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CASE REPORT

Survival of a Patient With Tetanus in Bhutan Using a Magnesium Infusion Managed Only by Clinical Signs

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Tetanus is a life-threatening disease that continues to have a high prevalence in developing countries. Severe muscle spasms often require patients to receive tracheostomy, high-dose sedatives, and sometimes prolonged neuromuscular blockade. Magnesium sulfate ($MgSO_4$) infusion has great promise as an adjunct treatment for severe tetanus, as it may allow clinicians to decrease the dose of other sedative medications. Although the mechanism of action of $MgSO_4$ is not well understood, it appears to attenuate both the muscle spasms and autonomic instability associated with severe tetanus infections. However, $MgSO_4$ infusions are often managed based on serial measurements of serum magnesium levels and other laboratory tests such as arterial blood gases, which can be difficult to obtain in resource-poor settings. We describe a case of severe tetanus in Bhutan managed through the use of magnesium infusion titrated solely to physical examination findings.

Key words: anticonvulsants, Bhutan, developing countries, magnesium sulfate, autonomic nervous system diseases, tetanus

Introduction

Tetanus is a life-threatening disease and is difficult to manage even in environments with the best resources available. Severe muscle spasms often require patients to receive tracheostomy, high-dose sedatives, and sometimes prolonged neuromuscular blockade. Magnesium sulfate ($MgSO_4$) infusion has great promise as an adjunct treatment of severe tetanus, as it may allow clinicians to decrease the dose of other sedative medications. Typically, $MgSO_4$ infusions are managed based on serial measurements of magnesium levels and other laboratory values. We describe a case of tetanus management in Bhutan through the use of magnesium infusion titrated solely to physical examination findings.

Case Report

A 56-year-old man was admitted to Wangdue Hospital, a small district hospital in Bhutan, 2 weeks after sustaining an injury to his left thigh. The patient had no history of receiving a tetanus vaccine. At the district hospital, the patient had the typical risus sardonicus facies, fever, and whole body spasms. He was treated with antitetanus serum based on the clinical diagnosis of tetanus infection. Seven days later, worsening clinical status prompted transfer of the patient to Jigme Dorji Wangchuck National Referral Hospital (JDWNRH) in Thimphu, Bhutan.

On admission to JDWNRH, the patient was experiencing severe spasms of all voluntary muscles with minimal provocation. He was febrile to 38.3°C and mildly tachycardic. His mentation was intact. Initial treatment included intravenous antibiotics and benzodiazepines. The severity of rigidity and spasms continued to increase, despite increased use of benzodiazepines. A tracheostomy was performed and the patient required mechanical ventilation as a result of respiratory distress. The patient experienced worsening muscle spasms refractory to medications such as atracurium, morphine, and diazepam. At one point, the patient received 80 mg of diazepam during 24 hours. Owing to the refractory nature of the spasms and the large amount of sedatives that were required, the decision was made to use $MgSO_4$ infusion as first-line therapy on hospital day 14.

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The use of magnesium infusion for treatment for tetanus had not been attempted in this hospital previously. JDWNRH lacks the ability to perform serum magnesium levels and arterial blood gas measurements. However, the hospital has used intravenous $MgSO_4$ to treat eclampsia by monitoring for clinical signs and symptoms of magnesium toxicity. The patient was started on IV $MgSO_4$ therapy according to a previously published protocol (Appendix).[1] The patient received a loading dose of 70 mg/kg IV $MgSO_4$ and then was started on a maintenance infusion of 2 g/h. The $MgSO_4$ infusion was titrated to control spasms and rigidity while monitoring vital signs, sedation, and deep tendon reflexes. All other sedative drugs were ceased. Urine output was monitored on an hourly basis.

After being placed on the magnesium infusion, the patient's spasms decreased. Within 3 days, the patient was receiving $MgSO_4$ as the sole treatment for his tetanus. Before the use of magnesium, examiners had not been able to passively flex the patient's knees. However, after initiation of $MgSO_4$, the patient's rigidity decreased substantially and the patient could independently flex his lower limbs. The rate of magnesium infusion was titrated to the patient's spasms with close observation of vital signs and sedation. After 8 days of treatment, the infusion dosage was decreased to 500 mg/h with occasional increases to treat intermittent spams. The infusion continued to be weaned and finally was stopped on hospital day 27, which represented 20 days of intravenous magnesium treatment. By hospital day 28, the patient was transferred to the medical surgical ward. At this time, the patient could sit up in bed and was able to maintain normal oxygen saturation without supplemental oxygen. Spasms were no longer present. He was neurologically intact with a Glasgow coma score of E4 V1T (intubated) M6. The tracheostomy tube was successfully removed shortly thereafter.

Discussion

In industrialized countries, improved medical services such as standardized immunization regimens and newborn delivery practices have significantly decreased the incidence of tetanus. However, tetanus remains endemic in the developing world. Although the majority of cases occur among neonates, there continues to be significant morbidity and mortality from nonneonatal tetanus in developing countries.[2] A World Health Organization estimate based on worldwide community-based surveys extrapolated at least 155,000 cases and 78,000 deaths from nonneonatal tetanus in 1990.[2]

Clostridium tetani is a gram-positive, obligate anaerobic bacillus.[3] The toxins secreted by *C tetani* enter the central nervous system and interfere with inhibitory impulses to motor neurons.[4,5] Reflex inhibitory arcs are lost, and both agonist and antagonist muscle groups contract simultaneously.[5] Tetanus also leads to derangements of the autonomic nervous system, including an excessive sympathetic state and increased circulating plasma catecholamines.

The incubation period for tetanus infections averages 7 to 10 days.[5,6] Shorter incubation periods correlate with a more severe disease course and worse prognosis.[5,7] The first week of the illness is characterized by muscle rigidity and spasms. Patients may present with trismus or risus sardonicus, attributable to increased tone in the orbicularis oris muscles.[3,5,6] Spasms then progress to more generalized involvement of the body. Tetanic spasms frequently are provoked by sensory stimuli, and affected patients are very sensitive to visual, tactile, and auditory triggers.[8] Opisthotonic spasms may occur, which are very painful, generalized tetanic spasms of the body associated with severe arching of the back.[3,5,8] Airway compromise may occur as a result of a variety of mechanisms, ranging from acute obstruction after laryngeal muscle spasm or decreased chest wall compliance owing to generalized muscle spasms.[3,6] Autonomic instability typically starts after the spasms and persists for 1 to 2 weeks.[5] By decreasing the incidence of respiratory complications, modern intensive care has uncovered the degree of autonomic instability that can be associated with tetanus. One study found that with intensive care unit (ICU) treatment, 40% of deaths from tetanus occurred secondary to sudden cardiac death and autonomic instability, whereas 15% of deaths were attributed to respiratory complications. Before the establishment of ICU care in this study, 80% of patients died as a result of acute respiratory failure.[9]

The treatment of tetanus infection includes antibiotic administration, passive immunization with human tetanus immune globulin (TIG), intravenous immune globulin (IVIG), or tetanus antitoxin.[3,7,10] Affected individuals also must be vaccinated because infection does not provide immunity.[5,10] As a result of the prolonged time frame of clinical infection, much of the treatment of generalized tetanus infections consists of supportive care such as airway protection, deep sedation, control of autonomic instability and muscle spasms, and artificial ventilation. Common medications used for such goals include benzodiazepines, opiates, and neuromuscular antagonists. Each of these classes of medications has its own associated toxicity. Thus, interest has developed in the use of $MgSO_4$ infusion as a possible mechanism to replace or reduce the use of sedative or paralytic medications.

The mechanism by which magnesium treatment affects muscle tone and contraction is not well understood. It is