

Clinical and bacteriological profile of the ear in otogenic tetanus: A case control study

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Abstract

Twenty two patients presented with otogenic tetanus. Seventeen patients had acute histories with only a single episode of otitis media with otorrhoea. Fifteen patients had unilateral central perforations, five had bilateral central perforations and two had no perforations but had acutely congested tympanic membranes which were bulging suggesting the presence of purulent fluid behind them. All patients with perforations had a purulent pulsatile discharge. A coexisting aerobic infection was seen in 85 per cent of the cultures and 59 per cent of these were due to *staphylococcus aureus* (versus 25 per cent in the controls). Only one patient had received partial immunization. Tetanus resulting from otitis media is not an indication for surgery.

Introduction

Tetanus is an acute, often fatal disease caused by an exotoxin produced by the organism *Clostridium tetani*, a non-invasive obligatory anaerobe. That tetanus can occur as a complication of otitis media is well known (Beatty, 1987). Otogenic tetanus accounts for about 15.8 per cent (Vakil *et al.*, 1966) to 35 per cent (Black and Atkins, 1972) of all cases of tetanus in developing countries.

Many papers have reported on the aspect of tetanus as a complication of middle ear disease and have compared it to tetanus resulting from other causes. However, there has been no systematic study where authors have attempted to characterize the ear disease and to identify any local predisposing factors. We therefore undertook this prospective study to identify these factors.

Materials and methods

This study on 22 patients was carried out in the tetanus and medical intensive care unit of a tertiary referral medical centre and university hospital. A detailed history of any previous ear discharge was sought from all patients admitted with tetanus over a nine month period. All patients were subjected to an otological examination. Those patients with a history of otorrhoea or middle ear disease detected on otological examination, who had any other possible portals of entry for *clostridium tetani* such as wounds, ulcers, recent surgery, recent abortions, intramuscular injections or tooth infections were excluded from this study. Thus, patients suffering from tetanus and middle ear disease who had not other sites through which *clostridium tetani* could have gained access were diagnosed as having 'otogenic tetanus' (Apte, 1961; De and De, 1970; Black and Atkins, 1972; Mahoney, 1980;

Mahanta and Das, 1991). Pus from the infected ear/ears was sent for bacteriological examination. Pus was collected from all the discharging ears by the method described by Sugita *et al.* 1981. All patients received anti-tetanus serum (10,000 units intravenously after testing for allergy), penicillin for the clostridial infection and diazepam which was administered orally or through a nasogastric tube in patients who were unable to swallow. All patients received enteral alimentation. Patients who had frequent spasms or who were unable to cough out tracheal secretions were subjected to tracheostomy. The ear was subjected to removal of the discharge and installation of topical antibiotic ear drops.

Controls

Since the otological examination and bacteriological data revealed unexpected findings, we studied twenty age, sex and social status matched controls who attended the outpatient department for otorrhoea. Ear examination and collection of pus for bacteriology was performed in all controls in the same way as for the patients suffering from otogenic tetanus.

Results

Twenty two patients suffering from tetanus and otorrhoea admitted between August 1990 and April 1991 met the criteria for the diagnosis of 'otogenic tetanus'. These included 13 (59 per cent) males and 9 (41 per cent) females. There were 21 children (ages one and a half years to 12 years) and one adult aged 55 years. None had a past history of tetanus. Only one patient had received partial immunization against tetanus (a single dose of tetanus toxoid). All the others were unimmunized.

TABLE I
CLINICAL SCORE SHEET FOR ASSESSING THE SEVERITY OF TETANUS

Clinical features	Score	Maximum	Classification
1. Rigidity			
Trismus	1	4	
Neck	1		Mild tetanus
Abdomen	1		1-3
Limbs	1		
Spasms			
1 spasm/hour	2		
>1 spasm/hour	6	10	Moderate tetanus
Continuous laryngeal spasms	4		4-10
3. Temperature >38°C	2		
Pulse >120/min	2	6	Severe tetanus
Respiratory rate >40/min	2		11-20
Maximum score—20			

A clinical score sheet for assessing the severity of tetanus was designed (Table I). Three (13.6 per cent) patients had severe tetanus, 11 (50 per cent) had moderate tetanus and 8 (36.4 per cent) had mild tetanus. Seventeen patients had only a single episode of otorrhoea at the time of presentation while five patients had multiple episodes of otorrhoea. Two patients had had otorrhoea on and off over two years and three patients had otorrhoea for a period of one year. The last episode of otorrhoea ranged from two months to three weeks before the present bout of otorrhoea. All patients had fever along with ear discharge.

Perforations of the tympanic membrane were present in 20 of the 22 patients. Fifteen (68 per cent) patients had unilateral central perforations, while five (23 per cent) had bilateral central perforations. None had marginal perforations or perforations in the region of the pars flaccida. Two (9 per cent) patients had apparently intact tympanic membranes and yet they presented with unilateral acute otitis media with purulent discharge in the external ear canal. On evacuation of the discharge the tympanic membranes were found to be severely congested and were bulging suggestive of purulent discharge behind them. None of the patients in our series had evidence of a cholesteatoma.

The control group too displayed a similar pattern. Fourteen children had unilateral central perforations, four had bilateral central perforations and two had unilateral acute otitis media with apparently intact tympanic membranes. None had cholesteatoma.

Bacteriology

From among the group of patients suffering from tetanus of otogenic origin, *staphylococcus aureus* was isolated in 59 per cent of swabs, while gram negative bacilli such as *pseudomonas*, *proteus* and *E. coli* predominated in the control group with *staphylococcus aureus* being isolated in 30 per cent of swabs (Table II).

Treatment of ear disease

None of the patients with otogenic tetanus had any indication for surgical intervention and recovered with conservative therapy alone.

Discussion

The spores of *clostridium tetani* are present every-

where, especially in soil, dust and faeces. They frequently contaminate ulcers, wounds, surgical incisions, the post-partum uterus and ulcerated tumours (Karnad and Tilve, 1990), but tetanus only develops in unimmunized persons. In previously immunized subjects the toxins produced by the bacilli are neutralized by circulating specific antibodies. In the present study 21 out of 22 patients with otogenic tetanus were unimmunized while only one had received partial immunization.

In the present series only three had severe tetanus. There was no mortality compared to the overall mortality of 28 per cent for all tetanus patients in this unit (Karnad *et al.*, 1986). Many previous large series of patients with otogenic tetanus have stressed the course and severity (Apte, 1961; Patel *et al.*, 1963; Wagle, 1963; De and De, 1970). Tetanus following middle ear disease is generally milder and has a better prognosis than that developing from any other site. Thus, our findings are consistent with this observation.

Most authors (Corcoran, 1938; Apte, 1961; Wagle, 1963; Vakil *et al.*, 1966; Mahanta and Das, 1991) have labelled the otological disease associated with tetanus to be one of chronic suppuration. However none have actually described the otological pathology. Our findings therefore assume importance. Seventeen of our 22 patients had acute histories and the examination findings in all patients were suggestive of acute otitis media. None of our patients had a cholesteatoma. Wadsworth (1962) described one patient suffering from otogenic tetanus who had a cholesteatoma. In Mahoney's (1980) series of 67 patients, four had cholesteatomas. The otological findings in the remaining patients were not described. Black and Atkins (1972) described two patients with otogenic tetanus. Both had chronic ear disease with mastoiditis. None of our patients had mastoiditis.

Some authors (Bishop *et al.*, 1932; Stonham, 1938) have reported the presence of foreign bodies in the ear in patients suffering from otogenic tetanus. None of our patients had foreign bodies or a history of instrumentation of the ear. Thus contrary to popular teaching this study has demonstrated that the middle ear disease associated with tetanus is acute otitis media rather than chronic otitis media.

Being obligatory anaerobes *clostridium tetani* spores can germinate and proliferate only in an environment with a low redox potential. All our patients had their external canals filled with pus. On evacuation of the pus the canals rapidly refilled in patients with perforations. Thus the purulent discharge may seal off the perforation. The eustachian tube is blocked in acute otitis media (Sando *et al.*, 1991). Thus the middle ear is effectively sealed off from the environment preventing entry of air, thereby favouring

TABLE II
ORGANISMS ISOLATED FROM PATIENTS SUFFERING FROM OTOGENIC TETANUS AND FROM THE EARS OF THE CONTROLS

Bacteria	Otogenic tetanus (n = 27)	Controls (n = 24)
<i>Staphylococcus aureus</i>	16	6
<i>Pseudomonas</i>	3	6
<i>Proteus</i>	0	5
<i>E. Coli</i>	4	4
No organisms grown	4	3

*P value for difference between groups <0.025 (chi square test).

growth of the tetanus bacilli. Other anaerobic bacteria too may infect the middle ear. Sugita *et al.* (1981) reported the presence of anaerobes in 8 per cent of cases with spore forming anaerobes constituting 3.6 per cent of isolates. In another similar study by Pande *et al.* (1990) anaerobes were isolated in 10.2 per cent of cases. In both these studies all patients with anaerobes in their middle ears also had coexisting aerobic infections.

Onderdonk *et al.* (1976) and Fulghum *et al.* (1977) believe that the metabolism of aerobic bacteria lowers the local concentration of oxygen and reduces the oxidation—reduction potential thereby providing a suitable environment for the anaerobic pathogens. Potts *et al.* (1978) believe that leucocytes in closed cavities also contribute to the consumption of oxygen. MacDonald *et al.* (1963) believe that growth factors produced by one organism permit the survival of a pathogen at the infected site. Furthermore anaerobes are known to interfere with the phagocytosis of aerobes (Shenoi, 1987). Thus a vicious cycle can be generated. We believe that such a synergistic infection in a closed middle ear may have operated in our patients too.

Staphylococcus aureus was isolated in 59 per cent of our cases. We investigated this unusual finding by studying 20 age, sex and social status matched patients with acute otitis media, but not suffering from tetanus. Gram negative bacilli were isolated in 62.5 per cent of these controls and *staphylococcus aureus* were found in only 25 per cent of patients. The incidence of staphylococcal infection in the control group is consistent with the 22 to 25 per cent reported in studies by Sugita *et al.* (1981) and Pande *et al.* (1990). However the high association between staphylococcal infection and otogenic tetanus remains unexplained. Sugita *et al.* (1989) too have reported a similar high association of the isolation of staphylococci and the presence of other anaerobic bacteria in the middle ear. Sugita (1977) reports an incidence of 29 per cent of *staphylococcus aureus* in the presence of anaerobic bacteria and Palva *et al.* (1969) report an incidence of 22.5 per cent.

None of our patients required surgery for their ear disease. Black and Atkins (1972) based on their experience of two cases recommend radical mastoidectomy to maintain an aerobic environment even if the usual surgical indications are absent. On the other hand Mahoney (1980) based on his experience of 67 cases recommends no surgical intervention. We believe that otogenous tetanus in itself is not an indication for surgery on the middle ear. Moreover diseases like cholesteatoma were not seen in our study. Thus ear toilet to maintain an aerobic environment and instillation of local antibiotics to treat coexisting aerobic infections may be adequate in most cases.

Our study has a small limitation. We did not attempt to isolate *clostridium tetani* from the ears of our patients. However the isolation rate in most series is low, 15 per cent in Tomkins (1959) series, 16 per cent by Vakil *et al.* (1966) and 36 per cent by Wagle (1963). Moreover the tetanus bacilli may also be isolated from the ears of some patients who clinically do not have tetanus (Black and Atkins, 1972). Hence in practise the diagnosis of otogenic tetanus remains a clinical entity.

Conclusion

Most patients with otogenic tetanus probably have

middle ear infections for the first time. An examination revealed acute otitis media in all our cases. A middle ear cavity which is sealed off from the environment and whose oxygen is consumed by coexisting aerobic bacteria seems to favour the growth of *clostridium tetani*. Otogenic tetanus in itself is not an indication for surgery upon the ear.

The incidence of staphylococcal middle ear infection in the patients, attending the outpatient department of our hospital is similar to that of patients elsewhere. For some as yet unknown reason unimmunized patients with staphylococcal infections are probably more likely to develop tetanus.

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