Parasitic agents of bio-terrorism – Is it a reality?

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Abstract

The use of biological agents for purpose of bioterrorism is being increasingly recognized now a days .A wide range of microbial pathogens have been used for causing disease not only in humans but also in food animals .Most of these agents include bacteria such as anthrax , plague , etc. ; viruses such as small pox, arena virus ,etc. .However, parasitic agents of bioterrorism have received very less attention till today .*Cryptosporidium* and *Cyclospsora* are coccidian parasites which can be employed as agents of bioterrorism .These can produce severe and prolonged diarrhoea in humans, and even fatal infections in the immunocompromised patients such as the AIDS .*Ascaris lumbricoides* is a helminthic parasite which has already been used intentionally as agent of bio terrorism. *Baylisascaris procyonis*, a roundworm infection of raccoons, is emerging as an important helminthic zoonosis, principally affecting young children. *B. procyonis* infection of humans typically results in fatal disease or severe sequelae. In an era of increasing concern about bioterrorism, certain characteristics of *B. procyonis* make it a feasible bioterrorist agent .*Echinococcus granulosus* , the causative agents of cystic echinococcosis , and *E. multilocularis* , the causative agent of alveolar echinococcosis present several characteristics which would make them as potential long term agents of bioterrorism .In conclusion , although the use of parasites as agents of bioterrorism is less than those of bacteria or viruses , but still has a potential to be used increased as agents of bioterrorism and cause fear psychosis in human populations relating to food and water supplies .

Introduction

The use of biological agents for purpose of bioterrorism is being increasingly recognized now-a-days .A wide range of microbial pathogens have been used for causing disease not only in humans but also in animals .Most of these agents include bacteria such as anthrax, plague , etc. ; viruses such as small pox, arena virus ,etc. However, parasitic agents of bioterrorism have received very less attention till today [1].

In general, the potential biological weapons include the use of any human microorganism which may be fast and easily disseminated in the environment, mainly airborne, also by contaminating the water supplies [2].Long term biological weapon show effects immediately after the attack through the development of sub acute and /or chronic disease. They consist of the following

characteristics:

1 It should be highly potent and easy to deliver.
2 Long term biological weapon would allow terrorists to disseminate the agents in the environment with enough time to leave the attacked area, before the appearance of symptoms.
3 It would necessary to implement long-term control and diagnostic schedules to detect slow-development symptomatic disease and would require extended follow-up.
4 If long-term medical treatment or surgery would be required, incurred health care expenses will also increase.
5 It would cause socio-economic after-effects, long-term sick leaves and definitive invalidations. This affects the social prevision of the attacked. If the disseminated parasites endemically establish in the attacked country, they may become reservoirs of the disease, with the long-term consequences [2].

Parasites as agents of bioterrorism

Parasites have the possibility of being used as agents of bioterrorism on the basis of rapidity in which they can produce disease and/or pathology in the human host[1]. Since parasites cannot be as readily propagated in the laboratory nor can they be utilized as aerosols as can many bacterial and viral agents, the use of these organisms revolves principally around their introduction into the water and food supply. To be introduced into the water supply would generally require large quantities of organisms which are immediately infective when obtained from animal or human hosts or would require considerable periods of time for external incubation to the infective stage before their usage[1].

Protozoal agents

Cryptosporidium and *Cyclospsora* are coccidian parasites which can be employed as agents of bioterrorism .They can be obtained in large numbers from animal and human hosts. These can produce severe and prolonged diarrhea in humans, and even fatal infections in the immunocompromised patients such as the AIDS. In a terrorist attack, *Cryptosporidium parvum* would most likely be disseminated through contamination of food or water supplies [3]. Although frequent mention of *Giardia* infections occur in the literature, the problem of collecting large number of organisms poses difficulties for bioterrorism use on a large scale [1].

Helminthic agents

Some helminthic parasites offer opportunities for collection in large numbers and subsequent dissemination into food or water. *Ascaris lumbricoides* is a helminthic parasite which has already been used intentionally as agent of bio terrorism. This could be utilized as bioterrorism agents because of their large size, extreme fecundity, and ready availability in animal hosts [1].

Echinococcus granulosus, the causative agents of cystic echinococcosis, present several characteristics which would make them as potential long term agents of bioterrorism [2]. These are as follows:

1 Infections are caused by the eggs of the parasite, which easily survive in the environment, even under freezing conditions.

2 The larval stage has a low degree of host specificity as well as a great reproductive potential.
3 Parasitic eggs are easy to obtain, deliver and disseminate.
4 Contamination of vegetable, fruits and other raw food is easily performed.
5 Development of disease is slow and progressive (years).
6 Early stages of the disease are asymptomatic and thus very difficult to detect.
7 Long-term sick leaves constitute great socio-economic costs.
8 Diagnosis requires the use of radiological, ultrasonographic and serological methods, which are costly.
9 Generally surgery has to be done to treat the condition, which is costly and not done in all health care centers [2].

Echinococcus multilocularis is another cestode, causative agent of the alveolar echinococcosis (AE), has a potential for use as agent of bioterrorism .Some of its biological and development characteristics are:

1 The eggs of *E.multilocularis* may be obtained from naturally infected hosts, experimentally infected ones (foxes and dogs) and also from samples.
2 The eggs survive well in the environment.
3 The development of the larval form in the intermediate host including man is relatively fast.
4 The diagnosis of AE is expensive since it requires ultrasonography, computed tomography, magnetic resonance imaging and serology.
5 The mortality rate in untreated or long-term chemotherapy with monitoring.
6 The disease causes long-term sick-leaves.
7 The disease could be endemically introduced in the target country by infecting its native fox and wild rodent's populations [2].

In an era of increasing concern about bioterrorism, certain characteristics of *Balylisascaris. procyonis* make it a feasible bioterrorist agent. The organism is ubiquitous in raccoon populations and therefore easy to acquire. Enormous numbers of eggs can be readily obtained, and these eggs can survive in an infectious form for prolonged periods of time. As with other ascarids, the eggs can remain viable in a dilute (0.5%-2%) formalin solution for an indefinite period of time, and animal studies suggest that *B. procyonis* has a relatively small infectious dose. Moreover, the organism causes a severe, frequently fatal infection in humans, and no effective therapy or vaccine exists. Introduction of sufficient quantities of *B. procyonis* eggs into a water system or selected food products could potentially result in outbreaks of the infection. Contamination of community water sources would be difficult since the eggs of *B. procyonis* are relatively large (80 µm long by 65 µm wide) and would be readily removed by standard filtration methods or the flocculation and sedimentation techniques used by municipal water systems in the United States. However, post-treatment contamination or targeting of smaller systems could be possible [4].

Conclusion

In conclusion, Baylisascariasis, cystic echinococcosis, ascariasis and intestinal coccidian infections are the potential emerging agents of bioterrorism with the potential for severe infection that may be a more important public health problem than is currently recognized. Educating the medical community is of paramount importance in helping to define the extent of infection.

Although, the utilization of parasites as effective bioterrorism agents is less than with bacteria or viruses but still could contribute to the installation of fear in human populations concerned with their food and water supplies.

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