

# Bacillus anthracis

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## Organism

Derived from Greek word for coal – refers to Eschar seen in cutaneous anthrax

Virulence factors:

- Capsule:
  - Produces a polypeptide capsule made of poly-D-glutamic acid under anaerobic conditions
  - Capsule synthesis by 3 enzymes encoded for by *capA*, *capB*, *capC* genes on pX-02 plasmid
  - 4<sup>th</sup> protein = encoded by *dep* gene – catalyses the formation of low molecular weight polyglutamates that inhibit phagocytosis
- Toxin:
  - Two binary toxins = (o)edema factor (EF) and lethal factor (LF)
    - EF = converts adenosine monophosphate (AMP) to cyclic AMP (cAMP) = results in dysregulation of water and ions
    - LF = zinc-dependent metalloproteinase = inhibits dendritic cell function
  - Bind a 3<sup>rd</sup> protective toxin component = protective antigen (PA) before entering the target cell = receptor identified in 2001
  - 3 toxin components encoded for by pX-01

## Epidemiology

- Anthrax most commonly occurs in domestic animals in Asia, Africa, South and Central America
- Humans rarely infected – most common form of infection = cutaneous anthrax linked to occupational exposure to animal products e.g. wool, hair, meat, bones and hides

## Clinical Presentations

Four main forms of human disease:

- Cutaneous anthrax:




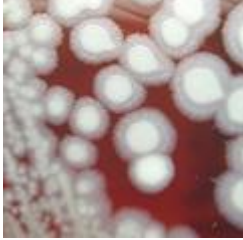



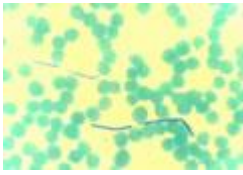


- >95% cases acquired by direct contact with infected animals
- Incubation period = 1-5 days
- Initial lesion = pruritic papule
- Becomes a vesicular or bullous lesions surrounded by non-pitting oedema
- Central part becomes necrotic and haemorrhagic and satellite vesicles may develop

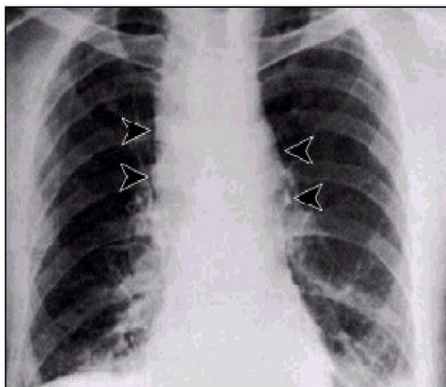
- Finally classic black eschar results which falls off in 1 – 2 weeks unless systemic disease ensues
- Gastrointestinal anthrax:
  - <5% cases
  - Oropharyngeal anthrax:
    - Presents with febrile neck swelling due to cervical adenopathy and soft tissue oedema
    - After ingestion of contaminated meat
  - Intestinal anthrax:
    - More common
    - Presents with:
      - Phase 1: fever, syncope and malaise
      - Phase 2: abdominal pain, nausea and vomiting
      - Phase 3: paroxysmal abdominal pain, ascites, facial flushing, red conjunctivae and shock
    - Examination shows abdominal distension and a mass in the right iliac fossa/periumbilical area
- Inhalation anthrax:
  - Very rare
  - Occurs after inhalation of spores
  - Incubation period <1 week
  - Presents with:
    - Flu like illness
    - Non-productive cough
    - Haemorrhagic mediastinal lymphadenopathy
    - Multi-lobar pneumonia +/- pleural effusions and bacteraemia
    - Chest X-ray typically shows a widened mediastinum
    - High mortality rate 45 – 85%
- CNS disease:
  - Very rare
  - Presents with haemorrhagic meningoencephalitis
  - 95% mortality

## Diagnosis

- Specimens – take wound swabs (if ?cutaneous), nasal swabs and blood cultures
- Gram-positive rods (cigar shaped)
- Spore is oval shaped and central/terminal
- McFadyean's stain shows: capsulated, dark, square-ended bacilli in short chains
- Colonies white/grey-white with characteristic 'medusa head'
- Non-haemolytic and non-motile (in contrast to other *Bacillus* spp.)
- Identification via specific PCR of phage lysis

	
<p><i>B. cereus</i> (L) and <i>B. anthracis</i> (R) on blood agar</p>	<p><i>B. anthracis</i> capsule production on bicarbonate agar</p>
	
<p>Typical tenacity of <i>B. anthracis</i> colony when teased with a loop</p>	<p><i>B. anthracis</i> close up of colonies on blood agar</p>
	
<p><i>B. anthracis</i> on blood and bicarbonate agars</p>	<p><i>B. anthracis</i> Gram stain</p>
	
<p>MacFadyean's stain, showing capsule <i>B. anthracis</i></p>	<p>MacFadyean's stain, non-capsulate <i>B. anthracis</i></p>

Widened mediastinum on chest X-ray:



## Treatment

See below guidelines

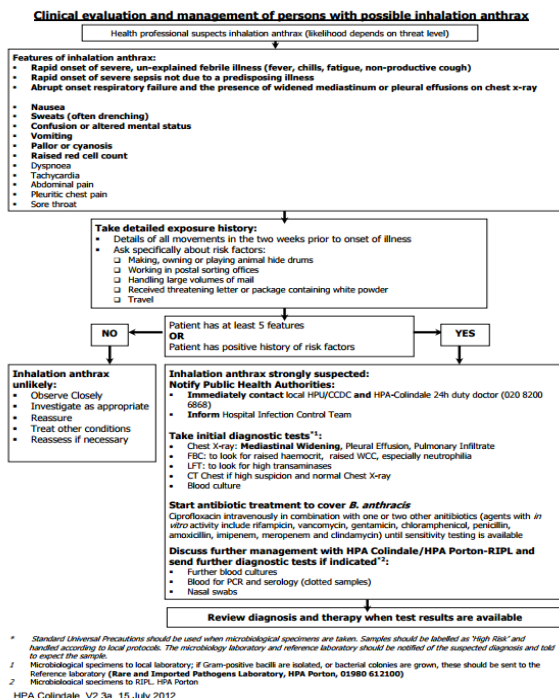
- Cutaneous anthrax = ciprofloxacin/doxycycline for 60days
- Inhalation anthrax: initial therapy = IV ciprofloxacin/doxycycline + 1 or 2 of:
  - Rifampicin
  - Vancomycin
  - Penicillin
  - Ampicillin
  - Chloramphenicol
  - Imipenem
  - Clindamycin
  - Clarithromycin
  - Followed by ciprofloxacin or doxycycline until day 60

## Prevention

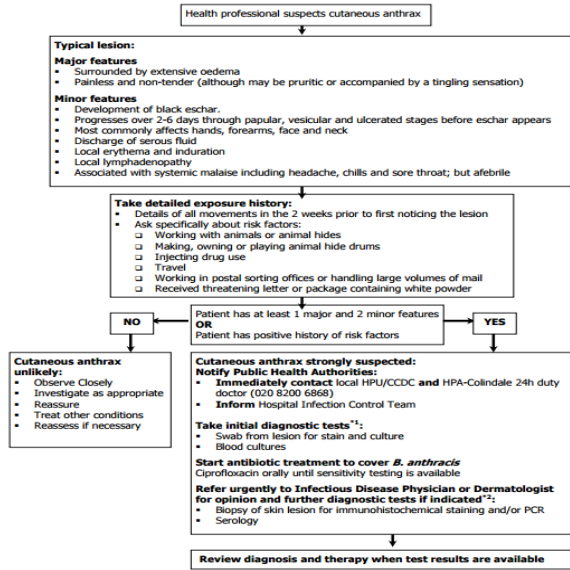
- Vaccines – human and animal vaccines available = for workers at risk and for post exposure prophylaxis for inhalation anthrax
- Antibiotic prophylaxis – oral ciprofloxacin or doxycycline are indicated for post exposure prophylaxis of inhalation anthrax

## Infection Control and Public Health

Notifiable infection!



## Clinical evaluation and management of persons with possible cutaneous anthrax

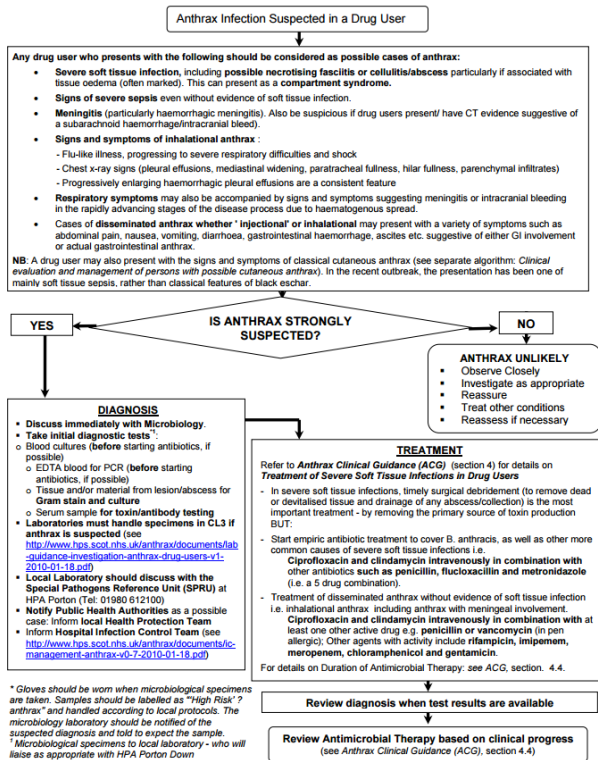


\* Gloves should be worn when microbiological specimens are taken. Samples should be labelled as "High Risk" and handled according to local protocols. The microbiology laboratory and reference laboratory should be notified of the suspected diagnosis and told to expect the sample.

<sup>1</sup> Microbiological specimens to local laboratory - if Gram-positive bacilli are isolated, or bacterial colonies are grown, these should be sent to the Reference laboratory (Rare and Imported Pathogens Laboratory, HPA Porton, 01980 612100)

<sup>2</sup> Microbiological specimens to RPL, HPA Porton.

HPA Colindale, V2.4a, 15 July 2012



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<sup>1</sup> Microbiological specimens to local laboratory - who will liaise as appropriate with HPA Porton Down