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Study of tracheostomized patients in Intensive Care Unit

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Abstract

***Objectives*: To describe the short-term and long-term outcomes of tracheostomized Intensive Care Unit (ICU) patients and to identify any predictors of complications during and after the tracheostomy procedure.**

***Design*: A retrospective and prospective, observational case series performed in a general medical-surgical adult ICU in a regional hospital in Hong Kong.**

***Results*: A total of 153 patients were recruited. The most common indication for tracheostomy was prolonged mechanical ventilation (72.6%), followed by failure of extubation (15%). Surgical tracheostomy was the predominant method used (73.9%). There were no statistically significant differences between surgical and percutaneous tracheostomy on the complication rate. Minor bleeding was the most common short-term complication (10.5%) and tracheal stenosis was the most common long-term complication (5.1%). Hypertension (adjusted odds ratio 5.28, 95% CI 1.05-26.51, p=0.044) and chronic renal failure (CRF) (adjusted odds ratio 17.56, 95% CI 2.87-107.42, p=0.002) were independent risk factors for minor bleeding; while the need to reintubate within 48 hours after extubation (adjusted odds ratio 10.5, 95% CI 1.30-84.88, p=0.027) was an independent risk factor for tracheal stenosis. CRF was independently associated with composite complications (minor bleeding and tracheal stenosis; adjusted odds ratio 13.63, 95% CI of 2.47-75.16, p=0.003). Mental health score at 1 year or more was generally better than physical health score in this cohort of patients.**

***Conclusion*: This study described the outcome, complications with associated predictors in tracheostomized ICU patients in Chinese population. Further larger trials are required to confirm the findings.**

Key words: Intensive care, tracheostomy, complications.

Introduction

Tracheostomy is a common procedure performed in the critical care setting. In patients requiring mechanical ventilation, tracheostomy has the role of facilitating airway management. Firstly, tracheostomy can avoid complications of translaryngeal intubation, such as laryngeal edema. Secondly, tracheostomy can facilitate nursing care and decrease the risk of cannula displacement. Thirdly, tracheostomy can improve patient comfort, allowing patient to speak and to feed orally.

According to a French study including 152 Intensive Care Units (ICUs), a median of 7.2% of mechanically ventilated patients had undergone tracheostomies. (1) The most frequently reported indications for tracheostomy were prolonged mechanical ventilation and failure of extubation. Surgical techniques largely remained the preferred technique compared to percutaneous method in this study, however percutaneous technique has gained its popularity

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in recent years. The development of bedside percutaneous tracheostomy has obviated the need for transporting patient to the operating theatre, thus reducing the risks during transfer of critically ill patients.

Past studies on tracheostomized patients were mostly focused on Caucasian populations. In the present study, the performance of tracheostomy in Chinese patients was investigated with a retrospective and prospective observational case series, which was conducted in the ICU of a regional hospital in Hong Kong. The primary objective of this study was to describe the short-term and long-term outcomes of tracheostomized ICU patients. The secondary objective was to identify any predictors of complications during and after the tracheostomy procedure.

Patients and Methods

A retrospective and prospective observational case series was conducted in a tertiary care center. The mixed surgical-medical ICU is a 22-bed closed ICU providing critical care services except for burns and cardiothoracic surgical support.

Medical records from July 2008 to December 2009 were reviewed in the retrospective part. Data were collected prospectively from July 2010 to June 2011. Two study periods were chosen because we would like to study the functional outcome of patients at 1 year or more after discharge during the retrospective part; and would like to study the intra-procedural complications during the prospective part. The inclusion criteria were patients aged 18 years or above and had tracheostomy performed during the ICU stay in the above periods and those immediate post-operative cases. Patients who already had tracheostomy upon current ICU admission would be excluded from the study.

The baseline characteristics of patients were recorded. The duration of intubation, indication for tracheostomy and method of tracheostomy were also recorded. Concerning complications associated with tracheostomy, intra-procedural complications were recorded in the prospective study; short-term complications were recorded in both periods; and long-term complications were retrieved from retrospective part.

ICU and hospital mortality, ICU and hospital length of stay (LOS), status during ICU and hospital discharge and discharge destination were recorded. Functional outcome was assessed among those discharged patients from the retrospective part in the form of Barthel Index (BI) and Short-form -36 (SF-36) health survey. BI was performed using telephone contact to patients, their family members or old age home staff. SF-36 health survey was conducted by sending questionnaires to individual patient, family member or corresponding old age home.

This study was approved by the Ethics Committee of the Hong Kong East Cluster. The need for informed consent was waived since no intervention was required in this study.

Statistical analysis

The data were analyzed using the SPSS version 16 (SPSS, Chicago, III, United States).

Results were presented as mean±standard deviation or percentages. Continuous variables were compared using Student's t-test or Mann Whitney U test as appropriate. Categorical variables were compared using Pearson chi-square test or Fisher's exact test as appropriate during univariate analysis. Multivariate analysis using logistic regression with forward stepwise approach was performed for individual variables with p value less than 0.2 in univariate analysis.

Results

One hundred and fifty-three patients were recruited, ninety-nine patients were recruited during the retrospective period and fifty-four patients were recruited in the prospective period, which contributed 5.5% and 4.5% among total ICU admissions during the study periods respectively. There was no statistically significant difference between the patients recruited during the two study periods; therefore the results were presented as a cohort of patients. The baseline characteristics were shown in **Table 1**. The baseline characteristics were similar between patients underwent surgical or percutaneous tracheostomy, except there were more male (p=0.05) and chronic obstructive airway disease

(COAD) patients (p=0.041) in percutaneous tracheostomy group.

The two most common reasons for admission were neurological problem (45.8%) and respiratory tract problem (41.2%). The mean duration of intubation was 9.05±6.48 days during the study period. The most common indication for tracheostomy was prolonged mechanical ventilation, which was defined as intubation more than 7 days (72.6%), followed by failure of extubation (15%). Among those failed extubation, 11.3% of patients required reintubation within 48 hours after extubation. Surgical tracheostomy was the mainstay method of tracheostomy, in which 73.9% of patients underwent surgical tracheostomy (**Table 2**). The duration of procedure was recorded during the prospective period, the mean duration of surgical tracheostomy was 42.36±20.33 minutes (retrieved from operation record), which was significantly longer than the mean duration of percutaneous tracheostomy of 8.33±5.51 minutes (from skin incision to connection to ventilatory circuit) with p value of 0.011 (**Table 2**).

Concerning complications raised from tracheostomy, there were no statistically significant differences in terms of short-term (**Table 3a**), intra-procedural (**Table 3b**) and long-term complications (**Table 3c**) between patients undergoing surgical or percutaneous tracheostomy. Ten point five percents of patients (9.73% in surgical tracheostomy and 12.5% in percutaneous tracheostomy, p=0.623) developed minor bleeding which can be tackled with simple bedside procedures including adrenaline gauze and Surgicel® placement. Major bleeding which required operative intervention occurred in 2% of patients (1.77% in surgical tracheostomy and 2.5% in percutaneous tracheostomy, p=0.775). None of the patients developed pneumothorax.

Intra-procedural complications were recorded during the prospective period, which was uncommonly observed; in which one patient had posterior wall laceration and another patient had false track during surgical tracheostomy, while none of the patients experienced more than one puncture, accidental puncture of endotracheal tube cuff or arterial puncture.

Concerning long-term complications, five patients developed tracheal stenosis, which required tracheal stenting during the observation period. Among those patients developed tracheal stenosis, three of them had percutaneous tracheostomy performed, while the remaining two had surgical tracheostomy performed (p=0.174). None of the patients developed tracheo-esophageal fistula, tracheo-arterial fistula or tracheomalacia during the study period.

Most of the patients were weaned off from mechanical ventilation before discharged from ICU (75.2%). Uncommonly, patients were decannulated before ICU discharge (3.3%). The ICU mortality of tracheostomized patients was 9.1% in this study. About half of the patients were decannulated upon hospital discharge (53.6%) and only a minority of them was discharged with mechanical ventilation (5.2%). The hospital mortality was 28.8% in this study. Most of the patients were transferred to rehabilitation hospital upon discharge (53.2%), followed by discharge home directly (33%) or old age home (13.8%). The ICU LOS was 16.93±15.54 days and hospital LOS was 60.91±57.25 days (**Table 4**).

Functional outcome of 41 survived patients was assessed during the retrospective period. Telephone consultation was conducted for obtaining BI. Questionnaires of SF-36 were sent out to individual patients. BI was obtained from all the 41 patients with mean of 46.59±37.27 (out of 100). The response rate of returning SF-36 questionnaire was 51.2% (21 out of 41). The mean physical score was 34.17±12.28 and the mean mental score was 39.28±13.36.

Minor bleeding and tracheal stenosis were found to be the most common short-term and long-term complications respectively. In univariate analysis, presence of hypertension (68.8% with hypertension versus 45.3% without hypertension, p=0.075), diabetes mellitus (DM) (31.2% with DM versus 17.5% without DM, p=0.185), chronic renal failure (CRF) (25% with CRF versus 2.2% without CRF, p=0.002), malignancy (31.3% with malignancy versus 16.8% without malignancy, p=0.157) and need to reintubate within 48 hours after extubation (25% need to reintubate within 48 hrs after extubation versus 9.49% without the need to reintubate within 48 hrs after extubation, p=0.068) were associated with increased risk of minor bleeding (**Table 5**). Multivariate analysis using logistic regression with forward stepwise approach identified the presence of hypertension (odds ratio 5.28, 95% CI 1.05-26.51, p=0.044) and CRF (odds ratio 17.56, 95% CI 2.87-107.42, p=0.002) as independent risk factors for minor bleeding after adjusted

for disease severity (**Table 6**).

While male gender (10% in male versus 0% in female, p=0.023), need to reintubate within 48 hours after extubation (40% need to reintubate within 48 hrs after extubation versus 8.51% without the need to intubate within 48 hrs after extubation, p=0.008), hemoglobin level (11.2±2.37 g/dL, p=0.052), COAD (20% with COAD versus 4.2% without COAD, p=0.117) and percutaneous tracheostomy (9.45% in percutaneous tracheostomy versus 3% in surgical tracheostomy, p=0.174) were associated with increased risk of tracheal stenosis during univariate analysis (**Table 5**). Multivariate analysis using logistic regression showed that only the need to reintubate within 48 hours after extubation (odds ratio 10.5, 95% CI 1.30-84.88, p=0.027) was an independent risk factor for tracheal stenosis after adjusted for disease severity (**Table 6**).

Logistic regression was also performed for composite complications (minor bleeding+tracheal stenosis), in which the presence of CRF (odds ratio 13.63, 95% CI 2.47-75.16, p=0.003) was associated with increased risk for composite complications (**Table 6**).

Discussion

Previous study has shown that it is difficult to predict the outcomes of patients who undergo tracheostomy in the ICU. (2) This current study described the outcome and complications associated with tracheostomy. The commonest indications for tracheostomy in our study were prolonged mechanical ventilation (72.6%), followed by failure of extubation (15%), which was similar to other study. (1) Surgical tracheostomy was the mainstay method used during this observational period, with 73.9% of patients underwent surgical tracheostomy.

In our institution, general surgeons, ear-nose-throat surgeons, neurosurgeons and ICU physicians will perform tracheostomy. The surgeons will perform surgical tracheostomy for the patients under their corresponding specialty. For those non-surgical patients, we will consult our ear-nose-throat surgeon for surgical tracheostomy if we foresee that the patient will be a difficult candidate, such as obese, having a short neck or goiter, or having bleeding tendency. Otherwise, we will perform percutaneous tracheostomy by ourselves. We used the Ciaglar Blue Rhino method or the Griggs method for performing percutaneous tracheostomy depending on the preference of individual intensivists or physicians. In our series, a large proportion of our patients were neurosurgical patients, therefore the number of patients undergoing percutaneous tracheostomy (26.1%) is relatively low comparing to those underwent surgical tracheostomy (73.9%).

Functional assessment was performed during the retrospective period, emotional health was generally better than the physical health of our survivors. Similar results were found in a study done in Michigan, (3) the medical records of 429 patients were reviewed and SF-36 was administrated prospectively to review the health status outcome. Among the 429 patients, the hospital mortality was 19%, 57% of survivors were liberated from mechanical ventilation. Sixty-six patients completed the SF-36 with response rate of 39%, their emotional health was generally good but physical function was quite limited.

The secondary outcome of this study was to describe the complications associated with tracheostomy and to find out if any individual variable was associated with these complications. The most common short-term and long-term complications were minor bleeding and tracheal stenosis respectively. Previous studies have reported cases of tracheal stenosis developed after tracheostomy. (4,5) There was no statistically significant difference in the rate of complications when comparing patients underwent surgical tracheostomy and percutaneous tracheostomy, likely due to small sample size. The duration of procedure was recorded during the prospective period; the mean duration of surgical tracheostomy was 42.36±20.33 minutes, which was significantly longer than the mean duration of percutaneous tracheostomy of 8.33±5.51 minutes with p value of 0.011. This finding showed that both methods were safe and no superiority of one method over another was found, and percutaneous tracheostomy had an advantage of shortening duration of procedure. However due to the small number of complications, it was difficult to draw any conclusion.

Univariate and multivariate analysis were performed to identify any factor associated with minor bleeding and tracheal stenosis, since they were the most common short-term and long-term complication observed in this study. Hypertension and CRF were independent risk factor for

minor bleeding after adjusted for disease severity. Patients suffering from hypertension or poor blood pressure control had increased risk of bleeding from any wound. Another possible reason was that patients with CRF were very likely to have hypertension at the same time, but Spearman correlation was done which failed to show significant correlation between hypertension and CRF in this study. CRF patients may suffer from bleeding from any source due to platelet dysfunction. We did not use desmopressin (DDAVP) before tracheostomy for patients who had underlying CRF, whether this practice can reduce the incidence of minor bleeding will need further study to confirm. The need to reintubate within 48 hours after extubation was an independent risk factor for tracheal stenosis after adjusted for disease severity. The possible underlying reason could be related to trauma to the trachea during repeated intubation. CRF was found to be independently associated with increased risk of composite complications during multivariate analysis. The number of patients with CRF is small in this study; only seven patients were defined as CRF by the Chronic Kidney Disease Epidemiology Collaboration equation (CKD-EPI) to estimate glomerular filtration rate (GFR) of less than 60 ml/min for 2 occasions at least 3 months apart before current admission. Among those seven patients, four of them were admitted due to respiratory problems and the remaining three were admitted due to neurological problem. In view of this small number of patients, whether CRF is really associated with increased risk of composite complications and mortality in tracheostomized patients will need further larger trials to confirm.

There are several limitations of this study. First of all, this is an observational study and not a randomized control trial. Secondly, it is a single center study done in one of the tertiary center in Hong Kong, therefore it may not be representative of other patient populations. In particular, we had a high proportion of neurosurgical patients in this series. Thirdly, the sample size is small in this study although we found that the presence of CRF in tracheostomized patients was independently associated with increased risk of composite complications, however due to such small number of patients suffering from CRF, a conclusion cannot be drawn from this finding, and larger trials will be needed to confirm this observation. Fourthly, previous studies have focused on the effect of the timing of tracheostomy on the outcome of patients. One systematic review showed that early tracheostomy may shorten the duration of mechanical ventilation and ICU length of stay, (6) another study concluded that early tracheostomy should no anticipate a large potential survival benefit. (7) However, due to similar duration of intubation among the recruited patients, the effect of early versus late tracheostomy cannot be performed in this study. Furthermore, varies studies have focused on the difference of surgical versus percutaneous tracheostomy and showed different results. (8-11) However, due to selection bias in this study, the effect of the tracheostomy method on patients' outcome was not studied. Lastly, the response rate of completion of SF-36 questionnaires was low which contributed only 51.2%, and a proportion of patients have died before the study was conducted, therefore the result may not reflect the overall picture.

Conclusion

Tracheostomy is a common procedure performed in the critical care setting. Various studies concerning the method, timing, complications and long-term outcome had been performed; however most of them were focused on the Caucasian populations.

This observational study described the outcome of tracheostomized patients and some predictors of complications of tracheostomy from one of the tertiary center in Hong Kong. Further larger trials would help to confirm the findings.

Table 1. Baseline characteristics of recruited patients

Variables	Mean±SD or percentages (number)			P value
	Overall (153)	Surgical tracheostomy (113)	Percutaneous tracheostomy (40)	
Age (years)	65.54±14.34	66.01±14.46	64.2±14.1	0.534
Weight (kg)	50.25±11.02	50.42±11.28	49.12±9.76	0.579
Height (cm)	153.27±9.02	152.59±9.5	155.15±7.34	0.368
Male gender	54.2% (83)	50.0% (56)	67.5% (27)	0.05
Marital status				
Single/divorced	11.8% (18)	11.5% (13)	12.5% (5)	0.867
Married	88.2% (135)	88.5% (100)	87.5% (35)	
Smoking status				
Current/ex-smoker	36.6% (56)	39.0% (44)	30.0% (12)	0.724
Admitting service				
Emergency	95.4% (146)	93.8% (106)	100% (40)	0.107
Elective	4.6% (7)	6.2% (7)	0% (0)	
Reason for admission				
Shock	0.7% (1)	0% (0)	2.5% (1)	0.092
Respiratory	41.2% (63)	40.7% (46)	42.5% (17)	0.843
Cardiac	2.0% (3)	1.8% (2)	2.5% (1)	0.775
Gastrointestinal	2.4% (4)	2.7% (3)	2.5% (1)	0.958
Neurological	45.8% (70)	49.6% (56)	35.0% (14)	0.089
Trauma	3.3% (5)	3.5% (4)	2.5% (1)	0.751
Post cardiac arrest	4.6% (7)	1.8% (2)	12.5% (5)	0.001
APACHE IV score	80.53±31.55	77.22±30.94	89.87±31.77	0.127
APACHE risk of death	0.39±0.28	0.36±0.27	0.46±0.28	0.079
Hemoglobin level (g/dL)	10.23±1.89	10.23±2.0	10.23±1.57	0.657
Platelet count (x 10^9/L)	300.0±143.20	304.97±149.83	285.85±123.2	0.483
INR level	1.09±0.13	1.1±0.13	1.06±0.11	0.192
Medical comorbidities				
Acute coronary syndrome	10.5% (16)	12.4% (14)	5.0% (2)	0.341
Congestive heart failure	3.3% (5)	4.42% (5)	0 (0)	0.401
Hypertension	47.7% (73)	52.2% (59)	35.0% (14)	0.061
Diabetes mellitus	19.0% (29)	19.5% (22)	17.5% (7)	0.785
Chronic obstructive airway disease	3.9% (6)	1.78% (2)	10.0% (4)	0.041
Asthma	2.6% (4)	2.65% (3)	2.5% (1)	0.958
Bronchiectasis	2.0% (3)	0.88% (1)	5.0% (2)	0.167
Chronic renal failure	4.6% (7)	4.42% (5)	5.0% (2)	0.881
Malignancy (any form)	18.3% (28)	16.8% (19)	22.5% (9)	0.424
Coagulopathy	2.0% (3)	2.7% (3)	0 (0)	0.568
Goiter	3.3% (5)	4.4% (5)	0 (0)	0.401

Table 2. Tracheostomy characteristics (n=153)

	Percentages (number) or Mean±SD
Indications for tracheostomy	
Prolonged mechanical ventilation	72.6% (111)
Failed extubation	15.0% (23)
Upper airway obstruction	6.5% (10)
Post op elective	5.9% (9)
Method of tracheostomy	
Surgical tracheostomy	73.9% (113)
Percutaneous tracheostomy	26.1% (40)
Duration of tracheostomy (minutes)	
Surgical tracheostomy	42.36±20.33
Percutaneous tracheostomy	8.33±5.51

Table 3A. Short-term complications associated with tracheostomy

	Overall (n=153)	Surgical tracheostomy (n=113)	Percutaneous tracheostomy (n=40)	P value
Minor bleeding	10.5% (16)	9.73% (11)	12.5% (5)	0.623
Major bleeding	2.0% (3)	1.77% (2)	2.5% (1)	0.775
Pneumothorax	0 (0)	0 (0)	0 (0)	-
Accidental decannulation	0.7% (1)	0.88% (1)	0 (0)	0.551
Stoma infection	0.7% (1)	0.88% (1)	0 (0)	0.551
Sputum retention	2.6% (4)	2.65% (3)	2.5% (1)	0.958

Table 3B. Intra-procedural complications during tracheostomy (prospective period)

	Overall (n=54)	Surgical tracheostomy (n=46)	Percutaneous tracheostomy (n=8)	P value
More than 1 puncture	0 (0)	0 (0)	0 (0)	-
Accidental puncture of ETT cuff	0 (0)	0 (0)	0 (0)	-
Arterial puncture	0 (0)	0 (0)	0 (0)	-
Posterior wall laceration	1.9% (1)	2.17% (1)	0 (0)	0.551
False track	1.9% (1)	2.17% (1)	0 (0)	0.551

Table 3C. Long-term complications associated with tracheostomy (retrospective period)

	Overall (N=99)	Surgical tracheostomy (N=67)	Percutaneous tracheostomy (N=32)	P value
Tracheal stenosis	5.1% (5)	2.99% (2)	9.38% (3)	0.174
Tracheomalacia	0 (0)	0 (0)	0 (0)	-
Tracheo-esophageal fistula	0 (0)	0 (0)	0 (0)	-
Tracheo-arterial fistula	0 (0)	0 (0)	0 (0)	-

Table 4. Discharge characteristics

Status at ICU discharge (n=153)	
Decannulated	3.3% (5)
Tracheostomy without mechanical ventilation	75.2% (115)
Tracheostomy with mechanical ventilation	12.4% (19)
Death	9.1% (14)
Status at hospital discharge (n=153)	
Decannulated	53.6% (82)
Tracheostomy without mechanical ventilation	12.4% (19)
Tracheostomy with mechanical ventilation	5.2% (8)
Death	28.8% (44)
Discharge destination (n=109)	
Home	33.0% (36)
Rehabilitation hospital	53.2% (58)
Old age home	13.8% (15)
Length of stay (days)	
ICU LOS	16.93±15.54
Hospital LOS	60.91±57.25

Table 5. Univariate analysis to identify individual variables associated with increased risk of minor bleeding and tracheal stenosis

Variables	Minor bleeding (n=16/153)		Tracheal stenosis (n=5/99)	
	Mean±SD or percentages	P value	Mean±SD or percentages	P value
Age (years)	71.19±13.45	0.527	61.6±7.23	0.865
Weight (kg)	40.0±3.937	0.224	44.7±4.58	0.478
Height (cm)	150.69±5.582	0.971	154.6±4.04	0.603
Gender	Male: 8.4% (7/83) Female: 12.9% (9/70)	0.373	Male: 10% (5/50) Female: 0% (0/49)	0.023
Smoking status	Smoker: 8.9% (5/56) Nonsmoker: 7.4% (5/68) Missing: 29	0.883	Smoker: 3.7% (1/27) Nonsmoker: 4.7% (2/43) Missing: 29	0.849
Hemoglobin (g/dL)	10.07±1.67	0.449	11.2±2.37	0.052
Platelet (x 10^9/L)	244±93.03	0.872	242±81.77	0.552
INR	1.06±0.73	0.911	1.0±0	0.621
ACS	Y: 12.5% (2/16) N: 7.3% (10/137)	0.616	Y: 0% (0/5) N: 7.4% (7/94)	0.720
CHF	Y: 0% (0/16) N: 2.2% (3/137)	0.739	Y: 0% (0/5) N: 2.1% (2/94)	0.895
Hypertension	Y: 68.8% (11/16) N: 45.3% (62/137)	0.075	Y: 60% (3/5) N: 45.7% (43/94)	0.533
Diabetes mellitus	Y: 31.2% (5/16) N: 17.5% (24/137)	0.185	Y: 20% (1/5) N: 19.1% (18/94)	0.962
COAD	Y: 6.2% (1/16) N: 3.6% (5/137)	0.612	Y: 20% (1/5) N: 4.3% (4/94)	0.117
Asthma	Y: 0% (0/16) N: 2.9% (4/137)	0.489	Y: 0% (0/5) N: 3.2% (3/94)	0.685
Bronchiectasis	Y: 0% (0/16) N: 2.2% (3/137)	0.550	Y: 0% (0/5) N: 2.1% (2/94)	0.742
CRF	Y: 25% (4/16) N: 2.2% (3/137)	0.002	Y: 0% (0/5) N: 5.3% (5/94)	0.597
Malignancy	Y: 31.3% (5/16) N: 16.8% (23/137)	0.157	Y: 20% (1/5) N: 20.2% (19/94)	0.946
Coagulopathy	Y: 0% (0/16) N: 2.2% (3/137)	0.550	Y: 0% (0/5) N: 2.1% (2/94)	0.742
Goitre	Y: 6.2% (1/16) N: 1.5% (2/137)	0.382	Y: 0% (0/5) N: 2.1% (2/94)	0.742
Method of tracheostomy	Surgical: 9.7% (11/113) Percutaneous: 12.5% (5/40)	0.623	Surgical: 3.0% (2/67) Percutaneous: 9.4% (3/32)	0.174
Need to reintubate within 48 hrs after extubation	Y: 25% (4/16) N: 9.5% (13/137)	0.068	Y: 40% (2/5) N: 8.5% (8/94)	0.008

Legend: Y=had minor bleeding or tracheal stenosis; N=did not have minor bleeding or tracheal stenosis

Table 6. Multivariate analysis using forward stepwise logistic regression to identify individual variables associated with increased risk of minor bleeding, tracheal stenosis and composite complications (minor bleeding+tracheal stenosis) after adjusted for disease severity

Minor bleeding		
Covariates	Odds ratio (95% CI)	P value
Hypertension	5.28 (1.05-26.51)	0.044
Chronic renal failure	17.56 (2.87-107.42)	0.002
Tracheal stenosis		
Covariates	Odds ratio (95% CI)	P value
Need to reintubate within 48 hrs after extubation	10.5 (1.30-84.88)	0.027
Composite complications (Minor bleeding+tracheal stenosis)		
Covariates	Odds ratio (95% CI)	P value
Chronic renal failure	13.63 (2.47-75.16)	0.003

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