



Medical aspects of bio-terrorism



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ABSTRACT

Introduction: Bioterrorism is a terrorist action involving the intentional release or dissemination of a biological warfare agent (BWA), which includes some bacteria, viruses, rickettsiae, fungi or biological toxins. BWA is a naturally occurring or human-modified form that may kill or incapacitate humans, animals or plants as an act of war or terrorism. BWA is a weapon of choice for mass destruction and terrorism, because of the incubation period, less effective amount than chemical warfare agents, easily distribution, odorless, colorless, difficult to detect, no need of specialized equipment for production and naturally distribution which can easily be obtained. BWA may be disseminating as an aerosol, spray, explosive device, and by food or water.

Classification: Based on the risk for human health, BWAs have been prioritized into three categories of A, B and C. Category A includes microorganisms or toxins that easily spread, leading to intoxication with high death rates such as Anthrax, Botulism, Plague, Smallpox, Tularemia and Viral hemorrhagic fevers. Category B has lower toxicity with wider range, including Staphylococcal Enterotoxin type B (SEB), Epsilon toxin of *Clostridium perfringens*, Ricin, Saxotoxins, Abrin and Trichothecene mycotoxins. The C category includes emerging pathogens that could also be engineered for mass spread such as Hanta viruses, multidrug-resistant tuberculosis, Nipah virus, the tick-borne encephalitis viruses, hemorrhagic fever viruses and yellow fever.

Clinical manifestations of biotoxins in human: Clinical features and severity of intoxication depend on the agent and exposed dose, route of entry, individual variation and environmental factors. Onset of symptoms varies from 2–24 h in Ricin to 24–96 h in Botulism. Clinical manifestations also vary from irritation of the eyes, skin and mucus membranes in T₂ toxin to an acute flaccid paralysis of bilateral cranial nerve impairment of descending manner in botulism. Most of the pyrogenic toxins such as SEB produce the same signs and symptoms as toxic shock syndrome including a rapid drop in blood pressure, elevated temperature, and multiple organ failure.

Management: There is no specific antidote or effective treatment for most of the biotoxins. The clinical management is thus more supportive and symptomatic. Fortunately vaccines

Abbreviations: BW, Biological warfare; CW, chemical weapons; BWAs, Biological warfare agents; BoNTs, *Clostridium botulinum* neurotoxins; LD₅₀, median lethal dose; PBT, pentavalent botulinum toxoid; SEB, *Staphylococcus aureus* enterotoxin type B; ED₅₀, median Effective dose; ETX, Epsilon toxin of *Clostridium perfringens*; RT, Ricin Toxin; TrMs, Trichothecene mycotoxins; ATA, alimentary toxic aleukia; PCR, polymerase chain reaction; CDC, Centers for Disease Control and Prevention; AbT, Abrin Toxin; ET, Edema toxin; LT, lethal toxin; MAPKK, mitogen-activated protein kinase kinase; ELISA, enzyme-linked immunosorbent assay; DIC, disseminated intravascular coagulation; LPS, lipopolysaccharide; ARDS, acute respiratory distress syndrome.

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are now available for most of BWA. Therefore, immunization of personnel at risk of exposure is recommended.

Conclusion: Biotoxins are very wide and bioterrorism is a health and security threat that may induce national and international problems. Therefore, the security authorities, health professional and even public should be aware of bioterrorism.

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1. Introduction

Bioterrorism is a terrorist action involving the intentional release or dissemination of a biological warfare agent (BWA), which includes some bacteria, viruses, rickettsiae, fungi or biological toxins (Balali Mood et al., 2013; Switala et al., 2011). BWA can be natural or genetically modified (Balali Mood et al., 2013). Some special BWAs can cause deterioration of materials, e.g. petroleum-eating bacteria (Balali Mood et al., 2013). Entomological (insect) warfare is also considered as a type of BWA, tactical arms (hurled nests) or strategic habitats (mosquito-infested swamps) (Lockwood, 2012). The special properties of BWAs attract terrorists and military services to use them as warfare agents. The most important characteristic is delay in starting activity resulted in an incubation period (Khardori, 2006c). The amount of effective materials for BWAs is less than the chemical warfare agents (CWAs) (Khardori, 2006c). A very small quantity of a BWA may be sufficient to cause morbidity and mortality. Some BWAs, in spite of CWAs, have ability of living and reproducing inside their host (Gustin, 2005). Some BWAs, such as plague and smallpox, are highly infectious and can fast spread to large population resulting in epidemics and sometime pandemics (Eiros Bouza et al., 2003). In contrast of CWA, they are odorless and colorless (Khardori, 2006b). BWA production does not need specialized equipment and huge infrastructure and they could be made in a very small laboratory (Khardori, 2006c). Furthermore, some of BWAs, like anthrax and brucellosis, occur naturally in animals (Eiros Bouza et al., 2003). Difficulty in detection and much easier storage and transport of BWA than CWA and nuclear weapons are also make them weapons of choice for mass destruction and terroristic action (Khardori, 2006c). However, some special toxins such as saxitoxin have currently been used for a few individuals (Anderson, 2012).

A successful bioterrorism event depends on several factors. Type of BWA and the target population are two important factors. The BWA which is chosen for this purpose at least should have these criteria: 1. It must be suitable for mass production, storage, and “weaponization” as it would be stable during process and dissemination (Khardori, 2006c). 2. BWA should ideally be stable in environment and some environmental influences like dryness, temperature extremes, or ultraviolet radiation degrade them very slowly (Anderson, 2012). Anthrax spores are an instance of a model of this stand point (SteelFisher et al., 2011). The efficient BWA also is able to induce the disease and death. Microbial BWA should be highly contagious and infective in low doses and have a known short and predictable incubation time. Furthermore, diseases which are induced by these BWA should

be difficult to detect and are very similar to common and/or endemic infections (Khardori, 2006b). Due to lack of natural or acquired immunity the resistancy of target population should be low. However, The population or soldiers of aggressor should protect, treat or be immunized (Khardori, 2006c).

Various methods of BWA dissemination include: I) aerosol sprays, the most common delivery and maximum effective method (Balali Mood et al., 2013; Roffey et al., 2002a). They are sprayed through equipment which could produce aerosols, such as spray devices, or via bombs or missiles. They could also be spreaded from ships, airplanes, vehicles or other matter like letter (Roffey et al., 2002a). The best BWA particle size is 1–5 μm in diameter. This size allows BWA inhaled deeply into the lungs and winds passes them for long distances (Roffey et al., 2002a). Particles larger than 5 μm stay in the nasal passages or trachea and do not reach the lung (Franz, 1997), however sometimes these particles could cause effective or incapacitant disease II) Explosive devices (artillery, missiles, detonated bombs) which are not as effective as aerosol, because BWAs tend to be destroyed by the blast, typically leaving less than 5% of the agent capable of causing disease (Balali Mood et al., 2013). III) Putting into food or water (Khardori, 2006b). IV) Skin application or by injection, that is usually used for assassination (Roffey et al., 2002b).

Following 11th September 2001 events, the whole world focused on the potential risks of biological weapons and numerous articles were published with 10 folds increase between 2001 and 2003. Furthermore, the number of countries investigating BWA hazards was doubled. Trends of publications on BWA, CWA and NWA (nuclear warfare agent) during the years 1992–2010 as have been extracted from Scopus[®] show that BWA had increased from 2001 and had a peak at 2003, then decreased over the following years (Figs. 1 and 2).

USA Centers for Disease Control and Prevention (CDC) has categorized BWAs based on the risk to national security, into three categories by the: A, B and C (Centers for Disease Control and Prevention (CDC), 2012; Darling et al., 2002; Moran, 2002).

2. Category A of BWAs

These agents are highly toxic and High-priority agents include organisms that pose a risk to national security. Their characteristics are as follows:

- Ability of person-to-person easily dissemination or transmission.
- Mortality and morbidity of them are high especially when they use against civilian populations.

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