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Laryngeal Mask Airway versus Endotracheal Tube Intubation for Repairing of Nasal bone Fracture: A 7 Year Single Institution Case-Control Study

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Abstract

Introduction: Closed reduction nasal fracture is a common and well established procedure in the otolaryngology literature. The Laryngeal mask airway (LMA) is being used more frequently for otolaryngologic procedures in recent years because it has been proven safe for select procedures especially in the pediatric population. The frequency of closed reduction nasal fracture repair and the increased propensity to use LMA anesthesia for otolaryngologic cases warrants investigation.

Objective: We sought to investigate the benefits, risks and safety of using LMA anesthesia for pediatric patients during closed reduction nasal fracture compared to case controlled equivalents that underwent ETT intubation.

Methods: We performed a retrospective case-control study in which all cases of closed reduction nasal fracture at a single pediatric institution by a single surgeon were studied. This included patients from 2007 to 2013 at Ann & Robert H Lurie Children's Hospital of Chicago. The primary outcomes assessed were postoperative VAS and FACES pain scores, blood loss, cough, stridor and aspiration. Secondary outcomes assessed included timing data to determine if one technique led to greater optimization of operating room (OR) time and/or total hospital stay. The timing data included overall OR duration, prep to cut time, cut to close time, non-operative OR time and the total hospital stay in minutes.

Results: Fifty patients met the inclusion criteria. Of the 50 patients included an endotracheal tube was used in 16 patients and a LMA was used for 34 patients. Two of the LMA group 2/34 (6%) had aspiration documented compared to zero of the ETT group. The average total length of hospital stay was 268.5 m when both groups were included. The average total hospital stay was 252.6 minutes for the LMA group and 312.4 for ETT group. The average postoperative VAS pain score, as documented 0-10 by the RN, was 0.47 for the LMA group as opposed to 0.56 for the ETT group. A total of 24 patients had cough noted, 15/34 (44%) of the LMA group and 9/16 (56%) of the ETT group. Ten patients had stridor noted, 5/34 (15%) of the LMA group and 5/16 (31%) of ETT group.

Conclusion: These results support the hypothesis that using an LMA versus an ETT for short procedures does save time when assessing overall hospital stay. Additional benefits of the LMA are reduced cough, pain, stridor and ease of placement. The data also supports our second hypothesis that using an LMA for close reduction nasal fracture can lead to more frequent post operative airway obstruction when compared to the ETT. Our data and review suggest that it is the combination of deep extubation (lack of airway protection) and the use of an LMA (allows for blood accumulation) that result in the increase risks of airway obstruction postoperatively. For operations in the pediatric population with a significant risk of bleeding into the pharynx we recommend using an ETT due to the risks of aspiration. If an LMA is used we recommend to only removing the LMA after the patient has been deemed in the state of anesthesia which is awake. For short cases with a low risk of immediate post operative bleeding into the pharynx, we are proponents of the LMA due to its' time saving effect.

Keywords: : Otolaryngology; LMA anesthesia; Nasal fracture

Introduction

Close reduction nasal fracture is a common and well established procedure in the otolaryngology literature [1]. The Laryngeal mask airway (LMA) is being used more frequently for otolaryngologic procedures in recent years because it has been proven safe for select procedures especially in the pediatric population. The frequency of closed reduction nasal fracture repair and the increased propensity to use LMA anesthesia for otolaryngologic cases warrants investigation. The LMA is a supraglottic device used in anesthesia to deliver anesthetic gas and to ventilate patients. It was first introduced in 1981 and its placement without direct laryngoscopy, decreased tracheal stimulation and smoother emergence from anesthesia were considered advantageous [2,3]. Because the LMA does not manipulate the glottis and/or trachea it can be removed in the deep state more easily with less risk of laryngospasm when compared to endotracheal tube intubation (ETT) [4]. Deep state extubation has the potential to save operating room time and to ease awakening in the pediatric population. The LMA is preferred to ETT when OR timing is of essence and when post operative discomfort of an endotracheal tube has the potential to affect overall hospital stay and symptomatic outcomes. An example of this is quick and efficient surgeries such as tonsillectomies where the intubation and extubation times have the potential to be longer than the operative time (Table 1).

Objective

We sought to assess the benefits, risks and safety of using LMA anesthesia for closed reduction nasal fracture compared to case controlled equivalents that underwent ETT intubation. Specifically, we hypothesized that the LMA saves time when compared to ETT for this

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procedure. We also hypothesize that the risk of postoperative airway compromise is greater with the use of LMA anesthesia in combination with deep extubation when compared to the ETT intubation.

Methods

We performed a retrospective case-control study in which all cases of closed reduction nasal fracture at a single pediatric institution by a single surgeon were studied. Having a single surgeon assured the standardization of operative technique and instrumentation. The inclusion criteria were diagnosis of nasal fracture, closed reduction nasal fracture repair from 2007 to 2013 and age from 1 to 20 years. Patients greater than 20 years old, those with difficult airways from genetic or anatomic variations and those with comorbidities such as cardio or bronchopulmonary dysplasia that would affect the selection of ETT versus LMA were excluded from this study. The exclusion criteria was set to focus on healthy patients with only minor trauma (nasal fracture) as to not influence the selection of ETT versus LMA. The dates examined correlated with implementation of our electronic medical records, which offered precise documentation. Those intubated with an ETT were compared to those patients anesthetized using a LMA. The decision to use an ETT versus a LMA was determined by the anesthesiologist. Of the 50 patients that met inclusion criteria none of them were syndromic and the children were otherwise healthy with no dysmorphic facial structures that would lead to a difficult airway and no significant cardio or bronchopulmonary dysplasia that would require an endotracheal tube. The postoperative VAS and FACES pain scores, blood loss, cough, stridor and aspiration were compared. Timing data was investigated to determine if one technique led to greater optimization of operating room (OR) time and/or total hospital stay. The timing data included overall OR duration, prep to cut time, cut to close time, non-operative OR time and the total hospital stay in minutes. Clinical characteristics including mechanisms of complications and anesthesia techniques are discussed. SPSS-14 was used for the analysis. A simple frequency tab was used to calculate the frequency and percentage of the selected patient population. The mean ± SD among two different groups was calculated and compared by using student t-test. Comparison analysis in the frequency was conducted by using Epi-Info software. P<0.05 was considered statistically significant.

Results

Fifty patients met the inclusion criteria. Of the 50 patients included, an endotracheal tube was used in 16 patients and a LMA was used for 34 patients. The average patient age at time of procedure was 12.5 years for the LMA group and 11.4 years for the ETT group. There was no statistical difference in the age, weight or height distribution of the patients to explain selection for ETT versus LMA. All patients required general anesthesia. The average blood loss was 6.9 mL for the LMA group and 6.1 mL for the ETT group. The average postoperative VAS pain score, as documented 0-10 by the RN, was 0.47 for the LMA group as opposed to 0.56 for the ETT group (Table 2). Two of the LMA group 2/34 (6%) had aspiration documented compared to zero of the ETT group. In both patient that had aspiration documented, the LMA was taken out in the deep state of anesthesia.

A total of 24 patients had cough noted, 15/34 (44%) of the LMA group and 9/16 (56%) of the ETT group. Ten patients had stridor noted, 5/34 (15%) of the LMA group and 5/16 (31%) of ETT group. Bleeding was noted in 28 patients postoperatively, 19/34 (56%) of LMA group and 9/16 (56%) of ETT group (Table 3). The average total length of hospital stay was 268.5 m when both groups were included. The average total hospital stay was 252.6 minutes for the LMA group and 312.4 for ETT group. This difference in total hospital stay was statistically significant (Table 4) (p-value ≤ 0.05). The average time from "prep" to "cut" was 0.63 minutes, 0.55 m for LMA group and 0.83 m for ETT group. The average length of time from "cut" to "close" was 8.8 minutes, 8.5 for the LMA group and 9.2 for ETT group. The average non-operative OR time was 21.1 minutes, 20.8 m for LMA group and 22 m for ETT group. The overall average operating room duration was 33.5 minutes, 29.9 m for the LMA group and 32.7 m for the ETT group. Four patients were excluded from the OR timing data because they had repair of nasal fracture along with another surgical procedure (one orbital floor fracture repair, two with septoplasty and another with bilateral turbinate reduction). All other patients underwent solely closed reduction nasal fracture. An additional patient was excluded from the total hospital stay

Closed reduction nasal fracture time in room: 1328
Prep: 1411
Cut: 1416
Close:1426
Time out of room: 1429
Pacu arrival: 1429
Respiratory event:
Desaturated: 1430
Intubated: 1435
Desaturated and coughed up large clot from ETT: 1437
Flexible scope through ETT: 1443
Time in OR for DLB: 1447
DLB Prep: 1450, Cut 1450, Close 1505
Pacu arrival: 1550

Table 1: Event timings per nursing documentation.

	Airway	n	Mean	p-value*
Blood Loss	LMA	34	6.85 ± 6.98	0.70
	ETT	16	6.06 ± 5.99	
VAS pain score	LMA	34	0.47 ± 0.51	0.60
	ETT	16	0.56 ± 0.62	
Age (years)	LMA	34	12.45 ± 3.89	0.42
	ETT	16	11.42 ± 5.59	
Weight Oz	LMA	33	1654.21 ± 656.52	0.79
	ETT	14	1598.14 ± 790.78	
Height inches	LMA	28	59.06 ± 10.90	0.40
	ETT	14	56.17 ± 12.65	

*Statistically significant difference using p=0.05

Table 2: Intraoperative blood loss, postoperative VAS pain, age, weight and height with means compared (No statistical significant difference appreciated between groups).

	Airway	n	# of Yes	%	p-value*
bleeding	LMA	34	19	56%	0.76
	ETT	16	9	56%	
Cough	LMA	34	15	44%	0.54
	ETT	16	9	56%	
Stridor	LMA	34	5	15%	0.25
	ETT	16	5	31%	
Aspiration	LMA	34	2	6%	0.92
	ETT	16	0	0%	

*Statistically significant difference using p-value=0.05

Table 3: Postoperative bleeding, cough, stridor, and aspiration compared by number of patients (No statistical significant difference appreciated between groups).

Timing (minutes):	Airway	n	Mean	p-value
Total Stay	LMA	33	252.55 ± 58.60	*0.03
	ETT	12	312.42 ± 121.86	
OR Duration	LMA	28	29.86 ± 10.23	0.48
	ETT	10	32.70 ± 12.36	
Prep to Cut	LMA	34	0.55 ± 1.31	0.55
	ETT	12	0.83 ± 1.57	
Cut To Close	LMA	34	8.706 ± 4.78	0.78
	ETT	12	9.17 ± 5.76	
Prep To Close	LMA	34	9.264 ± 4.86	0.68
	ETT	12	10.00 ± 6.68	

*statistical significance with a p-value of <0.05

Table 4: Timing data compared with a statistically significant difference noted in the total hospital stay when comparing LMA vs. ETT intubation for closed reduction nasal fracture.

data because that child stayed overnight and was an extreme outlier. For the overall OR duration, there were 28 LMA patients and 10 ETT that had the appropriate documentation. All numbers are presented appropriately in the tables.

Discussion

The postoperative complications varied as supported in the current literature. There was less cough stridor, and pain noted when using the LMA compared to ETT intubation for closed reduction nasal fracture at our institution. There was less bleeding noted in the ETT group. This is likely due to the patient swallowing some blood during the case and the fact that with a LMA the upper esophagus is obstructed by the device. Both groups of patients had significant and equal bleeding noted by the RN postoperatively, 56% and 56%. During closed reduction of a nasal fracture a certain amount of bleeding is tolerated due to the nature of the operation and the location of the fracture. An important point is to contrast closed reduction nasal fracture to an adenotonsillectomy in which all bleeding is controlled prior to the surgeon completing the procedure. Many otolaryngologist and anesthesiologist are comfortable using LMA's for adenotonsillectomy because of this fact [5]. Two patients had aspiration in the LMA group. One child required bronchoscopy to clear the aspiration and another required deep suctioning with a flexible suction. Both of the incidents of aspiration occurred after the LMA was removed in the deep state of anesthesia. Extubation in the 'Awake' state is defined as when the child has demonstrated facial grimacing, adequate tidal volumes and respiratory rate, coughing with an open mouth or opening their eyes, and purposeful movements. Extubation in the 'deep' state is defined as when the end-tidal sevoflurane level was greater than 1 minimum alveolar concentration and the child is deemed in the surgical plane of anaesthesia [3]. In the deep state of anesthesia the child does not yet have airway reflexes, thus no cough.

Extubating the child with an LMA and in the deep state does save time as shown in this retrospective case series review. It is likely the fact that the LMA is typically removed with the child in the deep state that offers the time saving effect of the device [6]. The difference in total hospital stay in minutes was reduced in the LMA group and this difference was statistically significant. The other timing points trended towards time reduction with the LMA though were not statistically significant.

There are two mechanisms by which bleeding during the closed reduction of a nasal fracture could lead to aspiration. First, if intraoperative bleeding occurs and pools below the nasal choana or on top of the LMA, it could then slide into the airway once the LMA is removed and while the child is still in the deep state without any airway protective reflexes. On the contrary, if an endotracheal tube is used during the case then the child will likely swallow the blood as opposed to allowing it to collect supraglotically. The second mechanism by which aspiration could occur is if all of the blood is removed intraoperatively and immediately postoperatively but then en-route to recovery the blood pressure rises leading to bleeding that could then obstruct the airway prior to return of protective reflexes. The fact that there is less cough, stridor and pain with the LMA when compared to the ETT can be explained by the fact that the LMA does not manipulate the sensitive larynx

Brimacombe et al. found the incidence of pulmonary aspiration intraoperatively with LMA to be 0.02%. They concluded that most aspiration episodes associated with the LMA were related to predisposing factors which could be controlled for. The predisposing risks they defined are: inadequate depth of anesthesia, intra-abdominal surgery, upper gastrointestinal disease, lithotomy position, patient movement, exchanging the LMA for tracheal tube, full stomach, multiple trauma, multiple insertion attempts, opioids, obesity and cuff deflation [7]. We would add the risk of using a LMA in combination with deep extubation for closed reduction nasal fracture because of the significance and frequency of bleeding and the possibility of airway obstruction [8].

Ultimately, the decision is whether or not the benefits of using the LMA outweigh the risks for closed reduction nasal fracture. The benefits are overall reduced hospital stay and decreased cough, pain and stridor. The risks, although low, are respiratory compromise and aspiration.

Conclusion

These results support the hypothesis that using an LMA versus an ETT for short procedures does save time when assessing overall hospital stay. Additional benefits of the LMA are reduced cough, pain, stridor and ease of placement. The data also supports our second hypothesis that using an LMA for close reduction nasal fracture can lead to more frequent post operative airway obstruction when compared to the ETT. The main risk elucidated, although rare, is aspiration and airway obstruction which may be exacerbated by deep extubation. The mechanisms of aspiration are likely multifocal including blood accumulation and lack of airway protection and should be a considered risk factor when using a LMA for closed reduction nasal fracture. Our data and review suggest that it is the combination of deep extubation (lack of airway protection) and the use of an LMA (allows for blood accumulation) that result in the increase risks of airway obstruction postoperatively.

For operations in the pediatric population with a significant risk of bleeding into the pharynx we recommend using an ETT due to the risks of aspiration. If an LMA is used we recommend to only removing the LMA after the patient has been deemed in the state of anesthesia at awake. For short cases with a low risk of immediate post operative bleeding into the pharynx, we are proponents of the LMA due to its' time saving effect.

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