

perception of light) and was later extracted, along with the delivery, by magnet, of a small metal fragment. The final vision was 6/24 with correction.

This case was exceptional in that the visual result was relatively poor. In contrast the remaining patients recovered good vision, as shown in the table.

Final Visual Acuity of the 20 Patients

Visual acuity ..	6/5	6/6	6/9	6/12	6/24
No. of patients ..	6	11	1	1	1

Such excellent results depend in part on prompt referral, since a retained intraocular foreign body may lead to siderosis if the iron content is sufficiently high. The following case illustrates this, as well as re-emphasizing that the patient may regard the initial injury as trivial.

A 46-year-old man complained of failing vision of his left eye. Two years earlier he had been adjusting some part of his car with a steel hammer when he felt something hit the eye. It was a bit red the next day and he saw spots for some four days. The eye settled down sufficiently, however, for him not to seek advice at that time. For a year the vision worsened progressively. There was a small scar in the left cornea with an associated nodule in the iris, in which an x-ray

film showed a foreign body. The iris was brown, in contrast to the blue iris in the other eye, and there was a cataract, reducing the vision to hand movements. The foreign body was removed with forceps and later the cataract was extracted, leaving 6/6 vision with a contact lens. This patient was exceptionally fortunate in retaining such good vision 12 years after the injury despite his presenting the classical signs of siderosis initially.

Another factor allowing good results was the lack of sepsis in any case. Metal fragments that perforate the eye travel at high speed and consequently become so hot that they are sterilized; they therefore rarely cause an endophthalmitis unless the fragment consists of virtually pure copper, in which event a fulminating inflammation usually results as opposed to chalcosis which is the long-term consequence of a retained intraocular foreign body in which the copper content is less than 70%.

We have great pleasure in thanking the surgeons of Moorfields Eye Hospital (High Holborn Branch) for allowing us to make this report on patients under their care.

References

- ¹ Roper-Hall, M. J., in *Systemic Ophthalmology*, ed. A. Sorsby, vol. 3. London, Butterworths, 1964.
- ² Johnston, Stewart, *Transactions of the Ophthalmological Societies of the United Kingdom*, 1971, 91, 895.
- ³ Roper-Hall, M. J., *British Journal of Ophthalmology*, 1954, 38, 65.

A New Look at Infectious Diseases

Anthrax

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Anthrax is a well-known infection of animals which is occasionally transmitted to man. The term "anthrax" is derived from the Greek "anthrakos" meaning coal, and refers to the black eschar typical of cutaneous anthrax. The disease was extensively studied by the pioneers of bacteriology, Pasteur and Koch. In 1877 Koch described the isolation and cultivation of the *Bacillus anthracis*, and the formation of spores, and showed that the organism satisfied all of his four postulates. In 1881 Pasteur showed that a living vaccine could protect animals against anthrax. The organism is a large Gram-positive spore-forming rod with sharply squared-off ends—literally a "big black bacillus." In vivo, it is encapsulated, while smears from skin lesions show the organism lying singly or in short chains. Growth on artificial media occurs readily under aerobic conditions, and sporulation is well advanced after 48 hours. Anaerobic growth may also occur. In culture the bacilli are arranged in strands or long chains with equatorial oval spores. Colonies on nutrient agar are dull, flat, and grey—presenting the "medusa-head" or "curled hair" appearance, which is due to interlacing chains of bacilli growing from the edges of the

colonies. Gelatin-stab cultures show growth with liquefaction resembling an inverted fir tree.

Pathogenicity

Virtually all animals are susceptible to infection with *B. anthracis* but the disease is most common among herbivora. Man is relatively resistant whereas mice and guinea pigs are among the most susceptible laboratory animals. In animals infection is usually through the alimentary tract after ingestion of infected food, but direct infection from animal to animal is rare. Among herbivora, the disease is usually fatal, death occurring rapidly from septicaemia. Just before death the animals excrete bacilli in the urine, faeces, and saliva and the surrounding ground is contaminated by spores from the organisms. Sporulation does not occur in vivo and hence the animal carcasses should be cremated or buried intact without necropsy examination. Spores may remain alive for many years, depending on the nature of the soil and temperature. In some areas in India, Russia, and France the disease never dies out. In Great Britain spore survival in soil is probably short because those surviving the winter may be rapidly destroyed by soil organisms proliferating in the summer. Anthrax in Great Britain is usually "imported" in infected feeding stuffs, such as bone and fish meal, maize, barley, and oil cake. Cutaneous anthrax in animals is uncommon but has been described. It is usually acquired from biting

flies which carry the spores passively. Infection by inhalation is not thought to occur naturally in animals but it has been shown experimentally.¹

Anthrax in Man

Infection by ingestion must be rare except in primitive societies where meat from infected animals might be used for food. There are no records of this route of infection either in Great Britain² or in the U.S.A.³

At one time pulmonary anthrax was relatively common among workers in the woollen industry and it is still known as "wool-sorters' disease". The mortality used to be around 80%, because of the sequence of pathological events—viz., mediastinitis, septicaemia, and widespread toxæmia. Pneumonic lesions were inconspicuous according to Albrink.⁴ This condition is now rare in Great Britain because of improved working conditions due to legislation. Even if it did become more common, however, it is unlikely that the mortality would be high because nowadays even the mildest respiratory infections are usually treated by chemotherapy. During 22 years' experience among workers in the bone meal industry, I did not encounter any case of pulmonary anthrax. Yet among these workers two cases of clostridial pneumonia were diagnosed and clostridial organisms were isolated from the appreciable pleural effusions as well as from sputum samples in both patients. The organisms concerned were *Clostridium tertium* and *Clostridium oedematiens*.⁵ Clostridial spores are common in animal bones and, when investigating for possible anthrax infection, guinea pigs for inoculation must be protected by clostridial vaccines.

CUTANEOUS ANTHRAX

This is the usual form of the disease in man and the incubation period is generally less than seven days—usually two to five days. The lesion is also known as malignant pustule, but pus is never a feature unless there is also pyogenic infection. The lesion begins as a small pimple, rapidly developing into a vesicle containing clear serous or blood-stained fluid. As the initial lesion enlarges, the centre becomes haemorrhagic and necrotic leaving a black eschar which also enlarges and is often surrounded by a ring of vesicles (Fig. 1). Extensive, firm, non-pitting oedema surrounds the sore (Fig. 2). Although pruritus is an early feature, pain is rare. Lymphangitis and regional lymphadenopathy are variable and rarely pronounced.

Pathology

Histologically, there is acute inflammation, with areas of coagulation necrosis extending to the voluntary muscle boundary. Definite interstitial oedema and necrotic exudate are present in these areas. The bacilli produce a specific oedema toxin and this is sometimes referred to as specific lethal factor. In guinea pigs death is thought to be due to overwhelming intoxication, probably due to this toxin. In experimental animals the organisms crowd inside the capillaries of the internal organs and to a lesser extent in the capillaries of skin and muscle.

Diagnosis

When the appearances of the lesion are typical and there is a history of occupational exposure, then clinical diagnosis is justified. Rarely there may be extensive oedema with no apparent sore, although trophic sores may ensue because of the extent and depth of the oedema. A careful search, however, may reveal a minute eschar, perhaps in a skin fold. Occupational exposure is not always obvious—for example, in the case of an 11-year-old boy who had a cutaneous anthrax sore of the right temple. His

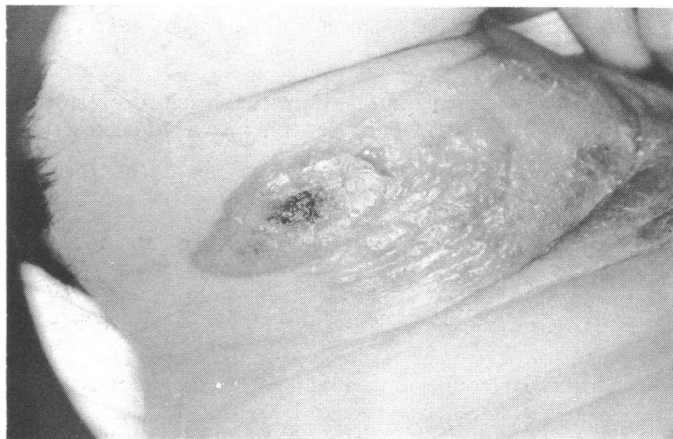


FIG. 1—Third day of anthrax sore; infection superimposed on furuncle. Patient died 13 days later after laparotomy for haematemesis and obstruction.



FIG. 2—Same patient two days later. There is an appreciable increase in oedema, and further vesiculation.

only possible exposure was contact with the dust outside a bone meal factory in his neighbourhood which he passed on the way to school. He admitted to fighting with his playmates, sometimes rolling in the dust. There is also the case cited by Christie,⁶ where the source of infection was a scarf belonging to the patient's son who worked in a tannery.

Infection may also occur among amateur gardeners handling infected bone meal. Accidental vaccinal infection may closely resemble cutaneous anthrax but the age of the lesion, degree of surrounding inflammation, and history of exposure to vaccinia should differentiate the two. (Fig. 3.) The lesion itself may also be altered by local treatment, such as application of poultices or carbolic dressings. Taylor and Carslaw⁷ described four cases of cutaneous anthrax presenting as a violent bullous haemorrhagic reaction. In two of these cases kaolin poultices had been applied, in another carbolic lotion had been used, and in the fourth sugar and soap. Probably the violent bullous reaction in these four cases was due to thermal or chemical injury on tissue already devitalized by anthrax oedema.⁸ I myself have not seen such severe bullous reactions in cutaneous anthrax without local medication. However, the first edition of Price's *Textbook of Medicine*⁹ points out that the treatment should be pure carbolic acid applied to the raw surface with continuous fomentation!

Bacteriological confirmation may be obtained by examining fluid from under the eschar or from the surrounding vesicles and blood should be cultured. If culture and morphological criteria are satisfied, the diagnosis is made. To prove virulence by guinea pig inoculation is unnecessary. Frequently, bacteriological investigations fail to confirm the infection, especially after effective chemotherapy.

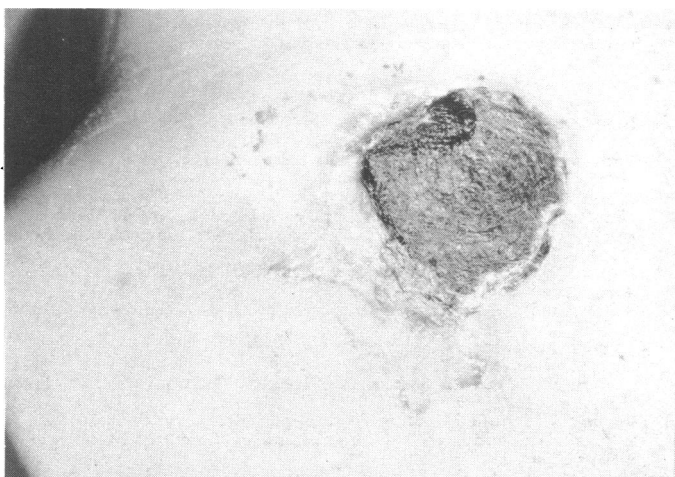


FIG. 3a—After four weeks the black eschar is beginning to separate. No surrounding oedema or inflammation.

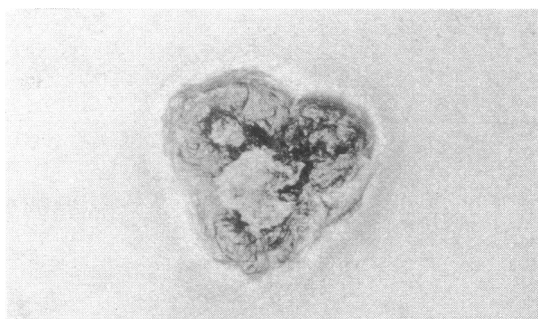


FIG. 3b—Vaccinal sore on twelfth day. Note surrounding ring of inflammation, and compare with "a".

Serological tests are available for diagnosis, the best known being Ascoli's test. The latter is occasionally used as an ancillary diagnostic aid, and may be of value in post-mortem diagnosis. Fluorescent antibody techniques may be used for identification of the bacillus in vesicular fluid smears, cultures, or tissue sections.

Illustrative Case Histories

I have reviewed the histories of 16 patients admitted to my unit over the last 20 years. Four were regarded as severely ill on admission, two of them so shocked as to require resuscitation, including intravenous fluids and hydrocortisone. Strangely enough, both these patients had cutaneous lesions above the right breast with extensive oedema extending into the breast.

Mrs. A. B., aged 54, was admitted in her fourth day of illness with a sore below the right clavicle and oedema extending down to and including the right breast. She was a sack repairer, the sacks being used for bones at the bone meal factory. Oral penicillin had been prescribed for 24 hours before admission. On admission she was in acute circulatory failure and this persisted for over 60 hours in spite of intravenous fluids and injection of hydrocortisone. Intramuscular penicillin G, 250,000 units was given six-hourly. The anthrax infection in the skin was confirmed bacteriologically, but blood cultures were sterile. Her temperature, which had been subnormal at the time of admission, became raised after five days and fever continued for another four days. After nine days in hospital a blood-filled vesicle developed 3 in (7.5 cm) below the original sore. The contents of this vesicle were sterile and it may have been a trophic lesion due to extensive oedema. This patient made a full recovery.

Mrs. C. D., aged 48, was admitted in acute circulatory failure. Four weeks before admission she had a furuncle on the right side of her neck, which she scratched while washing newly dug potatoes ten days before admission to hospital. Three days before admission this

"boil" had become much bigger and there was much surrounding oedema. Her family doctor prescribed oral penicillin V during the 24 hours before admission but she became so toxic and ill-looking that he arranged admission. When admitted there was a black eschar on the right side of her neck, with oedema extending down and into the right breast. After 36 hours of intravenous fluids and intravenous hydrocortisone her general condition improved and her blood pressure was 110/70 mm Hg. Five days later she had a severe haematemesis and was severely shocked again. Gastroenterostomy for gastric ulcer had been performed seven years previously and probably the hydrocortisone was a factor in the reactivation of this ulcer. She was transferred to a surgical unit and emergency laparotomy carried out. At operation disruption of gastroenterostomy was noted and this was reconstituted and pyloroplasty carried out. Deterioration was rapid and death occurred some five days after operation.

Although cutaneous anthrax was not confirmed bacteriologically in her case, post-mortem sections of the skin lesion showed extensive haemorrhage into the deep dermis with necrosis of the subcutaneous tissue and a moderate polymorphonuclear exudate at the periphery. Some of the vessels were thrombosed at the edge of the necrotic area and there was an extensive fibrinous exudate throughout the necrotic tissue. On the stomach a large ulcer was noted in the posterior wall with fibrosis extending into the afferent loop of the gastroenterostomy causing partial obstruction. While her death was not considered as being primarily due to anthrax infection, the possibility of iatrogenic haematemesis cannot be ruled out.

Of the other twelve patients regarded as moderately or mildly ill, high fever was recorded in six cases and was related to the degree of illness. A polymorphonuclear leucocytosis was noted in only four cases and these were those regarded as severely ill.

Treatment

Having made a clinical diagnosis, and submitted the appropriate specimens, the doctor should start treatment forthwith. Until effective chemotherapy was available treatment was confined to local therapy with phenol or to surgical excision. However, in 1929 Fleming¹⁰ reported that *B. anthracis* growth could be inhibited by penicillin diluted 1/10, and in experimental infections in mice treated with penicillin he found a high degree of protection.¹¹ Although the organism is sensitive to penicillin, chloramphenicol, tetracycline, erythromycin, and streptomycin, penicillin remains the treatment of choice. During 22 years I have not encountered any resistant strains of *B. anthracis*, but Christie has reported one such case.⁶ Unless there is a history of penicillin hypersensitivity then penicillin should be employed. For some years I have been employing a preparation containing sodium penicillin G benethamine penicillin G, and procaine penicillin, administered in doses of 1.25 megaunits daily to a total of seven days. This dosage is more than adequate. With effective treatment the lesion does not regress, but instead may extend for a few days. The eschar may not separate for several weeks. Scarring is frequent and in some cases skin grafting may be necessary as it was in one of the author's cases. A sterile dry dressing is sufficient and no local medication should be applied.

Prevention and Control

The eradication of anthrax in animals is of prime importance and this stage has almost been reached in South Africa.¹² In Great Britain anthrax among animals is uncommon, but when it does occur Government regulations ensure that the carcass is disposed of either by cremation or deep burial, without necropsy. In this way contamination of pastures, abattoirs, and animal lairages is minimized. When a case of anthrax does occur, then all animals of the herd should be vaccinated against anthrax and no movement of animals allowed until the veterinary officer considers it safe. Wool and hair imported into Britain are disinfected at the Government Disinfecting Station at Liverpool by the Duckering process, which, it is claimed, will kill all anthrax spores in wool or hair. Imported bone meal is a common source of anthrax and workers in this industry are at risk, even when

down-draught extractor fans are installed and protective clothing is worn. It is almost impossible to sterilize bone products and it would be a costly, indeed uneconomic, process. At a symposium at the Veterinary Public Health Association meeting in 1964 it was concluded that "considering the widespread distribution of anthrax spores in imported animal products, coupled with the small number of cases in man, then man's resistance must be considerable. Extensive disinfection processes seem hardly justified since effective immunization is available to those at risk and effective chemotherapy for established cases." Few cases of anthrax among bone meal workers in this area have been seen since anthrax inoculation became routine. The odd case has occurred in those whose inoculation schedules had not been completed. I believe that professional gardeners should also be vaccinated against anthrax and that bone meal fertilizers should be packed in sacks carrying a prominent warning that gloves should be worn.

In spite of the falling incidence of anthrax in man, practitioners must always bear it in mind and endeavour to make an early diagnosis.

I am deeply grateful to my secretary Mrs. Irene Barclay for secretarial assistance, and to Mr. Harvey Cairns for the excellent photographs taken by him during our association over the past 15 years.

References

- ¹ Henderson, D. W., Peacock, S., and Belton, F. C., *Journal of Hygiene*, 1956, 54, 28.
- ² Wilson, G. S., and Miles, A. A., in *Topley and Wilson's Principles of Bacteriology, and Immunology*, 5th edn. London, Arnold, 1964.
- ³ Top, F. H., *Communicable and Infectious Diseases*, 6th edn. St. Louis, Mosby, 1968.
- ⁴ Albrink, W. S., *Bacteriological Review*, 1961, 25, 268.
- ⁵ Lamb, R., *Lancet*, 1958, 2, 151.
- ⁶ Christie, A. B., *Textbook of Infectious Diseases*, p. 771. London & Edinburgh, Livingstone, 1969.
- ⁷ Taylor, L., and Carslaw, R. W., *Lancet*, 1967, 1, 1214.
- ⁸ Lamb, R., *Lancet*, 1967, 2, 98.
- ⁹ Price, F. W., *Textbook of Medicine*, 1st edn. Oxford University Press, London, 1922.
- ¹⁰ Fleming, A., *British Journal of Experimental Pathology*, 1929, 10, 226.
- ¹¹ Heilman, F. R., and Herrell, W. E., *Proceedings of the Staff Meetings of the Mayo Clinic*, 1944, 19, 492.
- ¹² Sterne, M., in *Infectious Diseases of Animals*, ed. A. Stableforth, and I. A. Galloway. London, Butterworths, 1959.
- ¹³ *Lancet*, 1964, 1, 1028.

Contemporary Themes

Management for Health

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"Mention management . . . to the average doctor and he tends to bristle," remarked a leading article in the *British Medical Journal* six months ago.¹ British doctors have had frequent reason to bristle of late. In the space of six or eight months British medical journals have probably published more commentary on "management," pro and con, than in the whole of the previous decade, and this trend will continue for several more months while the white paper on N.H.S. reorganization and the "grey book" on management arrangements are debated. Yet for all the discussion, there is a danger that the profession will still be inclined to dismiss this concern with management as a passing fad, a whim of the Secretary of State, with no relevance to the lifeblood of the service. If so, the interests of patients, doctors, and the health service as a whole will have suffered a severe setback.

My purpose in this article is to expose (and demolish, if I can) some of the prevailing misconceptions about management, to point out some of the situations in health systems that cry out for better management, and to illustrate from my own experience in this and other countries the nature of the contribution management can make. I shall not attempt a defence of the report on management arrangements (which is concerned with means), but shall try to clarify the objective we should aim for and some ways this objective can be reached.

Much of the present discussion seems to suggest that management is something new and alien in health care. This is not the case. Ever since doctors first treated patients the doctor has had to manage the resources available to him. When resources became more varied, more potent, and more complex, the management task became that much more difficult. Sometimes it is done well, and sometimes badly, but it cannot be escaped. Some forms of management would of course be alien in the health services. Hostile reactions to the search for better management have assumed, with genuine or wilful misunderstanding, that such alien characteristics are essential components of management. They are not. Good management in health services must be appropriate to the health services environment. What we should all be seeking to do is to make it appropriate, not to deny its need.

What is Good Management?

My shorthand definition of good management is: a rational way of considering what you are going to try to do, and then getting things done without waste. That sounds so desirable an end as to be unassailable, but recent articles and correspondence have expressed a different view, painting management as necessarily insensitive, hierarchical, and narrow. For example²:

The white paper seeks to sacrifice both health workers and patients on the altar of "managerial efficiency." Health care is to become the province of cost-benefit analysis and management consultants who will base their assessment of priorities on the question "How much can be made out of it by putting a fixed amount in?" On this criterion, the non-productive sections of the population (the old, chronic sick, and mentally ill, etc.) can expect little help. No mention is made of increased financing, and Britain will continue to spend less on health care than the U.S.A., Canada, Sweden, or France.