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Review Article

Bioterrorism: Clinical and public health aspects of anthrax

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ABSTRACT

Bioterrorism is intentional use of bioweapons (bacteria, viruses, or fungi or their toxins) to harm people, animals, agriculture, or environment of a country. Its impact can cause high mortality and morbidity and serious disruption of economy and social and political life. Countries must be fully equipped to respond through adequate surveillance systems and management, containment, and preventive policies.

Bioterrorism has an ancient history. Terrorism due to infectious agents needs a different paradigm than nuclear or chemical bioterrorism.[1] Polluting drinking water of enemies with rye ergot (a fungus) by Assyrians in 600 BC was a common strategy. In Middle Ages, Tartar forces hurled plague-infected dead bodies in enemy cities and caused epidemic. Russians repeated it in Swedish forces in 1710. British forces used blankets contaminated with smallpox viruses in native Indians and French forces in America in the 18th century AD. During World War I, the German Army developed anthrax, glanders, and cholera as bioweapons. During World War II, Japanese forces and USA developed botulinum and anthrax. The British tested anthrax bombs in 1942. In 1979, there was an accidental release of spores of anthrax in the *Union of Soviet Socialist Republics* with at least 68 deaths. In the Persian Gulf War, Iraq stockpiled bioweapons of anthrax, botulinum, and aflatoxin. In 1984, Bhagwan Rajneesh contaminated salad bars in Oregon, USA, with *Salmonella* spp. to cause food poisoning. In 2001, anthrax spores were sent by postal mail to selective persons in the USA with 22 cases of cutaneous, inhalation, and meningeal anthrax and 5 deaths.[2,3]

1. Biologic agents used as bioweapons

The characteristic features of agents used as bioweapons are low dose, easy transmissibility in the community, stability in environment, high mortality, difficult to diagnose and treat, lack of effective vaccines, and potential to cause fear and disruption of life and economy. The Centers for Disease Control and Prevention (CDC) has classified such agents into three categories (A, B, and C: A being the most and C being the least potent).[4–6]

Category A: anthrax, botulinum, plague, smallpox, tularemia, viral hemorrhagic fevers.

Category B: brucellosis, *Clostridium perfringens* (epsilon toxin), cholera, *Shigella*, and *Salmonella* with water/food threats.

Category C: Nipah virus, coronavirus, and hantavirus.

2. Anthrax

Anthrax is a life-threatening disease caused by a gram-positive capsulated spore-forming *Bacillus*. It produces a potent exotoxin.[7] Spores can survive in the soil for years and decades. These get activated in the host in 1–6 days, but some may take up to 60 days or even more. Anthrax is common in herbivorous animals such as cattle, sheep, goats, and horses. The infective dose is only 1–10 spores. Humans acquire infection through respiratory, gastrointestinal, or cutaneous route (this being the commonest, 95% in the form of a malignant pustule). Inhalation anthrax is the most severe one because it frequently causes septicemia and meningitis with high mortality and the highest risk of man-made spread. Consumption of improperly cooked meat causes gastrointestinal anthrax. Injection abscesses in drug abusers (contaminated heroin) have been reported in Europe (especially Scotland). Humans are accidental dead-end hosts in this livestock-human interface. Any unexplained sudden deaths in livestock and humans who process or consume animal products must be properly investigated to rule out anthrax. There is a need for immediate laboratory confirmation, medical care, and containments because all types can lead to septicemia and death.[8–10]

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3. Management

CDC guidelines for treatment and prophylaxis have been outlined.

4. Treatment

Uncomplicated cutaneous anthrax can be treated with monotherapy: ciprofloxacin 500 mg twice daily (BD), doxycycline 100 mg BD, levofloxacin 750 mg once a day (OD), moxifloxacin 400 mg OD, or clindamycin 600 mg thrice a day. If the strain is penicillin sensitive, amoxicillin 1 g thrice a day or penicillin V 500 mg 6 hourly is advised. The duration of treatment is 60 days during terrorism or for 7–10 days otherwise. The antitoxin is added for suspected systemic disease. Human anthrax immunoglobulin (Anthrasil) or monoclonal antibody may be used.[11,12]

Meningeal disease: Three antibiotics (clindamycin must be used) combination should be used for 60 days, at least one of which is bactericidal and one protein synthesis inhibitor.[13]

Preexposure prophylaxis (in laboratory workers, veterinarians, and animal handlers) should be protected with 5 intramuscular injections of vaccine over 18 months with subsequent annual boosters.[14]

Postexposure prophylaxis should include 3 injections of vaccine over 4 weeks in addition to antibiotic therapy for 60 days.[15]

Anthrax immunoglobulin given intravenously has been tried as passive immunization in various animals and human cases. However, a meta-analysis of 9 such studies did not show significant results.[16]

It is well documented that a timely and appropriate antibiotic therapy leads to dramatic recovery. *Bacillus anthracis* from naturally occurring cases is invariably penicillin sensitive. It is also sensitive to aminoglycosides, macrolides, quinolones, chloramphenicol, tetracyclines, imipenem, and linezolid. However, one must carry out a laboratory evaluation of all isolates. Furthermore, one must use antibiotics that can act on spores germinating within macrophages, block the synthesis of protein toxin which is the actual cause of death, and also penetrate the blood-brain barrier.

Supportive care including mechanical ventilation should be made available.

5. Prophylaxis

Livestock anthrax vaccines made from live spores of attenuated strains are available. Live spore vaccines for human use and cell-free vaccines containing protective antigens are available in various countries (anthrax vaccine adsorbed) for veterinarians, laboratory workers, and others who are likely to be exposed to anthrax.[17]

6. Diagnosis

1. Cutaneous lesion: a sample of fluid or a biopsy for microscopy and culture and sensitivity is collected. Blood culture is mandatory.
2. Inhalation anthrax: X-ray and computed tomography of the chest with sputum microscopy and culture.
3. Lumbar puncture to confirm meningitis.
4. Stool sample for gastrointestinal anthrax.
5. A rapid and early detection test of anthrax infection has now been designed to detect anthrax lethal factor (endopeptidase) in blood using fluorescein-labeled peptide (MAPKKide Plus). It can detect less than 5 pg of lethal factor per ml.[18,19]

For prevention of anthrax in individuals who have been exposed (postexposure prophylaxis for aerosolized spores) but asymptomatic, doxycycline or ciprofloxacin is used and is equally effective. These should be used for 60 days in full dose irrespective of vaccination status.

Despite early treatment, patients of inhalation, gastrointestinal, and meningeal anthrax have a poor prognosis.

Inhalation anthrax should be treated with combination therapy with Anthrasil for 60 days.

Conflict of interest

None.

References

1. Thappa DM, Karthikeyan K. Anthrax: an overview within the Indian subcontinent. *Int J Dermatol*. 2001;40:216–222.
2. Walsh MG, Mor SM, Hossain S. The Wildlife-Livestock Interface Modulates Anthrax Suitability in India. bioRxiv 419465; doi: https://doi.org/10.1101/419465.
3. Abrol S. Countering Bioterrorism Threat to India: employing global best practices and technology as force multiplier. *India Q: J Int Aff*. 2016;72:146. https://doi.org/10.1177/0974928416637934.
4. Krishan K, Kaur B, Sharma A. India's preparedness against bioterrorism: biodefence strategies and policy measures. *Curr Sci*. 2017;113:1–8.
5. Banerjee D, Chakraborty B, Chakraborty B. Anthrax: where margins are merging between emerging threats and bioterrorism. *Indian J Dermatol*. 2017;62:456–458.
6. Pillai SK, Huang E, Guarnizo JT, et al. Antimicrobial treatment for systemic anthrax: analysis of cases from 1945 to 2014 identified through a systematic literature review. *Health Secur*. 2015;13:355–364.
7. The Public Health (Prevention. *Control and Management of Epidemics, Bio-Terrorism and Disasters) Bill*. Ministry of Health and Family Welfare, PH Division; 2017. Govt. of India http://www.prsindia.org/uploads/media//draft/Draft%20PHPCM%20of%20Epidemics,%20Bio-Terrorism%20and%20Disasters%20Bill,%202017.pdf.
8. Iqbal N, Basheer A, Ramesh AN, et al. Gastrointestinal anthrax in coastal south India: a critical alert on a fatal masquerader. *JMM Case Rep*. 2015;2:e0.000013.
9. Hendricks KA, Wright ME, Shadomy SV, et al. Centers for disease control and prevention expert panel meetings on prevention and treatment of anthrax in adults. *Emerg Infect Dis*. 2014;20:e130687.
10. Pinto VN. Bioterrorism: health sector alertness. *J Nat Sci Biol Med*. 2013;4:24–28.
11. Tewari AK, Rashi GW, Sharma SK, Jain CK. BIRS–Bioterrorism information retrieval system. *Bioinformatics*. 2013;9:112–116.
12. Labrague LJ, Hammad K, Gloe DS, et al. Disaster preparedness among nurses: a systematic review of literature. *Int Nurs Rev*. 2018;65:41–53.
13. Suryadi K, Shine N. Design and use of a novel substrate for simple, rapid, and specific early detection of anthrax infection. *PLoS One*. 2018;13:e0207084.
14. Balachandrudu B, Amrutha Bindu SS, Kumar CN, Malakondaiah P. An outbreak of cutaneous anthrax in a tribal area of Visakhapatnam district, Andhra Pradesh. *J NTR Univ Health Sci*. 2018;7:49–53.
15. Booth M, Donaldson L, Cui X, et al. Confirmed Bacillus anthracis infection among persons who inject drugs,Scotland, 2009-2010. *Emerg Infect Dis*. 2014;20:1452–1463.
16. Cui X, Nolen LD, Sun J, et al. Analysis of anthrax immune globulin intravenous with antimicrobial treatment in injection drug users, Scotland, 2009–2010. *Emerg Infect Dis*. 2017;23:56–65.
17. Xu W, Ohanjanian L, Sun J, et al. A systematic review and meta-analysis of preclinical trials testing anti-toxin therapies for B. anthracis infection: a need for more robust study designs and results. *PLoS One*. 2017;12:e0182879.
18. Garg N, Panmei K. First reported case of naturally acquired fatal anthrax from Northeast India. *J Fam Med Prim Care*. 2018;7:632–634.
19. Lalitha MK, Anandi V, Walter N, Devadatta JO, Pulimood BM. Primary anthrax presenting as an injection "abscess. *Indian J Pathol Microbiol*. 1988;31:254–256.