

TETANUS

ON JUNE 3, 1996, an 84-year-old woman tripped while gardening at her eastern Oregon home. She fell on a piece of wood and punctured her forearm. She went to the local ER where she was given a tetanus shot and sent home. Several days later she saw her regular physician. The wound was painful and seemed to be "festering." No specific treatment was attempted. On June 8 she saw another doctor, who removed a 4 cm splinter from her arm. The patient complained of dysphagia. The possibility of a stroke was being considered when another physician noted that the patient had developed neck spasms and was unable to open her mouth, as if her jaws had been locked shut...

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Although now rare in the United States, tetanus is still one of the leading killers among infectious diseases worldwide, causing hundreds of thousands of deaths each year. This article reviews the epidemiology of tetanus in Oregon and elsewhere.

DISEASE

Tetanus results from an intoxication with tetanospasmin, the neurotoxin that causes the characteristic muscle spasms of the disease. The toxin is produced during the growth phase of *Clostridium tetani*, a Gram-positive, spore-forming, obligately anaerobic bacillus. *C. tetani* is ubiquitous in soil and can be readily found in the intestines of most humans. Vegetative bacteria grow optimally at 37°C. The heat-resistant spores are extremely stable in the environment, retaining almost indefinitely the ability to germinate and cause disease. Any wound contaminated by soil is a potential nidus for growth if conditions of local anoxia obtain.

Tetanus, variably described as etymologically derived from the Greek for spasms, rigidity, or stretching, is characterized by painful muscular contractions that are sometimes violent enough to

break bones. The masseter and neck muscles are most commonly affected.¹ Generalized tetanus is the most commonly recognized form and usually begins with trismus.² In older children and adults, a common first sign of tetanus is abdominal rigidity, although rigidity is sometimes localized to the region of injury. Typical features of the tetanospasm are opisthotonus (see illustration) and risus sardonicus, the sardonic smile.³ The incubation period for tetanus varies from one or two days to a month or more; most have onset of symptoms within 7-14 days of the initial injury.

HISTORY

The elucidation of tetanus was one of the triumphs of the "golden age" of clinical microbiology in the latter 19th century. The infectious nature of the disease was first illustrated by injecting rabbits with pus from affected humans and inducing symptoms. Later experiments showed that inoculation of soil could lead to a similar outcome. Kitasato first cultured the agent in Robert (*nennen Sie mich "Bob"*) Koch's Berlin laboratory in 1889. Kitasato also determined that tetanus resulted from the action of a systemic toxin, and he and von Behring began to experiment with antitoxin, produced by injecting mice with minute amounts of *C. tetani*. Tetanus antiserum for use in humans was introduced in 1897.⁴

Tetanus was long recognized to be a sequela of wounds, notably battle injuries, but civilian injuries took their toll then as now. The AMA was moved to lobby for a ban on fireworks sales following a boisterous July 4th, 1903 holiday that led to 406 tetanus deaths among

3983 wounded revelers.⁴ Prophylactic regimens against tetanus were first introduced during World War I, as wounded soldiers were injected with antiserum in field hospitals. By 1941, the Allies had pre-exposure immunization programs in place using tetanus toxoid (inactivated toxin). Tetanus among U.S. troops declined from a rate of 200/100,000 in the Civil War to 0.6/100,000 in World War II.¹

INCIDENCE

Worldwide, most tetanus cases and deaths occur in sub-Saharan Africa, primarily as neonatal tetanus. That high incidence is associated with the use of non-sterile instruments or poultices on the umbilical cord. Maternal antibodies can cross the placenta, and immunization campaigns that cover adolescent girls and young women result in marked declines in neonatal morbidity and mortality.

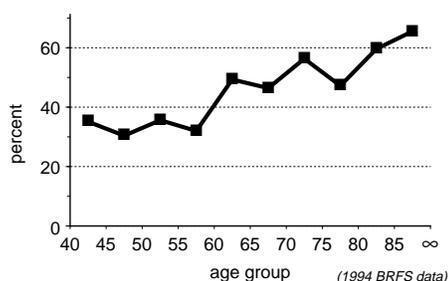
In the developed world, the success of tetanus immunization during World War II led to the incorporation of tetanus toxoid into routine immunization regimens after the war. Tetanus cases in the U.S. fell from 560 cases in 1947 to 53 in 1988, reflecting the use of tetanus [and diphtheria] toxoid (Td); diphtheria, tetanus, and pertussis (DTP) vaccinations for children; and tetanus immune globulin (TIG) for postexposure prophylaxis in wound treatment.⁵ Many persons born before WWII never received a primary vaccine series unless they served in the military, however^{2,6}; older women are particularly likely to have missed out. Since 1986, between 45 and 64 cases of tetanus have been reported annually in the United States—an average incidence of 0.02/100,000. Of 109 cases reported in 1989 and 1990, 58% were ≥ 60 years old and 6% were < 6 years old.

In Oregon

The woman in eastern Oregon was given tetanus immune globulin (TIG) on June 9, but antitoxin is of little use once symptoms have developed. She was intubated the next day, lingered in a state of induced paralysis, and died in mid-July.



Proportion of Oregonians Without a Tetanus Shot in Previous 10 Years



Ten other cases were reported in Oregon since 1982 (see table). The median age of these patients was 63 years. Three patients, all of them over 80, died. Most of the patients had sustained puncture wounds. At least 8 had no history of previous tetanus immunization. Seven did not seek medical care immediately after being injured. (Puncture injuries that lead to tetanus may be quite trivial.) TIG was given before symptom onset to 5 of the 11 patients—all of whom survived.

RECOMMENDATIONS FOR CONTROL

In the U.S., tetanus is now a rare disease that affects mostly older individuals with no or a poor history of immunization. Serosurveys indicate that 31-71% of older Americans lack protective levels of tetanus antibodies.⁵ In Oregon (and elsewhere), this correlates with age (see graph). Furthermore, most people are unaware of their vulnerability. A history of tetanus immunization is a poor predictor of immune status in elderly individuals.

Current ACIP recommendations⁷ call for immunization with tetanus toxoid in the form of DTaP for young children. DT is recommended for children with contraindications to pertussis vaccine. For persons ≥ 7 years old, Td is currently recommended. A booster every 10 years provides adequate protection. Schedules are identical for immunocompromised patients.

A summary guide for tetanus prophylaxis in routine wound management is shown in the table. If giving vaccine concurrently with TIG following an injury, use separate syringes and injection sites. While 7 days of penicillin may kill *C. tetani* in wounds, the wound and the patient still need to be appropriately treated and immunized, respectively. Minor local reactions to anti-tetanus biologicals are not uncommon, but more severe local and systemic reactions are rare.³

With all the fuss about “emerging” pathogens, it is worth remembering that some of the old standbys are still with us and still pack a punch. Measures to prevent or ameliorate many of these diseases, including tetanus, are well understood.

Their occurrence, and the often low levels of vaccine-induced immunity among older adults, is a reminder that immunizations are not just for children.

“Tetanus was never prevented by a recommendation; it is prevented by immunization.”⁸ The Health Division recommends that physicians who see patients, particularly older persons, consider a review of their immunization status as a part of routine care. Other vaccines routinely indicated for older adults target influenza and invasive pneumococcal disease.

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Tetanus in Oregon, 1982-1996

Year	Age	Sex	Injury	Vaccination Hx
1996	85	F	Punctured arm on railroad tie*	None
1992	81	M	Abrasion (foot)*	None
1992	63	M	Punctured foot on barbed wire	None
1991	91	F	Punctured leg on an anvil	None
1991	90	F	Punctured finger on a rose thorn*	None
1990	36	M	Reinfected a healing thumb wound	Unknown
1987	8	F	Punctured thumb with a splinter	None
1985	62	F	Punctured foot on a barbecue grate	None
1983	55	F	Scratched healing surgical wound whilst gardening	None
1982	78	M	Unknown	Unknown
1982	21	M	Punctured foot at a construction site	Unknown

*fatal

Tetanus Prophylaxis in Routine Wound Management

Tetanus immunization hx ▼	Clean, minor wounds	Dirty or big wounds
uncertain or <3 doses	Td ¹	Td + TIG ²
≥ 3 doses	if >10 years since last dose, Td booster	if >5 years since last dose, Td booster

1. For persons <7 years old, DTaP or DTP (or DT if pertussis vaccine is contraindicated) is preferred to tetanus toxoid alone. Td is preferred over toxoid alone for older persons.
2. 250 I.U. for wounds of “average” severity (ref. 7)