

ORIGINAL ARTICLE

Paediatric Tetanus in Rural Zambia: A Case Study

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ABSTRACT

Background: Health care professionals from industrialized nations often travel to work in developing countries as volunteers during natural disasters, as part of short-term medical missions, or to work as members of armed forces and non-governmental organizations. When providing direct patient care, these clinicians are more likely to encounter vaccine-preventable diseases that they may rarely observe in a developed country. In addition, many children who do not have adequate vaccine coverage enter developed nations through international adoption processes or as political refugees. Additionally, despite much debunking of immunization myths, there is a sizable community of parents who choose to withhold immunizations from their children because of fear of unproven side effects.

Methods and Results: This case study highlights a case of a globally-common, vaccine-preventable disease (tetanus), which rarely occurs in developed nations but is more common in Africa and Asia. Diagnosis and management of a 7-year old boy is presented with differential diagnoses and adaptation of optimal disease management within the context of an undeveloped nation. All cases of tetanus are diagnosed clinically, with laboratory testing used to rule out other causes of neurological impairment. The management of acute tetanus infection includes vaccination, antibiotics, immunoglobulin or antitoxin, and nutritional support. Even with optimal treatment, tetanus infection has a high fatality rate and requires prompt recognition for best possible outcomes.

Conclusion: Educating caregivers about the importance and safety of immunizations and maintaining the appropriate vaccination schedule is vital to control these preventable diseases.

Keywords: *paediatric; case study; tetanus; vaccine-preventable; metronidazole*

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Introduction:

Nurses often travel from the country of their original to provide health care. They may be members of the armed services traveling abroad to serve military personnel and civilians. International disasters, such as the tsunami in Indonesia and earthquakes that occurred in Haiti in 2010 and Japan in 2011, attracted international responses of volunteer nurses to help as part of a global medical response. Nurses may travel to work as part of short and long term medical missions to underdeveloped countries. They may also be members of international research teams. Tetanus is a global disease, but many nurses and midwives trained in industrialized countries have not seen a case of tetanus in clinical practice. In 2002, the World Health Organization (WHO) estimated that 14% of the mortality of children less than 5 years of age was due to tetanus (n.d.). Widespread vaccination has reduced cases of tetanus in industrialized nations. For example in the United States, there are only 50-100 cases per year according to the U.S. Center for Disease Control (CDC, 2011).

Even in countries where tetanus occurs more frequently, well-trained nursing professionals could encounter cases of tetanus with unusual presentations that obscure the diagnosis of the infection. The following case study represents a combination of all of these facets of this ancient disease. This boy exhibited a milder, more atypical presentation of generalized tetanus when he presented for care at a clinic staffed by U.S. trained volunteer health professionals. Through careful assessment and prompt recognition of tetanus as a possible diagnosis, this child was able to be transferred for admission to a hospital with the best possible facilities to care for his condition, which facilitated an optimal outcome from a potentially fatal infection. The case study also highlights the need for continued efforts to reduce the incidence of vaccine-preventable diseases in developing nations through mass vaccination. In an era of economic downturn, many private philanthropic organizations have had to decrease donations to programs for the treatment and prevention of neglected diseases such as human immunodeficiency viral infection (HIV), malaria, and tetanus that affect non-industrialized countries at a disproportionate rate. Even in this impoverished setting, it would have been possible to avoid tetanus if this child had received adequate vaccine coverage.

History of Present Illness

Chipo was a 7-year-old boy of the Kakaonde tribe who was seen at a clinic operated by an American church mission in Solwezi, a northwestern province of Zambia. He presented with a 3-day complaint of "a twisted neck" and the inability to eat or talk. His paternal aunt, who took him to the clinic, said that the boy had experienced these symptoms for the past few days. Chipo initially complained of neck pain, and his aunt noticed he was holding his head to the side. The previous day he was

able to eat cornmeal porridge and drink liquids. On the day Chipo came to the clinic, however, he refused to eat or drink. She reported that Chipo responded to his name and followed instructions, but refused to speak.

Past Medical History

Chipo's past medical history included being a full-term, fourth-born child of a G8P5 mother who recently died from complications of childbirth. In Zambia, childhood vaccinations are provided at no cost to children up to the age of 5. According to the national immunization program plan, Chipo had received some vaccinations before he was 5 years old, but caregivers were uncertain if these immunizations were completed. His national immunization card indicated that he received two diphtheria, tetanus, pertussis (DPT) vaccinations, three measles vaccinations, one bacillus Calmette-Guerin (BCG) vaccination, and two doses of oral polio vaccine. Chipo's aunt reported that he had experienced multiple cases of malaria. He had mumps when he was 5-years old, but had no other serious illnesses, hospitalizations, or surgeries. His aunt was unaware of any recent illnesses or injuries.

Family History

The patient's mother (G8T5P2A1L5) had recently died at age 42, a few days after her last birth, due to postpartum complications. His father, a farmer and mine worker in a nearby copper mine, was alive and well. Chipo had two siblings who died in childhood of unknown causes. The aunt said these children "just died." In total, Chipo was one of five living siblings.

Social History

Chipo lived in a small village with his extended family. He lived in a single room dwelling with his aunt, his paternal grandmother, several cousins, and two his living siblings. The youngest two siblings, an infant and toddler, had been placed in orphan care following the death of the mother. Chipo was in first grade and walked to a local community school.

Review of Systems

Chipo's aunt reported that he had been shivering that morning and felt warm to the touch. He had not played as he normally would and stayed in bed when it was time to get ready for school. He had appeared to have difficulty swallowing solids the day before, then that day, he had refused to eat or drink. He coughed occasionally when swallowing liquids. He was able to walk, although his posture was rigid and stiff. His head was tilted to the right, and he was unable to straighten it. He could not turn his neck from side to side. Chipo's aunt had not noticed any wounds, and he had not undergone any recent surgeries. The child made eye contact when his name was called and appeared to follow conversation, but he would not answer direct questions from his caregiver or the nurse midwife

examining him. Prior to being ill, the boy seemed well adjusted, was performing adequately in school, and coping well with the loss of his mother. None of the other household members reported current illness.

General. Physical measurements and vital signs were within normal limits, with the exception of slightly elevated temperature, rapid pulse, and rapid respirations: (a) height -121 cm, (b) weight - 18 kg, (c) temperature- 38.0 C (100.5 F), (d) pulse- 124, (e) respirations- 26, (f) blood pressure obtained manually - 87/40.

Appearance. Chipo was dressed appropriately in a school uniform; he was barefoot. He was alert and calm, making eye contact with the nurse midwife when addressed.

Neurological. Chipo was awake, alert, and oriented to his environment. A complete assessment was not possible due to his inability to speak. He followed all commands. His pupils were equal, round, and reactive to light. No nystagmus was observed. The examination of his cranial nerves was incomplete due to limited participation of the patient. He tracked and followed people and objects, suggesting that vision was intact but a formal exam for visual acuity was not completed. Chipo's hearing appeared to be intact because he turned towards the speaker when his name was spoken or given commands from both directions outside his sight line. The right arm was slightly weaker than the left, 4/5 vs. 5/5. Of importance to the clinical diagnosis of tetanus, testing of the right bicep brachii reflex elicited a spasm, which lasted for several minutes before relaxing. His balance was intact.

HEENT. The eyes, ears and nose appeared normal except for pale conjunctiva. During examination of the oropharynx, the child was only able to open his mouth approximately 4 cm. When the nurse midwife attempted to better visualize the oropharynx and depressed his tongue, Chipo immediately bit down on the tongue depressor but was able to release it without incident. This response is characteristic of tetanus infection.

Neck. There was demonstrated nuchal rigidity, and the neck was tilted to the patient's right. The neck resisted straightening when mild pressure was applied by the examiners hands.

Cardiovascular. The child was tachycardic; however, his cardiac rate was regular and no murmurs or rubs were noted.

Respiratory. The child was tachypneic. Breath sounds were clear bilaterally; no adventitious breath sounds or retractions were noted.

Gastrointestinal. The abdomen was soft, and slightly distended. Normoactive bowel sounds were present in all four quadrants.

Genitourinary. The patient was uncircumcised

with testicles distended. No hernias were observed.

Skin. Chipo was mildly diaphoretic. His skin was warm and damp and intact. The soles of his feet were particularly thick and callused.

Labs. A blood specimen was obtained by way of a capillary sample. The patient had a hemoglobin level of 10 based on the hemoglobin color scale test strip. The total white blood count via hemacytometer was measured at 12,000, with microscopic examination showing 73 neutrophils, 8 bands, 10 lymphocytes, 4 monocytes, and 5 eosinophils. A malaria rapid diagnostic test was negative for falciparum malaria.

Differential Diagnoses

Because of the patient's complaints and examination, the following differential diagnoses were considered;

Tetanus. There was evidence of inadequate vaccine coverage, but no evidence of a wound or report of injury. Two clinical signs characteristic of tetanus were observed. Masseter spasm was elicited when the posterior pharyngeal wall was stimulated. Spasticity was also noted to the right upper extremity when stimulated.

Meningitis. Meningitis is the inflammation of the membranes covering the brain and spinal cord and may be caused by multiple organisms including bacteria and viruses. Clinical presentation of a typical bacterial infection includes severe headache, high fever, nausea, photophobia, stiff neck, drowsiness, anorexia, weakness, and, in severe cases, seizures and coma. Meningitis must always be considered in the setting of a child with a fever, nuchal rigidity, and central nervous system changes. The diagnosis of meningitis would later be ruled out by the negative results of the lumbar puncture.

Rabies. Rabies is a viral disease of the central nervous system that is transmitted through broken skin when mucous membranes are contaminated with saliva from infectious mammals (CDC, 2011). Clinical signs include hydrophobias, muscle spasms, and altered mental status. This differential diagnosis was considered due to the presence of many unimmunized dogs and rodents in Chipo's surrounding. The diagnosis of rabies was tentatively ruled out because of no history of an animal bite.

Strychnine poisoning. Strychnine-based poisons are inexpensive and readily available in this part of Africa. These poisons are sometimes used for control of rats in dried corn stores. Strychnine poisoning can present with neurological changes, which may be similar to tetanus toxin symptoms. Both strychnine and tetanus toxins block the action of spinal and brain-stem inhibitory interneurons, which induces clinical symptoms such as episodes of marked muscle rigidity. Strychnine poisoning is characterized by rapid onset neurological symptoms. Strychnine poisoning, unlike tetanus toxin, usually

produces severe alterations in mental status (CDC, 2006). Without evidence of ingestion of strychnine and because of the slow progression of Chipo's symptoms, strychnine poisoning was considered unlikely.

Based on the examination and the occurrence of masseter spasm upon touching the posterior oropharynx, the decision was made for the Chipo to be admitted to the mission hospital for the treatment of generalized tetanus. The patient was assigned a Dakar Score of 2 (Bleck and Brauner, 2004, Thwaites, et.al. 2006). Secondary diagnoses of hypochromic, microcytic anemia and ascariasis (round worm infestation) were made based on hematology results and the abdominal examination, which indicated that the abdomen was mildly distended. This part of Sub-Saharan Africa is in an area where *Ascaris lumbricoides* (intestinal round worms) are widely prevalent, as mature worms are frequently observed after routine administration of anthelmintics to school children.

Chipo was transferred for admission to a nearby mission hospital. To reduce external stimuli and promote rest, he was placed in a separate room off the pediatric and women's ward. A malaria smear was obtained with negative results. A lumbar puncture was completed, which indicated normal protein, glucose, cell count, and a negative gram stain of the cerebrospinal fluid.

To reduce the patient's pain and rigidity, diazepam was given intravenously at a dose of 0.05 to 0.1 mg/kg every 2 hours as needed. Intravenous fluids were given to maintain hydration and to prevent rhabdomyolysis. Due to Chipo's dysphagia, a nasogastric tube was placed to provide enteral nutrition and prevent aspiration pneumonia. Metronidazole was administered intravenously at a dose of 7.5 mg/kg every 6 hours to reduce tetanus toxin production and equine tetanus antitoxin was given to neutralize unbound toxins. A tetanus booster was also administered as tetanus disease alone does not confer immunity (Thwaites & Yen, 2008).

The following test box includes a brief summary of the Dakar Scoring system for clinical tetanus as described by Thwaites et al. (2006). Because the patient was in an isolated area, junior-level nursing students were assigned to sit with Chipo to provide continuous close observation of the child's vital signs and respiratory status

and to care for his hygiene and toileting needs. Accommodations were made for Chipo's grandmother to stay with him during his hospitalization to provide family presence and emotional support.

Seven days after admission, Chipo's fever increased, and he developed vomiting and diarrhea. These symptoms were attributed to serum sickness from the antitoxin. Serum sickness is a hypersensitivity reaction by patients to non-human antibody proteins. Until resolution of symptoms was achieved, Chipo was treated with diphenhydramine, methylprednisone, and promethazine intravenously, and acetaminophen was administered via rectal suppository. Intubation was never required. Chipo remained in the hospital for a total of 14 days. At the time of his discharge from the hospital, he continued to have mild neck stiffness. He remained on the mission grounds with his grandmother and received physical therapy for two additional weeks before he was discharged home. He returned for follow up care. Chipo has recovered completely.

The adult family members of Chipo's family were educated on the importance of adequate immunizations for all children with all available vaccines for the prevention of tetanus and other vaccine preventable diseases. Chipo's siblings and cousins were brought to the clinic for complete physical examinations and catch-up immunizations, as needed, over the coming months.

Discussion

According to the World Health Organization (2011), generalized tetanus is a manifestation of infection with *Clostridium tetani*. Infection with *C. tetani* causes muscle rigidity and periodic or prolonged spasm of skeletal muscles due to production and distribution of the neurotoxins. *C. tetani* inoculation is usually the result of a wound infection. There are four classifications of tetanus. Generalized tetanus represents 80% of all tetanus cases. In generalized tetanus, skeletal muscles throughout the body are affected. Localized tetanus occurs when only skeletal muscles adjacent to the wound site are affected. In cephalic tetanus, the cranial nerves and neck are involved. Cephalic tetanus frequently occurs as a result of chronic otitis media or head injuries. Neonatal tetanus is generalized tetanus of the newborn. Neonatal tetanus is usually related to umbilical cord care, such as the use of contaminated

Dakar Score

The Dakar score has been used for many years as a means to estimate a prognosis for patients with tetanus. Patients are assigned a score based on clinical presentation at the time of diagnosis and assigned a score of 0-6. A score of 0-1 indicates mild illness which usually correlates with a mortality rate of up to 10%.

A score of 2-3 moderate illness with a mortality of up to 20%.

A score of 4 indicated severe illness with a mortality of up to 40%.

A score of 5-6 indicates very illness with up to 50% mortality. (Thwaites et al., 2006)

instruments used to cut the umbilical cord at birth or the implementation of cultural practices where dust or animal dung is used to dry the umbilical cord.

Pathophysiology

C. tetani is an obligate anaerobic bacterium. *C. tetani* requires low oxygen tension to reproduce and create disease. Damaged tissue, such as a puncture or infected wound, provides the environment for bacterial reproduction. The bacteria produce toxins that enter the nervous system through muscles adjacent to the wound and then can spread through the lymphatic system and blood throughout the body. Gamma-Aminobutyric acid (GABA) release is inhibited by tetanus toxins, resulting in muscle rigidity and spasm (Campbell et. al., 2009).

C. tetani is resistant to many common measures to eliminate bacteria including boiling water, household disinfectants, and dessication. For this reason, *C. tetani* can survive in the environment for long periods of time. In clinical treatment *C. tetani* is susceptible to penicillin, erythromycin, clindamycin, tetracycline, doxycycline, and chloramphenicol and metronidazole (Campbell et. al., 2009).

The Yellow Book (2011), the guide for traveler's health published by the CDC, records the incubation period of tetanus as ranging from as little as 2 days up to 2 months with an average onset of 14 days. Progressive spasm and rigidity develop. These signs can occur spontaneously or due to stimuli such as loud noises. Severe spasms can result in spinal fractures or avulsion fractures to extremities. In severe cases, autonomic dysfunction can occur resulting in periods of hyper and hypotension, respiratory failure, acute renal failure, and gastrointestinal symptoms (Afshar, Raju, Ansell, & Bleck, 2011).

Diagnosis

Laboratory studies are not useful to confirm *C. tetani* infection but can rule out other differential diagnoses. Leukocytosis may be present with tetanus, along with elevations in the sedimentation rate, but these findings would occur in other infectious processes as well. The diagnosis of tetanus is made clinically, based on the history of inadequate immunity through vaccine coverage and a reported wound. The clinician should keep in mind that due to a long incubation period, a patient or caregiver may not recall the injury, or the wound may have seemed innocuous at the time and not remembered at the time of the patients' presentation (Thwaites & Yen, 2008).

The spatula test may be helpful in diagnosis of tetanus. During the spatula test, a soft tipped object is touched to the posterior pharynx. In a negative result, a gag occurs. When spasm of the masseter muscle occurs, the patient will bite down on the spatula. This is considered highly sensitive for the confirmation of the diagnosis of tetanus (Apte & Kanard, 1995; Thwaites & Yen, 2008).

Treatment

Bleck and Brauner (2004) and Thwaites and Yen (2008) offered detailed guidelines for the care of the tetanus patient. Treatment of tetanus is largely supportive and focused on limiting morbidity. When available, the patient should be admitted to an intensive care setting. Ventilator support should be readily available whenever possible. Decreasing stimuli can limit spasms. If a wound is present, the lesion should be thoroughly cleansed. Antibiotic medications are administered to limit the production of tetanus toxin. Human tetanus immunoglobulin should be administered if available, but human tetanus immunoglobulin is expensive and limited in availability. In developing countries, equine tetanus antitoxin is more widely available and relatively inexpensive. Equine antitoxin, however, is associated with hypersensitivity reactions. Benzodiazepenes, magnesium sulfate, and other muscle relaxants are used to limit spasms and to relieve pain (Thwaites et al., 2006). If autonomic dysfunction occurs, short-acting beta blockers or morphine have been used effectively. The previous experience of tetanus disease is not considered to be proof of adequate immunity from future disease. For that reason, immunization with tetanus toxoid should be provided (Thwaites & Yen, 2008). Nursing care should include prevention and monitoring for the development of decubitus ulcers. The patient with tetanus will be bedbound and pressure should be applied over the bony prominences during periods of prolonged spasms. Intravenous fluids and enteral or parenteral nutrition would maintain hydration and nutritional status, and meet protein energy needs for healing.

Prognosis

Mortality rates for tetanus vary widely from 10% in developed countries, such as the United Kingdom and the United States, up to 50% in more impoverished

Text box B

Tetanus

- Clinical manifestation of infection with *Clostridium tetani* (*C. tetani*)
- *C. tetani* is present worldwide in soil and animal and human feces and is resistant to eradication from the environment through normal hygiene measures.
- Usually the result of wound infection
- Infection causes rigidity and periodic or prolonged spasm of skeletal muscles due to production and distribution of the neurotoxins.
- Associated with mortality of 10-50%
- The classifications of tetanus
 - Generalized
 - Localized
 - Cephalic
 - Neonatal

countries with less modern health care infrastructure. Mortality depends largely on the severity of the disease and the availability of comprehensive intensive care services (Bleck & Brauner, 2004; WHO, 2011). Prognostic scales such as the Philips and Dakar Scale have long been used to serve as a predictive tool for assigning a prognosis of the tetanus patient. The Dakar Score remains a highly sensitive tool (Thwaites et. al., 2006).

The text box B contains a brief overview of tetanus

Conclusion

Tetanus is a serious and, often avoidable, bacterial disease caused by the microbe *Clostridium tetani* (*C. tetani*). *C. tetani* is present worldwide in the soil and in the feces of humans and animals such as cattle (Bleck & Brauner, 2004; WHO, 2011). Because elimination of the microbial agent is not possible, control of tetanus is best achieved through adherence to vaccination recommendations. In the United States, 233 cases were reported from 2001-2008 with a 13.2% fatality rate (CDC, 2011). It is estimated that there are as many as 1,000,000 cases of tetanus worldwide annually, though reporting is limited by logistical challenges in many areas (WHO, 2006). Access to intensive care facilities including ventilator support, enteral and parenteral nutrition, appropriate antibiotics, antispasmodics, and medications to counteract autonomic dysfunction, is essential for optimal treatment of tetanus. Metronidazole is considered the antibiotic of choice because this drug is associated with the shortest recovery time and lower rates of fatality when compared to penicillin or other appropriate antibiotics (Campbell et. al., 2009). Mortality due to tetanus ranges from 10% to 50% depending on severity of disease, availability of critical care services, and predisposing factors. Prompt recognition, care, and support can help deliver the best possible outcomes. It is important for all nurses, including advanced practice nurses trained in countries with broad population immunization coverage, to remain alert to potential vaccine-preventable diseases like tetanus. This is especially important when these health care providers are caring for clients with inadequate vaccination immunity. Even in developed nations, many people remain unvaccinated or need booster vaccines to achieve immunity. Educating caregivers about the importance and safety of immunizations and maintaining the appropriate vaccination schedule is vital to control these preventable diseases.

References

1. Afshar, M., Raju, M., Ansell, D., & Bleck, T. (2011). Narrative review: Tetanus-a health threat after natural disasters in developing countries. *Annals of Internal Medicine*, 154(5), 329-335.
2. Bleck T.P., & Brauner J.S. (2004). Tetanus. In: Scheld W.M., Whitley R.J., Durack D.T. (Eds.) *Infections of the central nervous system* (3rd ed., pp. 629-623). Philadelphia, PA: Lippincott-Raven Publishers.
3. Campbell, J. I., Yen, L. T. M., Loan, H. T., Diep, T. S., Nga, T. T., Van Minh Hoang, N., Son, L. T., et al. (2009).

Microbiologic characterization and antimicrobial susceptibility of *Clostridium tetani* isolated from wounds of patients with clinically diagnosed tetanus. *American Journal of Tropical Medicine and Hygiene*, 80(5), 827-831.

4. CDC (2006). Facts about Strychnine. Retrieved from <http://www.bt.cdc.gov/agent/strychnine/basics/facts.asp>
5. CDC (2011). Tetanus Surveillance- United States, 2001-2008. *Morbidity and Mortality Weekly Report*, 60(12) 365-69. Retrieved from http://cdc.gov/mmwr/preview/mmwrhtml/mm6012a1.htm?s_cid=mm6012a1_w
6. Grunau, B. and Olson, J. (2010). An interesting case of pediatric tetanus. *Canadian Journal of Emergency Medicine*;12(1), 69-72.
7. Howard, C., & John, C. (2011). International adoption. In: CDC Health Information for International Travel, The Yellow Book, 2012. Oxford New York: Oxford University Press. Retrieved 09/25/11 from <http://wwwnc.cdc.gov/yellowbook/2012/chapter-7-international-travel-infants-children/international-adoption>.
8. Thwaites, C.L., and Yen, L (2008). Tetanus. In: Mason's Tropical Diseases (21st ed., pp 1113-19). Philadelphia: W.B. Saunders, Elsevier Limited.
9. Thwaites, C. L., Yen, L. M., Glover, C., Tuan, P. Q., Nga, N. T. N., Parry, J., Loan, H. T., Bethell, D., Day, N. P. J., White, N. J., Soni, N., & Farrar, J. J. (2006). Predicting the clinical outcome of tetanus: the tetanus severity score. *Tropical Medicine & International Health*, 11: 279-287. doi: 10.1111/j.1365-3156.2006.01562.x
10. World Health Organization. (n.d.). Immunization surveillance and monitoring. Retrieved from http://www.who.int/immunization_monitoring/diseases/en/
11. World Health Organization. (2006). Tetanus vaccine: WHO position paper. *World Epidemiological Record*. 81, 197-208.