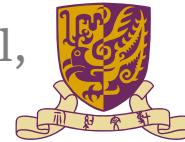


Predictive Factors of Difficult Tracheostomy Weaning and Neurological and Hospital Outcomes of Neurosurgical Patients

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Introduction

Tracheostomy is commonly performed on neurosurgical patients who had prolonged intubation due to poor neurological recovery [1] [2]. Timing of tracheostomy, outcome difference between early and late tracheostomy have been studied for many years [3], [4], [5]. However, there were limited studies about weaning tracheostomy.

Objectives

1. To investigate factors related to difficult tracheostomy weaning; and
2. To evaluate outcomes of tracheostomized neurosurgical patients

Methods

Study population

- All tracheostomized neurosurgical patients in Prince of Wales Hospital , Hong Kong between 1st September 2016 and 31st August 2019 were reviewed retrospectively.
- Patients who had been followed up for less than one year, with history of nasopharyngeal carcinoma (NPC) or with high cervical cord trauma were excluded.
- Easy weaning is defined as tracheostomy successfully weaned within 3 months, and difficult weaning is defined as inability to have tracheostomy successfully weaned within 3 months.

Included Parameters

- Factors such as age, gender, Glasgow Coma Score (GCS) and pupil size on admission, disease entity, neurosurgical intervention done, timing of tracheostomy done, past medical history of pulmonary diseases, cardiovascular diseases, smoking status, post-tracheostomy vocal cord status, and pneumonia with positive sputum culture within one month after tracheostomy were included for analyses.
- Neurological and hospital outcomes were assessed by Glasgow Outcome Score (GOS) at 6 months and 1 year, length of in-patient stay, GCS upon discharge, mobility upon discharge, and destination after discharge.

Data analyses

- Data were analysed by IBM SPSS Statistics Version 25 (Armonk, NYI, USA), using by Chi Square test, Fisher Exact Test, Independent Samples T-test, and Mann Whitney U Test as appropriate. Multivariable logistic regressions were carried out by Enter Method. Statistical significance was taken at $p < 0.05$.
- Numerical data were expressed as mean \pm standard deviation SD
- Categorical data were expressed as median (Lower quarter Q1, Upper quarter Q3, Interquartile range IQR) and number (percentage).

Results

One hundred and thirty-one patients were included in our study. Fifty-three (41%) patients were considered as difficult weaning. (Fig.1)

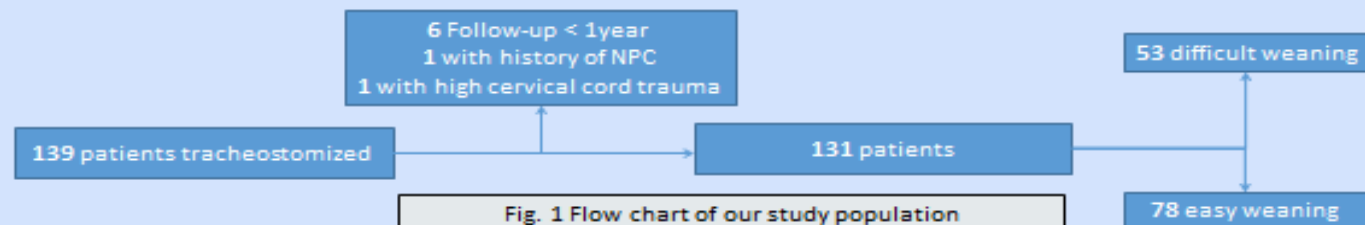


Fig. 1 Flow chart of our study population

In univariate analysis, male gender ($p=0.019$), GCS <8 on admission ($p=0.017$), vocal cord palsy at 3 months ($p<0.001$), and pneumonia at 1 month ($p<0.001$) were associated with difficult weaning.

In multivariable logistic regression for difficult weaning, GCS <8 on admission ($p=0.016$), vocal cord palsy at 3 months ($p<0.001$), and the presence of pneumonia at 1 month ($p=0.001$) remained statistically significant. (Table 1)

Predictive factors	No.	Easy weaning	Difficult weaning	Univariate analysis p value	Multivariate analysis p value
Total number	131	78 (60%)	53 (40%)		
Age	59±11	60±10	61±13	0.938	
Male	78 (60%)	40 (51%)	38 (72%)	0.019	0.106
GCS on admission	9 (Q1: 7, Q3: 14, IQR: 7)	11 (Q1: 5, Q3: 14, IQR: 6)	8 (Q1: 5, Q3: 13, IQR: 8)		
GCS <8 on admission	41 (31%)	19 (24%)	22 (42%)	0.017	0.016
Pupil size on admission (mm)	3±1	3±1	3±1	0.681	
Disease entity				0.476	
Stroke-related	97 (74%)	56 (72%)	41 (77%)		
Trauma	34 (26%)	22 (28%)	12 (23%)		
NS intervention					
Conservative	4 (3%)	1 (1%)	3 (5%)	0.153	
Burr hole	42 (32%)	24 (31%)	18 (34%)	0.701	
Craniotomy	37 (28%)	25 (32%)	12 (23%)	0.240	
Craniectomy	48 (37%)	28 (36%)	20 (38%)	0.830	
Timing of Tracheostomy (days)	8±4	8±4	8±4	0.976	
Co-morbidities					
Pulmonary disease	7 (5%)	5 (6%)	2 (4%)	0.51	
Cardiovascular disease	96 (73%)	56 (72%)	40 (75%)	0.641	
Smoker	54 (41%)	28 (36%)	26 (49%)	0.133	
Post tracheostomy					
VC palsy at 3 months	12 (8%)	1 (1%)	11 (21%)	<0.001	<0.001
Pneumonia within 1 month	94 (72%)	46 (59%)	48 (90%)	<0.001	0.001

Table 1. Tracheostomized neurosurgical patient profile

Easy weaning group had shorter length of in-patient stay (Median: 130, 91-211, IQR: 120 days vs Median: 279, 210-929, IQR: 719 days), significantly higher survival rate (95% vs 36%; $p < 0.001$), and more favourable neurological outcome (GOS 4 to 5) than difficult weaning group at both 6 months and 1 year ($p < 0.001$).

Amongst survivors, GCS upon discharge was significantly higher in easy weaning group (Median: 15, 13-15, IQR: 2) as compared to difficult weaning group (Median: 11, 8-15, IQR: 7; $p < 0.001$). Majority of easy weaning group patients (54%) were discharged to home, while majority of difficult weaning group (42%) of patients were discharged to infirmary. (Table 2)

Outcome	No.	Easy weaning	Difficult weaning	p value
GOS at 6 month	3 (Q1:2, Q3:3, IQR 1)	3 (Q1: 3, Q3: 4, IQR: 1)	2 (Q1: 1, Q3: 3, IQR: 2)	<0.001
4-5 vs 1-3	27 (21%) vs 104 (79%)	25 (32%) vs 53 (68%)	2 (4%) vs 51 (96%)	<0.001
GOS at 1 year	3 (Q1:1, Q3:3, IQR 2)	3 (Q1: 3, Q3: 5, IQR: 2)	1 (Q1: 1, Q3: 3, IQR: 2)	<0.001
4-5 vs 1-3	32 (24%) vs 99(76%)	29 (37%) vs 49 (63%)	3 (6%) vs 50 (94%)	<0.001
Total LOS (days)	159 (Q1: 100, Q3: 249, IQR: 149)	130 (Q1: 91, Q3: 211, IQR: 120)	279 (Q1: 210, Q3: 929, IQR: 719)	0.211
Survivors before discharge	93 (71%)	74 (95%)	19 (36%)	<0.001
GCS on discharge (survivors)	13 (Q1:12, Q3:15, IQR 3)	15 (Q1:13, Q3:15, IQR 2)	11 (Q1:8, Q3:15, IQR 7)	<0.001
Mobility on discharge (survivors)				
Unaid	18 (19%)	18 (25%)	0 (0%)	0.017
Walking aids	20 (22%)	15 (20%)	5 (26%)	0.567
Bed-/Chair-bound	55 (59%)	41 (55%)	14 (74%)	0.148
Destination on discharge (survivors)				
Home	47 (50%)	40 (54%)	7 (37%)	0.181
OAH	35 (38%)	31 (42%)	4 (21%)	0.094
Infirm	11 (12%)	3 (4%)	8 (42%)	<0.001

Table 2. Outcomes of tracheostomized neurosurgical patients

Limitations

- Single center study
- Relatively short study period: 3-year
- Potential missing data during retrospective data mining

Discussion

This study suggested GCS less than 8 on admission, vocal cord palsy at 3 months, and the presence of pneumonia within one month post-tracheostomy were associated with difficult weaning in tracheostomized neurosurgical patients.

Future studies on investigating the role of prevention of pneumonia by vigorous chest physiotherapy and prophylactic antibiotics in tracheostomy weaning would be warranted.

Conclusion

Difficult weaning is associated with poor neurological and hospital outcomes.

The above data could also provide some reference data to discuss with patient's family for the expectations after tracheostomy in neurosurgical patients.

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