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Tetanus, a Forgotten Disease. Description of Two Cases in Pediatric Patients and Literature Review

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Abstract

Tetanus is an infectious disease caused by the bacterium *Clostridium tetani.* In México, a significant decline in vaccination coverage has been observed in recent years, reflected by a rise in reported cases.

This upward trend highlights the urgent need to raise awareness among the general population regarding the importance of prevention through timely immunization.

Keywords: *Tetanus; Muscle Spasms; Vaccination; Prevention; Infection*

Abbreviations

IU: International Unit; WHO: World Health Organization; TIG: Tetanus Immune Globulin; FDA: Food and Drug Administration; pH: Potential of Hydrogen; Tdpa: Tetanus, Diphtheria and Acellular Pertussis Vaccine; Td: Tetanus and Diphtheria Vaccine

Introduction

Tetanus has become a rare disease in developed countries due to the success of widespread immunization programs. However, it remains a serious threat to unvaccinated individuals, particularly in developing countries.

In México, vaccination coverage among the pediatric population has declined significantly. According to recent data, by 2023, coverage with the pentavalent or hexavalent vaccine in children under five years of age was only 69%, far below the national target of 90% [1].

Due to its low incidence, the clinical manifestations, diagnosis, and management of tetanus are not widely recognized among healthcare professionals, potentially delaying timely identification and treatment. The main clinical forms of tetanus include [2]:

- Localized: Typically presents with muscle stiffness confined to a specific area.
- Generalized: Commonly presents with trismus, dysphagia, and nuchal rigidity, accompanied by generalized muscle rigidity and tonic contractions.
- Cephalic: May present with cranial nerve palsies.
- Neonatal: Manifests in newborns as irritability followed by severe muscular stiffness.

Case Descriptions

Case 1

A 9-year-old female patient with a background of low socioeconomic status, poor hygiene practices, and an incomplete vaccination schedule with no tetanus immunization sustained a penetrating injury on the dorsum of the right foot caused by a tree branch. The wound did not receive medical attention and was instead treated with natural remedies based on aloe vera.

Three weeks later, the patient began having trouble with speech articulation and ambulation, followed by generalized muscle stiffness and spinal arching (opisthotonos). She was brought to a secondary-level pediatric emergency department, where generalized tetanus was suspected. Treatment with tetanus antitoxin (500 IU) and intravenous penicillin G was initiated, but without advanced airway management.

After four days, she was transferred to the Hospital para el Niño Poblano. Upon arrival, due to the presence of generalized spasms and absence of airway control, she was admitted to the Pediatric Intensive Care Unit. Antibiotic therapy was switched to metronidazole, and muscle relaxants along with benzodiazepines were administered.

During hospitalization, the patient developed ventilator-associated pneumonia due to *Pseudomonas aeruginosa,* and a vascular line infection caused by *Candida pelliculosa*. She remained hospitalized for 26 days and was discharged without neurological sequelae.

Case 2

A 10-year-old previously healthy female patient with a background of low socioeconomic status and household overcrowding. Her parents had refused routine vaccinations. She sustained a 1 cm deep laceration on the heel of her left foot caused by a piece of wood in the backyard of her home.

Seven days later, she developed abdominal pain, followed by chest pain and muscle spasms in the trunk and neck. She was taken to a secondary-level healthcare facility, where abdominal pathology was initially suspected. An abdominal ultrasound was performed, surgical intervention was ruled out, and the patient was discharged home.

Due to persistent symptoms, she returned to the same facility, now presenting with neurological deterioration, laryngeal stridor, and decreased respiratory effort, which led to endotracheal intubation.

Bacterial meningitis was initially suspected. Lumbar puncture revealed a pH >7.8, glucose level of 127 mg/dL, protein level of 12 mg/dL, and 3 cells/mm^3. Empirical treatment with ceftriaxone and vancomycin at meningeal doses was initiated.

The patient was transferred to the Pediatric Intensive Care Unit at the Hospital para el Niño Poblano, where she was evaluated by the Pediatric Infectious Diseases Service. Based on her epidemiological background and clinical presentation, a diagnosis of cephalic tetanus

was established. Consequently, antibiotic therapy was switched to intravenous metronidazole, and she was treated with tetanus antitoxin (500 IU), benzodiazepines, and muscle relaxants.

During her hospital stay, she developed a vascular line infection caused by *Candida pelliculosa.* She remained hospitalized for 50 days and was discharged without neurological sequelae.

Sex	Age	Inoculation site	Clinical Presentation	Vaccination History	Treatment	Neurological sequelae
Female	9 years	Dorsum of right foot (tree)	Speech and gait disturbances, generalized rigidity (opisthotonos). Generalized presentation	Absent	Metronidazole, tetanus antitoxin 500 IU, benzodiazepines (midazolam), magnesium sulfate.	No
Female	10 years	Left foot heel (wood)	Chest pain, trunk and neck muscle spasms, laryngospasm. Cephalic presentation	Absent	Metronidazole, tetanus antitoxin 500 IU, benzodiazepines (midazolam), magnesium sulfate.	No

Table 1: *Clinical characteristics of patients diagnosed with tetanus.*

Source: Own database. Hospital para el Niño Poblano, 2024.

Discussion

Etiology and pathophysiology

Tetanus is caused by *Clostridium tetani*, a Gram-positive, spore-forming, strictly anaerobic bacterium [3]. It produces a potent neurotoxin known as tetanospasmin, which is responsible for the clinical manifestations of the disease.

The incubation period typically ranges from 3 to 21 days, with most cases presenting symptoms around the eighth day, depending on the site of inoculation. The microorganism proliferates in contaminated wounds, particularly those that are deep, devitalized, and poorly managed, increasing the risk of toxin production [4].

If the contaminating strain of *Clostridium tetani* harbors the plasmid encoding the tetanospasmin gene, the toxin is produced and accumulates in the bacterial cytoplasm and is released upon bacterial autolysis. It binds to peripheral motor and sensory neurons and is transported retroaxonally to the spinal cord, where it blocks the release of glycine and gamma-aminobutyric acid, resulting in spastic paralysis [5].

Other toxins released by *Clostridium tetani* include tetanolysin, which contributes to cell lysis, and a plasmid-encoded collagenase that hydrolyzes the extracellular matrix, providing nutrients for bacterial growth [5].

Epidemiology

Tetanus has a worldwide distribution and is more prevalent in tropical climates. The bacterium is naturally found in soil as well as in the intestines of animals and humans, making it ubiquitous in the environment and rendering eradication impossible.

In México, the incidence of tetanus has generally declined over the years. However, during the early 2000s, an increase in the number of cases was observed in both the general and pediatric populations when compared to more recent data [6].

Despite some year-to-year variations, the overall trend indicates a sustained reduction in the total number of tetanus cases over several decades. Additionally, a decrease in the proportion of pediatric cases relative to the total has been noted, suggesting improvements in prevention strategies, access to vaccination, and preventive healthcare focused on the pediatric population in México.

The following table (Table 2), presents the nationally reported cases in México over the past 10 years, categorized by age distribution.

Year	Cases	<1 year	1 - 4 years	5 - 9 years	10 - 14 years	15 - 19 years	Total (Pediatrics)
2012	28	0	1	2	1	0	4
2013	20	0	0	2	0	1	3
2014	25	0	2	2	1	1	6
2015	27	0	1	0	1	1	3
2016	33	1	1	2	1	0	5
2017	26	0	0	4	1	0	5
2018	23	0	2	1	1	1	5
2019	34	0	5	2	0	0	7
2020	14	0	1	0	0	1	2
2021	21	0	2	2	0	3	7
2022	29	0	2	6	2	4	14

Table 2: *Cases in pediatric patients in México from 2012 to 2022.*

Source: Secretaría de Salud. Histórico Boletín Epidemiológico [Internet]. gob.mx. [cited 20 December 2024]. Available from: https://www.gob.mx/salud/acciones-y-programas/historico-boletin-epidemiológico.

Notably, between 2021 and 2022, a significant increase in the number of pediatric tetanus cases was observed, with 7 and 14 cases reported, respectively. This rise is concerning and has prompted the recent publication of case reports, including Hernández., *et al*. in 2023 from Hospital Civil of Tepic [7] and Caro., *et al.* in 2024 from the General Hospital of Chetumal [8].

Clinical manifestations

In neonates, the primary route of entry is the umbilical cord, while in patients older than one month, wounds or dermabrasions are the most common portals of entry [4].

The severity of tetanus is largely determined by the rapidity of symptom onset; a faster progression is associated with a more severe clinical presentation. The incubation period varies depending on the distance between the inoculation site and the central nervous system, with an incubation period of less than 7 days considered a poor prognostic factor. The Ablett classification is the most widely used system for defining disease severity (Table 3) [9].

Grade	Severity	Symptoms
1	Slight	Mild to moderate trismus, generalized spasticity, no respiratory involvement.
2	Moderate.	Moderate trismus, marked rigidity, short spasms, mild dysphagia.
3	Severe	Severe trismus, generalized passivity, prolonged spasms, increased respiratory rate, severe dysphagia, tachycardia.
4	Very serious	Clinical manifestations of grade three tetanus, autonomic system dysfunction, severe hypertension and tachycardia, alternating with hypotension and bradycardia.

Table 3: *Ablett's classification.*

Source: [9].

Neonatal tetanus: In neonatal tetanus, the incubation period ranges from 3 to 28 days, with an average of 5 to 7 days after birth. The initial symptoms typically include uncontrollable crying and irritability, accompanied by refusal to feed. Subsequently, generalized spasms develop, often presenting with the classic "opisthotonos" posture due to spasms of the paravertebral muscles [10].

Generalized, localized, and cephalic tetanus: Tetanus spasms may present in a generalized form, involving all muscle groups; as localized tetanus, affecting a specific limb or region; or as cephalic tetanus, limited to the head and neck. Spasms can be triggered by auditory, tactile, or visual stimuli. Trismus and risus sardonicus result from sustained facial muscle contractions. In cephalic tetanus, clinical manifestations are restricted to the head and neck and may include cranial nerve palsies [9].

In severe cases, the autonomic nervous system is involved. Hypertension and tachycardia are the most common findings, although patients may exhibit rapid fluctuations in blood pressure and heart rate. Intestinal and bladder function may also be affected, along with increased respiratory secretions, which complicate clinical management[8]. Due to the prolonged hospitalization often required, patients are also at risk of complications associated with intensive care, such as healthcare-associated infections [10].

Discussions

The World Health Organization (WHO) defines confirmed neonatal tetanus as the onset of poor sucking and irritability between 3 to 28 days after birth, accompanied by the development of stiffness or muscle spasms in a newborn who previously had normal feeding behavior during the first two days of life [11].

For non-neonatal cases, the WHO defines confirmed tetanus as the presence of at least one of the following clinical signs: trismus, risus sardonicus (sardonic smile), or painful muscle contractions, in association with a history of wound or injury [11].

A clinical diagnosis of tetanus is made by ruling out other causes of tetanus spasms. Attempts to isolate *Clostridium tetani* bacteria are associated with poor results, and a negative culture does not rule out the disease. Therefore, it is not used for diagnosis, nor is titration of serum antitoxin levels. Disease may also occur despite adequate antibody levels [4].

Treatment

Although modern advances in critical care have improved patient survival, prevention through immunization and proper wound management remains the cornerstone of tetanus control [12].

Toxin neutralization

Human tetanus immune globulin (TIG): The recommended dose is 500 IU administered intramuscularly, regardless of the patient's weight. If TIG is unavailable, intravenous human normal immunoglobulin can be used as an alternative at doses of 200 - 400 mg/kg per dose. However, this use has not yet been approved by the Food and Drug Administration of the United States (FDA) [13].

Wound management

Proper wound care is essential and begins with thorough washing of the wound with soap and water for at least 10 minutes, followed by irrigation with saline solution. Adequate debridement of devitalized tissue is also considered crucial [14].

Regarding antimicrobial treatment, metronidazole (oral or intravenous) is the antibiotic of choice to reduce the number of vegetative forms of Clostridium tetani. The recommended dose is 30 - 40 mg/kg/day divided every 8 hours. In neonatal patients, the dosage is 15 mg/kg/day in those under 7 days of age and 30 mg/kg/day in those older than 7 days [10].

An alternative option is penicillin G at a dose of 100,000 IU/kg/day, administered for 7 to 10 days [4].

Supportive treatment

Airway management: Securing the airway is essential due to the risk of laryngeal and respiratory muscle spasms that compromise ventilation. For this reason, tracheal intubation and elective mechanical ventilation are often required in moderate to severe cases.

Spasm control: The following pharmacologic agents are used to manage muscle spasms:

- Benzodiazepines: These are the first-line agents for spasm control in tetanus. Diazepam is the most widely used worldwide; however, midazolam is also considered an effective alternative.
- Neuromuscular blockers: When spasms are not adequately controlled with benzodiazepines, the use of neuromuscular blockers may be considered. Recommended agents include vecuronium, pipecuronium, and rocuronium.
- Magnesium sulfate: Although its use has not demonstrated a reduction in mortality or the need for mechanical ventilation, several studies have shown that magnesium sulfate reduces the required doses of benzodiazepines and neuromuscular blockers [14].

Prevention and prophylaxis of wounds

In the pediatric population in México, the following are available [15]:

- Hexavalent vaccine: This formulation combines inactivated poliovirus vaccine, recombinant hepatitis B vaccine, acellular pertussis vaccine, diphtheria and tetanus toxoids, and conjugated *Haemophilus influenzae type B.*
- Triple bacterial vaccine (DPT): This preparation contains diphtheria and tetanus toxoids adsorbed onto an adjuvant, along with inactivated Bordetella pertussis.

Vaccine	Indication
Hexavalent	All infants are due to receive it at 2, 4, 6 and 18 months of age.
Triple bacterial (DPT)	This vaccine is administered as a booster at 4 years of age after the application of the hexavalent primary schedule (4 doses).

Table 4: *Vaccines included in the vaccination schedule in the National Health Card for children from 0 to 9 years of age.*

Gobierno de México. Manual de Vacunación. México: Gobierno de México, 2021 [citado mayo, 2024]. Disponible en: https://www.gob.mx/salud/censia/es/articulos/manual-de-vacunacion-2021-295402?idiom=es.

Similarly, it is important to train all health personnel on tetanus prophylaxis in wound management. Table 5 shows the scheme to be followed.

Vaccination history	Minor clean wounds		Other wounds[a]	
	Tdpa, Td	Anti Tetanus immunoglobulin	Tdap o Td	Anti Tetanus immuno-globulin
Less than 3 doses or unknown	Si	No	Si	Si
Three or more doses	No[b]	No	No[c]	No

Table 5: *Tetanus prophylaxis in wounds.*

Tdpa= Tetanus, Diphtheria and Acellular Pertussis Vaccine; Td: Tetanus and Diphtheria Vaccine.

a. Wounds such as those contaminated with soil, fecal matter, oil or saliva, as well as wounds caused by firearms, burns and crushing.

b. Administered it more than 10 years since the last tetanus toxoid-containing vaccine.

c. Administered it more than 5 years old from the last tetanus toxoid-containing vaccine.

CDC. Chapter 21: Tetanus [Internet]. Epidemiology and Prevention of Vaccine-Preventable Diseases. 2024 [citado el 3 de febrero de 2025]. Disponible en: https://www.cdc.gov/pinkbook/hcp/table-of-contents/chapter-21-tetanus.html

Conclusion

Tetanus remains a public health threat among non-immunized populations, particularly in settings with low vaccination coverage, such as those observed in México in recent years partly due to the indirect consequences of the SARS-CoV-2 pandemic.

The cases presented in this report demonstrate that, despite progress in critical medicine, prevention remains the most effective strategy against tetanus. It is crucial to strengthen childhood immunization programs and to ensure healthcare personnel are adequately trained in proper wound prophylaxis and early recognition of the clinical signs of tetanus.

Finally, this report highlights the importance of maintaining active epidemiological surveillance and raising awareness among both the general population and healthcare professionals, to prevent this entirely avoidable disease from continuing to cause mortality or long-term sequelae.

Conflict of Interest

The authors declare no conflict of interest related to this article.

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Ethical Considerations

This study complies with current regulations on bioethical research. Authorization from the Ethics Committee was not required, as no identifiable patient information is disclosed. Nevertheless, informed consent was obtained from the guardians of the patients referenced in this article.

Bibliography

1. Mongua-Rodríguez N., *et al*. "Cobertura de vacunación en niños, niñas y adolescentes en México". *Salud Pública de México* 65.1 (2023): s23-s33.
2. Deniz M and Erat T. "Generalized tetanus: a pediatric case report and literature review". *Revista Do Instituto de Medicina Tropical de São Paulo* 65 (2023): e40.
3. Ryan KJ., *et al*. "Ryan & Sherris medical microbiology". McGraw-Hill Education/Medical (2022).
4. American Academy of Pediatrics. "Tetanus". Red Book 2021: Report of the Committee on Infectious Diseases. Itasca, IL: American Academy of Pediatrics (2021).
5. Megighian Aram., *et al*. "Tetanus and tetanus neurotoxin: From peripheral uptake to central nervous tissue targets". *Journal of Neurochemistry* 158.6 (2021): 1244-1253.
6. Secretaría de Salud. "Histórico Boletín Epidemiológico" (2024).
7. Hernández-García M., *et al*. "Tétanos infantil". *Revista Mexicana de Pediatría* 90.5 (2023): 187-190.
8. Caro-Lozano J and Zúñiga-Carrasco IR. "Tétanos una enfermedad reemergente". *Revista Medica Sinergia* 9.8 (2024): e1168.
9. Yen L and Thwaites CL. "Tetanus". *The Lancet* 393.10181 (2019): 1657-1668.
10. Robinson AL and Andriatahina TN. "Tétanos neonatal". *EMC-Pediatría* 56.3 (2021): 1-7.
11. Rhinesmith E and Fu L. "Tetanus disease, treatment, management". *Pediatrics in Review* 39.8 (2018): 430-432.
12. Niu K-Y and Lin Y-K. "Generalized tetanus". *Canadian Medical Association Journal* 191.34 (2019): E944.
13. Fields B., *et al*. "Don't Be a Stiff". *Advanced Emergency Nursing Journal* 43.1 (2021): 10-20.
14. Berkowitz AL. "Tetanus, botulism, and diphtheria". *Continuum Lifelong Learning in Neurology* 24.5 (2018): 1459-1488.
15. Secretaría de Salud. "Manual de Vacunación. México". Gobierno de México (2021).
16. CDC. "Chapter 21: Tetanus". Epidemiology and Prevention of Vaccine-Preventable Diseases (2024).

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