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Timing of Tracheostomy and Outcomes in Adults with Moderate and Severe Tetanus: A Cross-Sectional Study

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ABSTRACT

Objective: This study aimed to evaluate the timing of tracheostomy and relationship to outcomes (length of hospital stay, length of mechanical ventilation, morbidity and mortality rate) in adults with moderate and severe tetanus.

Methods:

Design: Cross-Sectional Study
Setting: Tertiary Government Training Hospital
Participants: All adult patients (19 years old and above) diagnosed with moderate and severe stage tetanus from January 2015 to January 2018 were considered for inclusion.

Results: There were 109 patients included in this study, majority were males (n=95) with a male to female ratio of 7:1. Most belonged to the 51-60 years age group (mean: 53.7 SD: +/-16.1). Based on Cole Tetanus staging, the majority presented with severe stage tetanus (67.9%; n=74). Only 35.8% (n=39) were admitted at the Intensive Care Unit. Early tracheostomy was performed in 56.0% (n=61) of the patients (mean 6.3 hours SD: +/- 4.61). Mortality rate was noted to be 52.3% (n=57). Overall, early tracheostomy among moderate to severe stage tetanus patients showed shorter length of hospital stay and length of mechanical ventilation than late tracheostomy (tracheostomy >24 hours) (p-value < .05). However, no significant difference was noted for timing of tracheostomy in terms of morbidity and mortality rate (p-value > .05).

Conclusion: Early tracheostomy within less than 24 hours from time of admission for moderate and severe tetanus is associated with shorter length of hospital stay and mechanical ventilation than late tracheostomy, and may play a role in tetanus management.

Keywords: *tracheostomy; tetanus; hospital stay; mechanical ventilation; morbidity; mortality*

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Despite effective efforts by World Health Organization (WHO) to reduce deaths caused by tetanus through large-scale immunization programs, the disease remains an important public health problem in many parts of the world where immunization programs are suboptimal, particularly in the least developed districts of low income countries.[1] In 2016, there were 13,502 reported cases of tetanus with 72,600 estimated deaths in those less than 5 years of age despite 86% estimated DTP3 immunization coverage.[2] In the Philippines, morbidity and mortality trends for tetanus from 1993 to 2013 showed decreasing morbidity rates from 1.1/100,000 to 0.1/100,000 and decreasing mortality rates from 1.5/100,000 to 0.6/100,000.[3] However, despite these decreasing trends, tetanus may occur at any age and case-fatality rates are still high even where intensive care is available, approaching 100% in the absence of medical intervention.[2,3]

Securing the airway early in the disease with a tracheostomy is an important intervention in the management of tetanus where artificial ventilation is often necessary for weeks, in contrast to endotracheal intubation which can stimulate laryngeal spasms and exacerbate airway compromise.[4,5] In our setting, early tracheostomy is a standard treatment for tetanus patients presenting with moderate to severe trismus, but to the best of our knowledge, there is a dearth of local studies that evaluate the significance of timing of tracheostomy in the outcomes of tetanus management.

In order to guide our practice and improve patient care, this study aimed to evaluate the timing of tracheostomy and relationship to outcomes (length of hospital stay, length of mechanical ventilation, morbidity and mortality rate) in adults with moderate and severe tetanus.

METHODS

With institutional review board (IRB No. 2018-37) approval, this cross-sectional study considered for inclusion all adult tetanus patients aged 19 years old and above who were admitted with a Cole tetanus severity diagnosis of moderate and severe stage tetanus from January 1, 2015 to January 1, 2018. Initial lists were based on admission logbooks. Hospital charts were obtained from the medical records section and screened. Excluded were records of patients with comorbid illnesses, those in whom tracheostomy performed outside the study setting, those who did not consent to treatment or who opted to be discharged against medical advice, and those with incomplete or unavailable records.

Data was extracted from the medical records by the principal investigator and listed in data collection forms using Microsoft Excel 2013 (15.0.4420.1017) (Microsoft Corporation, Redmond, WA, USA). Data included age, sex, presenting symptoms, incubation period, period of onset, severity, site of injury and admission.

For this study, early tracheostomy was defined as performed within 24 hours from the time of admission with those performed beyond 24 hours categorized as late tracheostomy. Patients who had no tracheostomy performed were likewise treated as a group. Length of hospital stay was calculated in days from date of admission to date of discharge. Length of mechanical ventilation was calculated in days from date of ventilator set-up to date of removal. Morbidity and mortality rate were defined as occurrence of a complication and death in a given number of population per unit of time, respectively.

Data was analyzed using SPSS Statistics 22 (IBM Corporation, Chicago, IL, USA). Categorical variables were reported as count and percentage. Means and standard deviations were computed among variables in age, incubation period and period of onset. Subgroup analysis of the outcomes (length of hospital stay, length of mechanical ventilation, morbidity and mortality rate) according to timing or performance of tracheostomy (early, late, none) was performed. One-way analysis of variance (ANOVA) was utilized to compare the means between groups with a statistical significance of p-value < .05.

RESULTS

Out of 129 patients initially considered, this study finally included 109 adult patients with moderate and severe stage tetanus. There were 95 males and 14 females with male to female ratio of 7:1. The mean age was 52.7 years (SD: +/-16.1) with a range of 19 to 85 years. Presenting symptoms included trismus (n=64), spasm (n=17), dysphagia (n=15) and dyspnea (n=8). The mean incubation period and period of onset were 8.3 days (SD: +/-5.0, range 1 to 28 days) and 2.2 days (SD: +/-2.6, range 1 to 14 days), respectively. Majority of the patients presented with severe stage tetanus (n=74). The most common site of injury was in the lower extremities specifically punctured foot wounds (n=61), followed by the upper extremities (n=15) and dental-related infections (n=2). Of the 109 patients, only 35.8% (n=39) were admitted to the intensive care unit while 64.2% (n=70) were admitted in the medical isolation ward.

More than half of the study population (56%; n=61), were managed with early tracheostomy within one to 18 hours (mean: 6.3 hours SD: +/-4.6). Of these, 96.7% (n=59) were performed in the emergency room with one each in the operating room and medical isolation ward. The no tracheostomy group comprised 35.8% (n=39) followed by the late tracheostomy group which only comprised 8.3% (n=9). Tetanus related deaths occurred in 52.3% (n=57), while 47.7% (n=52) were eventually discharged from hospital. *(Table 1)*

Subgroup analysis of the outcomes revealed significant differences in timing of tracheostomy versus length of hospital stay and mechanical

ventilation. There were significantly shorter lengths of hospital stay and duration of mechanical ventilation among those who had early tracheostomy compared to those who had late tracheostomy, except for patients who did not undergo tracheostomy (One-way ANOVA, Length of hospital stay, Moderate, F(2, 21) = 13.54, p=.0002, Severe, F(2,22) = 8.33, p=.002) Length of mechanical ventilation, Moderate, F(1, 4) = 33.64, p=.004, Severe, F(1, 14) = 1.25, p=.28). *(Table 2)*

In contrast, there was no significant difference in morbidity and mortality rates for early versus late tracheostomy (One-way ANOVA, Morbidity rate, Moderate, F(2, 31) = 2.76, p=0.08, Severe, F(2, 72) = 1.30, p=.28, Mortality rate, moderate, F(2, 34) = 2.40, p=.11, severe, F(2, 73) = 0.63, p=.53). *(Table 3)*

Table 1. Number of patients based on timing of tracheostomy and mortality outcomes

Variable	Number of patients	(%)
Time of Tracheostomy		
Early	61	56.0
Late	9	8.3
No	39	35.8
Outcome		
Death	57	52.3
Discharged	52	47.7

Table 2. Subgroup analysis for length of hospital stay and length of mechanical ventilation based on timing of tracheostomy

Outcome	Severity	Timing of Tracheostomy			
		Early Tracheostomy (n=61)	Late Tracheostomy (n=9)	No Tracheostomy (n=39)	p-value
Length of Hospital Stay (mean, days)	Moderate	14.4	41.0	9.9	.0002
	Severe	18.9	41	11.6	.002
Length of Mechanical Ventilation (mean, days)	Moderate	4.1	18.0	NA	.004
	Severe	10.1	19	NA	.28

NA for the No Tracheostomy group because none of them were intubated or tracheotomized, and none were committed to mechanical ventilation. Despite moderate to severe tetanus, they were managed conservatively (including those who did not consent to either intubation or tracheotomy).

Table 3. Subgroup analysis of mortality and morbidity rate based on timing of tracheostomy

Outcome	Severity	Timing of Tracheostomy			
		Early Tracheostomy (n=61)	Late Tracheostomy (n=9)	No Tracheostomy (n=39)	p-value
Morbidity Rate (%)	Moderate	50.0	50.0	17.0	.08
	Severe	85.4	100	71.4	.28
Mortality Rate (%)	Moderate	50.0	50.0	16.7	.11
	Severe	56.2	71.4	71.4	.53

DISCUSSION

Our study found that early tracheostomy in moderate and severe stage tetanus showed shorter length of hospital and length of mechanical ventilation compared to late tracheostomy. In contrast, no significant difference were noted among timing of tracheostomy on morbidity and mortality rates. These study findings differ from those of Saeed *et al.* and Awan *et al.* which emphasized lower morbidity and mortality rates among early tracheostomized tetanus patients. However, the Awan *et al.* study of 56 patients presenting with moderate trismus underscored early recovery and shorter length of hospital stay comparable to our study findings.[6,7] In addition, our study further revealed shorter length of mechanical ventilation among early tracheostomy with moderate stage tetanus compared with late tracheostomy but no significant difference was noted with severe tetanus.

Other findings noted in this study that 67.9% (n=74) of our patients initially presented with severe stage tetanus, were similar with findings of previous studies that high mortality rate resulted from poor recognition of disease and delays in treatment.[5-8] Mortality rates in this study were still high at 52.3% (n=57), comparable to studies conducted in developing countries.[6-8] In addition, moderate to severe trismus 58.7% (n=64) was the predominant presenting symptom among study participants, comprising the primary indication for tracheostomy referral in our setting that was consistent with practices that avoid subsequent airway compromise once a patent tracheostomy was established.[9,10] Only 35.8% (n=39) of our patients were admitted in an intensive care facility similar to findings of another local study, reflecting the limited resources and inadequate care for most of these patients.[11,12] In contrast, earlier studies that recommend intensive care

unit (ICU) admission have shown satisfactory outcomes in the treatment of tetanus patients.[13-15]

Our study has several limitations. The unequal sample size between groups can create bias in formulating a statistically significant comparison and although airway control is one of the crucial approaches in the management of tetanus, several equally significant treatment strategies utilized such as immunotherapy, antibiotic treatment, muscle spasm and autonomic dysfunction control, could influence the study outcomes and partially explain better outcomes noted among patients who did not undergo tracheostomy in this study. Further studies have to be conducted to obviate these biases and lay the groundwork for an efficient treatment pathway in the management of tetanus.

In conclusion, despite vigorous campaigns conducted by international and local health organizations to reduce deaths caused by tetanus, this study revealed an unsatisfactory mortality rate of 52.3%. Early tracheostomy performed within less than 24 hours from time of admission for moderate and severe tetanus is associated with shorter length of hospital stay and mechanical ventilation than late tracheostomy, and may play a role in tetanus management.

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