DISCONTOOLS

Anthrax
Summary

Introduction

1. This note provides a brief summary of an analysis undertaken by a DISCONTOOLS group of experts on Anthrax. They reviewed the current knowledge on the disease, considered the existing disease control tools, identified current gaps in the availability and quality of the control tools and finally determined the research necessary to develop new or improved tools. Full details can be downloaded from the web site at http://www.discontools.eu/ by selecting Disease Database, then the specific disease and highlighting the variables of interest. This is completed by selecting "create a report" which can then be downloaded as either a PDF or Excel spread sheet

Disease profile

2. Anthrax caused by *Bacillus anthracis*, can be found worldwide and a number of genotypes have been identified. Bacilli sporulate when released by the dying or dead animal into the environment. The spores are more resistant than the vegetative form to extremes of heat, cold, pH, desiccation, ultraviolet light, gamma radiation and chemicals and can lie dormant for years in soils. Environmental disinfection is not simple.
3. All mammals, including humans, appear to be susceptible to anthrax. Wild and domestic herbivores such as cattle, sheep, and goats are the most susceptible. Horses, swine, cats, and dogs are less susceptible and in them, the disease usually has a more protracted course. Spores found in the soil are the main reservoir for anthrax. Herbivores are usually infected by exposure to spores from soil-contaminated food or water. Wild carnivores can become infected through the consumption of infected animals.
4. The progression of disease is dependent on the host species, immune status, dose and route of infection, be it cutaneous, gastrointestinal or by inhalation. Disease in animals can be per-acute or acute or sub-acute to chronic. Generally, herbivores develop the per-acute and acute forms, whereas carnivores and omnivores develop the sub-acute to chronic forms. In the per-acute form of disease, signs preceding death often go unobserved.
5. Most cases of human anthrax have resulted from direct or indirect contact with infected animals, or occupational exposure to infected or contaminated animal products. The cutaneous form of anthrax infection occurs when the bacterium enters a cut or abrasion on the skin, when handling contaminated animal products or infected animals. Deaths are rare with appropriate antimicrobial therapy. Infection by inhalation can progress to severe breathing problems, shock and death. The intestinal form of anthrax may follow the consumption of contaminated meat. This form is characterized by an acute inflammation of the intestinal tract and is usually fatal.

Risk

6. Although *B. anthracis* is present in most of the world, the global incidence of human cases is difficult to assess due to under-reporting.
7. Outbreaks in animals in endemic areas have been associated with a prolonged hot dry spell, which in turn was preceded by heavy rains or flooding, or with rain ending a period of drought. Further research is required to determine the conditions and the risk factors that lead to outbreaks and favour the spread of anthrax.
8. Risks of infection in humans are mainly associated with the handling of infected carcasses and contaminated animal products, including hides and skins from infected animals. There is the potential for anthrax to be used in bioterrorism.
9. Failure to vaccinate in endemic areas, or to follow effective disposal procedures of infected carcasses and contaminated material, will lead to continued environmental contamination with spores. Cultural practices (slaughter and consumption of sick animals) could put certain groups at high risk of contracting anthrax. Risks are reduced by improving the effectiveness of veterinary services, diagnostic capabilities and education of the public.

Diagnostics

10. Methods for the demonstration of encapsulated *B. anthracis* in blood or tissues from fresh anthrax-infected carcasses and growth of the organism on blood agar plates have been described (see OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals).
11. Commercial diagnostic kits are not available. There is a need for specific, rapid and inexpensive diagnostic tests that yield clear unequivocal results and can be operated with minimal training in the field. A better understanding is needed of the disease in animals to identify early markers of infection, which would underpin the development of improved diagnostic assays.
12. Simple and reproducible methods to isolate spores from environmental samples are required.

Vaccines

13. The most widely used vaccine for the prevention of anthrax in animals is the Sterne-strain vaccine. This vaccine is a non-encapsulated live variant strain of *B. anthracis* developed by Sterne in 1937.
14. Annual vaccination is recommended in endemic areas, however the development of improved vaccines that provide longer-lasting immunity would be of benefit. There is also a need to improve the stability of the vaccine and decrease the cost of production. The development of vaccines to allow mass vaccination would be an advantage.
15. More information on vaccine efficacy in different geographical areas and different animal species is needed.

Pharmaceuticals

16. In humans, many antibiotics are effective against *B. anthracis* and there is little need for new therapies to be developed. In animals treatment is rarely possible due to the rapid course of the disease.

Knowledge

17. More information is required from areas where the disease is endemic and better reporting systems are needed. More needs to be known about the ecology of anthrax in the environment and a better understanding of the routes of infection is required. Experimental data has identified vector-mediated mechanical and biological transmission by flies and scavengers such as vultures but further study is needed.
18. More information is required regarding pathology of the disease in different animal species. There is a lack of knowledge concerning the possible existence of carrier states, potential reservoir animals and sub-clinical infections. More needs to be understood about sporulation in the context of the disease and about the fate of *B. anthracis* in carcasses.
19. Environmentally friendly decontamination products and methods need to be developed. Methods for the effective decontamination of contaminated hides are also required.

Conclusions

20. Anthrax can be controlled if vaccination programmes are adhered to and if effective disposal of carcasses and contaminated materials is practised. Effective veterinary services and diagnostic capability are necessary to prevent and control anthrax. It is important to have a public communication strategy, which provides accurate and authoritative information.
21. Aspects of the epidemiology, pathology and control of anthrax require further study. Diagnostic methods and vaccines could be improved.