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Weapons of mass destruction: Overview of the CBRNEs (Chemical, Biological, Radiological, Nuclear, and Explosives)

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Abstract

The events of September 11, 2001, made citizens of the world acutely aware of disasters consequent to present-day terrorism. This is a war being waged for reasons obscure to many of its potential victims. The term "NBCs" was coined in reference to terrorist weapons of mass destruction, i.e., nuclear, biological and chemical. The currently accepted acronym is "CBRNE" which includes Chemical, Biological, Radiological, Nuclear, and Explosive weapons. Non-nuclear explosives are the most common terrorist weapon now in use. Nuclear and radiological weapons are beyond the scope of this publication, which focuses on the "CBEs", i.e. chemical, biological and explosive weapons.

Although neurologists will not be the first responders to CBEs, they must know about the neurological effects in order to provide diagnosis and treatment to survivors. Neurological complications of chemical, biological and explosive weapons which have or may be used by terrorists are reviewed by international experts in this publication. Management and treatment profiles are outlined.

Keywords: Terrorism; Weapons of mass destruction; Nervous system damage; Nerve agents; Brain trauma; Bioterrorism

1. Introduction

Even though attempts to create terror among combatants and civilians during times of war have been a part of human behavior since the beginning of recorded history, terrorism has perhaps reached new heights in the past decade. The events of September 11, 2001, in New York City and Washington, D.C., USA, forced citizens worldwide to focus on a war being waged in an unconventional manner. Rather than being a war fought primarily for territorial gain, as common in most previous wars, those events sought to attempt to promote the dominance of concepts and beliefs, doing so in part by creating fear in individuals and instability in societies.

The weapons of mass destruction (WMD) which terrorists might use are nuclear, chemical, and biological, the so-called NBCs. Non-nuclear explosives are now the most popular terrorist weapons, often in the context of suicide bombers. The acronym currently accepted is "CBRNE" referring to Chemical, Biological, Radiological, Nuclear and Explosive weapons. Nuclear and radiological weapons are not subjects of this publication. Chemical, biological and non-nuclear explosives can cause extensive nervous system damage and/or neurobehavioral effects upon survivors of an attack.

When such an attack occurs, neurologists will be called upon to provide diagnosis and management of such damage and effects. Neurologists will not only be called upon to treat those with specific nervous system diseases, e.g. epilepsy after head injury caused by explosives, but also will be called upon to evaluate and manage those who have not suffered physical or biochemical nervous system damage but who believe they have suffered such. The premise of this publication is that worldwide neurologists who have little or no experience with such nervous system damage and neurobehavioral effects should be educated. Therefore, this publication reviews such damages and effects, sometimes providing management and treatment information.

2. Discussion

Bloodletting was a well-accepted and the "prevailing practice" of medical therapy for centuries, not ending until

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the early part of the nineteenth (19th) century [1]. Elaborate theories were constructed to support its proposed efficacies. For example, the death of George Washington, who was the first President of the United States, was either hastened or caused by bloodletting [2]. Present-day medical therapies are mainly humane and increasingly evidence-based. Medical bloodletting is now rarely appropriate. Violent bloodletting was always and continues to be a common practice in other areas of human activity, i.e. politics, fanatic religiosity, personal and national self-aggrandizement. Such violent bloodletting often occurs in the form of wars. Elaborate theories are constructed to justify its use. Combatants often suffer death; however, non-combatants often lose their life's blood. In survivors, extensive bodily trauma occurs, e.g. lost limbs. Survivors often suffer psychological trauma as well, e.g. the so-called "post traumatic stress disorder (PTSD)"[3]. Likewise, nervous system complications in the survivors of warfare are common including port-traumatic encephalopathy with associated dementia, seizures and behavioral changes; cerebellar dysfunction; spinal cord injury; radiculopathies, peripheral neuropathies; and myelopathies [4–6].

Until recently, a term, the "NBCs", was used to designate weapons of mass destruction (WMD) potentially available to terrorists [7]. The currently accepted acronym "CBRNE"; which includes Chemical, Biological, Radiological, Nuclear and Explosive weapons, acknowledges that the use of dynamite and other non-nuclear explosives is the prevailing practice of terrorist.

Although, the authors of this publication acknowledge that nuclear and radiological events may occur, such events are beyond the publication's scope. The explosion of full-scale hydrogen bombs would cause immediate catastrophic loss of human life and destruction of physical structures as well as widespread long-term illness, e.g. development of cancer in survivors living at a distance from the explosion center. Those who do not die immediately but who suffer neurological effects because of high radiation exposure, e.g. 400–500 rads, will die within hours or days of the event.

The effects of a so-called "dirty bomb" would have less dramatic immediate loss of life and property. A "dirty bomb" or a Radiological Dispensed Device (RDD) is not the same as an atomic bomb, which involves the splitting of atoms and a huge release of energy that produces the atomic mushroom cloud [8]. Instead, a dirty bomb is a mixture of explosives with radioactive powder or pellets. Radioactive materials are widely used in hospitals, research facilities, industrial facilities and construction sites. These radioactive materials are used in diagnosis and treatment of diseases, sterilizing equipment, and inspecting welding seams. In the USA, over 21,000 organizations are licensed to use such materials. The vast majority of these sources are not useful for constructing an RDD. Furthermore, the extent of availability of such materials to potential terrorists is not well-known. A dirty bomb cannot create an atomic blast. However, it uses dynamite or other explosives to scatter radioactive dust, smoke of other materials in order to cause radioactive contamination. Such materials would probably not create enough radiation exposure to cause immediate severe illness, except to those very close to the blast site. The radioactive dust and smoke spread far away from the explosion site and can be dangerous to physical health while creating widespread terror. The main immediate danger is from the explosion, of which details are provided by Dr. Michael Finkel in another section of the publication.

Dr. Michael Donaghy has expertly reviewed biological terrorism in this publication. Neurologists are most likely to become involved in diagnosis and treatment of bioterrorist's attacks utilizing: botulitum toxin with its characteristic descending paralysis, anthrax with its potential for hemorrhagic meningitis, and Venezuelan equine encephalitis (Fig. 1).

Even though the terroristic use of mycotoxins has not been discussed in the lay media, e.g. the press and television, their potential use in low-level exposure with subsequent development of Parkinsonism is of special interest to neurologists. Juan Sanchez-Ramos, M.D., PhD. provides insights into this prospect.

Neurological consequences of explosives are legion and include penetration injuries, "primary blast" injuries to the brain and spinal cord, neurapraxis to receptor organs of the ear; cerebral evisceration; contusions and concussions of nervous tissue; peripheral nerve injury; and hypoxic encephalopathy secondary to primary injury to the chest wall and the heart. A cerebral and spinal column computed tomography (CT) analysis of injuries inflicted by missiles and explosives in 53 people during the war in the Republic of Croatia from June through December 1992 has been reported [9] (Fig. 2). Multiple injuries complicate recovery because of concurrent problems with cognition affect, attention, memory, and special sensory deficits. Chronic pain, dementia, and epilepsy will require neurologists to participate in management and treatment. Michael Finkel, M.D. provides expert insight on these issues. The use of explosives evidenced a highly dramatic and lethal effect in the World Trade events in

Fig. 1. Cutaneous smallpox seen as a propensity to develop associated encephalitis and/or a post encephalitic encephalitis.