



An Emblematic Case of Tetanus in a Young Adult Vaccinated

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Tetanus remains a major public health problem in developing countries. The annual number of cases in Morocco is relatively low. The prognosis for this disease is as severe as ever, and all the gloomier as the diagnosis and treatment are late. Despite the improvement in intensive care, its lethality is still high, especially due to respiratory complications, Managing injuries is a major tetanus prevention strategy. Failure to manage injuries places victims dangerously at risk of disease. It is important to also assess tetanus immunization through the health or vaccination record. Symptomatic treatment is based on the use of muscle relaxant and sedative therapy, in which diazepam is the leader. Barbiturates, in particular phenobarbital, can be used alone or in combination with diazepam in severe forms. Central analgesics, and sometimes curares, are used in the sedation of patients placed on mechanical ventilation through a tracheal intubation tube, or secondarily through a tracheostomy tube which is often necessary. The specific treatment consists of antibiotic therapy (Peni G or Metronidazole), serotherapy, and tetanus vaccination as well as the

management of tetanus-prone wounds. Vaccination should be routine to prevent recurrence, because tetanus is not an immunizing disease. We report a case of tetanus following a puncture wound to the soles of the feet by a rusty nail. The objective is to remind clinicians of the importance of this prophylaxis in any injured person who is not vaccinated or has a questionable immune status. Our Patient is a 28-year-old vaccinated against tetanus but without a booster for more than 5 years, was admitted to intensive care at the Avicenna military hospital in Marrakech, for neck pain, difficulty walking and opening the mouth (masseter muscle spasm, or lockjaw), abdominal contracture and para-vertebral muscles. In his history, he points to a perforating wound on the sole of the foot with a rusty nail that was treated without tetanus prophylaxis about two weeks ago. The examination on admission noted a trismus, abdominal contracture, and a puncture scar on the soles of the feet. The diagnosis of a generalized tetanus at portal of entry a puncture plantar wound was retained. Under treatment the initial evolution was favorable and he was released from the hospital on August 04, 2021. He was readmitted eight days later for the reappearance of neck stiffness, pain in back, painful tonic contractions and spasms and thoracic rigidity, the course was characterized by the occurrence of a spectacular opisthotonus particularly triggered by light stimuli. The introduction of phenobarbital with gradual reduction in dose of diazepam allowed a remarkable reduction in the frequency of spasm and paroxysms, he was discharged from the hospital on August 20, 2021 on Phenobarbital 50 mg twice a day in the morning and in the evening.

Keywords: Tetanus; resuscitation; treatment; prognosis.

1. INTRODUCTION

Tetanus is an acute, potentially fatal, and non-contagious illness caused by neurotoxin produced by the spore-bearing anaerobic bacterium. *Clostridium tetani* enters the body through a wound. When the anaerobic conditions are met, the germination of the spores begins. The bacteria will multiply and produce a neurotoxin, tetanospasmin. Disseminated in the general circulation, this toxin will attach itself to the nerve endings of the α motor neuron, enter the axon and migrate by retrograde intraaxonal transport to the regulatory interneurons located in the spinal cord and brainstem. The toxin then migrates through the synapse to the presynaptic nerve. This disinhibition leads to an increase in the resting action potential of the motor neuron, causing for painful muscle spasms associated with paroxysms as well as autonomic disorder. It is a medical emergency for which the management is being carried out in intensive care unit. Although tetanus is a vaccine-preventable infection [1], it continues to occur in many developing countries, with high case fatality rates [1-4]. Its penetration into the body is via a cutaneous wound, and when the anaerobic conditions are met [4,5]. Initial symptoms of generalized tetanus, which is the most common, includes fever, bilateral trismus or lockjaw, Risus sardonicus, dysphagia, generalized intermittent spasms descending from the head to the neck to the trunk. Finally, the rigidity of paraspinal muscles follows, and hyperextension

of the spine results in opisthotonus; often accompanied by dysautonomic disorders.

The diagnosis is made clinically; there is no diagnostic laboratory test.

Treatment of the entrance gate should be performed as early as possible with disinfection and surgical removal (excisions of necrotic tissue, removal of foreign bodies). Any occlusive dressing is to be avoided, associated with tetanus antitoxin (that is, antibodies in various forms), antibiotics (metronidazole or penicillin), sedatives and muscle relaxants and catch-up vaccination that should be systematic to prevent recurrence because tetanus is not an immunizing disease. The first dose is to be carried out from the first day on a site different from that of the serotherapy.

Nutrition is an important component, due to the high calorie needs due to muscle spasms.

The prognosis depends on the rapidity of the generalization of the signs and the appropriate therapeutic possibilities. Mortality is estimated at 20% in developed countries. It is often linked to complications of tetanus that include laryngospasm, respiratory arrest, aspiration pneumonia, autonomic disturbances. Patients may develop fever, rhabdomyolysis, and hyperthermia due to excessive muscular activity as well as the occurrence of nosocomial infections; pulmonary embolism especially in drug addicts and the elderly [6,7]. In France, the

lethality was 30.6% in 2008 to 2011. Sequelae are possible, they are of the motor difficulties, osteoarticular complications, complications of decubitus. They were reported in 16.7% of cases in France over the period 2008 to 2011.

The prevention of tetanus is based on vaccination and prophylaxis in the event of a wound; the vaccination is 100% effective and is well tolerated. Tetanus vaccine is produced by treating a toxin preparation with formaldehyde which transforms it into toxoid, immunogenic but without toxicity, the management of open wounds includes assessment of the patient's immunization status and the nature of the wound to determine the need for prophylactic tetanus toxoid and tetanus immunoglobulin [8].

2. CASE REPORT

This is a 28-year-old patient with no notable pathological history vaccinated against tetanus but without a booster for more than 5 years, having a history of perforating wound on the soles of the feet by a rusty nail, treated 2 days later in a public health unit in the city of Tan-Tan by carrying out local antiseptic care and an alcoholic bandage without tetanus prevention or antibiotic therapy, this two week earlier. He was admitted 10 days later on July 20, 2021 for difficulty in walking, opening his mouth and paroxysmal neck pain-like muscle pain that started four days earlier. This symptomatology motivated his consultation in the emergency department of Tan-Tan provincial hospital from where he was then evacuated to the Fifth Military Hospital in Guelmim for further treatment. The patient was admitted to the emergency room and a neurologist's opinion was requested, with the performance of a brain CT-Scan and an ENMG which returned to normal, the biological assessment was without anomaly, after four days of hospitalization and in front of the appearance of paroxysmal spasms seizures, and generalized painful spasms as well as muscle rigidity in the jaw muscles such as trismus, the patient was evacuated to the intensive care unit of the Avicenne Military Hospital in Marrakech on July 25, 2021.

The clinical examination on admission noted a patient in good general condition, conscious, colored conjunctiva, a temperature of 37 ° C, a loose trismus, contracture of the abdomen and paraspinal muscles, difficulty in walking. The brain computed tomography (CT) and the redone blood ionogram were without

abnormality. The diagnosis of generalized tetanus grade I in the portal of entry at the level of the soles of the feet was retained. Under treatment based on diazepam 20 mg x4 / d in SGI 5%, antibiotics (Metronidazole), tetanus serotherapy 500 IU IM, and tetanus vaccine a dose of 0.5 ml in IM, the evolution was favorable and he left intensive care on August 04, 2021, and transferred to the infectious disease department with a relay of diazepam 10 mg / day orally.

After eight days of his discharge from our hospital, the patient is resuscitated on August 13, 2021 for the reappearance of painful paroxysmal with thoracic rigidity and laryngeal spasms accompanied by desaturation responding to low flow oxygen without disturbances of swallowing and he was put back under continuous sedation by diazepam at a rate of 6 mg / h with pain control by morphine in a calm atmosphere, away from noise and light., the evolution was marked by the occurrence of a spectacular opisthotonos (Fig.1), in the form of hyperextension of the spine of the upper limbs in flexions and lower in extensions, and generalized muscle spasms particularly by the stimulus of light and not of noise or touch, this is where we decided to review its treatment by introducing phenobarbital at a dose of 4 mg / kg / 12h with gradual reduction in dose of diazepam, which was marked by a good evolution with a remarkable decrease in the frequency of spasms and paroxysms, he was discharged from the hospital on August 20, 2021 on Phenobarbital 1cp 50 mg morning and evening.

3. DISCUSSION

Worldwide, the incidence of tetanus is estimated at 700,000 to 1 million cases of tetanus / year which mainly affects young people in developing countries testifies to the need to intensify tetanus vaccination campaigns in these countries where tetanus remains a public health problem [9,10], while Public Health England recognizes the highest incidence of tetanus in people over 64 years of age who did not receive a primary immunization or lacked the booster dosage needed to maintain protective immunity [11]. Note a slight male predominance [4].

A primary vaccination of 3 to 4 doses induced by a protective immunity in nearly 100% of the vaccinated [12]. Protective immunity lasts for 10 years, but may weaken afterwards unless booster doses are given.



Fig. 1. Spasm of paraspinal muscles, producing the hyperextended opisthotonic posture in our patient

The production of toxins and therefore the development of the disease is correlated with risk factors that are in addition of no or under-vaccination, the association of anaerobic conditions in tetanus prone wounds such as wounds deep perforators, missile wounds and wounds with devitalized tissue [8], drug addiction especially in heroin addicts and, for unknown reasons, may present with more severe disease [6,7], Diabetes, with or without ulcers end up being a risk factor [5]. As well as inadequate wound management [4].

Diagnosis is based on clinical observation; acute onset of hypertonia with trismus; stimulus-induced muscle stiffness and tetany, history of recent or chronic (but not always) injury [4]; missing or incomplete vaccination, including boosters for adults.

The most frequent and serious form is the generalized form, as was the case in our patient, it represents 80% of cases [13]. Its symptoms develop in three phases, over 1 to 7 days, usually in a downward direction.

A usually incubation period is asymptomatic, is the interval between the injury and the onset of symptoms, its duration is variable from 2 to 21 days (average 7 days), in our patient the time between the wound and the appearance of the first symptoms was 6 days, a short incubation period (< 7 days) suggests the likelihood of developing severe tetanus; however, a long

incubation period does not necessarily indicate a milder disease.

An invasion period going from the appearance of trismus to the great crisis of generalized paroxysmal spasms, it is at this phase that the patient normally consults, where the only objective sign is a bilateral trismus due to a contracture of the masseters; All the semiological elements are important to look for in order to differentiate tetanus trismus from other causes of inability to open the mouth (lockjaw or trismus). The period of onset (the interval between the first symptom and first paroxysmal spasm) is a more predictor of severity: early elective tracheal intubation and mechanical ventilation are usually required if the interval is < 48 hours.

A state phase characterized by a background of permanent, or intermittent generalized spasms with extremely a very painful paroxysms, Prolonged spasms may compromise breathing. Often, they are permanent, painful, invincible and exacerbated by light (photophobia) sound (phonophobia), sometimes they are provoked by attempts to speak or swallow. Paravertebral muscle Rigidity follows, and hyperextension of the spine results in a characteristic opisthotonos attitude (backward curvature), flexion of the arms and extension of the legs, this symptoms were noted dramatically in our patient during his readmission to intensive care with the Several spasms seizures occurred in opisthotonos

mainly by the light stimulus, and not tactile or noises, while the patient is on high dose diazepam the frequency of which was reduced only after the introduction of phenobarbital. These paroxysms represent a permanent risk of complications, in particular ventilation disorders, apneas or laryngospasms. The paroxysms in our patient were mainly in response to bright lights. Proximal muscles of the extremity are also affected. Deep tendon reflexes are always exaggerated and ankle clonus is common. Tonic muscle spasms may affect head and neck muscles and laryngeal muscles, or may be generalized.

The patient is most often afebrile with a preserved consciousness. The general signs found in this phase are profuse sweating, dehydration, and sometimes restlessness. Neurovegetative disorders usually complicate the most serious forms with labile or persistent arterial hypertension, tachycardia, fever ranging from 39 to 41 ° C, arrhythmia, peripheral vasoconstriction, more rarely episodes of bradycardia and arterial hypotension [14]. This phase lasts from a few hours to two days. Our patient was admitted to intensive care at the start of this phase, which lasted for several days.

No specific laboratory test exists to confirm or exclude the diagnosis [6].

Some authors suggest assaying tetanus antibodies, because at protective levels, they go against the diagnosis; but this remains controversial [5,12], since cases of tetanus have been reported in the presence of antibody levels above the defined threshold of 0.01 unit / ml [2,5], especially since they are undetectable in most patients with symptoms [5].

Wound culture may be indicated if it is infected; however, methods of isolation of *Clostridium tetani* are not recommended due to their low sensitivity and specificity [6,8].

Electromyography may be helpful in some cases (if no site of entry is evident on physical examination or history), it may show continuous discharge from motor subunits without normal time latency [5].

The goal of treatment is to prevent the progression of the disease, neutralize the unbound toxin by serotherapy which will aim to prohibit the production of additional toxin and reduce mortality. It will have no effect on the

toxin already attached to the nerve endings [12,13,15]. It consists of the administration of antibodies, of which there are various preparations. Human tetanus immune globulins are specific human gamma globulins which are the first choice; they are administered intramuscularly at a dosage of 500 to 3000 IU depending on the studies; in adults, the optimal dose is not yet established, 500 IM units once is as effective as 3000-6000 units, it may be adjusted depending on the severity of the infection. If they are not available, the use of IV immunoglobulins is an alternative, when administered at a dose of 200 to 400 mg / kg IV, they offer some tetanus specific antibody activity [13,16]. Tetanus antibodies can also be used as part of a prophylactic program for the management of severe or contaminated wounds if the vaccine history is unknown or if less than 3 doses of tetanus vaccine have already been administered [12,13].

Our patient received a dose of 500 IU of IM gamma globulin as soon as he was admitted to intensive care, he was vaccinated at the same time. Tetanus vaccines are given as part of routine immunization, treatment of tetanus, and prophylactic management of tetanus-prone wounds [12,8]. It must be systematic to prevent recurrence, because tetanus is not an immunizing disease. The first dose is to be carried out from the first day on a site different from that of the serotherapy which is integrated within the framework of an immunization schedule against tetanus [6,14]. According to CDC (Centers for Disease Control and Prevention), the primary vaccination consisted of 5 doses for children or 3 doses for unimmunized adults, indicated routinely in all people without contraindication, and in the treatment and monitoring of people suffering from tetanus. Curative antibiotic therapy is applied systemically and comprising penicillin G, at a dosage of 100,000 to 200,000 IU / kg per day for seven days. If penicillin is contraindicated, metronidazole may be used. [12], our patient received metronidazole as an antibiotic. It stops the production of toxins and controls the portal of entry along with wound management.

Patients will be hospitalized in intensive care due to the major risk of respiratory distress from laryngeal spasm responsible for sudden asphyxia. Intubation or tracheostomy should be performed in severe laryngospasm; early tracheostomy is often useful for secretion control. General measures are essential with

hospitalization in a room only, in a quiet area, away from noise and light. A muscle relaxant and sedative treatment is instituted, making it possible to reduce the spasms. Benzodiazepines and baclofen are selected because of their efficacy and safety. Among the benzodiazepines, Diazepam is the leader of the group of benzodiazepines, it is used in high doses of the order of 15 to 100 mg h⁻¹, or even more intravenously continuously, it has been used as the only muscle relaxant in our patient during his first hospitalization in intensive care unit with a discontinuous infusion at a rate of 20 mg 6h⁻¹ [17]. On the other hand, during his second hospitalization, diazepam alone proved insufficient to reduce the number of paroxysmal attacks despite an increase in doses up to 10 mg h⁻¹ and which was limited by the fact that our patient was still in spontaneous ventilation, while its combination with phenobarbital immediately after the onset of opisthotonos proved to be effective in rapidly reducing the number of paroxysmal attacks and painful spasms. Midazolam has been used for its beneficial effects but it is expensive, however its short duration of action and its reversibility are advantages that distinguish it from diazepam, it is frequently used first-line, alone or with other hypnotics in combination to central morphine-mimetic analgesics in the context of the sedation of intensive care for patients placed on mechanical ventilation [18].

Baclofen is used in severe forms due to its gabaergic and anticholinergic action. In some studies, it is administered continuously or discontinuously in intrathecal route Propofol is an effective alternative drug in ventilated patients to achieve moderate sedation, control of spasms, and stiffness [6].

Curares are muscle relaxant drugs which act at the level of neuromuscular transmission, by temporarily and reversibly preventing the normal action of acetylcholine [19]; two molecules are used in tetanus: pancuronium (Pavulon®) and vecuronium (Norcuron®) [17-20].

Some authors have used botulinum toxin injection into the masseters and temporal muscles to fight trismus. Morphine has also been used, both for sedation and to reduce sympathetic tone [5]. Administration of labetalol (or esmolol) for high blood pressure, and atropine or isoproterenol for bradycardia [6]. Diuretics and selective beta-blockers (without alpha-blocking activity) should be avoided [6].

Vasopressors may be needed for associated hypotension that does not respond adequately to IV fluids expansion [6,21].

Magnesium sulfate is used in the treatment of tetanus in combination with diazepam. It replaced the phenobarbital that was usually used. Recent studies show the interest of its use in the treatment of tetanus for its effects on muscle spasms and on neurovegetative variations through its physiological antagonistic action of calcium; it does not have a clearly proven advantage over other agents, but some studies have shown a tendency for less need for mechanical ventilation and shorter hospital stays [22-24].

Nutritional support should be early and adapted to the patient's catabolism for the increased metabolic expenditure due to muscle spasms. Administration of IV Fluids should be 2-3 L / d to manage high levels of creatine kinase. It is important to proceed to a good nursing care to prevent pressure sores, deep vein thrombosis, stress ulcers, and aspiration pneumonia. Urinary catheterization is required in most patients as urinary retention is common and distension of the urinary bladder may provoke spasms and autonomic overactivity.

The duration of the disease varies, on average from 4 to 6 weeks. [5]

Its prognosis depends on the rapidity of the generalization of the signs, shorter incubation periods correlate with more serious disease, more complications and a higher risk of death [8], and appropriate treatment options. It is closely linked to the occurrence of infectious, respiratory, cardiovascular and metabolic complications due to the disease such as hypoxic respiratory arrest [3], aspiration pneumonia [8], cardiac arrhythmias, sudden asystole are common in patients with autonomic dysfunction, an acute myocardial infarction may occur in elderly patients with underlying coronary artery disease due to sympathetic overactivity, acute renal failure which can occur following rhabdomyolysis, and long-term decubitus complications in intensive care, mainly represented by nosocomial infections and pulmonary embolism. High-risk patients mainly include drug addicts, the elderly (65 years or older) and diabetics [8].

Mortality is estimated at 20% in developed countries. Without access to intensive care and

mechanical ventilation, adult death rates exceed 40% [3,25].

Lethality approaches 100% in the absence of medical intervention [26].

Tetanus is not an immunizing disease. Prevention involves vaccination with boosters which are necessary to maintain immunity [27,28]. For unimmunized adults, the CDC recommends a dose of TdaP (tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine) followed by a dose of Td (tetanus and diphtheria toxoids vaccine) at 4 weeks and 4 to 6 months later. the initial TdaP; these regimens may be modified depending on vaccine availability or other circumstances so require [28].

The vaccines available in Morocco are monovalent types reserved for pregnant women or combined to be injected intramuscularly, Vaccination begins at the age of 2 months, according to the 2014 vaccine schedule of the national immunization program, with a primary vaccination in infants by three doses of the combined Pentavalent anti TdaP-Hib-HB vaccine, at the age of 2 months, 3 months, 4 months, supplemented by a booster dose at the age of 18 months by an anti TdaP vaccine. In children, another booster takes place at the age of 5 years with anti-TdaP vaccine. An additional tetanus boosters given as Tdap at 10 years old and then and every 10 years during adulthood [29,30].

The absolute contraindication is a severe allergic reaction to a component of a vaccine against tetanus and diphtheria. [8] Tetanus immunoglobulin may be given in place of tetanus toxoid as a prophylaxis for wounds that would otherwise require tetanus toxoid. Prophylactic management of wounds that must be cleaned and if necessary, debrided from necrotic tissue with removal of any foreign material if present. It is important to also assess need for tetanus toxoid vaccine and tetanus immunoglobulin, based on immunization history and nature of wound. In the absence of these elements, immunoassays for rapid detection of tetanus antibodies could be useful with a sensitivity of 70 to 83% and specificity of 97 to 98%, therefore their diagnostic value is greater than the collection of anamnestic data. [31-33].

4. CONCLUSION

Tetanus is a serious non-contagious and non-immune disease. Protective immunity due to

vaccination in the general population, may wane with age thereafter unless booster doses are given. It is 62% in adulthood in France [34]. Improvements in boosters, vaccination and wound management are therefore necessary. The number of annual cases of tetanus in Morocco is relatively low. However, its lethality is still high, linked to diagnostic and therapeutic delay and especially to respiratory complications, but also to autonomic derangements that may affect the immediate vital prognosis of the disease. The cases and deaths that persist could be very easily avoided by routine vaccination of adults with tetanus toxoid, with an improvement in the application of booster's schedule (every 10 years in adults) and in the event of tetanus-prone wounds, by vaccination and early administration of immunoglobulins [29] ;hence the importance of establishing a public health strategy which aims to sensitize the public opinion on the interest to consult after having had a soiled wound and to respect the vaccination boosters. Any medical consultation, whatever the reason, must lead the doctor to check the vaccination status of his patient.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

ETHICAL APPROVAL

As a per international standard or university standard guideline, ethical approval has been collected and preserved by the authors.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCE

1. Maakaroun-Vermeesse Z, Bernard L. Traité de médecine AKOS, 2015-10-01. 2015 ;18, Numéro 4 :1-5, Copyright © 2015 Elsevier Masson SAS
2. Yen LM, et al: Tetanus. Lancet. 2019; 393(10181):1657-68, 2019
3. Woldeamanuel YW, et al: Case fatality of adult tetanus in Africa: systematic review and meta-analysis. J Neurol Sci. 2016;368:292-9.
4. CDC: Tetanus surveillance--United States, 2001-2008. MMWR Morb Mortal Wkly Rep. 2011;60(12):365-9.
5. Ergonul O et al: An unexpected tetanus case. Lancet Infect Dis. 2016;16(6):746-52.
6. Birch TB, et al. Tetanus (Clostridium tetani). In: Bennett JE et al, eds: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 9th ed. Elsevier. 2020;2948-53.e2
7. Gonzales y Tucker RD et al: View from the front lines: an emergency medicine perspective on clostridial infections in injection drug users. Anaerobe. 2014;30:108-15.
8. CDC: Tetanus. In: Pink Book: Epidemiology and Prevention of Vaccine-Preventable Diseases. 13th ed. CDC website. Updated September 8, 2015. Reviewed April 15, 2019. Accessed March 2, 2020. Available:<https://cdc.gov/vaccines/pubs/pinkbook/tetanus.html>
9. Manga NM, Dia NM, Ndour CT, Diop SA, Fortes L, Mbaye M, Diop BM, Sow PS. Tétanos néonatal et de la femme en âge de procréer à la clinique des maladies infectieuses de Dakar. Médecine et maladies infectieuses. 2009;39(12):901-5.
10. Takongmo S, ZeMinkandé J, Jeméa B, Guifo ML, PISOHTangnyin C, Simeu CH. Tétanos de l'adulte et chirurgie. à propos de deux cas. Health sciences and disease, the journal of medicine and science. 2009; 10, N°4.
11. Public Health England: Tetanus: Guidance on the Management of Suspected Tetanus Cases and on the Assessment and Management of Tetanus-Prone Wounds. PHE website. Updated July 2019. Accessed March 2, 2020. Available:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820628/Tetanus_information_for_health_professionals_2019.pdf
12. American Academy of Pediatrics: Tetanus. In: Kimberlin DW, et al, eds: Red Book: 2018-2021 Report of the Committee on Infectious Diseases. 31st ed. Elk Grove Village, IL: American Academy of Pediatrics. 2018;793-8.
13. CDC. Tetanus: For Clinicians. CDC website. Updated January 23, 2020. Reviewed January 23, 2020. Accessed March 2, 2020. Available:<https://www.cdc.gov/tetanus/clinicians.html>
14. Mallick IH, et al. A Review of the Epidemiology, pathogenesis and management of tetanus. Int J Surg. 2004; 2(2):109-12.
15. Médecins Sans Frontières: Tetanus. In: Clinical Guidelines--Diagnosis and Treatment Manual: For Curative Programmes in Hospitals and Dispensaries. Guidance for Prescribing. MSF website. Updated February 2020. Accessed March 12, 2020. Available:<https://medicalguidelines.msf.org/viewport/CG/english/tetanus-16689919.html>
16. Lee DC et al: Anti-tetanus toxoid antibodies in intravenous gamma globulin: an alternative to tetanus immune globulin. J Infect Dis. 1992;166(3):642-5.
17. Castelain V, Mathien C. Conduite pratique de la réanimation du tétanos de l'adulte EMC, Anesthésie réanimation. 20007;36-984-A-70.
18. Cook TM, Protheroe RT Tetanus: A Review of the literature British journal of anaesthesia. 2001;87(3):477-48.
19. Suppini A, Kaiser E Utilisation des curares en réanimation Annales françaises d'anesthésie et de réanimation. 1999;18: 341-54.
20. Bahtia R, Proobhakar S. Tetanus Neurology India. 2002;50;n°4:398- 407.
21. Brook I. Clostridium tetani (tetanus). In: Long SS et al, eds: Principles and Practice of Pediatric Infectious Diseases. 5th ed. Elsevier. 2018;995-9.e1
22. Mathew PJ, Samra T. Magnesium sulphate for treatment of tetanus in adults. Anaesth Intensive care. 2010;38(1):185-9.
23. Kole AK, Roy R, Kar SS, et al. Experience of use of magnesium sulfate in the treatment of tetanus in a tertiary referral Infectious Disease Hospital, Kolkata, India.

- Ann Trop Med Public Health. 2013;6:456-9.
24. Thaitwes CL, Yen LM, Loan HT. Magnesium sulphate for treatment of severe tetanus: A randomised controlled trial. *Lancet*. 2006;368 (9545):1436-43.
25. Marulappa VG, et al. A ten year retrospective study on adult tetanus at the Epidemic Disease (ED) Hospital, Mysore in southern India: a review of 512 cases. *J Clin Diagn Res*. 2012;6(8):1377-80.
26. WHO: Tetanus vaccines: WHO position paper—February. *Wkly Epidemiol Rec*. 2017;92(6):53-76.
27. Guide des vaccinations. Direction générale de la santé, comité technique de vaccination. Édition. 2012;230–5.
28. Liang JL, et al. Prevention of pertussis, tetanus, and diphtheria with vaccines in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep*. 2018;67(2):1-44.
29. Guide de vaccination : ministère de la santé, édition ; 2008,2014
30. CDC: Vaccines and Preventable Diseases: Diphtheria, Tetanus, and Pertussis Vaccine Recommendations. CDC website. Updated January 22, 2020. Reviewed January 22, 2020. Accessed March 2, 2020. Available:<https://www.cdc.gov/vaccines/vpd/dtap-tdap-td/hcp/recommendations.html>
31. Pilly E. *Maladies infectieuses et tropicales*. 2012;304-305.
32. HAS: Mise en évidence de l'immunoprotection antitétanique en contexte d'urgence. Évaluation des tests rapides immunochromatologiques; 2009.
33. HCSP. Avis relatifs aux rappels de vaccination anti-tétanique dans le cadre de la prise en charge des plaies. 24 mai ; 2013.
34. Antona D. Le tétanos en France entre 2008 et 2011. *Bull Epidemiol Hebd*.2012; 303-306.

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