Original Article

Outbreak of Cutaneous Anthrax in a Tribal Village: A Clinico-epidemiological Study

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Abstract

Background : Anthrax is a life-threatening infectious disease that normally affects animals, especially ruminants. It is caused by the bacteria *Bacillus anthracis*. The most common mode of infection is through the skin, which causes a painless sore that usually heals without treatment. If left untreated, cutaneous anthrax may progress in up to 20% of cases to septicaemia with potentially lethal outcome.

Methodology : We visited a small tribal village of the state of West Bengal, where an outbreak of cutaneous anthrax was suspected following slaughtering a dead bullock. The population at risk were subjected to detailed interrogation, thorough clinical examination and relevant investigations.

Results : The mean age of our study population was 32.1years, and 100% were male. The mean incubation period was three days. Most cases (81.8%) were exposed to the bacteria during butchering. The predominantly affected sites were fingers (54.5%), followed by forearms (18.2%), around elbows (18.2%) and arm (9.1%). All cases initially had painless papules, ulcers with vesicles; dissemination of the lesion was seen in 27.3% of patients. 9 patients (who were alive) underwent complete blood count, baseline biochemistry and chest X-ray. Smears were made from the cutaneous lesions for gram's stain in 5 patients. Wound swabs were also inoculated in nutrient broth and subcultured in blood agar media. FNAC from the enlarged axillary lymph node was done in 1 patient and blood was sent for aerobic culture in 2 individuals. Both the blood cultures were sterile. Smears made from the culture obtained from cutaneous lesion of one of the affected person revealed gram positive aerobic spore bearing non-motile bacilli in long chain with capsular halo suggesting *Bacillus anthracis*. In this outbreak, the attack rate was 7% and case fatality rate was 18%.

Conclusion : Cutaneous anthrax should be considered as a differential diagnosis in cases presenting with painless ulcers, vesicles or eschars with a recent history of exposure to animals or animal products. It is important to recognise the clinical aspects of this disease in routine practice since any delay in treatment may have fatal consequences, as observed in this study.

Introduction

Anthrax is a potentially fatal zoonotic disease caused by the gram-positive organism, *Bacillus anthracis*, which rarely affects humans under normal conditions. In most of the developed nations, anthrax has almost disappeared but in many of the developing countries the disease is still endemic. A good number of cutaneous anthrax cases have been reported from Turkey.[1,2] However, patients with cutaneous anthrax have been found in developed countries like United States[3] and France.[4] Anthrax is a potential agent for use as a biological weapon or for bioterrorism. In 2001, bioterrorist activities involving the United States Postal Service infected 22 people with anthrax. Seven survivors had confirmed cases of cutaneous anthrax. While at least 17 nations are believed to have a biological weapons program, it is unknown how many nations or groups are working with anthrax. However, most bioterrorism experts have concluded that it is technologically difficult to use anthrax effectively as a weapon on a large scale.

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The actual incidence of anthrax in India is largely unknown perhaps due to under-diagnosis or due to under-reporting of the cases. Cases of human anthrax have been reported mainly from southern part of India and thus confirm the endemicity of the disease. This outbreak of cutaneous anthrax occurred in a small village named Chandmurha, situated in the south-west part of the state of West Bengal. The village is inhabited by tribal people living on farming and cattle grazing. It has 65 households with an estimated total population of 320. Our study incorporates the epidemiological data and the clinical features of the involved cases. It is important to recognise the clinical features of this potentially lethal disease in clinical practice since any delay in initiating treatment may have fatal consequences, as illustrated by this study.

Background

A 43 year old gentleman RH (Table 3) was brought to the emergency on 26/04/2010 with laboured respiration and unconsciousness. He had frequent attacks of generalised tonic clonic seizure for last 10 hours. Clinical examination revealed the following: Glasgow Coma Scale: 4 (E-1, M-2, V-1), BP: 64/40mm of Hg. pulse: 124/mn. (very feeble), respiration rate:54/mn.,SpO2: 56% (while breathing ambient air). Neck was supple with non-responding plantars. Pupils were dilated, equal and non-reacting to light. Coarse crepitations were heard scattered over both the lung fields. The right arm, right axilla and neck

Fig.1 : Cutaneous lesions and axillary swelling of RH (a) and SS (b)

Table 1 : Investigations performed in the symptomatic individuals

Investigations performed	Number of patients (%) (n=9)
Complete blood count	9 (100%)
Blood sugar, Renal function tests	9 (100%)
Liver function tests	9 (100%)
Chest X-ray	9 (100%)
Wound material for gram stain	5 (55.5%)
Wound material for culture	5 (55.5%)
Blood culture	2 (22.2%)
FNAC from axillary lymph node	1 (11.1%)

were swollen. There were multiple vesicles over the right upper arm and axilla with some purplish discolouration (Figure 1a). Cardio-pulmonary resuscitation was started but the patient died within 20 minutes.

Soon after another patient SS (Table 3) aged about 30 years was admitted with almost identical clinical presentation. He had right axillary lymphadenopathy with some papulo-vesicular lesions over right ante-cubital fossa (Figure 1b). The patient died 3 hours after admission.

A detailed history from the accompanying persons revealed that both the deceased resided in the same locality and were suffering from identical illness for last 9 days and were admitted in the local health care facility. They were involved in slaughtering of a dead bullock 11 days back. 2 days after that they noticed cutaneous blisters appearing in their right hands followed by painful swelling over the right axilla. They had fever for the last 4 days with progressive clinical deterioration. We decided to visit the particular village to enquire about the symptoms, to identify new cases if any and have a confirmed diagnosis of the disease.

Aims and Objectives

1. To have a definite diagnosis.
2. Estimate the incidence and severity of the disease.
3. To identify the probable risk factors.
4. To provide recommendations to avoid further outbreak.

Materials and Methods

A medical team comprising of faculty members from department of Medicine, Dermatology, Microbiology, Community medicine and the Block Medical Officer of Health (BMOH) visited the said village. A total of 152 people (of 36 families) were at risk. They either have ingested the cooked meat or were involved during slaughtering or handling the raw meat. The team visited all the 36 households and all of the 152 individual were evaluated with a detailed history and thorough clinical examination. We found that only 11 persons (including those who died) had clinical manifestations of the disease.

Table 2 : Clinical manifestations observed in the study population

Clinical manifestations	Number of patients (%)(n=152)
Cutaneous manifestations	11 (7.2%)
Malaise	4 (2.6%)
Vomiting	3 (1.9%)
Diarrhoea and bloody dysentery	2 (1.3%)
Lymphadenopathy	3 (1.9%)
Death	2 (1.3%)

Investigations were performed in 9 patients who were alive and had signs and symptoms of the disease. All of them underwent complete blood count, baseline biochemistry (blood sugar, renal function tests, and liver function tests) and chest X-ray. Smears were made from the cutaneous lesions for gram's stain in 5 patients. In all those 5 patients wound swabs were also taken and inoculated in nutrient broth and subcultured in blood agar media. Smears and swabs were taken from the cutaneous vesicles, from the ulcer bases, and from accumulated fluids surrounding the lesions. FNAC from the enlarged axillary lymph node was done in 1 patient and blood was sent for aerobic culture in 2 individuals. Cutaneous lesions were almost healed in 3 of the 9 patients and in those individuals only baseline investigations were done (Table1).

On the basis of suggestive history and characteristic clinical features a provisional diagnosis of cutaneous anthrax was considered. All contacts and affected persons were given tab. Ciprofloxacin (500 mg BD) under supervision of BMOH. One patient with axillary lymphadenopathy received Inj. Benzyl Penicillin (120 million/day) in addition to ciprofloxacin.

Observations and Findings

What came out from the history is that a bullock was sick for past few days and died on 15/04/2010. It was butchered at a nearby field in the locality and the cooked meat was consumed over the next 3 days. The 11 symptomatic individual were involved during slaughtering, chopping, preparing and cooking the meat. Persons who were engaged in slaughtering were not butcher by profession. None of them wore gloves or any other protective equipment. Two of them (who ultimately died) sustained deep cut injuries over their hands during that time. Their helpers chopped and prepared the beef without any protection. Persons involved in skin trading carried the skin bare handed. The beef was boiled for 50 minutes before serving.

They noticed the cutaneous lesions appearing within the next 2-4 days after slaughtering. The lesions started as one or more painless papules, mainly on the hands and fingers transforming soon into blisters followed by healing with a black central scar. Some of these cases were initially associated with malaise and both the deceased had bloody diarrhoea. They were initially treated by a local quack with Inj. Tetanus Toxoid and some antibiotics.

Of the 152 exposed individual, 11 had clinical manifestations in the form of cutaneous features (papules, vesicles or eschars), regional lymphadenopathy or gastrointestinal symptoms (vomiting, diarrhoea or bloody dysentery) (Table2). All of the symptomatic individuals (n=11) were involved in handling the

Table 3 : Summary of the observations of the symptomatic patients

No.	Name	Sex	Age (yr)	Mode of contact	Cutaneous lesions	Lymphadenopathy	Culture material	Outcome
1	TM	Male	15	Slaughtering	Middle finger (Rt.) (Fig.3a)	No	Extract from vesicle	Cured
2	DH	Male	25	Slaughtering	Index finger (Rt.) (Fig.3b)	No	Extract from vesicle	Cured
3	SH (1)	Male	37	Slaughtering	Little finger (Rt.) (Fig.3c)	No	Extract from vesicle	Cured
4	SH(2)	Male	45	Slaughtering	Middle and ring fingers (Lt.) (Fig.4a)	No	-----	Cured
5	RH	Male	26	Handling raw meat only	Right thumb (Fig.4b)	No	Extract from vesicle	Cured
6	KS(1)	Male	45	Slaughtering	Right forearm (Fig.4c)	Yes (axillary)	FNAC from lymph node and blood	Cured
7	CS	Male	45	Slaughtering	Middle finger (Rt.) (Fig.5a)	No	-----	Cured
8	MS	Male	15	Handling raw meat only	Left elbow (Fig.5b)	No	Extract from vesicle and blood	Cured
9	KS(2)	Male	27	Slaughtering	Left forearm (Fig.5c)	No	-----	Cured
10	RH	Male	43	Slaughtering	Arm, axilla and chest (Rt.) (Fig.1a)	Yes (axillary, cervical)	-----	Died
11	SS	Male	30	Slaughtering	Antecubital fossa (Rt.) (Fig.1b)	Yes (axillary)	-----	Died

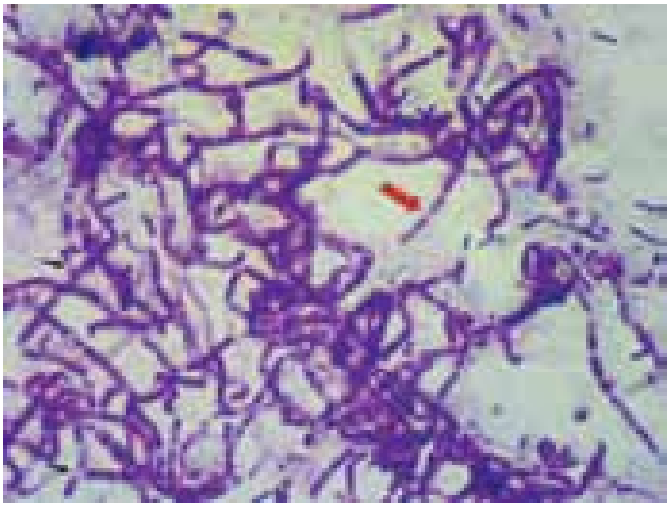

Fig. 2 : Gram positive bacilli in chains with spores (black arrow) and capsular halo (red arrow)

Fig. 3 : Cutaneous lesions of TM (a), DH (b) and SH (1) (c) (Table 3)

raw meat (either slaughtering or cooking) whereas persons who only ingested the cooked meat (n=141) did not report to have any clinical symptoms.

The mean age of our study population was 32.1years, and 100% were male. The mean incubation period was three days. Most cases (81.8%) were exposed to the bacteria during butchering. Only two patients used an antibiotic prior to the survey (18.2%). The predominantly affected sites were fingers (54.5%), followed by forearms (18.2%), around elbows (18.2%) and arm (9.1%). All cases initially had painless papules, ulcers with vesicles; dissemination of the lesion was seen in 27.3% of patients (Table 3). In this outbreak, the attack rate was 7% and case fatality rate was 18%.

Fig. 4 : Cutaneous lesions of SH (2) (a), RH (b) andKS (1) (c) (Table 3).

Fig. 5 : Cutaneous lesions of CS (a), MS (b) andKS (2) (c) (Table 3)

The baseline investigations were essentially normal except for a minimal elevation of total leucocyte count and sedimentation rate in the patient having axillary lymphadenopathy. The FNAC was suggestive of acute suppurative lymphadenitis. Both the blood cultures did not grow any organism. Gram stained smear made from the material obtained from cutaneous vesicles documented plenty of squamous cells with some isolated gram positive bacilli not fully resembling *Bacillus anthracis*. Another striking feature was the absence of neutrophils in the smear. Smears were also made from nutrient broth and examined under microscope. Smears made from the culture obtained from cutaneous lesion of SH[1] (Table 3) revealed gram positive aerobic spore bearing bacilli in long chain with capsular halo (Figure 2). Subculture of the specimen in blood agar produced typical medusa head colonies. It was catalase positive and non-motile. Based on these findings the organism was identified as *Bacillus anthracis* (as per CDC guideline) and the diagnosis of cutaneous anthrax was confirmed.

Discussion

Anthrax is a life-threatening zoonotic disease. It can be transmitted to humans by contact with infected animals or their

products. Anthrax does not spread from person to person. The agent of anthrax is a gram-positive, encapsulated, spore-forming rod-shaped bacterium called *Bacillus anthracis.* Anthrax can infect humans in three ways and thus there are three forms of the disease: cutaneous anthrax, inhalation anthrax and gastrointestinal anthrax. The most common type of human anthrax infection is cutaneous anthrax which accounts for nearly 95% of all anthrax cases worldwide. Cutaneous anthrax occurs when either the spores or the bacteria itself enter the body through a cut or abrasion. In most cases, symptoms begin to develop within 48 hours, although a range of 2-7 days has been found. Cutaneous anthrax begins as a small, red, itchy papule at the site of infection. Within about 2 days, it develops into a fluid-filled blister that eventually ruptures. The lesion ultimately dries into a coal-black scab (known as eschar) that covers an area of dead skin, hence the name anthrax (Greek for "coal"). Some patients may have painful enlargement of regional lymph nodes. In some cases, the infection can spread through the bloodstream and become fatal. However, death is extremely rare in the majority of individuals who receive prompt, appropriate treatment. If untreated, cutaneous anthrax is fatal in 20% of cases due to spread of the bacteria throughout the body and the release of deadly toxins in the bloodstream. However, with appropriate treatment, cutaneous anthrax is deadly in only 1% of cases. The patients in our study group presented late and we observed a case fatality rate of 18% which is consistent with the fatality rate mentioned in literature.

India, where people depend largely on livestock for their livelihood has many regions which are still enzootic for animal anthrax.[5] A significant number of cutaneous anthrax cases in India have been reported from Christian Medical College, Vellore[6] and JIPMER hospital, Puducherry.[7,8,9] A review of Indian literature done way back in 1996 has also found 71 cases of cutaneous anthrax (112 cases in total) in southern India.[10] Cutaneous anthrax was reported from a tribal area in Araku Valley of Visakhapatnam district of the state of Andhra Pradesh where people got infected after slaughtering, cooking and eating meat of dead goats, similar to what we observed in our study.[11] Four cases of cutaneous anthrax were encountered in a mini outbreak in Vizianagaram district, of Andhra Pradesh, India where one of the patients had axillary lymphadenopathy. Those cases were diagnosed by conventional methods like what we did in our patient population.[12]

In the background of a suggestive history some features are strongly suggestive of cutaneous anthrax. These are oedema out of proportion to the size of the lesion, lack of pain during the early phases of infection and the rare presence of polymorphonuclear leucocytes in the gram's stained smear made from vesicular fluid.[13] We had almost similar observations in our patients. As culture of the organism from typical skin lesions yields positive results in approximately 60 to 65 per cent of cases, the presence of the bacilli in the gram's stained smear from the cutaneous lesions and a robust epidemiological proof may be the only evidence in favour of the diagnosis of cutaneous anthrax.[14] Several other methods, such as specific enzyme-linked immunosorbent assays, enzyme-linked immunoelectrotransfer blotting and indirect microhemagglutination, have been used for the serologic diagnosis of anthrax.[15] However, because of lack of availability of the above tests in our set up we had to resort on conventional methods like examination of gram's stained smear and culture of the material obtained from cutaneous lesions and blood culture in cases of suspected septicaemia. We had only one positive culture (20%) and this may be attributable to the late presentation of the cases and prior antibiotic use by the local quack.

To the best of our knowledge till date there is only one study that has reported cutaneous anthrax from eastern India.[16] We observed a number of similarities between the present study and this study from Murshidabad district of West Bengal. In both the studies the attack rate was highest among the age group 15-45 years. It was also found that persons who were not involved in slaughtering or handling meat or skin and whose sole exposure was eating the cooked beef did not have any manifestations of the disease. The isolation rate of the causative bacterium in our study is identical to that in the second outbreak observed by Ray et.al.

Cutaneous anthrax, like the more deadly inhalational anthrax, is treated with antibiotics. The CDC recommends first-line treatment with ciprofloxacin or doxycycline. Other recommended antibiotics are erythromycin and penicillin. Cases of naturally occurring cutaneous anthrax are treated with a 10-14 day course of antibiotics. However, a full 60-day course of antibiotics is recommended for cases of cutaneous anthrax associated with bioterrorism. We have used ciprofloxacin and penicillin in our cohort.

Our study had some limitations. We could not ascertain the cause of death in those two individuals though septicaemia with multi-organ dysfunction was considered. One noticeable thing was that both of them sustained deep cut injuries during slaughtering which may have contributed to a higher bacterial inoculation and sepsis. Causes of death in anthrax include asphyxiation from oedema of the neck with tracheal compression and concurrent gastrointestinal anthrax.[17] Both of the deceased had bloody diarrhoea and one of them had swelling of neck. However, we are not sure whether the gastrointestinal symptoms were the manifestations of gastrointestinal anthrax. Moreover, because of lack of infrastructure we could not perform autopsies on those patients.

Conclusions

To summarise our findings, the disease was limited to the tribal population engaged in butchering the dead animal bare handed. The symptoms appeared 2-3 days after butchering and the lesions were painless and healed with central black scar. Because this anthrax outbreak was associated with a very high case fatality rate, probably due to the late presentation, we suggest that the healthcare providers in anthrax-endemic areas should be educated about the signs and symptoms of the disease, so that early initiation of appropriate antibiotic is possible. Different medical and government agencies should arrange medical education programmes to sensitize the primary care givers about the possible signs and symptoms of anthrax and should provide adequate supply of antibiotics for early use in such outbreaks. More importantly perhaps, the community must be educated about using personal protective gears during butchering of ruminant animals and handling of raw meat and skins.

To prevent such outbreak some simple precautions may be adopted by the local population.

1. Protective, impermeable clothing and equipment such as rubber gloves, rubber apron, and rubber boots with no perforations should be used when handling the body of an anthrax infected animal or person. No skin, especially if it has any wounds or scratches, should be exposed.
2. Effective decontamination of possible anthrax-contaminated sites can be accomplished by a thorough wash down with

antimicrobial soap and water. Waste water should be treated with bleach or other anti-microbial agent. Effective decontamination of articles can be accomplished by boiling contaminated articles in water for 30 minutes or longer. Chlorine bleach is ineffective in destroying spores and vegetative cells on surfaces, though formaldehyde is effective. Burning clothing is very effective in destroying spores.

3. Cremating victims is the preferred way of body disposal.

Delays of only a few days may make the disease untreatable and treatment should be started even without symptoms if possible contamination or exposure is suspected.

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