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Research Article

Proposed Tracheostomy Decannulation Protocol in Patients with Airway Secretions

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Abstract

Background: Airway secretions are one of the prognostic predictors of prolonged tracheostomy. Removal of a tracheostomy tube or decannulation, is deferred and postponed in patients with airway secretions. Here, we evaluate safety and effectiveness of a proposed decannulation protocol in patients with airway secretions and sought to identify the success and failure of decannulation.

Methods: A prospective clinical study was conducted in Deenanath Mangeshkar Hospital, Pune between April 2024 and February 2025. 20 tracheostomised patients with secretions 2 or higher in Murray's scale, were included in the study and decannulation was attempted by the proposed protocol. The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS ver22.0, IBM Corporation, USA) for MS Windows.

Results: Out of 12 cases with Murray secretion scale 2, all 12 cases (100.0%) had successful decannulation. Out of 8 cases with Murray secretion scale 3, 7 cases (87.5%) had had successful decannulation and only 1 case (12.5%) had failed decannulation. The incidence of failed deccanulation did not differ significantly across two severity scales of secretions, as measured by the Murray Secretion Scale (MSS) (P-value>0.05). The severity of secretions, as measured by the Murray Secretion Scale (MSS), does not have a statistically significant association with either the duration of tracheostomy or the incidence of failed decannulation (P-value>0.05 for both).

Conclusions: The proposed decannulation protocol is safe and efficient for tracheostomised patients with airway secretions, provided the rest of the airway is normal, the patient has good laryngeal adductor reflex and has the ability to effectively swallow and clear thin liquids on FEES. It reduces the duration of tracheostomy and relieves the burden of tracheostomy on the patient and the caretakers.

Keywords: Tracheostomy; Airway Secretions; Protocol

Introduction

Tracheostomy is an opening surgically created through the neck into the trachea for ventilation and for providing a safe airway. Most of the tracheostomies performed, are temporary and eventually removed. Decannulation is the removal of tracheostomy tube once the inciting factor or indication has been tackled. To be eligible for decannulation, the patient should have reasonable neurological status, with good swallowing function, adequate and safe airway with satisfactory pulmonary function [1]. Some of the patients indicated for tracheostomy, have synchronous swallowing dysfunction. They have co existing increased laryngeal secretions, decreased laryngeal sensitivity and dysphagia causing premature spillage and/or pharyngeal residues resulting in aspiration. Chronic aspiration can lead to pneumonia or respiratory failure through chronic pulmonary emphysematous disease or bronchiectasis. Hence in the algorithm of decannulation protocol, swallowing assessment is routinely done. For patients who demonstrate penetration and aspiration in FEES (Fibreoptic Endoscopic Evaluation of Swallowing), the decannulation protocol is deferred until a few

sessions of swallowing therapy and there is complete clearance on FEES on a later date [2]. Nasogastric tube insertion can counteract and deal with certain aspects of dysphagia. Sometimes it might not be sufficient to divert the feeding through nasogastric tube, as some of these patients persistently fail to handle their saliva and secretions. There is, however, paucity of literature regarding decannulation protocols for patients with airway secretions.

Having a tracheostomy insitu in a neurologically impaired patient, is a Herculean task for the patient's caretakers. They are under constant fear of the tube block and some of them were revolted by tube care and tube change. The family must struggle and go through these difficulties, which are major issues. Hence safe and early decannulation protocol facilitates an early relief from the burden of tracheostomy for the patient and their family.

Presently, airway secretions are a major hurdle in decannulation, prolonging the duration of tracheostomy. We propose a decannulation protocol to change the idea.

Materials and Methods

The primary objective of this clinical study is to formulate a decannulation protocol for patients on temporary tracheostomy, for non-obstructive indications, with airway secretions. Can patient with persistent airway secretions decannulated?

Study subjects

Tracheostomised patients with Murray secretion scale [3] 2 or higher on endoscopic examination were included in the study (Table 1).

MSS ratings	Description
0	Most normal rating. No visible secretions anywhere in the hypopharynx or some transient bubbles visible in the valleculae and pyriform sinuses. These secretions were not bilateral or deeply pooled.
1	Any secretions evident upon entry or following a dry swallow in the channels surrounding the laryngeal vestibule that were bilaterally represented or deeply pooled. This rating would include cases where there is a transition in the accumulation of secretions during the observation segment. A subject could start with no visible secretions but accumulate secretions in an amount great enough to be bilaterally represented or deeply pooled. Likewise, a subject would be rated as a "1" if initially presenting with deeply pooled bilateral secretions and ending the observation segment with no visible secretions.
2	Any secretions that changed from a "1" rating to a "3" rating during the observation period.
3	Most severe rating. Any secretions seen in the area defined as the laryngeal vestibule. Pulmonary secretions were included if they were not cleared by swallowing or coughing at the close of the segment

Table 1: Murray's Secretion Scale (MSS).

Inclusion criteria

- Presence of Secretions – Murray's scale 2 and 3
- Laryngeal Adductor reflex - present
- FEES – Able to swallow and clear thin liquids (IDDSI – 0)
- Rest of the airway is normal with no pulmonary pathology

Decannulation protocol

The parameters recorded include demographic details (age and gender), indication of tracheostomy and duration of tracheostomy. FEES was performed, reviewed and scored by the same otolaryngologist specialized in deglutogy. The flexible nasopharyngolaryngoscope was inserted into the nostril, after decongesting with nasal drops, and negotiated along the nasal floor through the velopharynx. The endoscope's tip was advanced into the oropharynx to observe the secretions. Laryngeal sensation was tested by gently touching the aryepiglottic region with the endoscope's tip. The arytenoids, having a great sensory supply [4], once touched with the tip of the scope cause adduction of vocal cords. Once contact is made, the endoscope was partially retracted to view the presence or absence of the LAR. Swallowing function was assessed using a standardized set of liquid and solid food trials. Patients were administered the following bolus consistencies to swallow: 1) 5 mL of green – coloured thin water; 2) 5 mL of green – coloured milk; 3) 5 mL blue-coloured puree consistency. All food/liquids were delivered using a spoon placed on the tongue's anterior half. When patients could not deliver food/liquid because of an inefficient oral phase, the food/liquid was placed with spoon at the back of the tongue. If inability to clear or aspiration was noted on any bolus, the second trial of that consistency (larger volume) was not given. The Patient should be able to swallow and clear thin liquids (IDDSI - 0) to be included in the study. The secretions were rated according to Murray's secretion scale. Patients with Level 2 and 3 in

the secretion scale were included in the study. Figure 1 shows the proposed decannulation protocol. Figure 2 a&b shows secretions in the Laryngeal vestibule going below the cords, secretions in Hypopharynx and laryngeal vestibule were depicted in c&d.

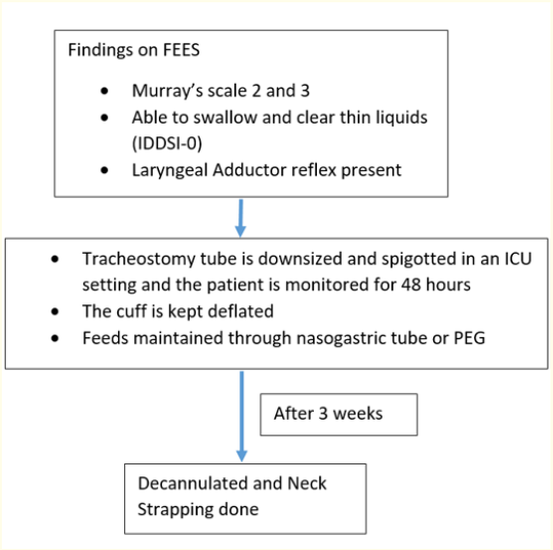

Figure 1: Proposed Decannulation Protocol of the study.

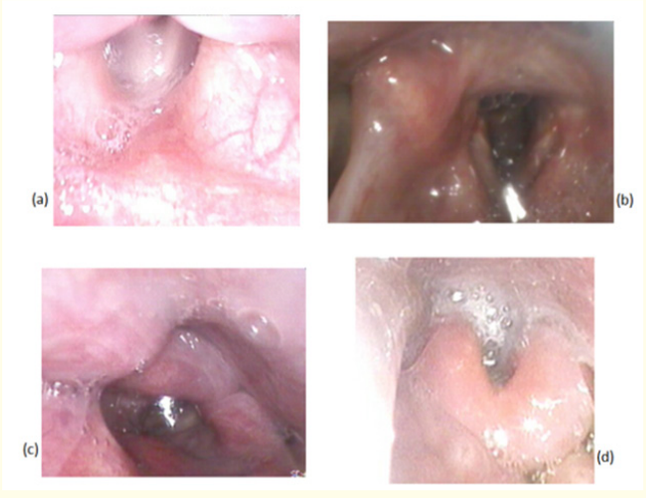

Figure 2: Secretions observed in (a&b) Laryngeal vestibule going below the cords (c&d) Hypopharynx and laryngeal vestibule during Fibreoptic Endoscopic Evaluation of Swallowing.

Statistical analysis

The data on categorical variables is shown as n (% of cases) and the data on normally distributed continuous variables is presented as mean and standard deviation (SD). The inter-group statistical comparison of distribution of categorical variables is tested using Chi-Square test or Fisher's exact probability test if more than 20% cells have expected frequency less than 5. In the entire study, p-values less than 0.05 are considered to be statistically significant. The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS version 22.0, IBM Corporation, USA) for MS Windows.

Results

Table 2 shows the demographic and clinical characteristics of cases studied (n = 20).

The mean age of the patients was 52.10 ± 15.75 years, ranging from 13 to 79 years. The majority of patients (60.0%) were between 51-70 years old. There were 13 male patients (65.0%) and 7 female patients (35.0%).

The primary indications for tracheostomy were stroke (50.0%), followed by traumatic brain injury (20.0%), then followed by infections and inflammatory conditions (5.0%), and then by tumors and vascular malformations (10.0%), and other conditions (15.0%).

The duration of tracheostomy was less than 6 months for 15 patients (75.0%) and 6 months or more for 5 patients (25.0%), with a mean duration of 3.50 ± 2.21 months with range of duration being 1 – 8 months.

The severity of secretions, as measured by the Murray Secretion Scale (MSS), was categorized as MSS MSS 2 (60.0%), and MSS 3 (40.0%). All 20 patients (100%) had good laryngeal adductor reflex, and all 20 patients (100%) had a Fibreoptic Endoscopic Evaluation of Swallowing (FEES) IDDSI Level 0, indicating they could swallow, clear thin liquids without penetration and aspiration.

The success rate of decannulation was 95.0%, with 19 patients (95.0%) successfully decannulated and 1 patient (5.0%) experienced failure.

Different Factors	Parameters	No. of cases	% of cases
Age group (years)	<18	1	5.0
	18 – 30	1	5.0
	31 – 50	5	25.0
	51 – 70	12	60.0
	>70	1	5.0
	Mean ± SD Min – Max	52.10 ± 15.75 13 – 79	
Sex	Male	13	65.0
	Female	7	35.0
Indications of tracheostomy	Stroke	10	50.0
	Traumatic brain injury	4	20.0
	Infections and inflammatory conditions	1	5.0
	Tumours and vascular malformations	2	10.0
	Others	3	15.0
Duration of tracheostomy (months)	<6	15	75.0
	≥6	5	25.0
	Mean ± SD Min – Max	3.50 ± 2.21 1 – 8	
Severity of secretion by Murray secretion scale (MSS)	2	12	60.0
	3	8	40.0
Laryngeal adductor reflex	Present	20	100.0
Fibreoptic Endoscopic Evaluation of Swallowing (FEES)	IDDSI Level 0 (Could swallow and clear thin liquids)	20	100.0
Success of decannulation	Success	19	95.0
	Failure	1	5.0

Table 2: Distribution of age, sex, indications & duration of tracheostomy, MSS scores and FEES results of participants (N=20).

		Severity of secretion by Murray secretion scale (MSS)						
		2 (n = 12)		3 (n = 8)		Total (n = 20)		
		n	%	n	%	n	%	P-value
Duration of tracheostomy (months)	<6	9	75.0	6	75.0	15	75.0	0.999^{NS}
	≥6	3	25.0	2	25.0	5	25.0	
Success of decannulation	Success	12	100.0	7	87.5	19	95.0	0.400^{NS}
	Failure	0	0.0	1	12.5	1	5.0	
P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. NS – Statistically non-significant.								

Table 3: Results of Chi-Square test for the association between (i) duration of tracheostomy and Murray secretion scores; (ii) association between Success of decannulation and Murray secretion scores.

Table 3 presents the statistical association of duration of tracheostomy and incidence of success of decannulation with Severity of secretion by Murray secretion scale (MSS).

Out of 12 cases with Murray secretion score of 2, 9 (75.0%) had duration of tracheostomy below 6 month and 3 (25.0%) had duration more than or equal to 6 months. Out of 8 cases with Murray

secretion score of 3, 6 (75.0%) had duration of tracheostomy below 6 month and 2 (25.0%) had duration more than or equal to 6 months. The severity of secretions, as measured by the Murray Secretion Scale (MSS), does not have a statistically significant association with duration of tracheostomy (P-value>0.05).

Out of 12 cases with Murray secretion score of 2, all 12 cases (100.0%) had successful decannulation. Out of 8 cases with Murray secretion score of 3, 7 cases (87.5%) had had successful decannulation and only 1 case (12.5%) had failed decannulation. The incidence of failed decannulation did not differ significantly across three severity scales of secretions, as measured by *the* Murray Secretion Scale (MSS) (P-value>0.05).

The severity of secretions, as measured by the Murray Secretion Scale (MSS), does not have a statistically significant association with either the duration of tracheostomy or the incidence of failed decannulation (P-value>0.05 for both).

S. No.	Age and Gender	Indication of tracheostomy	Duration of tracheostomy	Murray's secretion scale	Laryngeal adductor reflex	FEES IDDSI Level 0	Decannulation status
	56/ M	Lateral Medullary Syndrome	6 months	**2**	Present	Could swallow and clear thin liquids	Decannulated
2	41/M	Left MCA infarct, Post decompression	1 month	**2**	Present	Could swallow and clear thin liquids	Decannulated
3.	43y/M	Pontine bleed with accelerated hypertension	1 month	**2**	Present	Could swallow and clear thin liquids	Decannulated
4.	63y/M	Gangliocapsular bleed	5 months	2	Present	Could swallow and clear thin liquids	Decannulated
5.	31y/M	RTA – Diffuse axonal injury with brain injury	3 months	**2**	Present	Could swallow and clear thin liquids	Decannulated
6.	61y/M	RTA – Subdural hemorrhage	3 months	**3**	Present	Could swallow and clear thin liquids	Decannulated
7.	79y/M	Acute Right parenchymal bleed, Cerebral venous sinus thrombosis	1 month	**2**	Present	Could swallow and clear thin liquids	Decannulated
8.	55y/M	Gangliocapsular bleed	2 months	**3**	Present	Could swallow and clear thin liquids	Decannulated
9.	69y/F	Disseminated tuberculosis	4 months	**2**	Present	Could swallow and clear thin liquids	Decannulated
10.	54y/M	Left retromastoid craniotomy with excision of Left Petroclival Meningioma	1 month	**2**	Present	Could swallow and clear thin liquids	Decannulated
11.	42y/M	Left MCA infarct with hemorrhagic transformation. Post Left Fronto- Temporo _ Parietal Decompressive craniectomy	2 months	**2**	Present	Could swallow and clear thin liquids	Decannulated
12.	13y/F	Brainstem AV malformation , Pneumococcal meningoencephalitis	5 months	**3**	Present	Could swallow and clear thin liquids	Decannulated
13.	65y/M	Status epilepticus with IHD	6 months	2	Present	Could swallow and clear thin liquids	Decannulated
14.	69y/M	Left parietal intracerebral hemorrhage with residual Right hemiparesis and aspiration pneumonia	2 months	**2**	Present	Could swallow and clear thin liquids	Decannulated

15.	44y/f	Traumatic brain injury. Post decompression hemicraniectomy Right MCA unfarct with right cerebellar infarct.	2 months	**3**	Present	Could swallow and clear thin liquids	Decannulated
16.	59/M	Miller Fisher GBS	1 month	**3**	Present	Could swallow and clear thin liquids	Decannulated
17.	51/f	Intracranial bleed with vp shunt *insitu*	8 months	**3**	Present	Could swallow and clear thin liquids	Decannulated
18.	64y/f	Left intracranial bleed. Postemergency posterior fossa decompression	5 months	3	Present	Could swallow and clear thin liquids	Failed decannulation
19.	30y/f	Posterior circulation stroke	6months	3	present	Could swallow and clear thin liquids	Decannulated
20.	53/ f	Cardiogenic shock , hypoxix brain injury	6months	2	present	Could swallow and clear thin liquids	Decannulated

Table 4

Discussion

The term "Decannulation" refers to the process of weaning which involves removal of tracheostomy tube and maintaining spontaneous respiration with airway protection.

For objective evaluation prior to decannulation, Standardized Endoscopic Swallowing Evaluation for Tracheostomy Decannulation in Critically Ill Neurologic Patients (SESETD) was introduced in 2013. It is a stepwise evaluation of secretion management, spontaneous swallows and laryngeal sensitivity/cough. The first step is evaluation of secretions. The failure criteria for 'saliva management' are massive pooling (not only coating) causing an impaired view on the vocal folds and/or silent penetration and/or aspiration of pooled saliva (permanently without any reaction) [5]. In such patients, decannulation is deferred to protect the airway from increased risk of aspiration and to bridge the time for swallowing rehabilitation [6]. Though decannulation is deferred in view of aspiration of secretions, it can be speculated that tracheostomy tube by itself can be the reason for it. The prolonged presence of the tube results in desensitisation, stasis of secretions, in coordinated glottic closure, poor cough strength, aspiration risk [7].

One of the physiological mechanisms to ensure a safe airway is the laryngeal adductor reflex. It is a protective brainstem reflex which causes the vocal folds to adduct in response to mechanical or chemical stimulation, protecting the lower airway. It is triggered by the stimulation of superior laryngeal nerve through the laryngeal mechanoreceptors and chemoreceptors [8]. How ever with repeated stimulation with inter-stimulus intervals of less than 2 s there is conditioning of the response [9]. Tracheostomy has a marked effect on the upper airway especially the protective functions of the glottis. Sasaki., *et al*. concluded that prolonged tracheostomy causes central reorganization of the neural pathway of the laryngeal adductor reflex. It increases the latency of the response. Increased secretions in the laryngeal vestibule causes constant stimulation of the superior laryngeal nerve, thereby weakening laryngeal adductor response with reduced strength of glottis closure and the closure is not sustained [10]. This reduction in laryngeal sensitivity culminates in aspiration.

Tracheostomy tube by itself increases the tracheal secretions due its presence in the trachea and also due to the unhumidified, dry air entering the trachea bypassing the nose. The effectiveness of cough is reduced due to the inability to generate sufficient subglottic pressure. This leads to a vicious cycle of repeated suctioning, stimulation of lower airway, increased secretions, tracheal granulations and a whole spectrum of conditions that are difficult for the patient, care takers and for the doctors to manage.

Though the standardised protocols [1,2,11] are there for decannulation, the existing protocols conclude severe secretion retention (MSS level 3) is a good predictor of prolonged tracheostomy [12].

The decannulation was done in a very short period where decannulation was attempted 48 hours after spigotting. Sufficient time was not given for the larynx to adapt to the normal physiology. We prefer to gradually return airflow to the upper airway and restore the physiological functions. Downsizing the tube enables sufficient air flow to permit the external tracheostomy to be capped-off or "corked" and facilitates speech [13]. Downsizing the tracheostomy tube was done in the ICU set up and the patient was monitored for 48 hours. The cuff is deflated to enable the patient to cough effectively. The patient were not subjected to oral challenges and feeding was continued with nasogastric tube or PEG. In the 3 weeks of this trial, the warm humidified air reaches the larynx, the mucociliary clearance returns to normal, the secretions reduce, laryngeal sensitivity improves and the patient learns to manage and clear the secretions. In case of inability to manage secretions, the secretion management can be done through the tracheostomy tube. 6 patients required occasional tracheal toileting through the tracheostomy tube in the first week. After 3 weeks, decannulation was done followed by neck strapping. Out of 12 cases with Murray secretion score of 2, all 12 cases (100.0%) had successful decannulation. Out of 8 cases with Murray secretion score of 3, 7 cases (87.5%) had had successful decannulation. Only 1 case (12.5%) had failed decannulation. The patient couldn't tolerate downsizing and spigotting trial and had to be recannulated. On follow up scopy after 3 weeks, post decannulation all our patients had either no airway secretions or a Murray scale score 1.

Conclusion

Prolonged tracheostomy has its own spectrum of cons that goes unnoticed. Most of the time, is because of the overzealous effort and fear to maintain a safe airway. Our study reveals that, airway secretions in tracheostomised patients does not impede decannulation, provided, there is no abnormality in the rest of the airway, the patient has good laryngeal adductor reflex and has the ability to effectively swallow and clear thin liquids on FEES. This could facilitate reduction in the duration of being tracheostomised, increased decannulation rates and significant improvement in the quality of life of tracheostomised patients.

Compliance with Ethical Standards

The authors declare no competing or conflicting interests. The research involved no animal procedures. Informed consent was obtained from all participants prior to their involvement in the study.

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