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ORIGINAL PAPER

A pilot study of fibreoptic endoscopic evaluation of swallowing in patients with cuffed tracheostomies in neurological intensive care

Susan L. McGowan · Michael Gleeson · Martin Smith · Nicholas Hirsch · Caroline M. Shuldham

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Abstract
Introduction Patients on neurological intensive care units (NICU) who require ventilatory support often suffer from co-existing bulbar dysfunction, either because of their underlying disease or because of their decreased level of consciousness. For this reason, most patients are ventilated through a cuffed tracheostomy tube, which allows a degree of protection from tracheal aspiration of saliva and gastric contents. Patients who are awake often complain of thirst, but traditionally are only offered oral fluids when the cuff of the tracheostomy tube has been deflated. Given that many patients in NICU cannot tolerate cuff deflation, a reliable technique is needed to assess the adequacy of the patient's swallow and therefore the risk of aspiration when the tracheostomy cuff is inflated.
Methods The aim of this feasibility study was to examine the viability of Fibreoptic Endoscopic Evaluation of Swallowing (FEES) as a diagnostic tool to assess the effectiveness of swallowing in four NICU patients with cuffed tracheostomies.
Results The technique was successful in all of the four patients. One patient was found to have a normal swallow. Two patients were seen to have laryngeal penetration of fluids and one patient aspirated the fluid challenge.
Conclusion This pilot study has demonstrated the feasibility of using the FEES technique for assessment of swallowing in patients with cuffed tracheostomy tubes; it therefore presents the prospect of allowing earlier drinking in such patients whilst helping confirm the safety of such a strategy.

Keywords Thirst · Swallowing · Dysphagia · Tracheostomy · Endoscopy · Aspiration

S. L. McGowan (✉) · M. Gleeson · M. Smith · N. Hirsch
Directorate of Clinical Neurosciences, National Hospital for Neurology and Neurosurgery, Box 113, Queen Square, London WC 1N 3BG, UK
e-mail: susan.mcgowan@uclh.nhs.uk

C. M. Shuldham
Royal Brompton and Harefield Trust, London, UK

Introduction

Patients who are ventilated on a neurocritical care unit (NICU) via a cuffed tracheostomy tube are at risk of developing swallowing problems and a number of causes contribute to these problems. Tethering of the larynx by the tracheostomy cuff is often thought to contribute to the development of dysphagia but this has not been demonstrated in systematic, prospective studies [1]. Regardless of these causes, there is agreement that the swallowing function of patients on NICU needs to be assessed [2, 3].

However assessments of swallow function in ITU lack reliability. Bedside tests are not reliable at detecting aspiration. An example is the blue dye test: sensitivity and specificity of this test in identifying aspiration are between 45–80% and 62–100%, respectively [4]. Videofluoroscopy was considered by some to be the ''gold standard'' in swallow assessments but recent evidence has not shown that Videofluoroscopy is more sensitive than FEES for detection of aspiration [5]. In addition, Videofluoroscopy necessitates transfer to an X-ray suite, which may not be possible for the majority of patients who are being ventilated.

Fibreoptic Endoscopic Evaluation of Swallowing (FEES) allows for bedside visualisation of the soft palate, larynx and hypopharynx before and after swallowing.

FEES is an established tool in other clinical areas but its use in intensive care units although validated, has been limited [2, 3, 5, 6]. It is a sensitive and specific diagnostic test that identifies aspiration and can be carried out at a patient's bedside [5].

However, the potential benefit of using FEES for a swallow assessment in a NICU while the tracheostomy cuff is inflated has not been investigated. Historically, these patients were denied any form of swallow assessment due to two mistaken assumptions: that hyolaryngeal elevation is impinged by the inflated cuff and that the inflated cuff protects against aspiration. However, tethering of the larynx has not been demonstrated and an inflated cuff does not preclude leakage of oral intake past it. Thus the potential risk of using FEES is minimal. In addition, logistical and technical difficulties would only be caused by lack of equipment or FEES operator availability.

Thus there is a need to discover whether the use of FEES in this patient group on NICU is viable. This is especially pertinent as many of these patients may require long term weaning, are awake and experience thirst. If FEES was shown to be a practical tool the results may at least enable alleviation of thirst where oral intake is deemed to be possible.

The aim of this study is to investigate whether FEES is a practicable tool for the assessment of swallowing in patients who have cuffed tracheostomy tubes.

Methods

Following ethics approval from the Joint Research Ethics Committee of the National Hospital for Neurology and Neurosurgery and Institute of Neurology, four patients were recruited into the study. Inclusion criteria were patients who had had a new tracheostomy within the preceding 3 weeks and with an inflated cuff, who were awake and alert at the time of assessment (Glasgow Coma Scale of 15) and who were able to close their lips around a teaspoon for intake of fluids. Exclusion criteria included patients who had undergone oro-pharyngeal surgery and those with a new tracheostomy tube placement within the preceding 24 h.

All patients were seated upright in bed, and still receiving ventilatory support via a cuffed tracheostomy. The more patent nostril was identified by asking the patient to breathe through each in turn. A topical anaesthetic solution (Lidocaine Hydrochloride 5% w/v and Phenylephrine Hydrochloride 5% w/v) was then applied to the preferred nostril using a cotton bud and 3 min allowed for the local anaesthetic action to take effect.

The nasendoscope was then passed through the nose so that a good view of the pharynx and larynx was obtained. The presence and amount of pooled salivary secretions were noted using a subjective grading scale of minimal coating to severe pooling. Graded volumes of green-dyed milk (3×5 ml, 2×10 ml, $2 \times$ sips) were offered orally in turn and the patient instructed to swallow. If aspiration of the dyed milk was seen via the endoscope the patient's larynx and trachea were suctioned and the assessment was stopped. The FEES was recorded and subsequent analysis of each swallow was assessed by two independent experienced experts in the field of video swallows. The site at which the aspiration took place was noted according to the Penetration-Aspiration Scale [7]. After the procedure, patient feedback (verbal or written) was obtained on the comfort of the procedure.

Results

Four patients were recruited for the study. All were fully ventilated and had a double- lumen Portex^{TM} tracheostomy tube in situ (Table 1). A minimal to mild degree of pooling of secretions was seen in all patients on preliminary endoscopic evaluation (Table 2). During the FEES stage one patient was found to have a normal swallow, two patients had laryngeal penetration of the dyed milk and one patient aspirated (Table 3). Three patients found the procedure completely painless and one only mildly uncomfortable.

Table 1 Patient demographics

Patient number	Age	Sex	Medical diagnosis	Ventilation status	Size and type of double lumen tracheostomy
1.	69	F	Viral Encephalitis	Pressure Support (12) PEEP (5 cmH_20)	7.0 Portex
2.	32	M	Guillain Barre Syndrome	Pressure Support (10) PEEP (6 cmH_20)	8.0 Portex
3.	32	M	Left Frontal Extradural Hematoma	Pressure Support (10) PEEP (5 cmH_20)	8.0 Portex
4.	58	F	Multiple Sclerosis and Encephalitis	Pressure Support (10) PEEP (5 cmH_20)	7.0 Portex

PEEP: Positive End Expiratory Pressure

Table 2 Pooling of saliva and secretions prior to fluid being offered

Pooling of secretions	Minimal coating				Mild				Moderate				Severe			
Patient number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Valleculae Right/Left	✓		✓	✓		✓										
Posterior pharyngeal wall	✓	✓	✓	✓												
Pyriform fossae Right/Left		✓	✓	✓	✓											
Laryngeal vestibule	✓	✓	✓	✓												
Aryepiglottic folds Right/Left	✓	✓	✓	✓												

Table 3 Penetration-aspiration scale results

Patient number	Aspiration	Penetration-aspiration scale (1–8)						
		5 ml	5 ml	5 ml	10 ml	10 ml	Sip	Sip
1.	Yes	1	1	1	1	3		
2.	Yes	1	3					
3.	Yes	5						
4.	No	1	1	1	1	1	1	1

1. Material does not enter the airway.
2. Material enters the airway, remains above the vocal folds, and is ejected from the airway.
3. Material enters the airway, remains above the vocal folds, and is not ejected from the airway.
4. Material enters the airway, contacts the vocal folds and is ejected from the airway.
5. Material enters the airway, contacts the vocal folds and is not ejected from the airway.
6. Material enters the airway, passes below the vocal folds and is ejected into the larynx or out of the airway.
7. Material enters the airway, passes below the vocal folds and is not ejected from the trachea despite effort.
8. Material enters the airway, passes below the vocal folds and no effort is made to eject [7].

Discussion

The inability to swallow is commonly seen in patients with neurological disease nursed on intensive care units. Furthermore, aspiration of saliva and gastric contents is well recognised in this group of ventilator and tracheostomy dependent patients; a reliable technique (and one that can be carried out at the patient's bedside) for assessment of the swallowing ability of such patients is therefore highly desirable [3, 8–10].

Two patients who showed an area of mild pooling on their own secretions (patients 1 and 2) were not seen to be aspirating their own saliva. Mild saliva pooling may be a predictor of dysphagia. Murray et al. found that pooled salivary secretions are associated with a greater likelihood of aspiration of fluids [11]. Thus, all patients were able to swallow their own secretions successfully, but in one patient the FEES identified aspiration on liquids. This additional information adds to the overall risk assessment of bulbar dysfunction and may influence weaning plans.

A major limitation of this study is the small number of patients and we intend to study more using a prospective case series design. However, we report these preliminary results at this stage because we believe that the findings are relevant to everyday clinical practice. A further limitation is that the topical anaesthetic solution may influence the ability of the patient to swallow successfully. Future studies would not incorporate the use of topical anaesthesia, thus aiming to improve reliability of the physiologic evaluation [3].

The lack of gold standard for swallow assessments in ITU limits the consideration of reliability when interpreting the FEES results. However it is widely accepted that instrumental investigations such as FEES undoubtedly reveal more information than a clinical bedside examination [5].

The study has raised questions which are important to consider in future research. These are: first, what is the correlation between bedside observations of saliva management and FEES rating of pooled pharyngeal secretions? And second, does the degree of pooled secretions bear any relation to the degree of swallow impairment on fluids? Recognising that the population of patients with cuffed tracheostomy tubes in a single NICU will always be small, a multi-centre collaboration is likely to be required to answer these questions.

Conclusions

This pilot study suggests that FEES was useful in identifying the adequacy of the swallow of patients who were ventilated though a cuffed tracheostomy tube on a NICU. If verified in a larger study, FEES offers the prospect of early assessment of swallow in patients with cuffed tracheostomies, thus allowing earlier and safer administration of oral fluids. In addition, the demonstration of effective swallowing using FEES challenges the assumption that normal swallowing is inhibited by tethering of the larynx by inflated tracheostomy cuffs.

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