

Laryngeal mask airway vs the endotracheal tube in paediatric airway management: A meta-analysis of prospective randomised controlled trials

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ABSTRACT

A meta-analysis was performed on prospective randomised controlled trials to assess whether the laryngeal mask airway (LMA) offered any advantage over the conventional endotracheal tube in the paediatric age group. Using the Cochrane methodology, a literature search was carried out through peer-reviewed indexed journals in three medical databases to obtain all publications comparing the LMA with the endotracheal tube in the paediatric age group (age less than 12 years), available till December 2010. Data from 16 randomised controlled clinical trials were selected for analysis. A null hypothesis was formed against each of the seven issues tested using the Fisher's method of combining *P* values. The LMA was seen to have three advantages over the tracheal tube in the form of lower incidence of cough during emergence, lower incidence of postoperative sore throat and lower incidence of postoperative vomiting ($P < 0.05$). It was seen to offer no advantage over the tracheal tube in incidence of bronchospasm or laryngospasm during emergence; also, it did not offer any advantage in increasing the efficacy of the airway seal. The only disadvantage the LMA had over the tracheal tube was its greater incidence of placement failure in the first attempt.

Key words: Children, endotracheal tube, laryngeal mask airway, meta-analysis, paediatric age group, tracheal tube

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INTRODUCTION

Management of the airway in a paediatric patient requires an understanding and knowledge of the differences and characteristics unique to a child's or an infant's airway, as compared to an adult airway. New techniques are continually being explored and developed to allow us to take care of infants and children better and to provide the safest and most effective means of delivering that care. Undoubtedly, there will be more advances and exciting ideas to come that will lead to better management of the paediatric airway. But for now, with the introduction of the laryngeal mask airway (LMA) in smaller sizes appropriate for paediatric usage, a debate whether the conventional tracheal tube carries more risk of trauma to the delicate tissues of the child or not has shaped up. On one hand, if there is requirement of proper skill

in effective placement of the LMA,^[1] then on the other, we have unwanted airway problems during extubation with the endotracheal tube.^[2]

The following meta-analysis of prospective randomised controlled trials in indexed peer-reviewed journals was performed to determine whether the LMA offered any advantages over the endotracheal tube in children or not.

METHODS

Search strategy

Following the Cochrane methodology,^[3] a literature search was conducted to obtain all publications comparing the LMA with the endotracheal tube in the paediatric age group (age less than 12 years). Three medical databases: Medline, Embase and the Cochrane

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library were searched for relevant comparative prospective randomised controlled trials available till December 2010 using the following keywords: Laryngeal mask, LMA, endotracheal intubation, tracheal tube, paediatric age group, children, randomised controlled trial. Only papers and abstracts from peer-reviewed journals were included. Hand searching of major indexed anaesthetic journals and their references from 1992 to December 2010 resulted in rest of the included studies.

Study selection

All issues addressed by each study were catalogued and their *P* values documented. A pool of 150 individual patients sharing a given issue across several studies was considered a minimum to allow valid meta-analysis,^[4] and only those issues which met the above criterion were included in this study.

Statistical analysis

The issue studied and the age group (less than 12 years) were considered the criteria for homogeneity. '*P*' values for each issue in all homogenous studies were recorded and analysed.

A null hypothesis stating that the LMA offered no advantage over the endotracheal tube was formed for every issue. This null hypothesis was tested against each issue using Fisher's method for combining *P* values.^[5,6] The test statistics were taken as two times the sum of the natural logarithms of the *P* values of each study and a χ^2 distribution with degrees of freedom equal to twice the number of studies. A *P* value of less than 0.05 was considered to be significant.

RESULTS

Data abstraction

From a pool of 762 references, 34 studies which complied with the previously mentioned criteria were shortlisted. Out of them, 16 studies finally remained, in which the following seven issues were addressed:

1. Ease of placement
2. Efficacy of airway seal
3. Cough during emergence
4. Bronchospasm during emergence
5. Laryngospasm during emergence
6. Postoperative vomiting
7. Postoperative sore throat

The primary criterion for exclusion of the rest of the studies was shortage of sufficient number of individuals studied for a particular issue. The studies

and their issues which could not be included for the above reason were as follows:

Changes in intraocular pressure

(Gulati^[7] *et al.* [n=60], Watcha^[8] *et al.* [n=41], Duman^[9] *et al.* [n=38], Total, n=139)

Changes in respiratory mechanics

(Reignier^[10] *et al.* [n=20], Bortone^[11] *et al.* [n=30], Genzwuerker^[12] *et al.* [n=60], Total, n=110)

Efficacy of low-flow anaesthesia

(Engelhardt^[13] *et al.* [n=45], Total, n=45)

Changes in peak airway pressure

(Ozdamar^[14] *et al.* [n=40], Tartari^[15] *et al.* [n=100], Total, n=140)

Depth of anaesthesia required for insertion

(Grabowska^[16] [n=30], Taguchi^[17] *et al.* [n=42], Li^[18] *et al.* [n=48], Total, n=120)

Relationship between end tidal CO₂ and arterial CO₂

(Chhibber^[19] *et al.* [n=22], Chhibber^[20] *et al.* [n=12], Total, n=34)

Changes in intragastric pressure during paediatric laparoscopy

(Ozdamar^[14] *et al.* [n=40], Total, n=40)

Cardiovascular response to extubation

(Fujii^[21] *et al.* [n=60], Total, n=60)

Work of breathing

(Keidan^[22] *et al.* [n=24], Total, n=24)

Recovery time (Time taken to achieve an aldrete score of 10 before discharge)

(Al-Mazrou^[23] *et al.* [n=60], Fuentes-Garcia^[24] *et al.* [n=60], Total, n=120)

The total study population was 1242. The mean age was 56.88±0.121 months (range: 6 months-12 years).

The 16 studies included in this meta-analysis and the various issues studied in them have been shown in Table 1.

Table 2 shows the total number of positive cases in every issue, as against their respective sample sizes.

Table 3 shows *P* values derived for all the issues after forming a null hypothesis for every issue.

The LMA had three advantages over the tracheal tube in the form of statistically lower incidence of cough

Table 1: Major issues of the included randomised controlled trials		
References	n	Issues addressed
Al Mazrou ^[23]	60	Sore throat, cough, airway seal
Splinter ^[25]	112	Sore throat
Lalwani ^[26]	60	Sore throat, cough, bronchospasm, laryngospasm, placement, seal
Patel ^[27]	60	Sore throat, cough, vomiting, placement
Doksrod ^[28]	134	Sore throat, vomiting
Kaya ^[29]	60	Sore throat, placement, seal
Klockgether ^[30]	100	Sore throat, vomiting
Fujii ^[21]	60	Cough
Tait ^[31]	82	Cough, laryngospasm, bronchospasm
Jamil ^[32]	100	Bronchospasm, laryngospasm, airway seal
Fuentes-Garcia ^[24]	60	Placement
Genzwuerker ^[12]	60	Placement
Sinha ^[33]	60	Placement
Williams ^[34]	104	Placement
Frohlich ^[35]	30	Airway seal
Tartari ^[36]	100	Airway seal
Total	1,242	

Table 2: Issues and their analytical data		
Issue	Findings with LMA (%)	Findings with TT (%)
Placement failure (1 st attempt)	40:232 (17.24)	14:232 (6.03)
Incidence of sore throat	29:295 (9.83)	44:288 (15.27)
Incidence of cough	22:161 (13.66)	68:161 (42.23)
Incidence of bronchospasm	0:121 (0)	4:121 (3.30)
Incidence of laryngospasm	3:121 (2.47)	2:121 (1.65)
Incidence of vomiting	16:149 (10.73)	25:142 (17.60)
Incidence of ineffective airway seal	28:205 (13.65)	22:205 (10.73)

LMA: Laryngeal mask airway

during emergence, lower incidence of postoperative sore throat and lower incidence of postoperative vomiting ($P < 0.05$).

The LMA offered no advantage over the tracheal tube in incidence of bronchospasm or laryngospasm during emergence; also, it did not offer any advantage in increasing the efficacy of the airway seal ($P > 0.05$).

The only disadvantage the LMA had over the tracheal tube was its statistically greater incidence of placement failure in the first attempt ($P < 0.01$).

DISCUSSION

Very few studies were found to be eligible for selection;

Table 3: Issues tested against a null hypothesis using Fisher's method		
Null hypothesis formed (assumption)	Actual findings LMA (%) vs TT (%)	P value derived
LMA offers no difference in Placement failure (first attempt) over TT	17.24 vs 6.03 (LMA>TT)	<0.01*
LMA offers no advantage in incidence of postoperative sore throat over TT	9.83 vs 15.27 (LMA<TT)	<0.05*
LMA offers no advantage in incidence of cough during emergence over TT	13.66 vs 42.23 (LMA<TT)	<0.05*
LMA offers no advantage in incidence of bronchospasm during emergence over TT	0 vs 3.30 (LMA<TT)	>0.05
LMA offers no advantage in incidence of laryngospasm during emergence over TT	2.47 vs 1.65 (LMA<TT)	>0.05
LMA offers no advantage in incidence of postoperative vomiting over TT	10.73 vs 17.60 (LMA<TT)	<0.05*
LMA offers no difference in ineffective airway seal over TT	13.65 vs 10.73 (LMA>TT)	>0.05

*Significant, **Highly significant; LMA: Laryngeal mask airway

hence, it was not possible to classify the available results into different age groups viz. infants, toddlers, young children or adolescents, and thus the observations had to be restricted to the paediatric population in general.

Respiratory complications in the form of laryngospasm or bronchospasm during emergence, or postoperative sore throat and postoperative cough are major areas of concern while choosing a device for paediatric airway management. The aetiology of respiratory tract complications in the perioperative period is multifactorial. They include improper endotracheal tube size, cuff design, lack of airway humidity, trauma during insertion and suctioning, high anaesthetic gas flow rates and manipulation of the airway and adjacent tissues.^[37] None of the included studies satisfactorily ruled out the possibility of any of the above factors. Only two of the 16 studies specified the selection criteria for the appropriate tube size. Deficits in complete information like these have potential likelihood to modify the actual interpretation of the results in a meta-analysis.^[6]

Similarly, only one study defined the LMA insertion technique used. Consequently, the results of this meta-analysis, in context to ease of placement of LMA, are probably contrary to the popular belief that LMA insertion is one of the most reliable techniques to secure a paediatric airway. The most commonly

used insertion techniques are namely the standard or classical technique, 180° rotation technique or reverse technique, fully or partially inflated cuff technique and techniques based on head position.^[38] Inappropriate positioning during some of the commonly used insertion techniques can lead to failure in effective placement. Soh and Ng, in 2001, studied two techniques for placement of LMA in children, and demonstrated that the reverse technique is a more efficient technique in 100% of paediatric patients as compared to 90% of efficacy with the standard technique. A lower incidence of complications in children was found with partially inflated cuff by the same author in the same study.^[39] As stated earlier, inclusion of such valuable information in individual studies plays a vital role in drawing a conclusion in an evidence-based analysis.

In two studies,^[27,33] the proseal LMA was used instead of the classic LMA. The proseal LMA is claimed to provide a better airway seal due to its modifications.^[40] The data collected were, thus, not absolutely homogenous, and a possibility of the same having some influence on the outcome of this analysis cannot be overruled.

There are several other areas where the LMA has potential benefits over the tracheal tube. As stated earlier, certain issues could not be included in this meta-analysis, only because sufficient research has not been done in those areas. Further research is needed to determine the importance of these issues to allow recommendations to be made.

Despite these shortcomings, the overall results from the available information suggest that barring one disadvantage of placement failure, the LMA provides lesser perioperative airway complications, in comparison to the conventional tracheal tube. The common apprehension of an ineffective airway seal by the LMA requires reconsideration.

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