Prevention of Tetanus

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Brit. med. J., 1965, 2, 1333-1336

There has been considerable discussion in recent years about the prevention of tetanus in injured persons. For the actively immunized patient a booster dose of tetanus toxoid at the time of injury provides a simple, safe, and effective protection. The prevention of tetanus is more difficult and less secure in those patients who have not been actively immunized. Although tetanus antitoxic serum (A.T.S.) has some protective value, there is increasing concern about the frequent occurrence of minor sensitivity reactions and the occasional case of severe or fatal complication. In addition, repeated doses of A.T.S. are not only hazardous but they have been shown to be less effective (Littlewood, Mant, and Wright, 1954; Kind, 1957; Woodward, 1960). These limitations and dangers of passive immunization with A.T.S. have stimulated interest in the search for alternative forms of protection for those injured persons who do not have established immunity. Reports from various centres have suggested that penicillin or tetracycline can satisfactorily replace A.T.S. in the treatment of patients who present with fresh wounds (Filler and Ellerbeck, 1960; Cox, Knowelden, and Sharrard, 1963). Favourable reports have been published from several casualty departments which have practically abandoned the prophylactic use of A.T.S. in favour of long-acting penicillin or some other antibiotic. Chemoprophylaxis is being advocated because it apparently offers a high level of protection, while it is clearly safer than horse serum.

From November 1959 to March 1961 inclusive the use of A.T.S. was curtailed in the casualty department of University College Hospital, Ibadan. During this period most of the injured patients were given penicillin and one dose of tetanus toxoid; they were asked to return for a second dose of toxoid three weeks after the first dose. After the withdrawal of A.T.S. there was apparently a rise in the incidence of tetanus in persons who had been treated at the casualty department, and it was therefore decided to reintroduce the routine use of A.T.S. The present study was undertaken to review the question of the prophylaxis of tetanus at this hospital, with particular reference to the apparent failure of chemoprophylaxis during this test period, and to devise a rational prophylactic policy for injured persons in this area.

Materials and Method

This paper reviews the incidence of tetanus in patients who received treatment at the casualty department of University College Hospital, Ibadan, during the four-year period 1959-62. For the purposes of this study "casualty associated tetanus" is defined as a case in which tetanus develops within one month of a patient receiving treatment in the casualty department of this hospital. The in-patient records of 572 tetanus patients who were admitted to the hospital over the relevant period were examined in order to find the cases of "casualty associated tetanus." From the casualty record cards of these patients information was obtained about the date and the time of injury, the nature of the injury, and the appearance of the wound. A note was also made of the treatment that was given in the casualty department, including especially the surgical treatment

of the wound, antibiotic therapy, and specific prophylaxis in the form of A.T.S. and tetanus toxoid.

Information about the use of A.T.S. and tetanus toxoid at the casualty department was obtained from the following sources: (a) records of the pharmacy department showing the total amount of prophylactic A.T.S. and tetanus toxoid that was used in the hospital; (b) the daily requisition slips from the casualty department; and (c) casualty record cards—a sample of the new cases in 1960 was selected by means of random numbers.

Results

Between January 1959 and December 1962 inclusive at least 20 persons developed tetanus within 30 days of receiving treatment at the casualty department, and in 11 cases the illness proved fatal. The monthly distribution of these cases of tetanus is shown in the Chart.

Distribution of cases of "casualty associated tetanus" in relation to the prophylactic policy of the casualty department.

The annual rate of tetanus among the patients who were treated in the casualty department is shown in Table I; it was highest in 1960 (9.8 cases of tetanus per 10,000 patients) and was lowest in 1959 (1.9 cases of tetanus per 10,000 patients).

TABLE I.—Annual Incidence of Tetanus Among Patients who Received Treatment for Injury at the Casualty Department

Year	No. of New Patients	Cases of Tetanus	Incidence Rate per 10,000 Patients
1959	10,403	2	1.92
1960	11,603	11	9.78
1961	11,673	4	3.43
1962	12,452	3	2.40
Total	46,131	20	4.34

The exact date on which chemoprophylaxis was introduced as the routine procedure at the casualty department is not known, but records show that there was a sharp decline in the use of A.T.S. as from about 1 November 1959. The use of A.T.S. again increased as from the end of March 1961. The period under review has therefore been divided into three parts on the basis of the prophylactic policy of the casualty department (Table II). During the first period, from January to October 1959 inclusive, A.T.S. was given routinely; the attack rate of tetanus was 2.3 cases per 10,000 patients. In the second period, from November 1959 to March 1961 inclusive, when antibiotic prophylaxis was used routinely, the attack rate

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was 7.8 cases per 10,000 patients. From April 1961 to December 1962 inclusive there was a return to the use of A.T.S., and the attack rate during this period was 2.4 cases per 10,000 patients.

TABLE II.—Incidence of Tetanus in Relation to Main Prophylactic Policy of Casualty Department

Period	Prophylactic Policy	No. of Patients	Cases of Tetanus	Incidence Rate per 10,000 Patients	Mean No. of A.T.S. Doses* per Month
Jan.—Oct. 1959	Serum prophylaxis	8,603	2	2.32	200†
Nov. 1959—Mar. 1961	Antibiotic prophylaxis	16,699	13	7.79	26
Apr. 1961—Dec. 1962	Serum prophylaxis	20,829	5	2.40	336
Total ..		46,131	20	4.34	

* Each dose consisted of 1,500 units of A.T.S.

† Approximate estimate—data incomplete.

Table III shows a detailed analysis of these 20 cases. The cases are classified into the following five groups according to the prophylactic treatment given: group A, penicillin and tetanus toxoid; group B, penicillin alone; group C, tetanus toxoid alone; group D, none; group E, tetanus antitoxin.

A 4% sample was taken at random from the casualty records for 1960. Table IV shows the analysis of these 418 case records. About half of the patients (218 cases) presented with recent trauma: in 177 of these cases there was an open wound,

but the remaining 41 patients presented with closed injuries such as bruises, sprains, and fractures. Guinea-worm ulcers (15 cases) and abscesses of the skin (68 cases), hand (33 cases), and breasts (25 cases) accounted for 141 cases; foreign bodies in the eye, nose, or throat were found in seven cases; the remaining 52 patients were an assortment of miscellaneous non-traumatic conditions. Only 13 out of the 177 patients with open injury received A.T.S.; 81 patients had antibiotics alone or in combination with tetanus toxoid; 42 others were given toxoid alone, and in the remaining 41 cases no specific prophylaxis was administered. There was no record that any of the 116 patients who were given tetanus toxoid had previously been actively immunized, and it must therefore be

TABLE IV.—Analysis of a Random Sample of New Cases in the Casualty Department in 1960

Condition	No. of Cases	Prophylaxis				
		A.T.S.	Toxoid Alone	Anti-biotic Alone	Anti-biotic and Toxoid	None
1. Trauma:						
Open wound ..	177	13*	42	26	55	41
No open wound ..	41	—	1	—	—	40
2. Abscesses and septic ulcers ..	141	2†	3	66	3	67
3. Others ..	59	—	1	—	—	58
Totals ..	418	15	47	92	58	206

* A.T.S. with toxoid (2 cases); with antibiotic and toxoid (9 cases); with antibiotic (2 cases).

† A.T.S. with antibiotic (2 cases).

TABLE III.—Analysis of 20 Cases of Post-traumatic Tetanus Treated in the Casualty Department

Case No.	Age (Years)	Sex	Date of Injury	First Visit to Casualty	Type of Injury	Appearance of Wound	Penicillin	Tetanus Diagnosed	Outcome
Group A. Post-traumatic Tetanus—Penicillin and Tetanus Toxoid Given									
1	25	M	23/1/60 (evening)	23/1/60 (10.30 p.m.)	Fell off motor-cycle	Fresh abrasions and lacerations	Crystalline 1 mega and Triplopen* 1 amp. on 25/1/60. Triplopen 1 amp. on 27/1/60	4/2/60	Recovered
2	25	M	6/2/60	10/2/60	Splinter in toe	Septic swollen foot	Crystalline 1 mega daily 10/2/60 to 12/2/60	19/2/60	Recovered
3	25	M	15/8/60	18/8/60	Fell off kola-nut tree	Infected large deep wound of leg	Crystalline 1 mega 4-hourly from 18/8/60	21/8/60	Died
4	33	M	14/9/60 (a.m.)	14/9/60 (11.35 a.m.)	Fell off palm tree	Compound fracture of femur	Crystalline 1 mega 4-hourly from 14/9/60	20/9/60	Died
5	14	M	4/10/60 (noon)	4/10/60 (4.10 p.m.)	Lacerated by starting-handle of car	Large laceration of thigh	Crystalline 1 mega on 4/10/60. Procaine 600,000 units daily 4/10 to 7/10/60	9/10/60	Died
6	18	F	7/10/60 (noon)	7/10/60 (12.20 p.m.)	Knocked down by car	Laceration of scalp. Abrasions	Crystalline 1 mega on 7/10, 11/10, 12/10, 13/10, 15/10, 16/10/60	17/10/60	Recovered
7	41	M	31/12/60 (evening)	31/12/60 (8.20 p.m.)	Fell off motor-cycle	Multiple abrasions. Some skin loss	Crystalline 1 mega on 31/12/60 2/1, Triplopen 1 amp. on 31/12/60 2/1, 4/1, 5/1, 7/1, 9/1/61	9/1/61	Recovered
8	12	F	4/2/61 (morning)	4/2/61 (4.10 p.m.)	Cut foot on broken glass	Dirty lacerated wound	Triplopen 1 amp. on 4/2, 6/2, 8/2, 11/2/61	13/2/61	Died
Group B. Post-traumatic Tetanus—Penicillin Given									
9	32	M	9/2/60	9/2/60 (4 hrs later)	Burned—house on fire	45% skin burns	Crystalline 1 mega b.d. from 9/2 to 11/3/60	10/3/60	Recovered
10	42	M	21/4/61 (9 a.m.)	21/4/61 (5.35 p.m.)	Fell off palm tree	Compound fracture of wrist	Crystalline 1 mega b.d. from 21/4 to 30/4/61	30/4/61	Died
11	42	M	4/3/62	7/3/62	Fell down	Infected abrasions. Cellulitis	Procaine 600,000 units daily from 7/3 to 10/3/62. (Also streptomycin 1 g. daily on same dates)	11/3/62	Died
12	4	F	10/4/62	17/4/62	Burned by fire	Clean burns of both legs	Procaine 300,000 units daily 17/4, 18/4, 19/4/62	19/4/62	Recovered
13	2/12	F	6/4/59	13/4/59	Burned—house on fire	Infected burns of leg	Crystalline penicillin 500,000 units daily from 13/4 to 16/4/59	16/4/59	Recovered
14	6	F	20/7/59	20/7/59	Fell down	Fracture radius and ulna. Plaster ulcer on 11/8/59	Triplopen 1 amp. 13 and 14/8/59	14/8/59	Died
Group C. Post-traumatic Tetanus—Toxoid Alone Given									
15	3	F	16/1/60	16/1/60	Burned feet in fire	Blistered soles of feet	None given	29/1/60	Died
16	7	F	31/5/60	31/5/60 (8.43 a.m.)	Knocked down by car	Abrasions on elbow and foot	" "	6/6/60	Died
17	16	M	6/3/61 (evening)	6/3/61 (9.45 p.m.)	Fingers crushed by printing machine	Lacerations of fingers; crush injuries	" "	23/3/61	Recovered
Group D. Post-traumatic Tetanus—No Prophylaxis Given									
18	15	F	5/8/60	10/8/60	Fell down	Swelling of wrist	" "	11/8/60	Died
19	14	F	20/5/62	27/5/62	Fell down	Ulcer of neck; fracture cervical spine	" "	12/6/62	Recovered
Group E. Post-traumatic Tetanus—A.T.S. Given									
20	28	M	27/12/61 (evening)	27/12/61 (5.50 p.m.)	Fell off bicycle	Deep lacerations on knee and forehead. Other lacerations and abrasions	" "	11/1/62	Died

* Each ampoule of Triplopen contains: benethamine penicillin 500,000 units, procaine penicillin 250,000 units, sodium penicillin G 500,000 units.

presumed that for most of them this was the first dose. Most of them failed to return for the second dose of tetanus toxoid, only 12 out of the 116 patients completing the prescribed course.

Discussion

During the period under review the incidence rate of tetanus in the casualty department was 4.34 cases per 10,000 patients. This may be an underestimate, since some of the patients who developed tetanus may not have returned to this hospital for treatment. While bearing this limitation in mind, one can still draw tentative conclusions from the data.

The risk of contracting tetanus was not uniformly distributed over the period. The highest incidence rate occurred at the time when there was minimal use of A.T.S. as a prophylactic agent. Records of the pharmacy department show that there was almost complete withdrawal of prophylactic A.T.S. from the casualty department between November 1959 and March 1961 inclusive. At least 13 cases of tetanus occurred during this period, when the use of A.T.S. was markedly restricted; but only four cases (4.17) would have been expected to occur if the complication had arisen with the same frequency that was observed when A.T.S. was used more liberally (Tables I and II). This difference is unlikely to have arisen by chance (Poisson distribution, $P = 0.01$).

A detailed analysis of the data links the occurrence of "casualty associated tetanus" more closely with the failure to give A.T.S. Only one out of the 20 patients who developed tetanus had been given A.T.S., but in 14 cases antibiotics had been administered. These data indicate that antibiotic prophylaxis is not an effective substitute for A.T.S. in all situations. This limitation is recognized even by those who strongly advocate a wider use of chemoprophylaxis. For example, in a recent release from the Ministry of Health (1964) of the United Kingdom it was suggested that "where there is reason to believe surgical toilet cannot be or has not been complete . . . the use of tetanus antitoxin should certainly be considered." The results of this study confirm the wisdom of such advice. In several cases in this series there had been considerable delay before antibiotic prophylaxis was instituted (Cases 1, 2, 3, 11, 12, and 13); and in some of the others surgical toilet of the wound had been incomplete (Cases 4, 6, and 8). It can therefore be argued rightly that antibiotic prophylaxis should not be discredited on account of these cases, which were clearly unsuitable for such treatment according to current views. The failure of antibiotic prophylaxis was not confined to these cases in which there had been delay or in which surgical toilet of the wound was incomplete. In a few cases antibiotic prophylaxis failed to protect against tetanus even though the patients had fresh injuries and the surgical toilet of the wound was apparently satisfactory (Cases 5, 7, 9, and 10). Close scrutiny of the records of these patients showed that antibiotic prophylaxis was properly indicated according to the current view which favours such treatment for fresh uncontaminated wounds.

This report has pointed out the failure of penicillin to protect some patients against tetanus, but it is not suggested that A.T.S. is without faults. It must be noted, however, that so far the complications of serum prophylaxis have not assumed important proportions in this area. Though some cases of allergic reactions to A.T.S. were encountered, no case of fatal anaphylaxis was recorded during the period under review; on the other hand, casualty associated tetanus accounted for 11 deaths and critical illness in nine other persons. Laurent and Parish (1952) have estimated that the mortality rate from A.T.S. is between 1 in 50,000 and 1 in 200,000 (0.05 to 0.2/10,000), but the mortality rate from tetanus among patients who were treated in the casualty department from 1959 to 1962 was at least 2.4 deaths per 10,000 patients. At this stage, therefore, tetanus poses a graver risk than serum disease.

There is as yet no satisfactory method for the prevention of tetanus in injured persons who have no established immunity. A rational prophylactic policy must therefore be a well-judged compromise. No doubt antibiotic prophylaxis has some place in the management of injured persons, but the indications must be clearly defined in relation to persons, place, and time. In Britain and in North America antibiotic prophylaxis may be a satisfactory procedure, though the incidence of tetanus in such areas is so low that it might take many years to decide whether antibiotics or A.T.S. provided the more effective protection. In Ibadan, where a high proportion of the community is not immunized, where there is often significant delay after an injury before treatment is sought, where there is a high risk that wounds will be contaminated before and even after they are dressed in hospital, and where severe allergic complications of serum prophylaxis are still infrequent, the place of antibiotic prophylaxis needs to be redefined. It is not intended to offer the results of this study in refutation of the favourable experience of others, but as a warning against the wholesale and uncritical transfer of policies that appear to be of proved value in one area to other areas where different local conditions might render them inappropriate.

Conclusion

In summary, we feel that the following observations, conclusions, and proposals are justifiable in view of the results of this study.

Active Immunization.—Active immunization with tetanus toxoid remains the safest and the most effective method of preventing tetanus. Since only a few persons in this community have been immunized with tetanus toxoid, the others should be offered this protection whenever the opportunity presents in hospital, dispensaries, antenatal clinics, and in health centres.

Combined Simultaneous Active-passive Immunity.—At least in this area, tetanus antitoxin should be given to injured persons if there has been some delay before the wound is treated, or if the wound is so heavily contaminated with soil that surgical toilet cannot be complete. Passive immunization should also be considered for certain susceptible groups: women who have delivered babies at home under insanitary conditions, and their newborn babies; patients who may develop pressure sores following the application of a plaster cast; and patients with guinea-worm ulcers. Anyone who has been given A.T.S. should at the same time receive the first dose of tetanus toxoid. The effectiveness of simultaneous combined active-passive immunization with alum-adsorbed toxoid has been demonstrated in patients and in experimental animals (Smith *et al.*, 1963; Smith, 1964).

Trial of Antibiotic Prophylaxis.—There is need for controlled trials which will compare the effectiveness of penicillin with that of tetanus antitoxin in the prevention of tetanus in patients who present with fresh, clean wounds. Results of this survey indicate that it would be ethical to exclude from such a trial patients who have any of the following: (a) a wound more than 12 hours old, (b) multiple injuries or a single massive injury, (c) extensive burns of the skin, (d) an injury sustained in a road accident, (e) a compound fracture, (f) a wound that is grossly contaminated with soil.

All the patients who are excluded from the trial should be given simultaneous combined active-passive immunization. Antibiotics should also be prescribed, if indicated.

Summary

This paper reports the occurrence of tetanus among patients who were treated at the casualty department of the University College Hospital, Ibadan.

During the four-year period from January 1958 to December 1962 20 cases of tetanus occurred in injured patients who had received treatment at this casualty department.

The frequency of tetanus was highest when the use of anti-tetanus serum was almost completely replaced by prophylaxis with penicillin.

The limitations of penicillin in the prevention of tetanus are discussed.

It is suggested that a study should be carried out to compare the effectiveness of long-acting penicillin with that of tetanus antitoxic serum in the prevention of tetanus.

We would like to thank the staff of the Medical Records Office and the Pharmacy Department for their kind co-operation. We are also grateful to the staff of the Casualty Department.

ADDENDUM.—Since submitting this paper our attention has been drawn to a statement by R. L. Batten (Batten, 1965). His

impression, based on the same material but admittedly without analysis of the data, was that following the withdrawal of A.T.S. "there was no increase in the number of cases and that those that did develop the disease had it in a milder form." The results of this study show these impressions to have been erroneous.

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Self-poisoning*—Part II

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Brit. med. J., 1965, **2**, 1336–1340

We have discussed the social setting of people involved in self-poisoning acts and the methods they employed. In exploring their personal characteristics and their motives we began by considering diagnosis. I make no apology for thus entering the clinical arena ; to influence the public health we have to understand the private illness. I shall, however, concentrate on those aspects of the personal situation which will provide guides to prevention and to management.

Distress

Is there a unifying basis to self-poisoning acts ? Is there some feature that informs them all ? The answer has already been hinted at. Distress drives people to self-poisoning acts: distress and despair, unhappiness and desperation. It may arise from within, from a morbid appreciation that the patient has of himself in the world ; such is the person with a depressive illness. Often it is generated from outside, from the intolerable yet insoluble social situation in which he is caught ; that is why so many patients cannot be classed as ill. Sometimes it springs from both sources. Nobody takes poison, a little or a lot, to live or to die, unless at that moment he is distressed beyond what he can bear and so desperate that he cannot see a more rational solution. He does not think that no solution exists, but he cannot himself find it. The suicide says, in effect, "There is no way out," but people who poison themselves are saying, "I cannot see a way out." They find themselves trapped. They are desperate ; and their distress drives them to an action that is both stupid and, at the same time, a blow for liberation, to an action that is both senseless and purposeful. We must respect the conjunction of these epithets.

* The Milroy Lectures (abridged) delivered at the Royal College of Physicians of London on 1 and 3 February 1965. Part I was published last week.
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Almost always the patients can. Many of them did even as they were taking the tablets.

A married woman of 27 whose husband was threatening to leave her took 50 aspirins: "I didn't think they'd kill me. I thought they might. I hoped they wouldn't. I thought of my mother and father. I couldn't let them be hurt. I hoped really it would bring John back. If it didn't I might as well die."

Senseless and purposeful—it is a paradox that we have to accept.

Motive

The sorts of predicaments which cause people such distress are legion. "Every unhappy family is unhappy in its own particular way." Yet some generalizations can be made. Some patients referred the drama to something wrong within themselves (Table X). It was, they thought, their feelings about the world that were faulty ; however, such notions were by no means always accompanied by self-blame. Others explicitly incriminated bad relationships with someone else—generally, if they were married, the spouse. Although they recognized that it takes two to quarrel, they inclined to reproach the other more than themselves. Very often they were right. Not many mentioned material circumstances—debt or unemployment, for instance—and very few indeed held them to be the only factors at work. Broadly speaking our assessment of these factors corresponded with the patients' views.

We noted one phenomenon over and over again. An insensitive spouse, generally the husband, although he cared for his wife had failed to notice either her need for emotional support

TABLE X.—*Motives for Self-poisoning*

	Males (163)	Females (348)
*Troubled relationships with other people ..	39% (51%)	59% (65%)
*Distress arising from within ..	45% (66%)	37% (49%)
*Material problems (money, housing, etc.) ..	15% (18%)	14% (16%)
"No reason" or "don't know" ..	23%	16%

* These factors are not exclusive of each other.
 Figures in parentheses are the clinical assessments based on interviews with relatives as well as with patients.