

A Ten-year Retrospective Study of Tetanus at a Teaching Hospital in Bangladesh

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Summary:

Aims: To study the demographic, clinical features, treatment as well as outcomes of tetanus patients in the Bangladeshi population from 1994 to 2003.

Design: A retrospective descriptive study. **Setting:** A large public Medical college hospital with a regional as well as referral service. **Materials and Methods:** All cases of tetanus in adult patients from January 1994 to December 2003 were identified from the medical record at the hospital and these were then retrospectively reviewed.

Results: A total of 80 cases of tetanus were seen at the Faridpur Medical college hospital in the 10 years period with a mean of 8 cases per year. There were 55 male (68.75%) and 25 female (31.25%) patients. The mean age of the study population was 51.7 ± 10.08 years. Most cases occurred in the age group of 60-69 years. Risk factor analysis revealed identifiable acute injury (puncture, prick/laceration) in 85%, CSOM (2.5%), surgery (2.5%), abortion (2.5%), skin ulcer (1.25%), burn (1.25%), child birth (1.25%), boil (1.25%). Thirty-two (40%) patients had medical wound care before hospital admission but none received tetanus immunoglobulin despite the absence of tetanus immunity. All the patients had the generalized type of disease. Body stiffness, trismus and dysphagia were the three commonest presenting complaints. All the patients with injury and wound (74/80) had their wound debrided. All the tetanus patients (80/80) received intravenous diazepam infusion as part of their management. Seventy

two (90%) patients received intravenous crystalline penicillin. Sixty-five (81.25%) patients received intramuscular human antitetanus immunoglobulin and fourteen (17.5%) had tracheostomy performed. In-hospital complications were observed as respiratory (80%), cardiovascular (65%), gastrointestinal (57.5%), renal (33.37%), neurological (17.%) and others (22.5%).

There were eighteen deaths in hospital, accounting for overall mortality of 22.5% (18/80). Higher mortality were observed in age group above 50 years than the age group below 50 years (29.16% vs 12.5%, $P < 0.05$), in female than the male (40% vs 14.54%, $P < 0.05$), in farmer than non-farmer (30.95% vs 13.15%, $P < 0.05$), in patients who had short incubation period than those who had incubation period more than one week (53.33% vs 23.25%, $P < 0.05$).

Conclusion: In general, tetanus remains in Bangladesh an important disease with substantial mortality that primarily affects unvaccinated or inadequately vaccinated individuals. Prevention during wound management of tetanus prone wounds was inappropriate in many patients. The elderly population may have the highest risk for tetanus since they may not have had tetanus toxoid immunization or regular booster injections. It is, however, highly preventable through both routine vaccination and appropriate wound management. Our case series show comparable pattern and outcome with other case series in the developing countries reported in the literatures.

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Introduction

Tetanus is a neurological disorder, characterized by increased muscle tone and spasms. It is caused by

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tetanospasm, a powerful protein toxin elaborated by *Clostridium tetani*. *C.tetani* is a ubiquitous organism, found worldwide in soil, in inanimate environment, in animal, and occasionally human faeces. The organism exists in two forms: spores and vegetative cells. Tetanospasm is formed in the vegetative cells under plasmid control.

Tetanus occurs sporadically and almost always affects non-immunized, partially immunized, or fully immunized persons who fail to maintain adequate immunity with booster doses of vaccine. Although tetanus is entirely preventable by immunization,

tetanus persists as a global health problem. While tetanus has become a rare disease in the developed world, it is a continuing problem in the developing world. The global incidence of tetanus is still estimated at one million cases annually, with a case fatality ratio ranging from 20 to over 50 percent^{1, 2, 3}. The disease is common in areas where soil is cultivated, in rural areas, in warm climates and among males. In places without a comprehensive immunisation programme, tetanus occurs predominantly in neonates and young children. In countries with successful immunisation programmes, neonatal tetanus is rare and the disease affects other age group inadequately covered by immunisation.

Most cases of tetanus follow an acute penetrating skin injury. The injury may be major but often is trivial, so that medical attention is often not sought. Tetanus is also associated with chronic skin ulcers^{1, 2}, abscesses, gangrene, burns, surgery, abortion², childbirth², and intravenous drug abuse². In some patients no portal of entry for the organism can be identified¹.

In Bangladesh, like most developing countries in the world, tetanus is endemic and remains an important health problem especially among the rural farming folks. Although an estimated 41,000 cases of neonatal tetanus occur annually⁴, the exact incidence of other types of tetanus in Bangladesh, a country with 140 million inhabitants, is not known, partly because of lack of compliance in reporting new cases to the authorities. The Government of Bangladesh, Bureau of Statistics has reported 7.5% of maternal deaths or an estimated 1080 women died in 1996 from pregnancy related tetanus⁵. However, the mortality in other types of non-neonatal tetanus in Bangladesh is not known. We undertook a ten-year retrospective study of all the tetanus cases in adults managed at a 250-bedded teaching hospital, looking into its demographic and clinical profiles, risk factors for tetanus, treatment received and the outcomes.

Materials and Methods

All cases of tetanus in adult patients from January 1994 to December 2003, who were admitted at the Faridpur medical college hospital, were included in this 10-year retrospective descriptive study. The tetanus cases were searched for and identified from the case record files in the Record Office of the hospital.

Selection criteria for the patients consists of: (1) Physicians made clinical diagnosis of tetanus (2) Age of 16 years or above and both sexes. Neonatal tetanus and tetanus in children, patients with doubtful clinical diagnosis of tetanus where there were other differential diagnosis like hysterical conversion reaction (HCR), drug induced rigidity were not included in this study.

The individual case notes were then retrieved and studied. Age, sex, occupation, clinical features of the individual cases of tetanus, incubation time, identifiable injury, history of previous vaccination against tetanus, wound prophylaxis, treatment received, complication if any were noted on a standard case record form. Tables and charts were then made to summarize the various data of interest.

Statistical analysis

A descriptive analysis was done on all variables to obtain a frequency distribution. The mean \pm SD and ranges were calculated for quantitative variables. Between groups comparison were analyzed by Z test to see the statistical significance. The level of significance was considered as $P < 0.05$.

Results

There were 80 cases of tetanus in the study period with a range of 6 to 14 cases per year and a mean of 8 cases per year. There were 55 male (68.75%) and 25 female (31.25%) patients.

The age distribution of these 80 tetanus patients is shown in figure 1. Most cases occurred in the age groups 60-69 years and 50-59 years, with 20 and 16 cases respectively. Sixty (75%) cases occurred in people more than 40 years of age. Only four patients were less than 20 years of age. The mean age in our series was 51.7 ± 10.08 years.

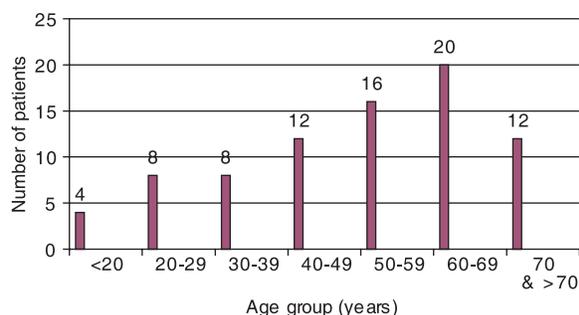


Fig.1: The age distribution of the tetanus patients (n=80).

The occupational groups of the patients are shown in Table I. Forty two (52.5%) patients were farmer, sixteen (20%) were labour and industry worker, ten (12.55%) were housewives and in six (7.5%) patients the exact occupations of the patients were not known as the occupational history were not recorded in medical record files.

Table-I.

Occupational group of the tetanus patients from 1999 to 2003 (n=80).

Occupation	Number of patients (%)
Farmer	42(52.5%)
Labour/industrial worker	16(20%)
House wives	10(12.5%)
Businessmen	3(3.75%)
Student	2(2.5%)
Service	1(1.25%)
Not known	6(7.5%)
Total	82 (100%)

Risk factors for tetanus

Sixty-eight of the 80 (85%) patients had a reasonably identifiable acute injury (prick, puncture wound or laceration) prior to the onset of tetanus, as shown in Table II. In thirty-nine (48.75%) patients, the injuries were on the lower limbs whereas in twenty-nine (36.25%) patients, the injuries were described on the upper limbs. In one (1.25%) patient, a fall led to a wound (ulcer) on the scalp at the occipital region. In another (1.25%) patient, there was a boil on the right leg for about a week before the first symptoms of tetanus. Two (2.5%) patients had chronic suppurative otitis media (CSOM). Other risk factors identified were surgery (2.25%), abortion (2.2%), child birth (1.25%), burn (1.25%). In two (2.5%) patients, there was no clinically identifiable portal of entry. Thirty (41.66%) patients did not consider the injury severe enough to be treated either by themselves or by doctors. Of the other forty two (58.33%) patients with a wound who did seek medical help, all got wound cleaning and debridement, thirty (41.66%) received an immunization with tetanus toxoid, and sixteen (22.22%) got prophylactic penicillin antibiotic in combination with an immunization (Table-III). None of the patients received tetanus immunoglobulin in prophylaxis treatment of the wound.

Table-II

Risk factors identified in tetanus patients (n=80)

Presence of injury	Number of patients (%)
Acute injury (puncture, prick, laceration)	68 (85%)
Skin ulcer	1(1.25%)
Boil	1(1.25%)
CSOM	2(2.5%)
Surgery	2(2.5%)
Child birth	1(1.25%)
Abortion	2(2.5%)
Burn	1(1.25%)
No identifiable portal of entry	2(2.5%)
Total	80(100%)

Table-III

Number of patients who received prophylactic treatment for injury/wound before hospital admission (n=72)

Types of prophylaxis	Number of patients (%)
Wound cleaning and debridement	42 (58.33)
Tetanus toxoid	30 (41.66)
Prophylactic antibiotic	16 (22.22)
Tetanus immunoglobulin	0 (0)
No medical treatment	30 (41.66)

Immunization history

A history of previous tetanus immunization was obtained only from fifteen (18.75%) patients (Table-IV). Four patients had received the immunization much more than 10 years ago. There was no written proof of the immunization schedule in any cases. Thirty-seven (46.25%) patients said they never had been vaccinated. The remaining twenty-eight (35%) patients could not provide any information at all regarding vaccination against tetanus. Serology to detect anti-tetanus antibodies was not performed.

Table-IV

Previous tetanus immunization history (n=80)

History of immunization	Number of patients (%)
Received immunization	15(18.75)
Received no immunization	37(46.25)
No information available	28(35)
Total	80(100)

Incubation period

The incubation period, defined as the time between the inoculation of the wound and the onset of the symptoms, could be evaluated in fifty eight (72.5%) patients. The mean incubation period was 10.8 ± 2.1 days (range 3-28 days). Fifteen patients had an incubation period of less than one week, and twelve of them suffered from severe disease. The period of onset, defined as the interval between the first symptoms and the first spasm, could not be evaluated, as it was not recorded in case history of the patients.

Symptoms

All 80 patients developed the generalized type of the disease. A mild type or a local or cephalic type of tetanus was not seen in our patient population. Table-V shows the presenting complaints of the 80 tetanus patients in our series. Body stiffness / spasm (100%), trismus (100%) and dysphagia (51.25%) made up the three commonest presenting complaints. Body ache (25%), backache (22.5%) and abdominal pain (15%) were also fairly common; urinary retention occurred in five (6.25%) patients, while the other complaints (neck pain, jaw pain, dyspnoea) were only present in four (5%) patients each. The diagnosis of tetanus was based upon the clinical presentation. Progression of the disease after initiation of treatment was observed in forty six patients. An increase in trismus, dysphagia, pain and rigidity of the neck and thoracolumbar spine with opisthotonus and generalized rigidity were the manifestations. In the remaining thirty-four patients, symptoms did not deteriorate during the first few days of the treatment.

Table-V

The presenting complaints of the 80 tetanus patients in our series.

Presenting symptoms	Number of patients (%)
Body stiffness / spasm	80(100)
Trismus	80(100)
Dysphagia	41(51.25)
Body ache	20(25)
Backache	18(22.5)
Abdominal pain	12(15)
Urinary retention	5(6.25)
Neck pain	4(5)
Jaw pain	4(5)
Dyspnoea	4(5)

Treatment

All the patients were treated in two isolated rooms to guarantee a quiet environment. There was no intensive care unit at Faridpur medical college hospital. Table VI shows a summary of the treatments given to the 80 tetanus patients. Surgical toileting and debridement of the wounds were performed in all the seventy-four (92.5%) patients with an identifiable portal of entry (68 with acute wounds and 6 with an infective wounds). Seventy-two (90%) patients received intravenous crystalline penicillin as antibiotics (mean dose 10 MU per day for a mean of 9.6 days); forty (50%) patients received it as the only antibiotics and thirty-two (40%) patients received it in combination with metronidazole. Eight (10%) patients received metronidazole only as antibiotics. Sixty-five patients (81.25%) received intramuscular human antitetanus immunoglobulin. All the 80 (100%) patients received intravenous diazepam infusion as an integral part of their management. Supportive treatment such as balanced fluid and calorie intake, prevention of gastric stress ulcer, prevention of pressure sores were provided in all patients. Prophylactic heparin was used in fourteen patients. Sixteen (20%) patients had to be ventilated artificially via orotracheal intubation (2 patients) or tracheostomy (14 patients). The mean duration of artificial ventilation was 27.5 days (range 4-38 days).

Table-VI

Summary of the treatments afforded to the 80 tetanus patients in hospital.

Treatments given	Number of patients (%)
Wound toilet and debridement	74(92.5)
Intravenous diazepam infusion	80(100)
Intravenous crystalline penicillin	72(90)
Intravenous metronidazole	40(50)
IM human antitetanus immunoglobulin	65 (81.25)
Tracheostomy	14(17.5)
Prophylactic heparin	14(17.5)

Complication and outcome

Sixty-four patients (80%) had pulmonary complications such as bronchopneumonia or repetitive atelectasis (Table-VII). Dysfunction of the autonomic nervous system caused

cardiovascular instability in fifty-two patients (65%). Nosocomial infections were diagnosed in fourteen patients. Four patients died in septic shock. The eventual outcomes of the 80 tetanus patients in our series are depicted in fig-2.

Table-VII

<i>Complication occurring during management</i>	
Complications	Number of patients (%)
Respiratory (infection, aspiration, hypoxia, bronchospasm)	64(80)
Cardiovascular (autonomic dysfunction, thromboembolism)	52(65)
Gastrointestinal (stasis, haemorrhage)	46(57.5)
Renal (UTI, renal impairment)	27(33.37)
Neurological (rigidity, memory impairment)	14(17.5)
Miscellaneous (anaemia, hyponatremia, hypoglycaemia)	18(22.5)

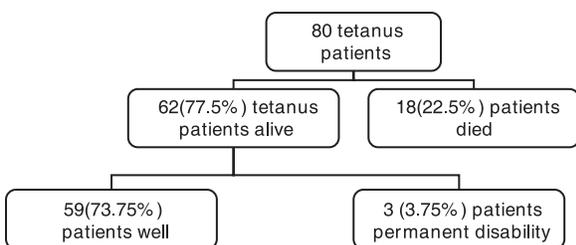


Fig.-2: Flow chart showing the outcomes of the 80 tetanus patients in our series.

There were eighteen deaths, accounting for an overall mortality of 22.5%. Mortality was compared between subgroups of patients. Factors associated with poor outcome were (1) age greater than 50 years (2) female sex (3) occupation as a farmer (4) lack of medical treatment for tetanus prone wound and (5) short incubation period. Four (12.5%) died among 32 patients who were below 50 years of age. Fourteen (29.16%) died among 48 patients who were above 50 years of old and higher rate of death was observed among this group patients (29.16% vs 12.5%, $P<0.05$, Fig-3). Mortality rate was also higher among female than male patients (40% vs 14.54%, $P<0.05$, Fig-4). Farmers experienced more death than non-farmer

(30.95% vs 13.15%, $P<0.05$). Mortality was higher in patients who had not received any medical treatment for their wound than in patients who had received it for their wound (36.66% vs 14%, $P<0.05$). Patients with short incubation period of less than one week had higher mortality in comparison with those who had incubation period more than one week (53.33% vs 23.25%, $P<0.05$).

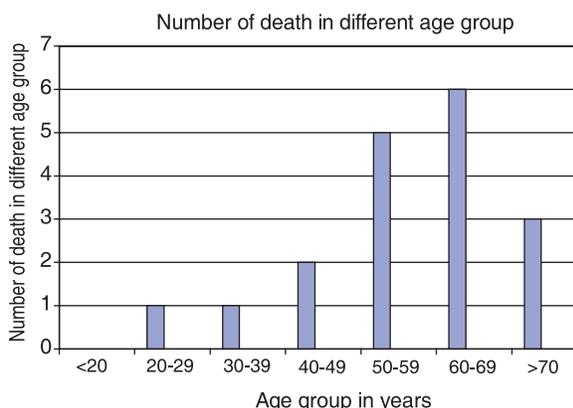


Fig.-3: Number of death in different age group (n=18)

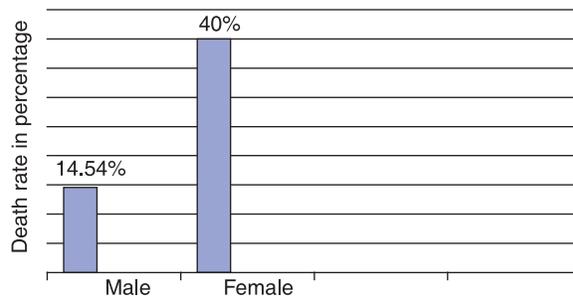


Fig.-4: Mortality in male and female tetanus patients.

Sudden cardiac arrest was the most common (50%) cause of death (Table-VIII). Of the 80 patients, sixty two (77.5%) were alive, though two remained in a persistent vegetative state due to hypoxic brain damage and another required a below knee amputation of the left leg. Hence, 59 (73.75%) were discharged well and 3 (3.75%) were discharged with permanent disabilities.

For those 62 patients that were discharged alive, the length of hospital stay ranged from 16 to 150 days with an average length of stay of 83 days. Two patients spent more than 100 days in the hospital; one spent 150 and the other, 119 days. This made the

average length of stay skewed towards a longer duration.

Table -VIII

<i>Causes of death in tetanus patients (n=80)</i>	
Causes of death	Number (%)
Sudden cardiac arrest	9(50)
Septicemia	4(5)
Recurrent aspiration/ARDS	2(2.5)
Acute hypoxia	1(1.25)
Pulmonary embolism	1(1.25)
Myocardial infarction	1(1.25)

Discussion

In this retrospective descriptive study we identified a total of 80 cases of tetanus in the ten-year period from 1994 to 2003, giving a mean of 8 cases per annum. The case records of these 80 tetanus cases were thoroughly studied to gather various demographic and clinical data of interest. We found regrettably that in some cases the occupational data of the tetanus patients was incompletely entered and hence, we were not able to analyse these tetanus cases in relation to the occupations of the patients. We were also unable to collect sufficient information on immunization history. More detailed history taking and recording should therefore be mandatory in the future so that important and complete data would be available for analysis to provide invaluable information³. Most cases of tetanus occurred in middle aged and elder patients with no prior immunization or with an unknown history of immunization. Waning immunity, caused by the disappearance of the protective antibody levels in subjects who did not receive a regular booster injection, may also account for some tetanus cases⁶. We observed a mean of 8 patients per year with generalized tetanus in our referral hospital. This implies that the present immunization programme does not reach part of the Bangladeshi population. The sex distribution analysis revealed that almost two-thirds of the cases (68.75%) occurred in men while a third occurred (31.25%) in women. This finding is consistent with that of other studies^{4,6,7}. This could be explained by the fact that men tend to spend more time outdoor, in farming activities and other types of fieldwork. Hence, they are more likely

to be exposed to both the causal organism, *C. tetani*, which is ubiquitous in soil in a tropical country like Bangladesh and the penetrating injury necessary for the organism to enter the body.

The mean age of tetanus patients in our series was 51.7 ± 10.08 years. 75% of the tetanus cases occurred in individuals more than 40 years of age. The possible explanation for this observation is that tetanus immunization programme was only commenced in this country in the mid-1960. Hence, people more than 40 years of age have low immunity against tetanus, because they had never received tetanus immunisation^{3,8}. This observation is also consistent with a population-based serologic survey of immunity to tetanus in the United States which showed that the prevalence of Americans with protective levels of tetanus antibody declined rapidly starting at the age of 40 years and that most cases of tetanus occurred in persons of older age group⁹.

Majority (52.5%) of the tetanus patients were farmers. This pattern of occupational risk group is explained by the fact that farmers or the peoples who live in the rural areas and engage themselves in the agricultural sector are more likely to be exposed to the causal organism as well as the injury necessary for the organism to enter the body. Sixty-eight (85%) of the tetanus patients had an identifiable acute skin injury; a prick, a puncture wound or a laceration wound, a figure fairly consistent with that of other studies¹⁰. Thirty-nine (48.75%) of these injuries occurred in the lower limb, while only twenty-nine (36.25%) were on the upper limbs. Other studies also reported that the majority of tetanus wounds were located on the lower limbs¹¹. *C. tetani* exists in soil; hence, any lower limb injury would be open to contamination and infection by this organism, bearing in mind too that most tetanus patients were rural farming folks. In 2.5% of the patients, no probable portal of entry was identified; the injuries were likely to trivial to be recalled^{1,3,10}.

Body stiffness/spasm, trismus and dysphagia, in that order, were the commonest complaints of the tetanus patients in our series. Other investigators had also found trismus and rigidity to be the commonest presenting symptoms^{4,12}. Hence, a high index of

suspicion for tetanus should be exercised whenever patients present with any of these symptoms as tetanus is essentially a clinical diagnosis and laboratory results as well as cultures are of little diagnostic value^{1,4}. If a patient presents with all the three complaints, the probability of tetanus would be extremely high. Tetanus patients also complained of pains and aches involving other parts of the body, either generalised or localized such as back, neck and jaw pain. If these were the only complaint, the correct diagnosis as well the appropriate management might be delayed¹³.

In terms of management, all patients were given intravenous diazepam infusion to control the spasm and relieve the body rigidity^{1,7,12,14}. The usual dose was 10 to 30 mg every eight hours. Sixty-five patients were given intramuscular human antitetanus immunoglobulin to neutralize the free unbound tetanospasmin. All the patients with identifiable portal of entry for the causal organism underwent surgical wound debridement to prevent further elaboration and absorption of the toxin tetanospasmin^{11,12,15,16}. Seventy-two (90%) of the patients received intravenous crystalline penicillin as the treatment antibiotics; Forty (50%) received it as the sole antibiotics and thirty-two (40%) received it in combination with metronidazole (500 mg every six hours). Metronidazole was only used in the management of tetanus after the mid-1996, before which time penicillin was the sole antibiotic employed^{1,17}. In treating *C.tetani* infection, metronidazole as an antibiotic is more effective than penicillin G since it is a GABA antagonist¹⁸. Fourteen patients had tracheostomy performed to circumvent the problem of laryngeal spasm (which could lead to asphyxiation and hypoxia) and to enable tracheal suction and toilet to be carried out efficiently (airway protection)^{6,16}.

The mortality rate of tetanus in our series was 22.5%. This finding is fairly consistent with that of other studies^{6,10,11,14}. Most of the deaths in our series were attributed to sudden cardiac arrest and septicemias, though the blood cultures were positive only in six (33.33%) cases of death. This is in consistent with other studies which showed that the most frequent cause of death was cardiac arrhythmias and infections was the second commonest cause of

mortality¹⁵. A Jamaican study, however, also showed that infective respiratory complications occurred most commonly in their series of 108 tetanus patients, but sudden cardiac arrest was the most common cause of death⁴.

77.5% of patients of our series survived. Three of them, however, suffered permanent disability. One, a diabetic patient, required a below knee amputation for left foot sepsis (following an injury which was the portal of entry for *C. tetani*) that was unresponsive to conservative management. Another patient, presented with back pain, was wrongly thought to have a non-medical problem and was admitted to the orthopaedic ward. There was a delay in the diagnosis of tetanus and the institution of appropriate management¹². One more patient presented late with history of generalized convulsion. Both developed hypoxic brain damage and remained in a persistent vegetative state upon discharge. The average length of hospital stay was 83 days. Two patients stayed for more than 100 days, one stayed 150 days and the other, 119 days.

In conclusion, tetanus remains in Bangladesh an important disease with substantial mortality and morbidity that primarily affects unvaccinated or inadequately vaccinated individuals^{4,7,11,12}. As Bangladesh, like most third world countries, has very limited resources, the continued occurrence of this preventable disease represents a drain on existing health care funds. This must be brought to the attention of institutions responsible for planning health care programmes. Tetanus is highly preventable through both routine vaccination and appropriate wound management^{3,9,10,18}. The method of good management emphasizes: 1) wound care, 2) neutralization of the toxin, 3) antibiotic therapy, 4) supportive measures including good nursing care with control of convulsions, 5) completion of active immunization^{3,18}. Another important aspect that was revealed in our study was the inadequate management of those patients who did seek medical care for their wounds. Patients with tetanus prone wounds and an unknown immunity for tetanus only received a booster vaccine without tetanus immunoglobulin or any prophylaxis at all. The lack of appropriate prophylactic measure during wound management was

found in other studies as well ^{5,6}. Tetanus is a persistent danger that we must not forget but must prevent it. A case of tetanus reflects the failure of our health care delivery system to provide adequate and appropriate immunization ¹. The solution to the problem of tetanus remains prophylaxis ^{10,17,19}.

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Rererences

- Sanford JP. Tetanus- Forgotten but not gone. *N Engl J Med* 1995; 332:812-3.
- Oladiran I, Meier DE, Ojelade AA, Olaolorun DA, Adeniran A, Tarpley JL. Tetanus continuing problem in the developing world. *World J Surg* 2002; 26(10): 1282-85
- Bowen V, Johnson J, Boyle J, Snelling CF. Tetanus - A continuing problem in minor injuries. *Can J Surg* 1988; 31:7-9.
- Perry H, Weierbach R, Hossain I, Islam R. Tetanus toxoid immunization coverage among women in zone 3 of Dhaka city: the challenge of reaching all women of reproductive age in urban Bangladesh. *Bull World Health Organ* 1998; 76(5): 449-57.
- Islam W, Hossain MS. Reproductive health status in Bangladesh. *Bangladesh Bureau of Statistics* 1997:26
- Henderson SO, Mody T, Groth DE, Moore JJ, Newton E. The presentation of tetanus in an emergency department. *J Emerg Med* 1998; 16:705-8.
- Harding-Golson HE, Hanna WJ. Tetanus: a recurring intensive care problem. *J Trop Med Hyg* 1995; 98:17984.
- Bhatia R, Probhakar S, Grover VK. Tetanus. *Neurol-India* 2002; 50(4): 398-407.
- Zuber PL, Schierz A, Arestegui G, Steffen R. Tetanus in Switzerland 1980-1989. *Eur J Epidemiol* 1993; 9:617-24.
- Gergen PJ, McQuilln G, Kiely M, Ezzati-Rice TM, Sutter RW, Virella G. A population-based serologic survey of immunity to tetanus in the United States. *N Engl J Med* 1995; 332:761-6.
- Richardson JP, Knight AL. The prevention of tetanus in the elderly. *Arch Intern Med* 1991;51:1712-17.
- Percy AS, Kutora JS. The continuing problem of tetanus. *Surg Gynecol Obstet* 1985; 160:307-12.
- Peetermans WE, Schepens D. Tetanus - still a topic of present interest: a report of 27 cases from a Belgian referral hospital. *J Intern Med* 1996; 239:249-52.
- Sharma N, Trubuhovich R, Thomas MG. Tetanus in Auckland: a preventable disease. *N Z Med J* 1994; 107:82-4.
- Prospero E, Appignanesi R, D'Errico MM, Carle F. Epidemiology of tetanus in the Marches Region of Italy, 1992-95. *Bull World Health Organ* 1998; 76:47-54.
- Reddy VG. Pharmacotherapy of tetanus-a review. *Middle-East J Anesthesiol* 2002; 16(4): 419-42.
- Lima VM, Garcia MT, Rescende MR, Nouer SR, Campos EO, Papiordanou PM. Accidental tetanus: clinical and epidemiological profile of inpatients at a university hospital. *Rev saude Publica* 1998; 32:66-71.
- Lau LG, Kong KO, Chew PH. A ten-year retrospective study of tetanus at a general hospital in Malaysia. *Singapore Med J* 2002; 42(8): 346-50.
- Jamil K, Bhuya A, Streatfield K and Chakraborty N. The immunization programme in Bangladesh: Impressive gain in coverage, but gaps remains. *Health Policy Plan* 1999; 14(1): 49-58.