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Risk management protocol for gastrostomy and jejunostomy insertion in ventilator dependent infants

M. Chatwin [a,*], A. Bush [b], D.J. Macrae [c], S.A. Clarke [d], A.K. Simonds [a]

[a] Clinical and Academic Department of Sleep and Breathing, Royal Brompton & Harefield NHS Foundation Trust, United Kingdom
[b] Department of Paediatric Respiratory Medicine, Royal Brompton & Harefield NHS Foundation Trust, United Kingdom
[c] Department of Paediatric Intensive Care Medicine, Royal Brompton & Harefield NHS Foundation Trust, United Kingdom
[d] Department of Paediatric Surgery, Chelsea and Westminster Hospital NHS Foundation Trust, United Kingdom

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Abstract

Gastrostomy, gastrojejunostomy and anti-reflux surgery in infants and children who are chronically ventilator dependent are associated with significant risk of morbidity and mortality. We report outcomes of 22 high risk children who underwent these procedures at our centre. Pre-operative investigations included: overnight oxygen and carbon dioxide monitoring and subsequent optimisation of ventilatory support, echocardiography, video fluoroscopy, and assessment of gastroesophageal reflux. We carried out 24 procedures under general anaesthesia. Twenty-one children used ventilatory support pre-operatively. Median age of first surgical procedure was 18 months (range 3–180). Supplementary feeding was commenced in 20 children prior to procedure, median age 9 months (1–31). Median PICU length of stay was 1 (1–8) days. No children died in the post-operative period. Extubation was possible within 24 h in 87% of cases. Complications included; atelectasis ($n = 2$), ileus ($n = 2$), abdominal distension ($n = 4$) and loose stools ($n = 1$). We conclude that, in this high risk cohort of ventilator dependent children with predominantly neuromuscular disorders, with careful assessment, operative intervention can be carried out under general anaesthesia, with the child being extubated early back onto their routine ventilatory support and aggressive airway clearance. Additionally this protocol can minimise post-operative complications and is associated with a good outcome in the majority.

Keywords: Non invasive ventilation; Neuromuscular disease; Cough augmentation; Trisomy 21; Airway clearance; Spinal muscular atrophy; Gastro-oesophageal reflux; Aspiration

1. Introduction

Children with neuromuscular disorders, Trisomy 21 and chronic lung disease often fail to thrive. In children with neuromuscular disorders, this may be due to swallowing dysfunction as a result of bulbar muscle weakness, feeding difficulties or gastro-oesophageal reflux (GOR). Good nutrition has been shown to be important [1–3]. Observational studies in children with neuromuscular disorders showed improvements in weight and a decrease in chest infections with assisted enteral feeding [1–3]. In children with Trisomy 21 there also maybe swallowing and upper airway dysfunction due to hypotonic tongue and lips [4] and poor oromotor coordination [5]. Trisomy 21 children with cardiac abnormalities may also suffer from fatigue during feeding and aspiration events may lead to respiratory tract infections, which are is the commonest most common cause of mortality in this patient group [6–8]. The potential link with aspiration in this patient group warrants investigation and treatment [9–11]. In children with chronic lung disease, failure to thrive is most often due to fatigue during feeding along with the presence of GOR.

* Corresponding author. Address: Sleep and Ventilation Unit, Royal Brompton Hospital, Sydney Street, London SW3 6NP, United Kingdom. Tel.: +44 20 7351 8027; fax: +44 20 7351 8911.
E-mail address: m.chatwin@rbht.nhs.uk (M. Chatwin).

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Enteral feeding via naso-gastric (NG) or naso-jejunal tubes (NJ) is commonly used to optimise nutrition in children with long term respiratory failure. NG and NJ tubes have risks which include discomfort, epistaxis and exacerbation of GOR, along with the potential of tube displacement. In addition supplementary feeding via a NG or NJ tube may result in a poor mask fit in children who require ventilatory support in the form of non-invasive ventilation (NIV). Other options to NG or NJ feeding are surgical insertion of a gastrostomy or jejunostomy. Gastrostomy and jejunostomy can both be performed percutaneously using endoscopic or laparoscopic surgical techniques. However, there are significant risks associated with this surgery in infants and children who have chronic ventilator dependency [12,13]. These include: gastrointestinal bleeding; increase ventilatory dependence post operatively; acute sputum retention; atelectasis; aspiration and potential worsening of GOR with gastrostomy.

In children with GOR medical therapy may be ineffective. In some instances GOR has been associated with an increased risk of gastroenteritis and community-acquired pneumonia [14,15]. If GOR persists despite maximal medical therapy, a surgical anti-reflux operation, Nissen's fundoplication is usually indicated. In some centres a Nissen's fundoplication would always be carried out in combination with gastrostomy insertion [13,16]. Yuan and co-workers [16] reported that in the year following gastrostomy and Nissen's fundoplication in a small group of spinal muscular atrophy Type I and II children there was a decrease in the frequency of pneumonia.

In addition to procedure risks as previously described, there is a high peri-operative risk associated with general anaesthesia. These children may experience failed extubations or an increase in ventilator dependence as a result of the paralysis and sedation required for the procedure. There may be a critical reduction in upper airway calibre with large tonsils and as a result of the hypotonia seen in Trisomy 21, and this may make extubation difficult. By definition, children requiring ventilatory support have a poor respiratory reserve; other issues include poor lung function and ineffective airway clearance. Decisions about the indications for and timing of surgery must therefore be balanced against the risk of peri- and post-operative respiratory and procedure complications.

There are no randomised controlled trials investigating the most appropriate surgical procedure for enteral feeding in this patient group, nor are there likely to be, given their rarity and diagnostic diversity. We therefore report our experience and outcomes with multidisciplinary management for children who undergo surgery at our centre. The aim of sharing this experience is to inform future multidisciplinary approaches for managing high risk ventilator dependent children who require abdominal surgical procedures.

2. Methods

We identified 22 "high risk" (increased operative and anaesthetic risk) children based on a diagnosis of respiratory insufficiency or sleep disordered breathing undergoing gastrostomy or jejunostomy between 2006 and 2011. Data were collected from medical notes and electronic patient tracking systems. Descriptive data including referral information, patient age, age at supplementary feeding and NIV use, were noted. All children were investigated pre-operatively using the following protocol (Fig. 1).

2.1. Pre-operative cardio-respiratory management

All children underwent overnight monitoring of arterial oxygen saturation (SpO_2) and transcutaneous carbon dioxide ($TcCO_2$) (TCM4 electrode and in built Masimo SET® oximetry, Radiometer, Brønshøj, Denmark). In children who were already receiving NIV because of nocturnal hypoventilation (defined as $TcCO_2$ greater than 6.5 kPa for more than two thirds of the night [17]) we optimised their ventilator settings to normalise gas exchange. In children who were not on NIV, base line overnight monitoring was carried out. In patients who were not currently receiving NIV but were found to have nocturnal hypoventilation, nocturnal NIV was commenced. Any child who had previously decompensated as a result of respiratory tract infection was provided with NIV to use during any episode of perioperative respiratory insufficiency.

NIV was initiated with a nasal mask (Infant mask system large and small infant bubble cushion, ResMED, Abingdon, England, UK, small child's Profile™ lite and petit Profile™ lite, Philips Respironics, Bognor Regis, England, UK), so that secretions could easily be cleared from the mouth and abdominal bloating prevented. The

Protocol Management Check List

Pre-op

- Cardio-pulmonary sleep study (at minimum overnight monitoring of SaO_2 and $TcCO_2$)
  - If abnormal start NIV or optimise NIV
- ECHOCARDIOGRAM in patients whose diagnosis predisposes them to cardiac involvement of high level of ventilator dependence
- Teach appropriate airway clearance techniques, introduce MI-E
- Assess for gastroesophageal reflux with either or a combination of:
  - pH study
  - Milk scan
  - Upper GI contrast study
- Assessment of swallow

Post-op

- Aim for patients to have normal SaO_2 breathing air prior to extubation
- Extubate on to NIV
- Respiratory physiotherapy administration when SaO_2< 95% on room air
- Gastrostomy initially on free drainage
- 48 hours of prophylactic antibiotics
- Feeding to commence once paralytic ileus resolved

Fig. 1. Protocol management check list for the pre and post operative period. Oxygen saturation (SpO_2), transcutaneous carbon dioxide ($TcCO_2$), non invasive ventilation (NIV), and gastrointestinal (GI).