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Clinical Outcomes and Healthcare Costs of Inpatients with Tetanus in Korea, 2011-2019

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BACKGROUNDS

- Tetanus is a fatal but preventable infectious disease caused by Clostridium tetani.
- However, insufficient tetanus vaccination has been practiced by adults in some cases of tetanus.
- According to the Korea Centers for Disease Control and Prevention, the nationwide incidence of tetanus increased to a mean of 23.9 cases per year between 2010 and 2019 compared with a mean of 10.9 cases per year between 2000 and 2009.
- We aimed to investigate the recent trend of clinical outcomes and medical costs of inpatients with tetanus, which is a rare, vaccine-preventable but extremely grave disease, in Korea, in 2011-2019 for the first time.

MATERIAL AND METHODS

- This retrospective cohort study was conducted between January 1, 2011 and July 30, 2019 at Kyungpook National University Hospital and Chonnam National University Hospital.
- All patients included were older than 18 years.
- The patients were divided into 2 groups, namely a non-mechanical ventilation support group (n = 17) and a mechanical ventilation support group (n = 32).
- Most patients' medical charts were reviewed throughout their first and last hospital visits.
- All statistical data were analyzed using R statistics ver. 3.1.

RESULTS

- The mean patient age was 65.3 ± 16.1 years, and 32 (65.3%) were women.
- All patients had generalized tetanus, and 5 (10.2%) died during admission.
- Thirty-two (65.3%) patients required mechanical ventilation, and 20 (40.8%) developed aspiration pneumonia.
- Age older than 65 years and presence of dyspnea were risk factor for MV support in multivariate regression logistic analysis
- The median total healthcare cost was 18,010 United States Dollars [USD] per person.
- The cost for the procedure and operation, including MV management, was the most expensive, followed by the cost for medication and injection and the cost for diagnostic blood test.
- After discharge, 35 (79.5%) patients fully recovered without any disability.

Table 1. Baseline characteristics of adult patients with tetanus admitted to 2 Korean university hospitals between 2011 and 2019

Clinical characteristics	No. (%) of patients
General characteristics	
Female, n (%)	32 (57.1%)
Age, mean ± standard deviation (y)	65.3 ± 16.1
Generalized tetanus, n (%)	49 (100%)
Incubation time, median [IQR] (d)	5.0 [1.5-7.5]
Duration from symptom onset to tetanus immunoglobulin injection, median [IQR] (d)	4.0 [2.0-9.0]
Comorbidity, n (%)	
Hypertension	16 (32.7%)
Diabetes mellitus	11 (22.4%)
Malignancy	8 (16.3%)
Others	17 (34.7%)
Site of entry, n (%)	
Lower extremities	12 (24.5%)
Upper extremities	11 (22.4%)
Face	7 (14.3%)
Trunk	2 (4.1%)
Cryptogenic	17 (34.7%)
Clinical features, n (%)	
Trismus	42 (85.7%)
Muscle stiffness	36 (73.5%)
Swallowing difficulty	33 (67.3%)
Dysarthria	32 (65.3%)
Opisthotonos	11 (22.4%)
Seizure	11 (22.4%)
Headache	4 (8.3%)
[a]SBP > 150 mmHg	31 (66.0%)
[a]SBP < 100 mmHg	32 (65.3%)
Fever during admission	25 (51.0%)
Nausea and vomiting	2 (4.1%)
Sweating	5 (10.2%)
Drooling	2 (4.1%)
Dyspnea	28 (57.1%)
Respiratory failure	17 (35.4%)
Clinical course and outcome, n (%)	
Wound operation	6 (12.2%)
Intensive care unit treatment	38 (77.6%)

[a]SBP : Systolic blood pressure

Table 2. Characteristics of tetanus patients according to the mechanical ventilator support required

Factors	No mechanical ventilator group (N = 17)	Mechanical ventilator group (N = 32)	P value
General characteristics			
Female, n (%)	11 (64.7%)	21 (65.6%)	0.949
Age, year	55.1 ± 17.6	70.8 ± 12.3	0.001
Incubation time, median [IQR], d	2.0 [1.0-6.0]	6.0 [3.0-8.0]	0.237
Wound operation	3 (18.8%)	3 (12.5%)	0.928
Comorbidity, n (%)			
Hypertension	3 (17.6%)	13 (40.6%)	0.189
Diabetes mellitus	3 (17.6%)	8 (25.0%)	0.820
Malignancy	5 (29.4%)	3 (9.4%)	0.161
Site of entry, n (%)			0.314
Lower extremities	5 (29.4%)	7 (21.9%)	
Upper extremities	5 (29.4%)	6 (18.8%)	
Face	7 (15.9%)	0	
Trunk	0 (0.0%)	7 (21.9%)	
Cryptogenic	6 (35.3%)	11 34.4%)	
Symptom, n (%)			
Trismus	14 (82.4%)	28 (87.5%)	0.951
Swallowing difficulty	9 (52.9%)	24 (75.0%)	0.212
Opisthotonos	2 (11.8%)	9 (28.1%)	0.344
Seizure	2 (11.8%)	9 (28.1%)	0.344
Dyspnea	5 (29.4%)	23 (71.9%)	0.011
Autonomic dysfunction	10 (58.8%)	32 (100%)	<0.001
Complication, n (%)			
Aspiration pneumonia	2 (11.8%)	18 (56.2%)	0.007
Pulmonary thromboembolism	0	2 (6.2%)	
Multifocal infarction	0	1 (3.1%)	
Urinary tract infection	0	3 (9.3%)	
Atrial fibrillation	0	1 (3.1%)	
Other	1 (5.9%)	7 (21.8%)	
Clinical outcome, n (%)			
Duration of hospitalization, median [IQR], d	8.0 [5.0-21.0]	46.5 [39.5-52.5]	< 0.001
Duration of mechanical ventilator support, median [IQR], d	-	33.0 [22.0-40.5]	
Tracheostomy	-	27 (84.4%)	
Death	1 (5.9%)	4 (12.5%)	0.816
Rehabilitation	1 (5.9%)	11 (34.4%)	0.063
Ambulation	13 (92.9%)	22 (81.5%)	0.609
Aspiration pneumonia	2 (11.8%)	18 (56.2%)	0.007
Second tetanus vaccination	3 (17.6%)	21 (65.6%)	0.004
Third tetanus vaccination	1 (6.2%)	5 (16.1%)	0.617

Table 3. Multiple logistic regression analysis of risk factors associated with mechanical ventilator support in tetanus patients

Variable	Multivariate logistic regression analysis	
	Odds ratio (95% confidence interval)	P value
Age>65 years	4.63 (1.22-19.99)	0.029
Dyspnea	5.44 (1.44-23.43)	0.016

Table 4. Medical costs for 49 inpatients with tetanus

Factors	Medical costs for treatment (median, IQR)	
	KRW[a]	USD[b*]
Total cost	21,072,300 [3,136,000-40,362,000]	18,011 [2,680-34,497]
Cost for patient care	159,600 [67,000-289,000]	136 [57-247]
Cost for medication and injection	4,517,200 [706,000-8,323,000]	3,861 [603-7,114]
Cost for procedure and operation	6,437,500 [132,000-9,932,000]	5,502 [112-8,489]
Cost for diagnostic blood test	4,404,100 [524,000-6,098,000]	3,764 [448-5,212]
Cost for radiological test	935,300 [377,000-1,392,000]	799 [322-1,190]

*1 USD = 1,170 KRW
[a]KRW: South Korean Won; [b]USD, United States Dollar

CONCLUSION

- Tetanus remains a severe but preventable acute infection disease, and its treatment requires high medical costs, which could be challenging for many individuals.
- Patients aged older than 40 years have low tetanus immunity, however a high rate of complications and high medical cost from intensive care was observed among elderly patients.
- Early detection of tetanus is crucial and can be achieved by education among physicians, and tetanus prevalence can be reduced by making the public aware of tetanus immunization.