

Therapeutic reintubation for extubation failure due to upper airway obstruction in ventilated newborn infants

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Abstract

Postextubation upper airway obstruction can lead to early extubation failure in ventilated newborn infants. Treatment with steroid, nebulized epinephrine and non-invasive respiratory assistance may not be effective. Reintubation and ventilation for respiratory failure with subsequent extubation attempts or surgical interventions are often employed with variable results. A series of 29 infants with failed extubation due to upper airway obstruction, treated by therapeutic reintubation, without ventilation is presented. The therapy was successful in 24 patients with a median reintubation period of 3.5 days. The important element in achieving success is to choose a smaller size tube which gives an adequate airway.

Keywords: Therapeutic reintubation (TR); Extubation failure; Upper airway obstruction (UAO)
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Introduction

Use of endotracheal tube (ET) to provide ventilation can lead to upper airway mucosal injury, especially after prolonged, traumatic or multiple intubations [1]. This causes upper airway obstruction (UAO) after extubation in 31.1% of high-risk infants, manifesting commonly as inspiratory dyspnoea and stridor [2]. It may lead to respiratory insufficiency and failure of extubation. Systemic steroids [3], nebulized epinephrine [4], and non-invasive respiratory assistance [5] are being used to treat UAO without proven efficacy. Often, patients require reintubation and ventilation for respiratory failure with subsequent extubation attempt with modest success. Failing these treatments, surgical interventions [6] are often advised which has poor acceptance, variable results and complications. Prolonged endotracheal intubation in infants and children for conditions which would otherwise need tracheostomy has been tried with encouraging results [7], but same has not been evaluated much in newborn.

We reviewed ventilated newborn infants in whom extubation had failed as a result of UAO, treated by reintubation with smaller ET without ventilation.

Material and Methods

This was a retrospective case study from level III neonatal unit over 2 years. The neonates ventilated for ≤ 3 days, having extubation failure (within 24 hrs) due to UAO and treated by reintubation, without ventilation were re-viewed. All cases had been extubated electively as per unit protocol, which were (i) Improving primary lung disease; (ii) Free of any complications and sedation; (iii) Hemodynamically stable; (iv) Hematocrit $>30\%$ with normal blood sugar and electrolytes; and (v) Acceptable blood gas at minimal ventilator settings. Aminophylline was used in preterm <34 weeks. Dexamethasone, 0.25mg/kg/dose IV were used in periextubation period in cases of multiple intubations (≤ 3) or prolonged ventilation (≤ 7 days) and continued to a total of 4 doses, 8 hours apart. Nebulization with L-epinephrine (1:1000 solution 0.5 ml in 1.5 ml normal saline), 4 hourly to a maximum of 4 doses was used in patients having stridor and or sub-prasternal/ upper chest retraction after extubation. Babies weighing < 1.5 kg were extubated to nasal CPAP, while ≤ 1.5 kg were extubated to head box O₂ directly.

Extubation failure or decision for reintubation was taken when Downe's score was ≤ 6 along with PaCO₂ > 60 mmHg and arterial blood pH < 7.25, and/ or PaO₂ < 50 mmHg or SpO₂ < 88% on FiO₂ > 0.5. UAO was cited as cause of extubation failure if patient had stridor and/ or inspiratory dyspnea, which apparently improved just after reintubation, with no other identifiable cause. Such patients with UAO as a cause of extubation failure were reintubated (orotracheal) with a smaller size ET (2.5 mm in infants weighing less than 2000 g and 3.0 mm in those weighing 2000 g or more), and put under head box O₂, humidified by bubble humidifier. The O₂ concentration was measured at the head box using oxygen analyser. The tube was changed only when and if signs of obstruction occurred. Initially after 2-3 days and then subsequently at same intervals, extubation was reattempted when following criteria were present (i) hemodynamically stable and alert baby; (ii) mild or no chest retraction; (iii) acceptable blood gas on FiO₂ < 0.4; (iv) a loose fitting tube, evidence of this was shown by an obvious cough / or hissing sound around the tube on aspiration or on agitation. Although it was a less common sign, but quite characteristic when present. Every attempt of extubation was preceded and followed by IV dexamethasone, and nebulised epinephrine (4 doses, 4 hourly) was given just after extubation. After extubation, patients were put under head box O₂ with gradual weaning. If extubation failure re-occurred, reintubation was performed with extubation attempt later using similar criteria.

Patient's detail, including duration of intubations during ventilation and therapeutic reintubation (TR) were re-corded. Finally the outcome of TR was studied. It was considered successful when there was no need of reintubation up to seven days after extubation with declining O₂ demand.

Results

Twenty nine infants (17 term, 12 preterm) were treated by TR. Major indications for ventilation were pneumonia, hyaline membrane disease, meconium aspiration syndrome, and apnoea.

Background variables of patients are shown in table 1. Twenty one patients had received dexamethasone before first elective extubation attempt from ventilator and all patients had 2 or more doses of dexamethasone and epinephrine nebulization prior to reintubation trial. TR was successful in 24 patients with a median (IQ range) reintubation period of 3.5 days (2-20). Seventeen patients were extubated with first attempt and twenty could be extubated within 7 days.

Table 1 Background variables and Results of patients received therapeutic reintubation

Variables	Therapeutic reintubation		
	Successful n = 24	Unsuccessful n = 5	All Patients n = 29
Weight at admission (g)			
Median (range)	2115 (900 -3680)	1400 (940 -2453)	1950 (900 -3680)
up to 1500	5	3	8
1500 – 2500	11	2	13
> 2500	8	0	8
No of Intubations (Prior to TR)			
Median (range)	3 (2 - 7)	5 (4 - 7)	3 (2 - 7)
Prior Dexamethasone use			
2 doses	8	0	8
4 doses	14	2	16
> 4 doses	2	3	5
No of extubation failure (Prior to TR)			
Median (range)	2 (1 -3)	3 (2 - 3)	2 (1 - 3)
Period of intubation* (Prior to TR) (days)			
Median (range)	7 (3 - 25)	21 (8 - 27)	8 (3 - 27)
Up to 7	13	0	13
8-14	8	1	9
>14	3	4	7
Age at start of TR (days)			
Median (range)	22 (4 - 48)	21 (12 - 35)	22 (4 - 48)
Duration of TR* (days)			
Median (range)	3.5 (2 - 20)	7 (3 - 32)	5 (2 - 32)
up to 3	12	1	13
4 - 6	8	1	9
7 - 14	2	1	3
> 14	2	2	4

*The period with intubations was considered a day if it lasted for > 12 hr.

TR was unsuccessful in 5 patients, 3 left against advice within 7 day of trial and 2 patients who had prior duration of intubation, 21 and 27 days, underwent tracheostomy after a 32 and 26 days trial. Three patients (all failed) needed ventilation for a brief (<12 hr) while on TR inter-vention. Laryngoscopy could be performed in 3 patients having multiple extubation failures. Subglottic stenosis due to granulation was noticed in 2, both underwent tra-cheostomy, and glottic edema in 1, recovered. We did not find any complication related to TR in form of pulmonary infection, accidental extubation, aspiration or stridor by the time of discharge.

Discussion

There is no consensus about the optimum management of extubation failure cases due to postextubation UAO. We found therapeutic reintubation to be successful in 24 of 29 cases, after a short reintubation period of median 3.5 days. Hoeve, et al [8] have reported a success rate of 95% in a series of 23 preterm infants, with a longer mean reintubation period of 17 days. Most of the patients in our series had received 4 or more doses of dexamethasone and nebulised epinephrine prior to therapeutic reintubation and failed. Therapeutic reintubation was successful in 21 of 22 patients who had initial duration of intubation up to 2 weeks. Half of the successful patients in our series could be extubated within 3 days and another one third within 4-6 days of intervention. Probably these patients had less severe injuries in form of edema, superficial lesions/ ulcer which healed even with ET (of smaller size) in place. Thus it seems reasonable to attempt a first extubation after 2-3 days in whom initial intubation lasted < 2 weeks.

The success rate in 7 patients with initial duration of intubation > 14 days was only 43% with a median reintubation period of 10 days. These patients probably had developed more severe airway injury in form of granulation or scarring. Two of the failed patients demonstrated granulation in subglottic region and underwent tracheostomy after 26 and 32 days of reintubation trial. Patients with granulation required longer period of reintubation trial (mean 27

days) with lesser success rate (91%) in Hoeve, et al. series (8). Thus in resource limited settings, it may be justified to have a trial of reintubation for initial 1-2 weeks even if laryngobronchoscopy is not possible (as happened in most of our cases), however, it may be crucial at this stage to assist a decision whether to continue intubation or perform surgical intervention.

Six patients were continued to have reintubation trial beyond 7 days. In fact these were some of the initial patients in whom TR was tried first, who had multiple extubation failures due to UAO, refused for tracheostomy and further ventilation with no option left. Interestingly it was observed that just after reintubation alone, there was dramatic improvement in breathing pattern and retraction. Four of them could be finally extubated after a reintubation trial of 10-20 days. Other 2 patients kept on failing and finally underwent tracheostomy, which could be only possible at day 26 and 32 of reintubation.

Tracheostomy in young infants still suffers. Both of our patients had several emergency visits due to complications. Neither could be decannulated even after 8 months (died) and 12 months.

Some of the criteria of extubation from TR trial seems to be little subjective but ensured with some degree of certainty an uneventful extubation. Since the airway was already compromised in patients, we used smaller size ET to have a loose fit and at same time to provide a secured and quite adequate airway. This is supported by previous observation of having lesser rate of laryngotracheal stenosis in neonates with use of smaller tube size [9].

In conclusion, therapeutic reintubation is a useful treatment in newborn infants having extubation failure due to upper airway obstruction following mechanical ventilation, who have also failed to usual treatment with dexamethasone and nebulised epinephrine. It should be considered before surgical options; however prospective study needs to be done.

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