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# A Comparative Study of Tracheal Intubating Conditions without Muscle Relaxants between Propofoland Sevoflurane Induction

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**Abstract**

*Introduction:* Non-depolarizing neuromuscular blocking agents are alternative but are slower in onset and have a prolonged neuromuscular blockade [3] and also an inability to reverse the paralysis quickly if airway management via mask or tracheal intubation is not possible. *Methodology:* The study group consisted of 80 patients of both sexes, between the age of l-10years and belonging to ASA Physical status 1 and 2 who were scheduled for cleft lip/cleft palate/cleft alveolus surgery under general anaesthesia. *Results:* Regarding position of vocal cords, they were open in 50% of children, moving in 35% and closing in 15% of children in group A. In group B, vocal cords were open in 72.5% moving in 20%, closing in 5% and closed in 2.5% of children. *Conclusion:* A combination of sevofluranehad more acceptable intubating conditions compared to combination of propofol.

**Keywords:** Sevoflurane; Propofol; Intubation.

## Introduction

Endotracheal intubation is the most important and crucial step during administration of general anaesthesia. It is more so in paediatric patients, especially, if there are associated deformities in and around the airway like cleft lip and palate.

Insufflation of trachea for the purpose of ether anaesthesia was introduced in 1909 in USA and 1912 in UK [1]. As surgical procedures got more and more complicated and prolonged, tracheal intubation became a part of anaesthesia practice. It was usually performed under deep inhalation anaesthesia with ether. The same technique was continued with halothane and of late, sevoflurane is gaining attention especially in paediatricanaesthesia practice.

Neuromuscular blocking agents to aid tracheal intubation were first introduced into clinical practice in 1942 in USA [1]. Neuromuscular blocking agents have made technique of endotracheal intubation much easier, but not without risks of subjecting the patient to potential risks. Until early 1990, suxamethonium was the only drug for facilitating tracheal intubation due to its rapid onset and ultra short duration of action, but it has many potential problems like myalgia, elevated intraocular and intracranial pressure, hyperkalemia, prolonged apnea, masseter spasm and malignant hyperthermia [2]. In United States (1993), FDA advised that suxamethonium was contraindicated for routine use in children and adolescents [3]. The justification was the increased incidence of fatal or near fatal cardiac arrest in children who had received suxamethonium. Most of the cardiac arrests were attributed to hyperkalemia in patients with undiagnosed muscular dystrophies, triggered after use of suxamethonium [4].

Non-depolarizing neuromuscular blocking agents are alternative but are slower in onset and have a prolonged neuromuscular blockade [3] and also an inability to reverse the paralysis quickly if airway management via mask or tracheal intubation is not possible [2]. They leave sympathetic responses unaltered and there is a potential for failed intubation [3]. The excessive or unnecessary neuromuscular blockade contributes to awareness under general anaesthesia, residual paralysis and sometimes allergic reactions [5]. So avoiding muscle relaxants when they are not required for planned procedure may prevent complications of their use, misuse and antagonism. With these reasons, a method of providing good intubating conditions rapidly without using

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muscle relaxants has been sought.

Since the advent of potent short acting opioid drugs and newer intravenous induction agents which are good in suppressing airway reflexes, possibility of intubating the trachea without muscle relaxants has been under evaluation. The most favourable drug for this purpose is propofol, due to its profound depressant effect on airway reflexes [6]. It decreases pharyngeal and laryngeal activity and muscle tone [7,8]. Induction with propofol is quick and smooth with rapid awakening and orientation during recovery [9].

On the other hand, of all inhalational agents available, sevoflurane is one drug with its relatively pleasant smell, low airway irritability and low blood gas solubility, less myocardial depression and arrhythmogenecity, promises such intubating conditions. Currently, sevoflurane is hailed as the inhalational agent of future. With this background, study was conducted to compare the intubating conditions achieved with sevoflurane and propofol.

## Methodology

*Inclusion Criteria*

1. Pediatric patients, aged 1-10 years, both sexes, undergoing cleft lip, cleft palate and cleft alveolus surgery under general anaesthesia
2. Children belonging to ASA PS I & II.

*Exclusion Criteria*

1. Children with history of significant cardiac, respiratory, renal, hepatic or central nervous system diseases.
2. Children with history of sensitivity to the drugs used.
3. Children with anticipated difficult airway.
4. Children with active or recent upper respiratory tract infection.

The study of evaluation of endotracheal intubation without muscle relaxants in children undergoing cleft lip, palate and alveolus surgery: a comparative study sevoflurane and propofol was undertaken. The study group consisted of 80 patients of both sexes, between the age of l-10years and belonging to ASA Physical status 1 and 2 who were scheduled for cleft lip/cleft palate/cleft alveolus surgery under general anaesthesia.

The following groups of patients were excluded from the study, if they had history of significant cardiac, respiratory, renal, hepatic or central nervous system diseases, children with history of sensitivity to the drugs used, children with anticipated difficult airway, children with active or recent upper respiratory tract infection.

A thorough pre-anaesthetic evaluation was done to assess the general condition and status of cardiovascular, respiratory and central nervous system.

Routine investigations like hemoglobin percentage, total leucocyte counts, differential leucocyte counts, bleeding time, clotting time and chest X-ray was done and checked. A written informed consent was taken from parents.

## Results

Statistical analysis of age, weight and sex distribution was done by using student's unpaired-t test. A p-value of less than 0.05 was regarded as significant. Both groups were found to be statistically similar with respect to age, weight and sex distribution.

Duration of intubation was similar in group A and Group B. p-value (0.495) not significant.

17.5% children in group A required 2 or 3attempts forintubationcompared to 5% in group B children.

**Table 1:** Age distribution

| Group | Mean | Standard deviation | p- value |
|---|---|---|---|
| A (n= 40) | 5.51 | 2.995 | 0.978* |
| B (n= 40) | 4.53 | 3.137 | |

*Not significant

**Table 2:** Distribution based on weight

| Group | Mean | Standard deviation | p- value |
|---|---|---|---|
| A (n= 40) | 14.96 | 4.926 | 0.950* |
| B (n= 40) | 14.01 | 5.065 | |

*Not significant

**Table 3:** Gender Distribution

| Group | A | B | Total |
|---|---|---|---|
| M | 23 | 23 | 46 |
| F | 17 | 17 | 34 |
| Total | 40 | 40 | 80 |

**Table 4:** Average duration of intubation

| Time taken for intubation (s) | Group | N | Mean | Standard Deviation | P-value |
|---|---|---|---|---|---|
| | A | 40 | 14.60 | 3.225 | 0.495* |
| | B | 40 | 15.25 | 5.047 | |

* Not significant

**Table 5:** Number of attempts for intubation

| | | | No of attempts for intubation | | | Total |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | |
| Group | A | Count | 33 | 6 | 1 | 40 |
| | | % within group | 82.5% | 15.0% | 2.5% | 100.0% |
| | | % of total | 41.3% | 7.5% | 1.3% | 50.0% |
| | B | Count | 38 | 2 | 0 | 40 |
| | | % within group | 95.0% | 5.0% | 0.0% | 100.0% |
| | | % of total | 47.5% | 2.5% | 0.0% | 50.0% |

Chi-Square = 3.352 p-value=0.187 not significant

**Table 6:** Overall intubating conditions

| Group | Number of patients | | p-value |
|---|---|---|---|
| | Clinically acceptable | Clinically unacceptable | |
| **A** | 21 | 19 | 0.0015 |
| **B** | 35 | 5 | |

Chi square = 10.05

**Table 7:** Intergroup comparison of Laryngoscopy

| | | | Laryngoscopy | | Total |
|---|---|---|---|---|---|
| | | | Easy | Difficult | |
| Group | A | Count | 38 | 2 | 40 |
| | | % within group | 95.0% | 5.0% | 100.0% |
| | | % of total | 47.5% | 2.5% | 50.0% |
| | B | Count | 40 | 0 | 40 |
| | | % within group | 100.0% | 0.0% | 100.0% |
| | | % of total | 50.0% | 0.0% | 50.0% |

Chi-Square=2.05, p-value =0.152 not significant.

**Table 8:** Intergroup comparison of Vocal Cords

| | | | Vocal | | cords | | Total |
|---|---|---|---|---|---|---|---|
| | | | Open | Moving | Closing | Closed | |
| Group | A | Count | 20 | 14 | 6 | 0 | 40 |
| | | % within group | 50.0% | 35.0% | 15.0% | 0.0% | 100.0% |
| | | % of total | 25.0% | 17.5% | 7.5% | 0.0% | 50.0% |
| | B | Count | 29 | 8 | 2 | 1 | 40 |
| | | % within group | 72.5% | 20.0% | 5.0% | 2.5% | 100.0% |
| | | % of total | 36.3% | 10.0% | 2.5% | 1.3% | 50.0% |

Chi-Square=6.289, p-value= 0.098 not significant

**Table 9:** Intergroup comparison of Coughing

| | | | Coughing | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Noun | Slight | Moderate | Severe | |
| Group | A | Count | 22 | 0 | 13 | 5 | 40 |
| | | % within group | 55.0% | 0.0% | 32.5% | 12.5% | 100.0% |
| | | % of total | 27.5% | 0.0% | 16.3% | 6.33% | 50.0% |
| | B | Count | 32 | 4 | 1 | 3 | 40 |
| | | % within group | 80.0% | 10.0% | 2.5% | 7.5% | 100.0% |
| | | % of total | 40.0% | 5.0% | 1.3% | 3.8% | 50.0% |

Chi-Square=16.638, p-value= 0.001 not significant

**Table 10:** Intergroup comparison of Jaw relaxation

| | | | Jaw relaxation | | Total |
|---|---|---|---|---|---|
| | | | Complete | Stiff | |
| Group | A | Count | 39 | 1 | 40 |
| | | % within group | 97.5% | 2.5% | 100.0% |
| | | % of total | 48.8% | 1.3% | 50.0% |
| | B | Count | 40 | 0 | 40 |
| | | % within group | 100.0% | 0.0% | 100.0% |
| | | % of total | 50.0% | 0.0% | 50.0% |

Chi-Square= 1.013, p-value= 0.314 not significant.

**Table 11:** Intergroup comparison of Limb movements

| | | | Limb movement | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Noun | Slight | Moderse | Severe | |
| Group | A | Count | 15 | 12 | 10 | 3 | 40 |
| | | % within group | 37.5% | 30.0% | 25.0% | 7.5% | 100.0% |
| | | % of total | 18.8% | 15.0% | 12.5% | 3.8% | 50.0% |
| | B | Count | 31 | 6 | 1 | 2 | 40 |
| | | % within group | 77.5% | 15.0% | 2.5% | 5.0% | 100.0% |
| | | % of total | 38.8% | 7.5% | 1.3% | 2.5% | 50.0% |

Chi- square = 15.129, p-value = 0.002 significant a

Intubating conditions were clinically acceptable in 52.5% of patients in group A compared to 87.5% in group B, which is highly significant (p-value 0.0015).

In group A, laryngoscopy was easy in 95% of children and 100% in group B children. The two groups were comparable with respect to laryngoscopy. (p-value>0.152, not significant).

Regarding position of vocal cords, they were open in 50% of children, moving in 35% and closing in 15% of children in group A. In group B, vocal cords were open in 72.5% moving in 20%, closing in 5% and closed in 2.5% of children. The two groups were comparable with respect to vocal cord position, (p-value >0.098, not significant).

55% of children in group A had no coughing, while 32.5% patient and moderate coughing and 12.5% had severe coughing after intubation. Group A children had no coughing in 80%, slight coughing in 10%, moderate coughing in 2.5% and severe coughing in 7.5% of children respectively. Children in group A had more coughing than in group B, which is significant (p-value = 0.001).

Jaw relaxation was complete in 100% in group B compared to 97.5% in group A children. Both groups were comparable with respect to jaw relaxation (p-value > 0.314, not significant).

Limb movements were absent in 37.5%, slight in 30.0% moderate in 25% and severe 7.5% patients in group A. In group B 77.5% children didn't move, 15% slightly moved, the remaining 2.5% of children had moderate and severe movement. Children in group A had more limb movements than in group B, which is highly significant. (p-value = 0.002 highly significant).

## Discussion

Laryngoscopy and tracheal intubation are essential skills associated with practice of anaesthesia. It is said that for successful intubation it requires patient to be either deeply anaesthetized, paralyzed or anaesthesiologists stronger than patient.[7] The drugs should be combined in such a way that it produces unconsciousness, analgesia and muscle relaxation without compromising hemodynamic stability, at the same time providing best intubating conditions. Usually a combination of hypnotic agent, opioid and a neuromuscular blocking agent is used.

Over past few years, several factors have led researchers to ignore neuromuscular blocking agents for tracheal intubation. The driving force were introduction of propofol, short acting opioids and sevoflurane in clinical practice. Propofol not only suppresses upper airway reflexes and pressor response to laryngoscopy and tracheal intubation [6,7] but also provides faster recovery of consciousness, possess antiemetic action and reduces incidence of airway complications.

Sevoflurane, a new inhalational agent with low blood-gas solubility and a relatively pleasant odour produces rapid induction and recovery. It causes less myocardial depression and cardiac arrhythmias than haiotliane.

Newer potent short acting opioid such as fentanyl, alfentanilor remifentanil produce intense analgesia and decrease the pressor response and facilitates laryngoscopy and intubation when given with propofol.

Although, succinylcholine is the gold standard to provide adequate relaxation because of its rapid onset within 30-60s and quick metabolism, routine use of this drug has been questioned following several reports of cardiac arrest in young children. In addition it has many other potential problems myalgia, cardiac arrhythmias, elevated intraocular and intracranial pressure, hyperkalemia, malignant hyperthermia and prolonged apnea [2,4].Non-depolarizing neuromuscular agents are alternatives but are slower in onset and have a longer duration of action. They can produce awareness, allergy, failed intubation and residual paralysis.

In our study, we used a combination of oral midazolam 0.5mg/kg and atropine 20 $\mu$ g/kg. Midazolam 0.5mg/kg has rapid onset of action around 30 mins, provides adequate anxiolysis with mild sedative effects. Me Millan CO et al [9] also studied different doses of midazolam for oral premedication in children 1-6yrs of age and found that oral midazolam 0.5rng/kg is a safe and alternative premedication in providing anxiolysis, while 0.75mg/kg and lmg/kg did not provide any additional benefits and may cause more side effects like dysphoric reactions, blurred vision. Suresh C et al [10], Almenrader N et al [6] also used oral midazolam in doses of 0.5mg/kg to compare with oral ketamine and oral clonidine respectively and found this dose to be effective.

Studies have shown that pretreatment with 0.6mg of midazolam i.v 5 min before administration of 7% sevoflurane in 66% nitrous oxide via a face mask permitted good intubating conditions with an average time of only 2.5 mins in 70 kg healthy young adults [11]. Similarly, premedication with oral midazolam in our study could have improved the intubating conditions due to MAC sparing effects of midazolam which has resulted in better outcome.

In our study, we used fentanyl 2/g/kg, 5mins before induction, because in addition to analgesia, it also blunts pressor response against laryngoscopy and intubation. Fentanyl also has antitussive action. It has a peak effect around 6.8mins. Katohet al [12] suggested that fentanyl blocks afferent nerve impulses arising from stimulation of the pharynx, larynx and lungs during intubation. High concentrations of opioid receptor are present in the solitary nuclei and nuclei of the 9$^{th}$ and 10$^{th}$ cranial nerves, associated with visceral afferent fibers of the nerves originating in the pharynx, larynx and lungs. Through these receptors fentanyl provides antitussive effects. It may also prevent bucking after tracheal intubation by its antitussive effects.

Lignocaine has been used as an adjunct in adult and paediatric studies. It has been shown to attenuate the pressor and heart rate response to laryngoscopy and tracheal intubation. Dose related antitussive effect of lignocaine is important as it improves intubation scores. This is evident in a study done by Davidson et al [13]. They showed that addition of lignocaine lmg/kg improved intubating conditions when used with propofol in combination with alfentanil. We used lignocaine 0.2mg/kg to prevent pain on injection with propofol [3].

In our study, we chose to evaluate tracheal intubating conditions i 50 seconds after the start of induction for both sevoflurane and propofol. The timing of tracheal intubation is complicated by the lack of reliable end points. Depth ofanaesthesia is also difficult to assess clinically, with some anaesthetists using clinical indicators such as constriction and centralization of pupils, acceptance of face mask, while others have found eye signs unreliable [14]. A previous evaluation of sevoflurane [12,13] had found significantly greater time for tracheal intubation (243.4s), (242.2 ± 52.67s) and (325.93 ± 44.02). This difference was not only because of different clinical end points but also a different induction technique in which sevoflurane concentration was increased incrementally and ventilation was not assisted manually.

Addition of 60% nitrous oxide reduces the MAC of sevoflurane by 24% [19], and fastens the onset of time of induction. 7.5% Sevoflurane in nitrous oxide and oxygen (41s) had reduced induction time by 15% compared to sevoflurane in oxygen alone (48s) using a single breath induction technique [15]. Similarly, using a vital capacity rapid inhalational induction, the induction time was (55s) for 4.5% sevoflurane in 66% nitrous oxide with oxygen and (81s) for sevoflurane in oxygen [16]. Induction time was faster with immediate *8%* sevoflurane in 70% nitrous oxide (37s) than incremental 8% sevoflurane in 70% nitrous oxide (70s) [17].

Similarly, the induction time to achieve 80% successful intubation was 137s and 187s with 8% sevoflurane in 60% nitrous oxide with oxygen, between l-4yr and 4-8yr respectively. Thus, it has been shown that faster induction time (l min 12s) can be achieved by breathing 8% sevoflurane initially rather than incremental increase in vapor concentration [14]. In our study, the high initial concentration of 8%) sevoflurane in 66% nitrous oxide with manually assistedventilation could have accounted for the faster time to successful intubation than in previous studies [12,13].

The peak effect of propofol from the time of administration of drug was around 90-100s; Me Keating et al [6] study, showed that it is possible to perform laryngoscope safely and smoothly at 120s after induction with propofol. Therefore we took 150s as a fixed time interval from the start of induction to intubation to facilitate in comparing the two groups. The use of fixed time interval tests an easily reproducible technique, independent of subjective assessments of depth of anaesthesia.

In our study, tracheal intubation was accomplished in 87.5% of children receiving fentanyl and propofol and only 52.5% of those children had acceptable intubating conditions. Two factors that made the intubating scores unacceptable in our study were coughing (45%) and limb movements (32.5%). 37.5% of patients required additional dose of 1.53mg/kg propofol to achieve intubation because of coughing, excessive limb movements.

Akhilesh Gupta et al [18] in his study found that acceptable intubating conditions was achieved in 25%, 80% and 90% of children in each group. They found that 60% and 15% of children had coughing and 30% and 5% of children had limb movements after intubating with 2.5mg/kg and 3.0mg/kg of propofolrespectively.

Uma Srivastavaet al [19] showed acceptable intubating conditions in 67.5% of children when fentanyl 1/g/kg and propofol 3mg/kg was given in combination. 2.5% of the patients had vigorous coughing and 30% patients had limb movements.

Similarly Blair et al [20] with propofol 3mg/kg and alfentanil 10/g/kg achieved 52.5% acceptable intubating conditions in unpremedicated children. The results they obtained were similar to our study. They showed that coughing and limb movements were less common in propofol-succinylcholine group than in propofol- alfentanil group.

From the above studies, overall intubating conditions were significantly better in group B than in group A. In group A after initial dose of 3 mg/kg of propofol, 37.5% of pateinets required mean additional dose of 1.5 mg/kg propofoil at 150s to facilities intubation. In group A, two patients required succinylcholine for intubation because of excessive and limb movements during intubation. In group B, two patients requires succinylcholine for intubation due to laryngospasm.

**Conclusion**

A combination of 8% sevoflurane in 50% nitrous oxide with oxygen preceded by fentanyl 2/g/kg without muscle relaxants had more acceptable intubating conditions compared to combination of propofol 3mg/kg preceded by fentanyl 2/g/kg in children undergoing cleft lip, palate or alveolus surgeries

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