

Successful Airway Management with Awake Intubation in 40 Newborns with Tracheoesophageal Fistula (TEF)

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Abstract

Introduction: In this retrospective study a review of 40 cases of airway management for newborns with tracheoesophageal fistula (TEF) / esophageal atresia repair is presented. Almost all cases had associated cardiac anomalies.

Keywords

- Airway management
- Awake intubation
- Tracheoesophageal fistula
- Anesthesia

Materials and Methods: Selected management was awake intubation with flow of oxygen via Mapelson F. Sedated awake intubation was performed using Atropine 0.02 mg/kg and Fentanyl 1 µg/kg, and then occlusion of the fistula with ligation.

Result: In patients with small TEF, there was no problem in intubation and ventilation. Anesthesia management and post operative NICU care was performed for 26 cases with no problem, but in 14 cases there was difficulty for anesthesia management and NICU care.

Conclusion: We had no complication with performing the awake intubation technique.

Introduction

Esophageal atresia (EA) and tracheoesophageal fistula (TEF) have an incidence of 1 in 3000 and 1 in 4500 live births respectively,¹⁻³ and are one of the major challenges of neonatal surgery. During surgical repair of TEF and/or EA, the pediatric anesthesiologist is faced with a considerable

challenge since muscle relaxants and excessive positive airway pressure should be avoided.⁴ Preoperative bronchoscopy is a routine evaluation in many centers.^{5,6}

The aim of our study was to evaluate airway management with awake intubation in newborns suffering from tracheoesophageal fistula (TEF).

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Now a day's thanks to advances in medicine neonates with congenital anomalies such as esophageal atresia/tracheoesophageal fistula (EA/TEF) often have good basic medical condition.⁷ Awake intubation is the safest way to use in cases with TEF. Since it allows you to position the endotracheal tube properly without the need to use positive pressure ventilation thus eliminating the risk of gastric distention due to gas passing through the fistula. However, awake intubation can be quite challenging in vigorous infants. Usually mild sedation by fentanyl or morphine prior to intubation of the trachea is achieved without considerable hemodynamic change. In reality, in some patients, especially the premature infant, apnea accompanies even seemingly minimal sedation. That is why a different technique without a muscle relaxant (eg: an inhaled anesthetic) is preferred. In the setting of hemodynamic instability in response to either narcotics or an inhalation agent, a neuromuscular blocking agent may be delivered, necessitating support of positive pressure ventilation. With normal lung compliance, gentle positive pressure can be delivered with minimal delivery of inspired gases into the stomach via the fistula.⁸ This can be achieved by means of an awake intubation with topicalization and/or sedation, or with an inhalational induction. However, the awake approach can be traumatic and difficult, and a crying infant will only put more air into the stomach. Inhalational inductions in neonates can (but rarely do) cause major cardiovascular instability. An IV sedation is quicker (less crying) and may be more stable, allowing, for the use of NMBDs to optimize intubating conditions.⁹ Gentle mask ventilation with low peak pressure ventilation will decrease the amount of air that enters the stomach.⁸ In some

instances the surgeons will request for the patient to remain intubated after the surgery. In 30% of cases where the patient is extubated after the operation, reintubation to clear secretions will be required. Finally, it is often requested in the immediate days after surgery ventilation with a bag and mask be avoided, especially if the esophagus has been anastomosed. After repair of "long-gap" EA, tension at the anastomotic site may predispose to esophageal leaks, postoperative ventilator support for 5 to 7 days has been recommended to improve the rate of maintaining anastomotic integrity.⁸

Materials and Methods

A retrospective study was conducted on 40 patients who underwent repair of tracheoesophageal fistula (TEF) at Qods hospital in Qazvin University of Medical Sciences from 2001 to 2018. Awake tracheal intubation was routinely performed in this Centre and two pediatric surgeons performed all the repairs. Information regarding gestational age, birth weight, associated anomalies, and baseline O₂ saturation (SpO₂), surgical data, the presence of associated congenital anomalies and/or syndromes, anesthetic method, and related preoperative management (such as intubation and mechanical ventilation), intraoperative, and postoperative critical events were gathered. Also, Cardiac lesions were defined based on echocardiographic findings for VSD (ventricular septal defect), ASD (atrial septal defect), and PDA (patent ductus arteriosus). At the day of surgery airway management was performed with preoxygenation with 100% O₂ via Mapelson F. Sedated awake intubation was performed with Atropine 0.02 mg/kg and Fentanyl 1µg/kg. The endotracheal tube was inserted carefully by the anesthesiologist. All related data

about oxygen saturation before, and during and after anesthesia were assessed. Blood infusion, total time of mechanical ventilation, duration of NICU stay, duration of hospital stay, and survival to hospital discharge were examined. Difficult

laryngoscopy during the preoperative airway management was assessed based on the Cormack, Lehane, and Yentis classification system which is shown in **Table 1**.¹⁰

Table 1: A modified classification scheme with five different grades based on the Cormack -Lehane scoring system described by Yentis

Difficult laryngoscopy	Grade I		the epiglottis and vocal cords are in complete view
	Grade II	II A	partial view of the glottis
		II B	arytenoids or posterior vocal cords only are visible
	Grade III		associated with a significantly higher incidence of failed intubation
	Grade IV		epiglottis or larynx is not visualized

At the end, the information included whether or not the newborn was extubated or remained intubated to go under ventilation machine in NICU. Finally, outcome to hospital discharge for major morbidity or mortality was assessed.

Results

All 40 infants undergoing tracheoesophageal fistula (TEF)/esophageal atresia repair were presented in this study. **Table 2** shows the demographics of our cases before anesthesia and surgery.

Table 2: The newborn demographics

N= 40			
demographics		No	mean \pm SD, %
Gestational age (weeks, mean \pm SD)		40	34 \pm 2.2
Weight (kg, mean \pm SD)		40	2.5 \pm 1.9
Airway condition for laryngoscopy	Grade I, II	26	65 %
	Grade III, IV	14	35 %
associated anomalies	Cardiac	37	92.5 %
	Other	14	38.8 %

In this study 11 patients had an average birth weight of less than 1800 gr including 3 patients less than

1300 gr. **Table 3** shows associated anomalies with number and percent of cases.

Table 3: Associated anomalies

No: 40			
Anomalies	Cardiac	ASD	31
		VSD	1
		PDA	13
		TF	none
		SV	1
		PS	none
		TGA	1
	Gastrointestinal	2	
	Genitourinary	3	
	Musculoskeletal	1	
	Respiratory	4	
	Genetic	2	
VACTERL	2		
CHARGE	0		

In all 14 patients had associated anomalies such as, gastrointestinal, genitourinary, musculoskeletal, and respiratory, including 2 patients with VACTERL syndrome. Three patients had no cardiac anomalies. Thirty one patients had ASD, and only 1 patient had a large VSD, 1 patient with SV, and 1 patient with TGA. Presence of cardiac anomalies such as PDA and PFO was not significant in this study. Pre oxygenation with 100 % O² via Mapelson F was performed for all cases. Sedated awake intubation was carried out with Atropine 0.02 mg/kg and Fentanyl 1µg/kg. Prior to surgery,

7 patients were intubated and mechanically ventilated, and 19 patients received supplemental oxygen (FiO₂ 0.3 – 0.4) before surgery. None of the 40 patients were extubated after surgery and all had NICU care under ventilation for different durations due to their resistance and compliance. There was no difference between patients in the awake intubation technique in regard to their fistula size. It should be noted that, small TEF is defined as less than 3 mm.⁴ Among our 40 cases, there was no significant respiratory anomaly that would influence our choice of intubation.

There was no mortality for patients with extreme prematurity. There were no cases of gastric rupture from ventilation during and after anesthesia. No patient died in the operating room or within 24 hours of surgery. In our study only 2 cases (who also had low birth weight) did not survive to hospital discharge: one was a SV (single ventricle) case and another was a TGA (transposition of the great arteries) case.

All surgeries were performed in the lateral decubitus position and thoracotomy. There was

no procedure with endoscopic instruments. Six patients had gastrostomy tube after surgery. Patients with short esophagus undergoing esophagostomy and gastrostomy, needing secondary surgery were excluded from this study. In 31 patients a central venous line had to be placed right after the surgery in the operation room (77.5 %). Thirty four patients received blood products before, during, and after surgery as needed. **Table 4** shows different procedures carried out during preoperative and postoperative periods for our patients.

Table 4: Preoperative and postoperative courses

Courses in details	mean \pm SD, %
Before surgery intubation	9 %
After surgery extubation	0
days (after surgery Time of extubation)	31 \pm 1
CV line	77.5 %
left arch	67 %
Blood transfusion	34 %
days of Mechanical ventilation	16 \pm 1
ICU stay (days)	32 \pm 1
Hospital stay (days)	43 \pm 1
Survival to hospital discharge	95 %
Spo ₂ < 10% to baseline need to use vasopressor	0
Ductal dependent and non-dependent	.

Discussion

In this study we examined the perioperative management of patients with TEF, and the effect of associated anomalies, awake intubation, and NICU care on their survival. In 1962 an investigation was done by Waterston et al., on predictors of mortality in infants with TEF/EA and three main factors were revealed: birth weight (as an index of prematurity),

the presence of additional congenital anomalies, and pneumonia.¹¹ The method suggested in this study for management of the airway in TEF repair are: 1- awake tracheal intubation, 2- flow of oxygen via Mapelson F, 3-Sedated awake intubation performed with Atropine 0.02 mg/kg and Fentanyl 1 μ g/kg, 4- managing each case specifically 5-Avoid muscle relaxant administration until the exact determination of the tip of the tracheal

tube, 6-avoidance of excessive positive pressure ventilation until the fistula is controlled.¹²⁻¹⁸ All patients with no congenital heart disease survived to hospital discharge.

Limitations of this study are as follow; 1) not complete reporting the monitoring in NICU, 2) not enough information about patients' progressing in spontaneous breathing after surgery, and 3) it must be emphasized that despite the successful air way management, intraoperative problems may cause difficulties.

Conclusion

Appropriate placement of the tracheal tube, and proper ventilation are keys to successful

management in these patients.

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Conflicts of interest

There is not conflict of interest

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