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Management of severe croup: Barking up which tree?

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Abstract

Management of severe croup poses continual challenge to paediatricians. A patient with severe croup due to Parainfluenza type 1 infection who failed extubation repeatedly and required tracheostomy is presented here. The important issues in management of severe viral croup requiring intubation, including careful consideration of the size of the endotracheal tube, extent of airway instrumentation, use of steroids, antireflux therapy, antibiotics, and the potential utility of tracheostomy are reviewed.

Introduction

Management of severe croup poses continual challenge to paediatricians. We presented a patient with severe croup due to Parainfluenza type 1 infection who failed extubation repeatedly and required tracheostomy. We also reviewed the literature to provide an update on management of severe croup.

Case report

A 14-month-old girl was admitted for croup. She presented with typical barking cough, preceded by fever and coryzal symptoms. She was febrile but not toxic. She had inspiratory stridor at rest, tachypnoea and mild insucking of chest, but breath sound remained satisfactory. Westley score was 3/17.[1] She was given oral dexamethasone 0.6 mg/kg and had stable improvement in subsequent hours. Nasopharyngeal aspirate was positive for Parainfluenza type 1.

She deteriorated 11 hours after admission. Stridor became more prominent. She was tachycardic, tachypnoeic, and desaturated to 85-90%. Breath sounds were mildly reduced. Westley score rose to 9/17. Nebulized adrenaline and second dose of dexamethasone were given, but there was no obvious improvement.

She was examined under general anaesthesia with direct laryngoscopy and tracheoscopy. Arytenoids, vocal cord and subglottic region were oedematous. Epiglottis was normal. There was also mild tracheitis. Tracheal aspirate was taken. She was then intubated orotracheally with 4.0 mm endotracheal tube, and was put on mechanical ventilation.

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Baseline investigations showed normal white cell count and C-reactive protein. Blood culture was negative. Tracheal aspirate showed heavy growth of alpha-haemolytic Streptococcus, moderate growth of Nisseria species and scanty growth of Methicillin sensitive Staphylococcus aureus, but was negative for white cells.

On Day 5, after weaning sedation and paralytic agent for more than 12 hours and receiving one dose of dexamethasone, she was extubated in the operating theatre. However, she deteriorated after a few minutes, with marked respiratory distress and prominent stridor. She was then reintubated. Another similar trial of failed extubation occurred on Day 7. An episode of unplanned extubation occurred on Day 10. Again, she deteriorated soon and required reintubation. She was kept sedated afterwards. She was given prednisolone 2 mg/kg/day, antibiotics to cover for bacterial tracheitis, and omeprazole for possible gastroesophageal reflux.

There was no “air leak” observed. Direct laryngoscopy on Day 5, 7, 10, and 19 showed persistent oedematous arytenoids, vocal cords, and subglottic region with no air leak (Figure 1). Airway from trachea to main bronchi

Figure 1. Inflammed and oedematous false cord on Day10 of intubation.

was normal. In view of the repeated failed extubation and persistent laryngeal oedema, tracheostomy was performed on Day 22. Over the subsequent week, sedation and mechanical ventilation were weaned off. Laryngoscopy performed 10 days after tracheostomy showed resolved glottic and subglottic oedema. Tracheostomy was therefore removed. She remained stable thereafter.

Discussion

Few patients with croup would require intubation and tracheostomy, as most of them would respond to steroid. Available incidences for artificial airway required in croup were reported before the era when steroid became the recommended treatment. Most patients with severe croup who required intubation were expected to improve significantly with successful extubation within 1 week. Our patient was complicated by prolonged laryngeal inflammation and oedema, which led to extubation failure.

Determination of optimal size of endotracheal tube is important. Earlier study showed that using size of endotracheal tube for normal airway in croup children was associated with higher incidence of subglottic stenosis, as it compressed on the already oedematous airway, resulting in additional trauma and inflammation to the mucosa.[2] An optimum size of endotracheal tube should be able to provide "adequate" but not "maximal" airway. The general recommendation is that endotracheal tube of 0.5 to 1 mm smaller than normal size for age should be used for intubation of children with severe croup.

Laryngoscopy to directly visualise the upper airway is useful in the initial diagnosis to exclude epiglotittis, foreign bodies and other pathologies; and to assess the degree and level of involvement. Subsequent laryngoscopy may be useful in assessing the progress of the upper airway obstruction. However, repeated instrumentation poses additional risk of mucosal trauma and secondary infection. There is no relevant literature on this issue. However, we believe that instrumentation did contribute to the prolonged upper airway inflammation in our patient.

Bacterial tracheitis is not uncommon in severe viral croup. A review of intubated viral croup patients showed the 24% had secondary bacterial tracheitis, and was associated with longer duration of intubation and more prone to extubation failure.[3] Furthermore, up to 85% of patients with bacterial tracheitis had positive viral cultures, with Parainfluenza and Influenza A viruses being most common.[4,5] In our patient, tracheal aspirate yielded mixed growth of Streptococcus, Nisseria and Staphylococcus. Despite the fact that she lacked other typical features of bacterial tracheitis; we believed that superimposed bacterial infection might have contributed partly to the upper airway inflammation and oedema. Although the current consensus is that antibiotics is not useful in croup,[6] for patients who were ill enough to require intubation, antibiotics treatment to cover for possible bacterial tracheitis may be justified.

The exact incidence of gastroesophageal reflux in patients with viral croup requiring intubation is unknown. Simultaneous tracheal and esophageal pH monitoring showed that 40% of intubated patients had gastroesophageal reflux[7] and 20% had tracheal reflux.[8] However, the observation was limited by small sample size and short duration of monitoring. It is also well known that pH monitoring cannot detect non-acid reflux and may have underestimated the real incidence of reflux. It was shown in animal models that acid reflux would induce inflammation and ulceration of laryngeal mucosa. There was no study on prophylactic anti-reflux treatment on the effect of extubation. To date, there was insufficient evidence to suggest routine anti-reflux treatment for intubated children. However, gastroesophageal reflux should be considered in patients with persistent laryngeal oedema.

To determine the most appropriate time for extubation was another difficult issue A general guide is to wait for "air leak" around the endotracheal tube. "Air leak" was defined as vocalisation around the tube, audible air leak when the patient coughs, or presence of air leak with positive pressure insufflation via a T-piece. Studies have shown "air leak" is helpful but not absolutely prognostic.[9] One study with 70 children intubated for croup, found no difference in the rate of reintubation with or without "air leak".[10] The possible explanation for these findings is that "air leak" is dependent on multiple factors, including positive pressure applied, airway narrowing below the tube, neuromuscular blockade, head position,[11] size of tube and age.

The use of sedation in management of severe croup has not been substantiated. One study used chloral hydrate in children with severe croup and impending respiratory failure. There was a significant reduction in Westley score in treatment group as compared with the placebo group, but there was no significant difference in the transcutaneous carbon dioxide pressure. The

author concluded that the improvement in Westley score was due to decreased respiratory effort after sedation, but alveolar ventilation was not improved.[12]

Our case illustrates a management dilemma between prolonged intubation under sedation and tracheostomy. To give adequate sedation was essential for our patient to minimise mucosal trauma inflicted by excessive struggling. However, the longer the endotracheal tube was left in-situ, the more likely that laryngeal oedema would persist. Prolonged sedation also imposes additional risk of pulmonary complication and extubation failure.[13] On the other hand, tracheostomy in young children also carries significant morbidity and potential mortality. In our patient, the decision for tracheostomy was made as repeated attempts for extubation failed and laryngeal oedema did not improve while the endotracheal tube was still in place. Laryngeal oedema subsided readily upon removal of the endotracheal tube which we believed had contributed significantly to the local trauma on the inflamed upper airway structures, However, controversy exists regarding the benefit of tracheostomy in this setting. Thus, the decision for tracheostomy should be individualised.

Glucocorticoids have been shown to be effective in reducing the Westley scores, hospital admission rate, and the use of nebulised adrenaline. Current data suggest that dexamethasone at 0.6 mg/kg (orally or intramuscularly) is effective, although a few studies have shown that low dose dexamethasone (0.15 mg/kg) or nebulized budesonide are equally effective. However, glucocorticoids have not been shown to reduce the rate of intubation in children with severe croup.[14] Whether additional dose of steroids may prevent intubation is still unclear.

A few studies addressed the role of steroid in children intubated for croup. Tibballs studied 70 children intubated for croup. Thirty-eight were given prednisolone 1 mg/kg every 12 hours within 24 hours of intubation till 24 hours post-extubation. Prednisolone group required less reintubation and had shorter duration of intubation.[10] However, in another retrospective study, dexamethasone, hydrocortisone, and prednisolone were not shown to be effective.[15] Thus, at present, the role of steroids in intubated croup children is still unclear.

In conclusion, our case illustrates a few important management issues in patients with severe viral croup requiring intubation, including careful consideration of the size of the endotracheal tube, extent of airway instrumentation, use of steroids, antireflux therapy and antibiotics. Tracheostomy is rarely required but may be an option in patients requiring prolonged intubation.

References

1. Ausejo M, Saenz A, Pham B, Kellner JD, Johnson DW, Moher D, et al. The effectiveness of glucocorticoids in treating croup: meta-analysis. BMJ 1999;319:595-600.
2. Zulliger JJ, Schuller DE, Beach TP, Garvin JP, Birck HG, Frank JE. Assessment of intubation in croup and epiglottitis. Ann Otol Rhinol Laryngol 1982;91(4 Pt 1):403-6.
3. Durward AD, Nicoll SJ, Oliver J, Tibby SM, Murdoch IA. The outcome of patients with upper airway obstruction transported to a regional paediatric intensive care unit. Eur J Pediatr 1998; 157:907-11.
4. Bernstein T, Brilli R, Jacobs B. Is bacterial tracheitis changing? A 14-month experience in a pediatric intensive care unit. Clin Infect Dis 1998;27:458-62.
5. Donnelly BW, McMillan JA, and Weiner LB. Bacterial tracheitis: report of eight new cases and review. Rev Infect Dis 1990;12:729-35.
6. Ng DKK, Chow PY, Wong YL, Lau D. Clinical Guideline on Management of Viral Croup. Quality Assurance Subcommittee, Co-ordinating Committee in Paediatrics, Hospital Authority, 2001.
7. Gaynor EB. Gastroesophageal reflux as an etiologic factor in laryngeal complications of intubation. Laryngoscope 1988; 98:972-9.
8. Hue V, Leclerc F, Gottrand F, Martinot A, Crunelle V, Riou Y, et al. Simultaneous tracheal and oesophageal pH monitoring during mechanical ventilation. Arch Dis Child 1996;75:46-50.
9. Adderley RJ, Mullins GC. When to extubate the croup patient: the "leak" test. Can J Anaesth 1987;34(3 Pt 1):304-6.
10. Tibballs J, Shann FA, Landau LI. Placebo-controlled trial of prednisolone in children intubated for croup. Lancet 1992; 340:745-8.
11. Finholt DA, Henry DB, Raphaely RC. The “Leak” Test- a Standard Method for Assessing Tracheal Tube Fit in Pediatric Patients. Anesthesiology 1984;61:A450.
12. Fanconi S, Burger R, Maurer H, Uehlinger J, Ghelfi D, Muhlemann C. Transcutaneous carbon dioxide pressure for monitoring patients with severe croup. J Pediatr 1990;117: 701-5.
13. Fontela PS, Piva JP, Garcia PC, Bered PL, Zilles K. Risk factors for extubation failure in mechanically ventilated pediatric patients. Pediatr Crit Care Med 2005;6:166-70.
14. Russell K, Wiebe N, Saenz A, Ausejo SM, Johnson D, Hartling L, et al. Glucocorticoids for Croup (Review). Cochrane Database Syst Rev 2004;(1):CD001955.
15. Rajah J, Riera-Fanego J, Keeton J, Ramjee A, Bhana R, Lasersohn L, et al. Do steroids prevent reintubation in children with laryngotracheobronchitis? Crit Care 2000;4:314-8.