ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 01 | January - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ROLE OF FIBEROPTIC ENDOSCOPIC EVALUATION OF SWALLOWING IN TRACHEOSTOMY DECANNULATION OF NEUROTRAUMA PATIENTS

Otorhinolaryngology

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ABSTRACT

Background: Elective tracheostomy is most commonly indicated in neurotrauma patients who are anticipated to require prolonged ventilatory support. Once the indication of the tracheostomy is resolved, it is essential to wean off the patient from the tracheostomy. Prolonged tracheostomy may result in tracheal stenosis, recurrent infections, excessive irritant coughing, delaying decannulation and demoralizing for the patient. In order to successfully decannulate a tracheostomised patient, there needs to be a definitive protocol and tool for avoiding re-cannulation/ decannulation failure. This study aims at defining the role of Fiberoptic Endoscopic Evaluation of Swallowing (FEES) in tracheostomy decannulation. **Objective:** To determine the role of fiberoptic endoscopic evaluation of swallowing (FEES) as a tool in the decannulation of tracheostomised neurotrauma patients. **Methodology:** All the tracheostomised neurotrauma patients underwent clinical assessment of swallowing, and standardized protocols of clinical indicators listed by ROSS AND WHITE[1] were followed for clinical assessment. Patients were subjected to Fiberoptic Endoscopic Evaluation of Swallowing (FEES), Demography along with underlying neurotrauma details, duration of tracheostomy /Ryle's tube insertion, CAS scores and FEES detected PAS scores were documented in proforma. The data about the micro aspiration, Gross aspiration to different consistencies of the food along with any structural pathologies were noted during endoscopy and were recorded and scored according to Penetration Aspiration Scale (PAS)[2] in a proforma. **Results:** Among 51 patients recommended by the Clinical Assessment of Swallowing (CAS), 35 (68.62%) patients were decannulated after Fiberoptic Endoscopic Evaluation of swallowing (FEES), 16 (31.38%) were deferred decannulation due to signs of aspiration on endoscopic visualization (Silent aspirators). Amongst the 16 patients who were deferred of decannulation, 6 (37.5%) patients were noted to have edematous arytenoids, 5 (31.25%) patients had vocal cord congestion, 2 (12.5%) patients each with vocal cord mobility and false cord hypertrophy were noted and 1 (6.25 %) patient had bulky arytenoids with no signs of aspiration. **Conclusion:** Functional Endoscopic Evaluation of Swallowing (FEES) objectively identified silent aspirators who otherwise would have been missed during the clinical evaluation of swallowing. Thus, played an important role in preventing the chances of decannulation failure.

KEYWORDS

Neurotrauma patients, Clinical Assessment of Swallowing, Fiberoptic Endoscopic evaluation of swallowing (FEES), Penetration Aspiration Scale (PAS), Tracheostomy Decannulation, Silent aspirators.

INTRODUCTION

Tracheostomy is the procedure wherein a stoma is created at the skin surface that leads to the tracheal lumen. It is indicated in neurotrauma patients, in order to wean off the patients from mechanical ventilators who are anticipated to have prolonged intubation and shorten the duration of ICU stay. It also helps in minimizing the complications from prolonged tracheal intubation, such as ventilator-associated pneumonia (VAP) and tracheal lesions [3].

In intensive care unit settings, after a Traumatic Brain Injury (TBI), the main indications for tracheostomy include failure to wean invasive mechanical ventilation, absence of protective airway reflexes, impairment of respiratory drive, and difficulties in managing secretions[4]. As prolonged tracheostomy tube would bear psychological effects on the patients leading to anxiety and depression[5]. This transition process is critical.

However, there is no proper protocol or guidelines that have been designed for this transition process [6]. Factors such as Coordination of the Brain, swallowing, protective Cough reflex, phonation and strength of respiratory muscles will be ample in deciding on Decannulation [7].

The decision to decannulate is based on clinical assessment scoring in a setup where fibre optic endoscopy is not available. There is a higher risk of decannulation failure by doing just a clinical assessment i.e., a 4.5% failure rate [8].

Hence the role of Fiberoptic Endoscopic Evaluation of Swallowing (FEES) is important in avoiding Decannulation failure rates and the need for the re- establishment of an artificial airway. In various studies, FEES has been shown to be an important tool in assessing swallowing before decannulation by detecting silent aspirators [9].

OBJECTIVE

• To determine the role of fiberoptic endoscopic evaluation of swallowing (FEES) as a tool in the decannulation of tracheostomised neurotrauma patients.

MATERIALS AND METHODS

Study Design: Prospective study

Source Of Data:

51 tracheostomised neurotrauma patients satisfying the inclusion and exclusion criteria, treated at SSIMS AND RC Hospital (Tertiary care centre) were recruited for the study.

Method Of Sampling:

Sequential sampling technique.

Study Duration: December 2020 to December 2022.

Inclusion Criteria:

Subjects were enrolled after the following criteria were met.

1. Neurotrauma tracheostomy patients in the age group of 18-60 years.
2. Tracheostomised for anticipated prolonged ventilation.
3. Planned for decannulation after satisfying a CAS score of 4 or >4.

Exclusion Criteria:

1. Low GCS(GCS<8)
2. Patients requiring continuous mechanical ventilation support.

Ethical Clearance:

This study was approved by the Institutional Ethical Review Board, SSIMS & RC, Davanagere(IERB NO: 439-2021) prior to the commencement of the study.

Informed Consent:

Written and informed consent was obtained from all study participants after explaining to them the nature of the study.

• **Methodology:** All the tracheostomised neurotrauma patients satisfying the inclusion and exclusion criteria, underwent clinical assessment of swallowing. Clinical assessment of swallowing was carried out by following standardized protocols of clinical indicators listed by ROSS AND WHITE[1].

• The indicators used in the Clinical Assessment of swallowing were enlisted as follows.

1. Weaned off from mechanical ventilation.
2. Effective cough.
3. Normal gag reflex.
4. Ability to swallow own secretions.
5. Absence of serious chest infection.
6. Spo2 > 90% at room air for >24 hrs.
7. Reason for the tracheostomy tube resolved.

1 point was allotted for each indicator, hence a maximum score of 7. Patients with clinical assessment scores of 4 or more were considered for decannulation. The outcome of the evaluation was documented in a structured proforma.

The patient then underwent Flexible Nasopharyngolaryngoscopy (PENTAX CORPORATION, Model no – VNL – 1170K, 3.7mm flexible fiberoptic scope, Manufacturer – PENTAX corporation, 2-36-9, Maeno-cho, itabashi-ku, Tokyo 174- 8639 Japan). Under Local Anaesthesia (Topical 4 % Lignocaine with 0.1 % Xylometazoline) using aseptic precautions the tip of the scope was passed through the patent nostrils and then followed through into the nasopharynx and turned downwards so that the tip of the scope positioned itself behind the soft palate. The following observations were documented:
1. Position of Ryle's tube.
2. Retained secretions.
3. Laryngeal structures along with Vocal cord movements.
4. Feeds of different consistencies (Milk, Porridge and Biscuit) were given, and the pharyngeal phase of swallowing was observed and also looked for any signs of aspiration. PAS scores were recorded as follows.

Penetration Aspiration Scale[2].
1. Material does not enter the airway.
2. Material enters the airway, remains above the vocal folds and is ejected from theairway.
3. Material enters the airway, remains above the vocal folds and is not ejected fromthe 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 goes beyond the vocal folds and is ejected from the trachea into the larynx.
7. Material enters the airway, passes below the vocal folds and is not ejected from the trachea into the larynx, despite the effort.
8. Material enters the airway, passes below the vocal folds, and there is no spontaneous effort made to eject the material.

Patients with PAS scores of 4 or less were recommended for decannulation.The overall data was recorded in a structured proforma.

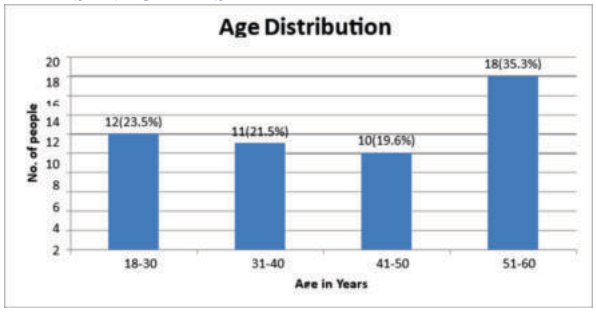
Statistical Analysis
Qualitative data were expressed in terms of frequencies and percentages**.** Quantitative data were expressed in terms of Mean and standard deviation. Considering PAS determined by the FEES as a gold standard, the positive predictive value, Negative predictive value of the Clinical assessment score was calculated. The number of patients who were planned for decannulation using CAS and patients who actually got decannulated using FEES–PAS criteria were calculated. The proportion of the patients who could have been recannulated if only CAS was considered was calculated. 'P' value of <0.05 was set as statistically significant. Statistical tests were done using SPSS 16 version.

RESULTS

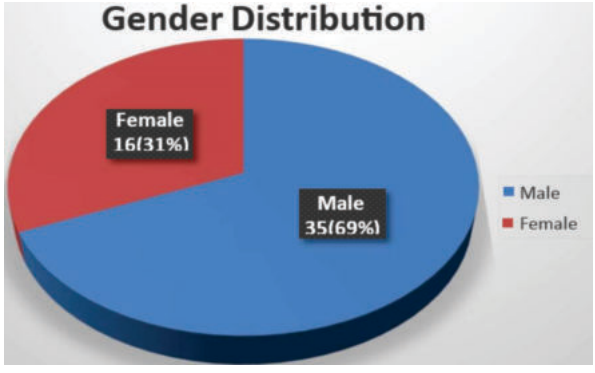
The study involved 51 patients with Ages ranging from 18-60 years. It shows that the patients in the age group 51-60 years constituted the majority of the study, making it 35%. (Graph. 1). The male -female demography of the study had the male group almost making up more than 2/3rd (68.6%) of the study group and females comprising almost 1/3rd (31.4%) as depicted in the graph. (Graph 2). The patients included in the study had been tracheostomised for varying ranges of the time period from as less as 6 days to the highest duration being 66 days. Amongst these patients tracheostomised for 10-30 days were in majority with about 72.6 % of the total study group. (Graph 3). Among the 51 patients who were given scores out of 7 according to the CAS scale, the majority of the study group was formed by people with scores of 5 and 6 which is about 60.7% of the group. (Graph 4). During the FEES, 16 patients with laryngeal lesions such as Edematous arytenoids, false cord hypertrophy, and impaired vocal cord mobility were identified. About 7 patients had edematous arytenoids making up to 43.75% of the patients deferred for decannulation, similarly, 2 (12.5%) patients were having false cord hypertrophy, 2 (12.5%) patients were having vocal cord immobility. 5 (31.25%) patients were found to have vocal cord congestion (Table 1). There were 36 people who were given a PAS score of 4 or less whereas the remaining 15 were given a score >4, (Graph.5). So, the 15 people detected on the FEES as silent aspirators who constituted about 29.42% of the study group which is a significant number. However, a total of 35 out of 51 patients underwent decannulation following FEES, which is about 68.62% of patients recommended by CAS for decannulation. About 31.38% of the study group were deferred of decannulation, depicted in (Table 2). 1 patient who had a PAS score of <4 but was still deferred for decannulation because of Bulky arytenoids and therefore a risk for developing respiratory distress post decannulation. The patients with laryngeal lesions such as Edematous arytenoids, false cord hypertrophy, and impaired vocal cord mobility were identified and their correlation with the PAS scores was tabulated as follows. A p-value of 0.003 was highly significant, indicating that these laryngeal changes were reasons for deferring decannulation. Among 51 patients, 35 (68.62%) patients were decannulated whereas 16 (31.38%) were deferred of decannulation.

Among the 16 deferred patients, the patients with a CAS score of 4, were forming a majority with 7 (43.75%), whereas no patients with a score of 7 were deferred for decannulation. (Graph 6). In a total of 51 patients there were 10 patients who were given a CAS score of 4, of whom 3 patients were given score of PAS scores 1-4 and 7 were given a score of 5-8, among 14 patients who had a CAS score of 5, 9 were alloted a PAS score of 1-4, and 5 were given a score of 5-8. among 17 patients with CAS score of 6 , 15 were alloted a PAS score of 1-4 and 2 were given a score of 5-8. there were 10 people with CAS score of 7 of which all were alloted a PAS score of 1-4 (Table.3). On analyzing the data, it was noted that when we consider various CAS scores as a threshold for recommending decannulation there is a change in specificity and sensitivity. As the score threshold was increased from 4 to 7 the sensitivity decreases but the specificity increases (Table 4) would depict the outcome.

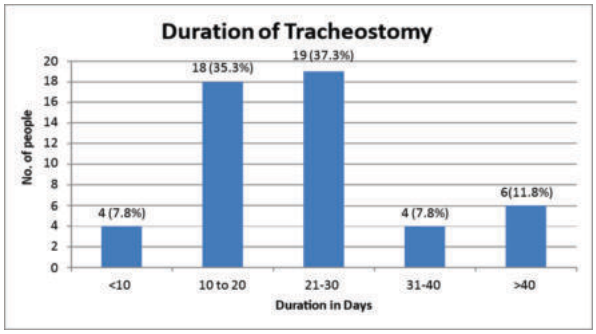
TABLES AND GRAPHS



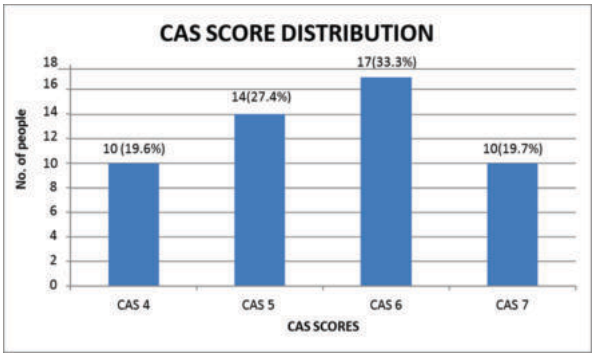
Graph 1. Representation Of Age Distribution Of The Study Group.



Graph 2. Gender Distribution.



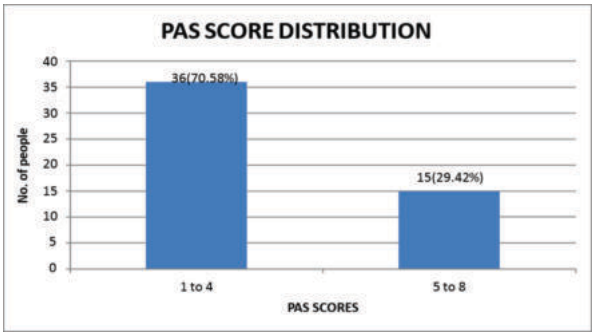
Graph 3. Duration Of Tracheostomy



Graph 4. CAS Score Distribution.

Table 1. Laryngeal Abnormalities.

Sl no	Laryngeal abnormalities	No. Of Patients	Percentage
1.	Edematous and Bulky arytenoids	7	43.75%
2.	Vocal cord congestion	5	31.25%
3.	Vocal cord immobility	2	12.5%
4.	False cord hypertrophy	2	12.5%



Graph 5. PAS Score Distribution

Table 2. Decannulated And Deferred Percentage

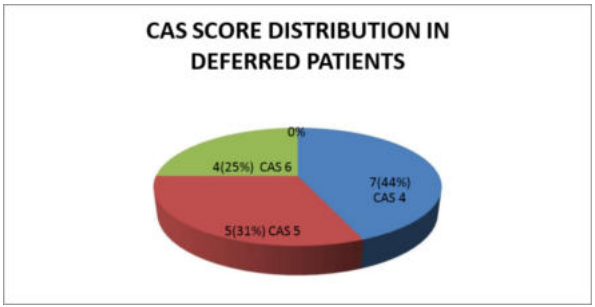
	Number	Percentage
Decannulated	35	68.62
Deferred	16	31.38
Total	51	100

Table 3. CAS vs PAS Score Distribution

SI.NO	CAS SCORE	PAS SCORE	
		1-4	5-8
1	4	3	7
2	5	9	5
3	6	15	2
4.	7	10	o

Table.4: Positive And Negative Predictive Value

Scores	Sensitivity	Specificity	PPV	NPV
>4	93.9%	44.4%	86%	66.6%
>5	69.7%	77.7%	92%	41%
>6	33.3%	100%	100%	28%



Graph 6: CAS Scores Distribution Among The Deferred Patients.

DISCUSSION

Neurotrauma patients are tracheostomised when they have low GCS and are anticipated to have prolonged intubation. This also helps in early weaning off the patient from mechanical ventilation and shortening the ICU stay. The presence of a tracheostomy tube for a long period carries its own disadvantages. Hence it is necessary to decannulate the patient at the earliest, once the reason for the tracheostomy tube is resolved. Hence it is necessary to identify the patient suitable for tracheostomy decannulation early without ending up with Decannulation failure. There are very few standardized Tracheostomy decannulation protocols established to date, all of which have an important component, which is the absence of aspiration. FEES (Functional Endoscopic Evaluation of Swallowing) is the key evaluation tool in determining aspiration. It is therefore important to study the role of FEES in the procedure of tracheostomy decannulation. There have also been certain studies that have been conducted in this regard.

Protocols For Decannulation.

As discussed earlier, Decannulation is an important but complex process as it needs to satisfy various criteria for it to be successful. It requires perfect coordination of the brain, swallowing, coughing phonation and respiratory muscles[7]. Choice of the protocol is important, as the protocol can adequately include most of the criteria and is also able to successfully identify the patients who are not fit for decannulation accurately.

In our study, the decannulation protocol constituted of, Clinical bedside assessment according to ROSS and WHITE[1] and then was followed by FEES, thus including both subjective and objective components for decision making. As a result, post FEES evaluation none of the 35 patients recommended by the FEES needed re-cannulation.

Whereas In a study, Zhang, C. *et al*[10], they had established a 4-step protocol where the first step included confirming the stability of various vitals of the patient such as being weaned from a mechanical ventilator for more than 48 hrs, no MODS and sepsis and haemodynamically stable, the second step involved checking the tolerance to the speaking valve, the third step is to make sure that patient is weaned off from the speaking valve, the final step involved measuring the cough strength using a tool – Peak Cough flow. In this study there was no FEES included in the decannulation protocol, the outcome was 1 patient amongst 57 needed re-intubation.

In a study by Grave. et al[11], the protocol adopted was-Tracheostomy tube occlusion following the downsizing of the tube. It had a failure rate of 20% which is a significant value. Since the study only had one criterion, that is the ability to maintain >90% Pao2 at room air, which attributed to its higher failure rate. Therefore, in our study, we adopted clinical indicators by ROSS and WHITE[1] which cover a wide array of factors followed by video endoscopy in the decision- making of decannulation. Thus, no incidence of the need for tracheostomy recannulation.

Bachet.al[12], had considered the factors such as measurement of peak cough flow, changing to fenestrated TT that can be capped, and nasal IPPV. This study had a failure rate of 32 %, here the patients having higher peak flow >150L/min were successfully decannulated, whereas the one with <160L/min had few decannulations. Choate et.al[8], in their study, considered the factors such as, switching to a cuffless tube, then monitoring the airflow in the upper airway system, and clinical indicators for bedside assessment were from ROSS and WHITE [1], followed by decannulation, it had a failure rate of 5%. In our study, we considered the same factors such as effective cough, spontaneous breathing at room air for >24 hrs, and Absence of serious chest infections. But it was followed by FEES and the decision for decannulation depended on the otorhinolaryngologist based on whether there were any signs of aspiration or any laryngeal structural abnormalities. Out of 35 patients decannulated in our study, none of the patients needed the re-establishment of the artificial airway.

Fibreoptic Endoscopic Evaluation Of Swallowing (FEES)

The FEES is an important diagnostic tool in swallowing disorders, to note the signs of aspiration. According to the American Speech-Language-Hearing Association (ASHA)[13], a clinical-instrumental evaluation of swallowing should reveal: organic and functional alterations in the structures involved, the degree of efficacy of swallowing in its various stages, adequate protection of the lower airways and co-ordination between breathing and swallowing, and

furthermore should detect and possibly quantify any penetration of the bolus in the tracheal- bronchial passage. The FEES has its own advantages and disadvantages, the Advantages being less invasive, the test can be performed bedside, can be repeated, economical, can assess both sensory and motor component can assess stagnation and bolus penetration in the airway. The disadvantage being it can investigate only the Pharyngeal stage of swallowing with no quantification of bolus ingested. A study by Warnecke et.al[14], which was conducted on critically ill neurological patients. Here the patients were clinically assessed and then subjected to video endoscopy to decide on the removal of the tracheostomy tube. Endoscopy was performed successfully in all subjects without any complications. Only one patient needed recannulation due to respiratory problems, resulting in a failure rate of 1.9%. Whereas in our study none of the 35 patients recommended for decannulation by FEES required re-cannulation.

Laryngeal Findings On FEES

In our study, During the FEES, about 31.38% of the patients with laryngeal lesions such as Edematous arytenoids, false cord hypertrophy, impaired vocal cord mobility, vocal cord congestion, false cord hypertrophy. About 7 patients had edematous arytenoids making up 43.75% of the deferred group, similarly, 2 patients were having false cord hypertrophy 12.5% (Table 1), 2 patients were having vocal cord immobility which comprised 12.5% of the decannulation group, 5 patients were found to have vocal cord congestion who made up 31.25% of the deferred decannulation group. A p-value of 0.003 was highly significant, indicating that these laryngeal changes were associated with aspiration.

Similarly, in a study by Ambika R S et al[15], Laryngeal findings during Fiberoptic Endoscopic Evaluation of Swallowing (FEES)were listed as follows- 19 (46.3%) patients had abnormal laryngeal findings and normal laryngeal findings were seen in 22 (53.7%). Of 41 patients studied 12 had congested vocal cords, 4 had congested arytenoids, 3 had arytenoids ulcers, 3 had left vocal cord palsy, 1 had bilateral restricted vocal cord movements, left arytenoids prolapsed, epiglottic edema. Only patients with abnormal laryngeal findings showed aspiration on FEES. The correlation was statistically significant (p = 0.006).

PAS Score Distribution

In our study, we considered the PAS score of 1-4 as non-aspirators and 5-8 were considered as aspirators. Hence, around 36 patients (70.58%) were given a PAS score of 1-4, whereas 15 patients (29.41%) were allotted scores of 5-8. Similarly, in a study by Jin-A Yoon et al[16], constituting 178 participants, penetration and aspiration of the patients were noted in the patients, for which PAS scores were allotted to them. Here the scores ranging from 1-5 were considered as penetration and scores 6-8 were considered to be aspirating. As a result, about 29.21% of the study group was noted with penetration and around 43.25% were noted to have aspiration.

Reasons For Decannulation Failure

From our study, it was observed that not all the patients recommended by the Clinical Assessment of swallowing for decannulation could undergo decannulation. Out of 51 patients recommended for decannulation by Clinical assessment of swallowing, about one-third of the patients – 16, were deferred, by FEES. The most common cause for deferring was signs of Aspiration on video endoscopy. Amongst these 16 deferred patients,7 of them were noted to have anatomical lesions such as oedematous arytenoids and bulky arytenoids, 5 had vocal cord congestion, 2 had false cord hypertrophy, and 2 had impaired vocal cord movement. The patients with bulky and oedematous arytenoids were majorly having a prolonged Ryle's tube history.

It was also observed that, in the case of Clinical Assessment of swallowing, if a low score threshold is set as the margin for decannulation recommendation, the chances of a number of patients being recommended increases (sensitivity) but at the same time more patients will be under the risk of getting decannulation failure/ deferred. Wherein if the threshold for the Clinical assessment of swallowing is kept higher, especially in neurotrauma patients, the chances of a number of patients with decannulation become minimal but many patients with potential for decannulation would be left out and would bear the consequence of prolonged tracheostomisation. Thus, strengthening the fact that FEES has a valuable role in decannulation protocol.

Need For Recannulation

Another study by Warnecke et al[14], comprised 100 tracheostomised neurotrauma patients in a neuro intensive care unit, which had considered Clinical assessment of swallowing followed by FEES. The study had a 1.9% failure rate. In our study, we adopted a similar scoring system for CAS with scores from 1-7. The patients with a score of 4 or >4 were considered to be fit for decannulation. These were then subjected to FEES after which the patients were decannulated. A total of 35(68.62%) patients were decannulated. There was no incidence of any need for recannulation amongst these patients.

Overall summarizing the study, the FEES has shown its important role in ways such as identifying the silent aspirators, and laryngeal anatomical lesions and avoiding the Decannulation failure rates and also avoiding the risk of postponing decannulation in False positives following CAS.

CONCLUSION

Fibreoptic endoscopic evaluation of swallowing (FEES) objectively identifies silent aspirators who otherwise would have been missed during clinical evaluation, especially in neurotrauma patients. These 16 deferred patients were also identified with one or the other laryngeal pathologies such as Edematous and Bulky arytenoids, Vocal cord immobility and False cord hypertrophy which would have contributed to silent aspiration of these patients.Therefore FEES plays an important Role in Tracheostomy decannulation of the Neurotrauma patients.

LIMITATIONS

In our study, the severity and the location of the neurotrauma were not considered specifically for the assessment of the swallowing. Because the patient with neurotrauma in specific areas for coordinated swallowing in the cortex would have played a role in deferring the decannulation in these patients.

SUMMARY

This prospective study was conducted in the department of Otorhinolaryngology, SSIMS and RC, Davangere from December 2020 to December 2022, which is a tertiary care hospital. A total of 51 patients who fulfilled the inclusion and exclusion criteria were enrolled on the study.

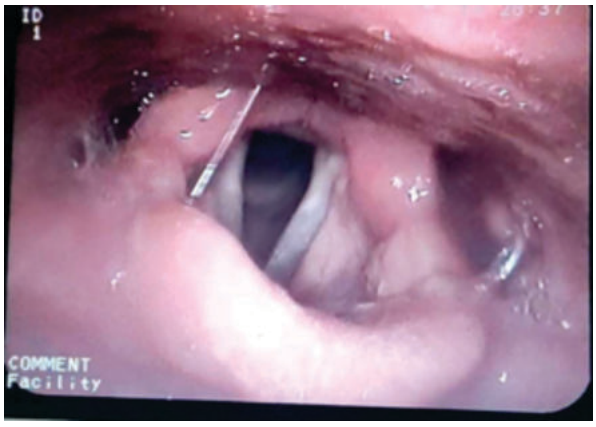
All patients were initially subjected to bedside Clinical Assessment for Swallowing and were given scores accordingly. The scoring system was adopted from ROSS AND WHITE[1] where scores were given from 1 to 7. Here a score of 4 or more was considered for a recommendation of decannulation by CAS. Amongst the 51 recommended patients: the patients with a score of 4 were 10 (19.6%), patients allotted with a score of 5 were 14 (27.4%), whereas with a score of 6 were 17 (33.33%) and with CAS score of 7 were about 10 (19.7%). The patient who was recommended for tracheostomy decannulation by Clinical Assessment of Swallowing was then taken up for FEES. Based on the video endoscopic findings, there were about 16 patients who were found to have laryngeal lesions such as Bulky arytenoids 7 (43.75%), Vocal fold congestion 5 (31.25%), 2 with vocal cord immobility (12.5%) and 2 (12.5%) more with false cord hypertrophy and based on Penetration Aspiration Scale[2] by Rosenbek, 15 of the 16 deferred patients were found to be silent aspirators. The patients who did not show any signs of aspiration and who did not have any laryngeal lesions were considered fit for decannulation and were decannulated.

The patients included in the study had a varying range of neurotrauma, among the deferred patients, 6(37.5%) patients had a subdural hematoma, 3(18.75%) patients had Subarachnoid hematoma, 4 (25%) patients had capsuloganglionic bleed, 2 (12.5%) patients had Diffuse Axonal injury, whereas 1(6.25%) had Cerebrovascular accident. Among the 51 patients which were recommended by the Clinical Assessment of Swallowing for the Decannulation, 35 of the patients were actually decannulated and 16 patients have deferred Decannulation. This implied that about 31.38% (one-third) of the patient in the study group were not fit for Decannulation despite being given clearance by the Clinical Assessment of Swallowing.

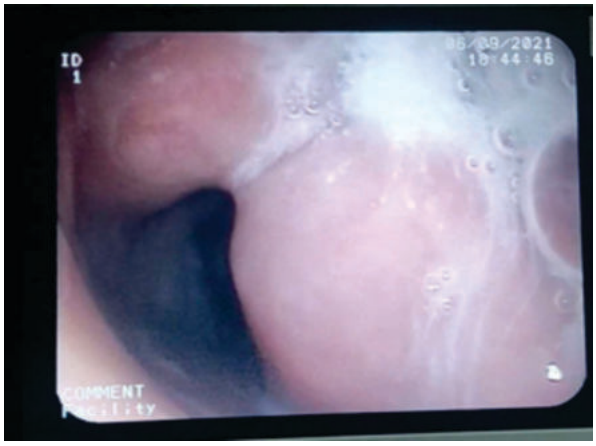
All the 35 patients recommended by the FEES for the decannulation were successfully decannulated without any single case of Decannulation failure or Recannulation.

Overall, the FEES played an important role in the process of

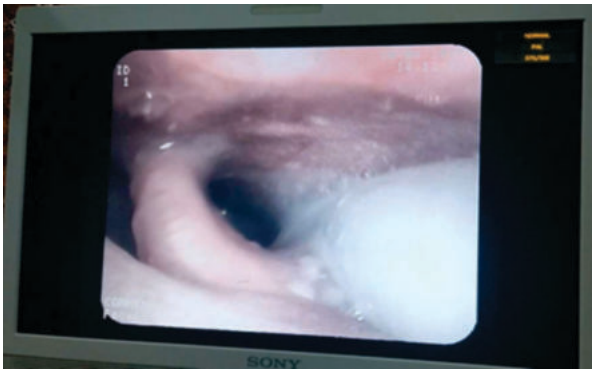
Tracheostomy decannulation of neurotrauma patients and hence is a solid tool in the assessment of swallowing and decannulation. Thus, it is the safe and more efficient tool for deciding Tracheostomy decannulation over mere Clinical assessment of swallowing alone.



Normal Laryngeal Findings.

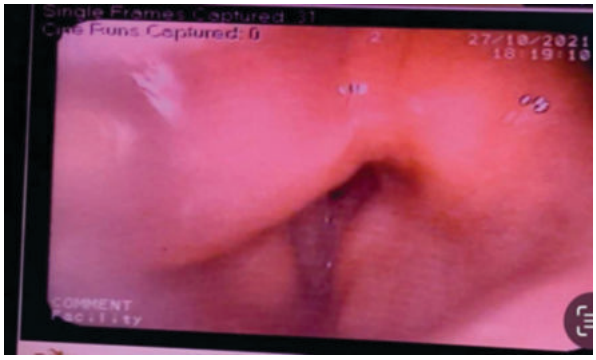


Still Image Of FEES During Milk Feed.



Still Image Of FEES During Porridge Feed.

Still Image Showing Edematous Arytenoids (Left)



False cord Hypertrophy.

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