Anaesthesia

[1]Dr. Pradeep, [2]Dr. Sameera, [3]Dr. Syed Himayathulla Hussaini
[1]Senior Resident, Department of Anaesthesiology, ESIC PGIMSR, Kalaburagi,Karnataka, India
[2,3]Assistant Professor, Department of Anaesthesiology, ESIC PGIMSR, Kalaburagi,Karnataka, India
Corresponding author - [3]Dr. Syed Himayathulla Hussaini
Assistant Professor, Department of Anaesthesiology, ESIC PGIMSR, Kalaburagi,Karnataka, India

Abstract:

Aim: The aim of the present study was to compare oxiport laryngoscope blade and miller laryngoscope blade for neonatal and infant intubations.

Material & Methods: This controlled interventional study conducted in the Department of Anaesthesiology for one year in which 100 neonates/infants in groups of 50 each posted for surgery in paediatric operation theatre over a period of 6 months were included in the study.

Results: A total of 100 patientswere included in the study, with 50 patients in the Miller group and 50 patients in the Oxiport group. Both groups were similar in terms of age, sex, weight, average time to intubation, and the anaesthesiologist doing the laryngoscopy. In the Miller group, the occurrence of mild desaturation (SpO2 levels up to 90%) was 84%, whereas in the Oxiport group it was 92%. In the Miller group, the occurrence of moderate desaturation, defined as SpO2 levels between 85% and 89%, was 4%. In contrast, the Oxiport group had a higher incidence of 8%. The Miller group had an incidence of severe desaturation (SpO2 <85%) of 12%, whereas the Oxiport group had an incidence of 0%.

Conclusion: Apneic laryngeal oxygen insufflation with the Oxiport laryngoscope blade reduces the occurrence and speed of oxygen desaturation, while providing improved hemodynamic stability, in comparison to the Miller blade, during intubation of neonates and infants.

Keywords: ***Miller, Oxiport, Haemodynamic, Laryngoscope***
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Introduction

Airwaycontrol is a crucial skill that ananaesthesiologistmust understand.Endotracheal intubation is necessary to maintain the airway and provide sufficient breathing throughout several surgical operations. Endotracheal intubation is a procedure that requires the use of laryngoscopy. The Macintosh/Miller laryngoscope is considered the most reliable and widely accepted tool for this purpose. Endotracheal intubation in paediatric patients is challenging due to their anatomical airway variations compared to adults. In newborns, the chest wall is very flexible and has a smaller functional residual capacity (FRC) and a higher closing volume, which leads to a greater likelihood of desaturation of oxygen at the end of expiration.[1] Furthermore, their elevated oxygen consumption rate of 7 ml/kg/minute, coupled with an underdeveloped pulmonary system, renders them susceptible to fast and premature desaturation. This occurrence is more common in premature infants that have a restricted capacity for breathing, have lengthy and repeated episodes of temporary cessation of breathing, or encounter challenges during the examination of the larynx.[2] The purpose of pre-oxygenation is to mitigate or advance the occurrence of hypoxia during periods of apnoea. Holmdahl is credited with introducing the notion of apnoeic diffusion oxygenation.[3]

A crucial skill for an anaesthesiologist to acquire is the proficiency in airway control. Although novel paediatric airway procedures and technologies, such as video laryngoscopes, have been developed, direct laryngoscopy (DL) remains the preferred method for tracheal intubation in babies and neonates, and is considered the most reliable approach by anaesthesiologists and paediatricians.[4]Endotracheal intubation is necessary to maintain the airway and provide sufficient breathing throughout several surgical operations. Endotracheal intubation is a procedure that requires the use of a laryngoscope, namely the Macintosh/Miller laryngoscope, which is considered the most reliable method. Unsuccessful intubation may account for as much as 21% of respiratory problems in paediatric patients. Furthermore, their increased oxygen consumption rate of 7 ml/kg/minute, coupled with an underdeveloped pulmonary system, makes them susceptible to quick and early desaturation. This occurrence is more probable in premature infants that possess a restricted capacity for respiration, have extended and recurring episodes of apnoea, or encounter challenges during laryngoscopies.[5]

Pre-oxygenation aims to pre-empt or postpone the occurrence of hypoxia during future apnoea. Pharyngeal insufflation of oxygen has been shown to prolong the time before desaturation and hypoxemia occur during apnoea by increasing the duration of safe apnoea.[6] This method enhances the process of pre-oxygenation and offers apnoeic diffusion oxygenation during laryngoscopy, thereby prolonging the time before oxygen levels decrease during subsequent apnoea.[7] One solution included attaching a feeding tube to the laryngoscope blade to provide oxygen flow[8], or integrating a channel along the side of the laryngoscope blade[9] using a suction catheter. Another approach included administering high flow nasal oxygen insufflation using nasal prongs to severely sick patients during laryngoscopy. Deep laryngeal oxygen insufflation provides oxygen in greater proximity to the larynx as compared to pharyngeal insufflations. The often-used Oxiport blade lacks the capability for oxygen insufflation. The Oxiport Blade is a Miller Blade that has been modified to include a metallic tube. This tube allows for the insertion of additional oxygen port, which may then be used for oxygen insufflation during laryngoscopy.[10] Therefore, the objective of the research was to compare these two blades specifically for neonatal intubations.

Material & Methods

This controlled interventional study conducted in the Department of Anaesthesiology for one year in which 100 neonates/infants in groups of 50 each posted for surgery in paediatric operation theatre 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. Abdominal surgeries included intestinal obstruction, duodenal atresia, ileal atresia, colostomy, laparoscopic and open pyloromyotomy, gastroschisis, omphalocele. Miscellaneous surgeries included ventriculoperitoneal shunt for hydrocephalus, cystoscopy and posterior urethral valve fulguration.

Exclusion Criteria

Babies having desaturation before the induction of anaesthesia (SpO_2 <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.

Methodology

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, pulse oximetry, capnometry, non-invasive BP, nasopharyngeal and skin temperature.

Pulse oximeter probe was used in all participants and attached on each participant's toe. This was connected to the monitor. Only waveforms generating a good plethysmographic trace were used for recording SpO_2 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 coinvestigators.

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 connected to anaesthesia work station. 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 atracurium 0.5 mg/kg IV. Baseline SpO2 was noted at this point. This was followed by direct laryngoscopy with the designated blade by an anaesthesiology resident 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)[6] 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 (resident 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< 85%).

Results

Table 1: Comparison of demographic profile, intubation time, experience of anaesthesiologist and haemodynamics between the study groups

Parameter	Miller group (n=50)	Oxiport group (n=50)	P value
Age in days (mean±SD)	46.84±51.49	39.51±53.37	0.750
Sex (male: female)	30:20	35:15	0.885
Weight in kg (mean±SD)	3.18±1.00	2.94±1.16	0.912
Intubation time in s (mean±SD)	42.58±20.40	42.90±22.36	0.678
Anaesthesiologist performing laryngoscopy (%)			
Resident	35	36	0.987
Consultant	15	14	0.870
Heart rate in beats/min (mean±SD)	132±17	128±22	0.775
Systolic BP in mmHg (mean±SD)	76±26	68±32	0.560

Out of the 100 patients 50 patients in Miller group and 50 patients in Oxiport group were included. Both groups were comparable with respect to age, sex, weight, mean time to intubation and anaesthesiologist performing the laryngoscopy. It did not show any statistical significance.

Table 2: Incidence of desaturation

Incidence of Desaturation	Miller Group (n=50)	Oxiport Group (n=50)	P Value
Mild	42 (84%)	46 (92%)	0.882
Moderate	2 (4%)	4 (8%)	0.912
Severe	6 (12%)	0	0.950

The incidence of mild desaturation (SpO2 up to 90%) was 84% in Miller group and 92% in Oxiport group. The incidence of moderate desaturation (SpO2 between 85% and 92.5%) was 4% in Miller group and 8% in Oxiport group. Incidence of severe desaturation (SpO2 <85%) was 12% in Miller group and 0 in Oxiport group.

Discussion

Neonates and infants due to their increased oxygen consumption rate of 7 ml/kg/minute and underdeveloped pulmonary system, they are susceptible to experiencing fast and early desaturation. This is more common in premature infants who have limited ability to breathe, have lengthy or repeated pauses in breathing, or have difficulty with laryngoscopies.[2] The purpose of pre-oxygenation is to pre-empt or postpone the occurrence of hypoxia during future apnoea. Holmdahl is credited with introducing the notion of apnoeic diffusion oxygenation.[11]Apnoeic oxygenationrelies on the absorption of oxygen into the circulation. This occurs when new oxygen is drawn from the larynx down the trachea into the lungs, replacing the amount of air that is absorbed. The blade has been commercially accessible since the 1980s and is used in newborns and neonates. Deep laryngeal oxygen insufflation is a technique that transports oxygen in close proximity to the larynx. The Oxiport laryngoscope blade enables the supply of oxygen via its integrated channel. Therefore, in contrast to nasal prongs, which may have varying levels of inspired oxygen concentration, delivering oxygen closer to the larynx results in a greater concentration of inspired oxygen.[2]

A total of 100 patients were included in the study, with 50 patients in the Miller group and 50 patients in the Oxiport group. Both groups were similar in terms of age, sex, weight, average time to intubation, and the anaesthesiologist doing the laryngoscopy. In the Miller group, the occurrence of moderate desaturation (SpO2 levels up to 90%) was 84%, whereas in the Oxiport group, it was 92%. In the Miller group, the occurrence of mild desaturation(SpO2 levels between 85% and 92.5%) was 4%, whereas in the Oxiport group it was 8%. The Miller group had an incidence of severe desaturation (SpO2 <85%) of 12%, whereas the Oxiport group had an incidence of 0%. Neonates and newborns may achieve greater SPO2 levels by maintaining a higher oxygen partial pressure in their lungs, which helps to prevent desaturation. This technique enhances the duration of safe breath-holding by keeping the SPO2 levels closer to the inflection point of the haemoglobin oxygen dissociation curve. Furthermore, our initial main assumption was that the duration required to achieve a SPO2 level of 90% would be notably extended with the use of additional oxygen.

Steiner *et al*., who conducted a comparable investigation on passive laryngeal oxygeninsufflationsin individuals aged 1-17 years, arrived at the same result. The researcher examined three distinct cohorts: direct laryngoscopy, laryngoscopy using TruView video laryngoscopy, and laryngoscopy with an oxygen cannula affixed to the side of a conventional laryngoscope. Their findings indicate that laryngeal oxygen insufflation prolongs the time it takes for oxygen levels to drop by 1% and decreases the overall rate of oxygen level decrease during laryngoscopy in children.[2] In her research, Dias R et al[1] found that the use of apnoeic laryngeal oxygen insufflation with the Oxiport Miller laryngoscope blade reduces the occurrence of severe desaturation during intubations in neonates and infants. In their research, Montanes M *et al*.[12]determined that the use of high flow nasal cannula resulted in a decrease in the frequency and intensity of desaturation during intubation in critically sick patients in the intensive care unit (ICU) who had mild to severe hypoxemia. The findings of this research may be extended to apply to paediatric patients who are prone to experiencing quicker desaturation.[13]In concordance with the findings of above-mentioned studies, our study has shown that, Oxyport Miller laryngoscope is an effective mode of apnoeic oxygenation and helps to prevent severe oxygen desturation during laryngoscopy in infants and neonates.

Conclusion

When compared to the Miller blade, the Oxiport laryngoscope blade is superior in terms of hemodynamic stability and reduces the incidence and rate and severity of desaturation during endotracheal intubation of newborns and infants and therefore helps to prevent general anaesthesia related morbidity.

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