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Perspective

Anthrax: A Neglected Bacterial Zoonosis of Major Public Health Concern

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Neglected zoonotic diseases, which received less attention, are caused by a variety of pathogens, and are prevalent in tropical and subtropical countries of the world affecting large numbers of people. There are several neglected zoonoses, such as brucellosis, rabies, leptospirosis, plague, anthrax, echinococcosis, leishmaniasis, taeniasis/cysticercosis, and schistosomiasis. Most of the neglected diseases occur in developing nations, which have inadequate medical facilities, and poor environmental sanitation. Among these, anthrax is a potentially fatal and highly contagious neglected bacterial zoonosis, which is recorded from many countries of the world including India. It acts as a double-wedged weapon, one by causing serious and fatal illness in humans, and other by producing a great economic loss to the livestock industry. The history of anthrax goes back to year 1976 when Robert Koch, was successful to culture *Bacillus anthracis* in pure form. Later, in 1881, Louis Pasteur developed first effective live bacterial vaccine against anthrax. The zoonotic significance of *B. anthracis* was established by Frederick Brauceli, a German Veterinarian, who first demonstrated the bacterium in the blood of man and then transmitted the infection to sheep. Anthrax is also known by several names, such as Charbon, Malignant oedema, Malignant pustule, Rag pickers disease, Splenic fever and Wool sorter's disease. The disease can re-emerge is some regions of the world resulting in death of many species of animals as well as humans. During the first half of 20th century, global annual incidence of human anthrax was estimated 20,000 to 100,000 cases. Disease is caused by *B. anthracis*, which is a spore forming, capsulated, aerobic, Gram positive, non-motile, and rod shaped bacterium. The bacterium does not produce haemolysis on 5% sheep blood agar. Anthrax is still endemic in humans as well as animals of many regions of the world. Soil is the chief reservoir of *B. anthracis.* The spores of *B. anthracis* are very stable and can live for decades in the environment, such as soil, water, air and vegetation. Alkaline soil with high humidity and organic matter provides an ecological niche for the propagation and survival of the organism. When organisms come out of the host's body, spores are formed in the presence of air (oxygen). However, capsules develop in the body of infected host. The highly infectious and resistance nature of spores to heat, radiation, disinfectant makes this organism as a choice to use as bio-weapon. Flies seem to play a significant role in several outbreaks of disease in endemic areas. Carnivores and vultures devouring infected anthrax carcass may further spread the infection in environment. Accidental release of aerosolized spores at Russian Military Biology Facility caused 79 persons sick of which 68 succumbed to death. This clearly demonstrated that inhalation form is highly fatal. In 2001, dried powder of spores of *B. anthracis* was sent in envelopes in US by some terrorist organization. The persons who were engaged in sorting and opening of mails were exposed to the spores of *B. anthracis* resulting into 23 cases with 5 deaths. Epidemics of anthrax were reported from Gambia and Zimbabwe affecting 448 and 10,000 peoples, respectively. An outbreak of anthrax in humans occurred in Chittoor, Andhra Pradesh, India following an epidemic of disease in cattle and sheep. The transmission of infection in humans can occur through several routes, namely cutaneous, inhalation, and ingestion. Direct contact with diseased animals, infected tissues, body discharges and contaminated fomites, the consumption of undercooked, raw, infected meat from food animals or game animals, and inhalation of *B. anthracis* spores while working with animal products, such as hair, wool, hide, skin, leather, fertilizer and animal protein can result in anthrax. Occasionally, laboratory acquired infection is also recorded. During the vaccination of animals, veterinarian may accidently get infection by needle inoculation. Human to human transmission is very rare. The disease in animals occurs in three forms, namely per-acute, acute, and sub-acute. In humans, according to the mode of transmission, cutaneous, gastrointestinal (oropharyngeal, intestinal), and pulmonary (inhalation) forms are described. Cutaneous form (Malignant pustule) is the most common clinical manifestation of human anthrax accounting for over 95% of cases. Pulmonary form known as wool sorter's disease carries very high mortality, and is observed in persons working with animal product processing industries. Mortality rate in untreated patients in cutaneous, gastrointestinal, and pulmonary form may be 20%, 25 - 75%, and 95 - 100%, respectively. Anthrax is considered as an occupational zoonosis of abattoir employees, industrial workers, livestock keepers, butchers, veterinarians, tanners, skinners, shearers, agricultural farmers, renderers, and shepherds. Analysis of 468 cases of human anthrax in Iran revealed more cases during summer and autumn and 74.2% of affected individuals gave a history of handling of animal products. Maximum cases are recorded in males than females because of occupational exposure. Natural infection has been described in many animals such as cattle, buffalo, bison, sheep, goat, camel, horse, pig, antelope, giraffe, elephant, rhinoceros, zebra, deer, gaur, hippopotamus, kangaroo, mink, jackal, lion, and tiger. Laboratory help such as direct microscopy (1% aqueous methylene blue), cultural isolation (blood agar, tryptose agar), animal inoculation (Guinea pig), immunological

test (indirect haemagglutination, enzyme linked sorbent assay), and molecular tool (polymerase chain reaction) is imperative to confirm an unequivocal diagnosis of anthrax. Ascoli precipitation test is of immense value to verify the presence of *B. anthracis* in hides and tissues of infected animals. It is pertinent to mention that biosecurity level 2 conditions should be provided in the laboratory for safe processing of specimens so that laboratory personnel are protected from getting infection. Disease should be differentiated from contagious ecthyma, cow pox, glanders, tularaemia, erysipelas, leishmaniasis, amoebic dysentery, necrotizing enteritis, coxiellosis, diphtheria, coccidioidomycosis and histoplasmosis, It is important to mention that isolation of the bacterium from cutaneous lesions is positive in 60 - 66%. A plethora of antibiotics, such as penicillin, amoxicillin, ampicillin, imipenem, chloramphenicol, gentamycin, erythromycin, ciprofloxacin, doxycycline, clindamycin, clarithromycin, rifampicin, and vancomycin are available to treat the patients. If the patient is allergic to penicillin, other antibiotics can be used. It is suggested that antibiotic susceptibility test should be conducted in all isolates of *B. anthracis.* The animals showing clinical illness can be treated with streptopenicillin. However, few nations do not allow antibiotic therapy of livestock for anthrax and recommend the slaughter of diseased animals with proper precautions and immediate sanitary disposal of carcass to prevent the spread of infection. Vaccination is considered is the only tool to prevent the disease. Several measures, such as immediate attention to cutaneous lesion, provision of protective wears to occupational groups, immunization of industrial workers, sanitary disposal of intact carcass, disinfection of premises with 5% formalin, sterilization of hair, wool, hide, and skin with gamma irradiation, boiling of clothes and equipments for 2 hours, maintenance of hygienic conditions in industrial plant, annual vaccination of animals, avoidance of consumption of milk from vaccinated animal, precautions during making blood smear from dead animal, decontamination of surfaces in laboratory with 0.5% hypochlorite, use of ciprofloxacin as chemoprophylaxis, and health education of high risk groups can certainly mitigate the incidence of anthrax. It is imperative that the person with skin lesions should not be allowed to work in animal product industry. It is suggested that serological screening of animals and humans may be useful to monitor the prevalence of anthrax in an area. Early diagnosis and prompt treatment is imperative to reduce the morbidity and mortality. Attempts should be made to further develop safe, effective, and low cost vaccine, which can be used as prophylaxis in high risk groups, as anthrax is a life threatening bacterial anthropozoonosis of global importance.

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