

## A REVIEW: HOLISTIC APPROACH FOR MANAGEMENT OF ANTHRAX

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### ABSTRACT

Anthrax is a zoonotic disease caused by *Bacillus anthracis*. Herbivores are the natural host. Anthrax kills many animal species. Human acquire the disease incidentally by contact with infected animal or animal products. The incidence of disease has decreased dramatically in developed countries as a result of animal vaccination programs and improved industrial hygiene. Three forms of anthrax are naturally occurring, namely; cutaneous, gastrointestinal, and inhalational. About 95% of human anthrax is cutaneous and 5% respiratory. Gastrointestinal anthrax is very rare, and has been reported in less than 1% of all cases. Diagnosis can be made by Gram stain, stool samples, blood tests, skin tests or by culture of body fluids or lesions. Serologic tests including enzyme-linked immunosorbent assay and polymerase chain reaction are available in specialized laboratories. Penicillin is the

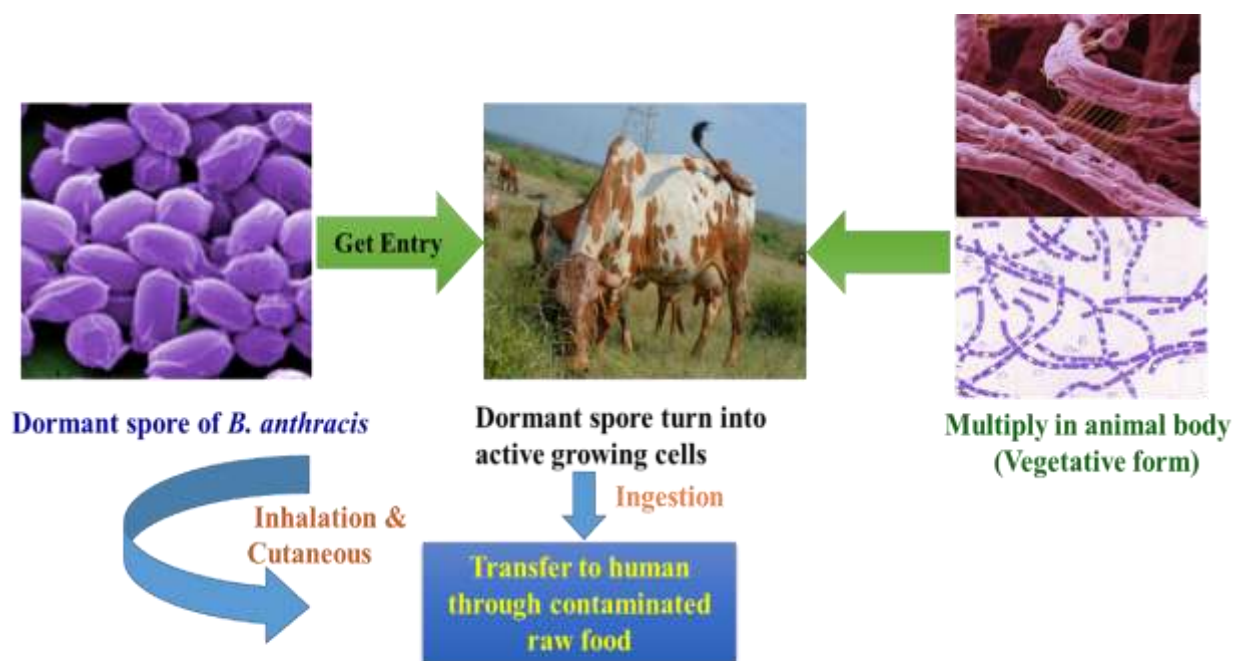
drug of choice for the treatment of anthrax infections. Other acceptable alternatives include ciprofloxacin, Ampicillin, Ciprofloxacin and doxycycline. Combination of drug also used and alternative source is medicinal plant to treat anthrax disease. There is need for new, safe and effective treatments to supplement traditional antibiotic therapy.

**KEYWORDS:** Anthrax, cattle, Gastrointestinal, cutaneous, spore, *Bacillus anthracis*.

## GENERAL INTRODUCTION

Once animal infected bacteria grow and reproduce inside the cells of animal body. As they grow and divide, many bacteria make toxins (poisons). These toxins can damage the cells. Some bacteria damage cells directly as they grow. Disease symptoms such as a high temperature, headaches and rashes can be caused by the damage and toxins or by the way body responds to the damage and toxins produced by the bacteria (Jaton and Greub, 2014).

An aerobic, gram-positive, spore-forming rod called *Bacillus anthracis* causes anthrax. It is soil-borne bacterium with a remarkable ability to survive in the environment for long periods of time (Hugh-Jones and Blackburn, 2009). This bacterium is found naturally in the soil in most part of the world usually is carried by herbivorous animals (cattle, antelopes, camel, sheep and goats) (Reddy et al., 2006; Fasanella et al., 2010).



**Fig. 1: Anthrax cycle**

Animals commonly contract anthrax by grazing on contaminated land, eating contaminated feed, or drinking contaminated water. Humans usually contract anthrax from animals in 1 of 3 ways: by handling contaminated hides, wool, hair, or carcasses; by inhaling *B. anthracis* spores from products of infected animals such as industrial processing of contaminated wool, hair, or hides; or by consuming infected or undercooked contaminated meat.

Anthrax spores are very resilient and may live in the soil and water for many years. *Bacillus anthracis* spores resist most disinfectants and may be boiled for 10 minutes with little effect. A temperature of 120°F for at least 15 minutes usually will deactivate them (Sandlin et al., 2002). Anthrax derives its name from the Greek word for coal, anthrakis, because the cutaneous form causes a black ulcer of the skin. Although it is rare, people can get sick with anthrax if they come in contact with infected animals or contaminated animal products (Barro et al., 2015). Contact with anthrax can cause severe illness in both humans and animals (Figure 1).

### Alternative Names

Woolsorter's disease, Ragpicker's disease, cutaneous anthrax, gastrointestinal anthrax.

### Types of Anthrax

There are three major anthrax types are given below.

#### (I) Cutaneous (skin) anthrax

Transmission occurs when *Bacillus anthracis* enters a cut or abrasion on the skin, which can happen when handling contaminated wool, hides, leather, or hair products (especially goat hair) of infected animals.

### Symptoms

Cutaneous anthrax start 1 to 7 days after exposure: An itchy sore develops that is similar to an insect bite. This sore may blister and form a black ulcer (Figure 2). The sore is usually painless, but it is often surrounded by swelling. A scab often forms, and then dries and falls off within 2 weeks. Complete healing can take longer. About 95% of human anthrax is cutaneous.



Figure 2: Cutaneous anthrax

## (II) Inhalation anthrax (pulmonary anthrax)

Inhalation anthrax is caused by breathing in the anthrax bacteria or spores (Figure 3). Most of the time, this occurs by breathing in spores from infected animal products. Inhalational anthrax is a much more deadly disease. The bad news with inhalational anthrax is that absent both early detection, when symptoms often resemble those of influenza, and immediate aggressive antibiotic treatment, the mortality rate is extremely high. Prior to the 2001 attacks, that rate in the U.S. was estimated to be 89 percent. Inhalational form is used as a biological warfare agent. About 5% of human anthrax is inhalational.



**Figure 3: Inhalation anthrax**

**Symptoms:** Begins with fever, malaise, headache, cough, shortness of breath, and chest pain, fever and shock may occur later. Cutaneous and inhalational anthrax are the forms most likely to result from a bioterrorism attack using *Bacillus anthracis* (Canter 2005).

## (III) Gastrointestinal anthrax

Gastrointestinal anthrax occurs with the consumption of contaminated meat (Figure 4). This anthrax type is characterized by an acute inflammation of the intestinal tract (Owen et al., 2015). Symptoms can include; nausea, loss of appetite, bloody diarrhea, fever, severe stomach pain and vomiting blood. Gastrointestinal anthrax is very rare (less than 1%).



**Figure 4: Gastrointestinal anthrax**

**The roles of anthrax toxin in pathogenesis spores**

The secreted lethal toxin produced by *Bacillus anthracis* is a major virulence factor associated with anthrax. Anthrax lethal toxin is a multi-functional virulence factor that has evolved to target multiple host functions to allow for optimal establishment of *Bacillus anthracis* infection. The toxin appears to play a role in all stages of infection, from germination to the induction of vascular collapse leading to host death. Early in infection, at sublethal doses, it acts to suppress immune cell and cytokine responses, thereby promoting bacterial outgrowth. Later in the disease, lethal levels of toxin induce the cytokine-independent shock-like death associated with anthrax.

**Diagnosis**

Blood and skin tests

Stool samples

Spinal tap

Chest X-ray, CT (computed tomography) scan

Endoscopy

**Treatments**

The preferred way to treat anthrax is with antibiotics. The goal of antibiotics is to destroy the infection and prevent complications and death. Many antibiotics are effective against *B. anthracis* and includes following:

Doxycycline

Penicillin

Amoxicillin

Ampicillin

Ciprofloxacin

Levofloxacin

Gatifloxacin

Chloramphenicol

Inhalational anthrax is treated with a combination of antibiotics such as ciprofloxacin plus another medicine, which are given by intravenously. Antibiotics are usually taken for 60 days by people who have been exposed to anthrax, because it can take spores that long to germinate. Cutaneous (skin) anthrax is treated with antibiotics taken by mouth, usually for 7 to 10 days. Doxycycline and ciprofloxacin are most often used.

### Medicinal plant alternative source

The frequency of life threatening infections caused by pathogenic microorganisms has increased worldwide and is becoming an important cause of morbidity and mortality in immune compromised patients all over the world. This ongoing emergence of multi drug resistant bacteria and the infectious diseases caused by them are serious global problem. Antibiotics are one of the most important weapons in fighting bacterial infections and they are the main basis for the therapy of microbial infections. Antibiotics may work today may not work tomorrow due bacterial resistance in existing antibiotics (Rakholiya et al., 2014a, b). Therefore need to search alternative medicine to treat infectious disease. The use of medicinal plant to treat different diseases (Piluzza et al., 2015). They are also economical, easily available and affordable. Lastly, natural products, either as pure compounds or as standardized plant extracts, provide unlimited opportunities for new drug leads because of the unmatched availability of chemical diversity. Gebrezgabiher et al. (2013) reported that leaf of *Malva parviflora* L. (Malvaceae) crushed and mixed with butter and used for treatment of anthrax. *Piper nigrum* Fed with rice gruel for indigestion to cattle orally to cure anthrax (Kapoor et al., 2009; Usha et al., 2015).

### Future Direction: Synergistic therapy

One possible approach to improve the range and scope of antimicrobial therapy is the use of combinations of antimicrobials. The use of combination therapy in clinical practice is very common and is employed for the therapeutic advantages it may provide over single agents. In synergistic interaction between two agents, one agent enhances the action of the other and together, they may act more effectively than a single agent. This could be a new approach to solve the problem of bacterial resistance and less susceptible bacteria. Therefore, drug synergism between known antimicrobial agents and bioactive plant extracts is a novel concept and has been recently reported. Therefore, combination therapy is often profitable for patients with serious infections caused by drug resistant pathogens. Combination drug beneficial for anthrax disease (Jamie, 2002). Karginov et al (2004) also reported that treatment of anthrax infection with combination of ciprofloxacin and antibodies to protective antigen of *Bacillus anthracis*. Vaccine used to treat anthrax (Pittman et al., 2014).

### Conflict of Interest

We declare that, have no conflict of interest.



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