Tetanus Immunization Status and Predictors of Immunity in Older Family Practice Outpatients

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Effective immunization programs initiated many years ago have made tetanus a rare disease in the United States today. These programs have been so successful that in 1981 the Sixth International Conference on Tetanus (Lyon, France) proposed a goal of eliminating tetanus from the United States by 1985 and from the rest of the world by the year 2000.[1] This goal has yet to be achieved. During the last two decades 50 to 100 cases have been reported each year.[2] Between 1991 and 1994 there were 201 reported cases of tetanus in the United States, 54 percent in persons who were older than 60 years.[3] Ninety-five percent of patients with tetanus reported to the Centers for Disease Control and Prevention had not completed a primary immunization series.[4]

The low tetanus mortality rate (deaths per population at risk) in the United States is due to preventive rather than therapeutic efforts. The case fatality rate (deaths per cases of disease) remains high at 25 percent.[3] Immunization, therefore, remains the most important element in reducing the mortality rate of the disease.

The US immunization strategy, stated in Healthy People 2000, targets the young,[5] although a tetanus booster is recommended for all adults every 10 years. Tetanus immunity declines with age, however,[6,7] and currently the highest rates of tetanus infection and associated mortality occur in patients older than 65 years.[6-9] A few studies have attempted to determine the relation between historical data and tetanus antibody titers, but the results have been contradictory.[10-12] We undertook this study to determine the rate of tetanus immunity in older patients of a family practice center. We also investigated whether certain patient characteristics and recollection of past tetanus immunization could be used to predict serologic evidence of immunity to tetanus.

Methods

The study was conducted in a family practice residency program of a community teaching hospital in a Midwestern city (population 28,000). The geriatric patients in this practice are primarily middle income and white. All patients older than 65 years who were seen for routine (nonacute) outpatient visits by one of the authors (AJC) during a 6-month period were invited to join the study. The planned sample size of 100 patients was based on an expected immunity rate of 30 percent[3] ± 10 percent (95 percent confidence interval [CI]). An adequate sample size required 81 patients, and we added 19 additional patients to allow for sample attrition.

The study was approved by the institutional review board of the teaching hospital. All patients signed written informed consent to participate. Information obtained on all patients included age, sex, self-reported history of military service (immunization is routine in the military), and self-reported history of past tetanus immunization. Venous blood samples were drawn from all patients and sent to a standard reference laboratory for measurement of tetanus antibody titers (IgG). Antibody was measured using an enzyme-linked immunoassay technique, with a level of 0.01 IU/mL (64 mg/L) or greater indicating immunity.[13] Data were analyzed using EpiInfo statistical software.[14] Odds radios and 95 percent confidence intervals were calculated. Significance was determined using the chi-square or Fisher exact test with $P < 0.05$ considered statistically significant.

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Table 1. Characteristics of Study Patients (n = 62).

Characteristic	Percent
Aged ≥ 75 years	46.8
Female	61.3
Military service	29.0
Reporting vaccination	67.7
Vaccination < 10 years earlier (n = 42)	38.0

Results

We extended the enrollment period to 6 months because fewer eligible patients than anticipated visited the practice; of 68 eligible patients who were approached, 62 (90 percent) agreed to participate. Patients were predominantly white women (61.3 percent). The average age was 74.8 (± 6.8) years, and 47 percent were older than 75 years. Eighteen patients (29 percent) (17 men and 1 woman) had previously served in the armed forces.

Two thirds of all the patients reported having at least one tetanus immunization at some time in their life. Of the 42 patients reporting previous tetanus immunization, 16 (38 percent) reported having it within the past 10 years (Table 1). Despite these self-reports, only 12 patients had tetanus antibody levels indicating immunity. The overall immunity rate in this study was 19 percent (95 percent CI 10.4-31.4 percent).

Men, patients younger than 75 years, and those who had a history of recent immunization were significantly more likely to have an immunity to tetanus. All 12 tetanus-immune patients reported a history of tetanus immunization (Table 2).

Military service was analyzed for men only, because only 1 woman reported having served in the military. Men who had been in the military (n = 17) were more likely to be immune to tetanus than men who had not served, but the result was not statistically significant ($P = 0.17$) (Table 2). The single woman who reported military service was not immune to tetanus. The positive predictive values of the four factors considered are shown in Table 3.

We compared men who did not have a history of military service with women to find out whether military service accounted for the higher rate of tetanus immunity in men.[4] The difference in immunity between men who had no military service and women was not statistically significant. We believe, therefore, that most of the effect of sex was related to military service.

Discussion

The 19 percent (95 percent CI 10.4-31.4) immunity rate we observed is consistent with that reported by others.[3] We recruited from a family practice population from which less than 10 percent of the patients declined to participate. Given the high response rate and the consistent findings, it is unlikely that selection bias occurred.

Although three easily obtained historical facts were predictors for tetanus immunity in this population—age less than 74 years, self-reported history of having received at least one tetanus immunization, and male sex—none had a sufficiently

Table 2. Immune Status of Patients (n = 62) and Patient Characteristics.

Characteristic	Immune	Not Immune	Odds Ratio	95% CI	*P* Value
Sex					
Men	10	14			
Women*	2	36	12.9	2.2-29	0.0006
Age					
< 75 years	10	23			
≥ 75 years*	2	27	5.9	1.1-58.9	0.04
Military service (men)					
Yes	9	8			
No*	1	6	6.8	0.6-344.2	0.17
Previous vaccination					
< 10 years	6	10			
≥ 10 years or never*	6	40	5.6	1.2-26.8	0.01

CI - confidence interval.
*Referent category.

Table 3. Positive Predictive Values of Patient Characteristics and Immunity to Tetanus.

Characteristic	Percent Immune
Male sex	42
Aged < 75 years	30
Military	53
Self-reported immunization < 10 years	41

high predictive value to be clinically useful. On the other hand, a negative history for immunization did prove to be useful. No patient was immune to tetanus among those reporting no immunization (negative predictive value, 100 percent).

The only way to control tetanus is through immunization. Focusing immunization efforts on geriatric patients is appropriate because of the low rate of tetanus immunity and the higher case fatality rate in this age group. With a rate of systemic reactions at only 0.06 percent,[12] tetanus immunization is very safe in adults. The cost per year of life saved by tetanus immunization has been estimated at $143,138.[12]

It might be possible to develop a cost-effective immunization strategy, targeting those geriatric patients who are most likely to be susceptible, but we think such a strategy would be ineffective. There are patient characteristics that indicate a higher likelihood of immunity, but the predictive value is not sufficient for clinical use. It seems reasonable to immunize all older patients who have no documented history of recent tetanus immunization.

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References

1. Halpern JS. Goal for 1985: elimination of tetanus in the United State. J Emerg Nurs 1983;9:276-82.
2. Surveillance of tetanus, 1987 and 1988. Wkly Epidemiol Rec 1990;65:261-3.
3. Izuricta HS, Sutter RW, Strebel PM, Bardenheier B, Prevos DR, Wharton M, Hadler SC. Tetanus surveillance—United States 1991-1994. CDC surveillance summaries, 21 Feb 1997. MMWR Morbid Mortal Wkly Rep 1997;46(55-2):15-24.
4. Knight AL, Richardson JP. Management of tetanus in the elderly. J Am Board Fam Pract 1992;5:43-9.
5. Healthy people 2000: national health promotion and disease prevention objectives. Washington, DC: Public Health Service, 1991. [DHHS publication no. [PHS] 91-50213.)
6. Gergen PJ, McQuillan GM, Kiely M, Ezzati-Rice TM, Sutter RW, Virella G. A population-based serologic survey of immunity to tetanus in the United States. N Engl J Med 1995;332:761-6.
7. Murphy SM, Hagarty DM, Feighery CS, Walsh JB, Williams Y, Coakley DP. Tetanus immunity in elderly people. Age Ageing 1995;24(2):99-102.
8. Groleau G. Tetanus. Emerg Med Clin North Am 1992;10:351-60.
9. Richardson JP, Knight AL. The prevention of tetanus in the elderly. Arch Intern Med 1991;151:1712-7.
10. Weiss BP, Strassburg MA, Feeley JC. Tetanus and diphtheria immunity in an elderly population in Los Angeles County. Am J Public Health. 1983;73:802-4.
11. Pai S, Romanic BM, Deforest A, Walters DT. Tetanus immune status of adult patients in an urban family practice. J Fam Pract 1986;23:582-3.
12. Stair TO, Lippe MA, Russell H, Feeley JC. Tetanus immunity in emergency department patients. Am J Emerg Med 1989;7:563-6.
13. Balestra DJ, Littenberg B. Should adult tetanus immunization be given as a single vaccination at age 65? A cost-effectiveness analysis. J Gen Intern Med 1993;8:405-12.
14. EpiInfo [computer program]. Stone Mountain, Ga: U.S.D., 1990.