Bioterrorism: Infectious Agents Utilized In Biological Warfare

There are several infectious agents that have been utilized in biological warfare. Although exposure to these types of cases is rare, anesthesia providers should be aware of the possible treatments and anesthesia implications for patients who have been exposed to these infectious agents. Early recognition is key, as the nurse anesthetist can then implement the necessary interventions specific to that agent.

Anthrax

Anthrax is gram-positive bacteria that is transmitted through animals and soil. The type and severity of the disease process depends on the route of administration. Humans contract anthrax via cutaneous, gastrointestinal, inhalational and injection routes (Dichtwald & Weinbroum, 2008). The inhalation type is most insidious and the most dangerous type. Once anthrax spores enter the body, the spores are activated and become bacteria, which produce toxins that ultimately lead to severe illness. Anthrax is not contagious and cannot be transmitted through human contact. Anthrax is most commonly transmitted through contact with infected animals, eating raw or undercooked meat from infected animals, or injecting heroin. Anthrax made its way into the public eye when letters containing anthrax were sent to U.S. lawmakers shortly after 9/11, which ensued a panic and the realization that anthrax can be used as a biological weapon. The signs and symptoms of anthrax infection depends on the type of transmission. With a cutaneous transfer, blisters and painless ulcers with black centers may appear. Injectional anthrax will have blisters and skin sores with black centers. With gastrointestinal transmission, fever, chills, bloody diarrhea, stomach pains, painful swallowing, nausea, bloody vomiting, and abdominal swelling can occur. Inhalational anthrax can manifest as fever, chills, shortness of breath, chest discomfort, sweating and extreme fatigue can occur. Treatment for anthrax consists of antibiotic treatment and antitoxins; a vaccine is also available (Dichtwald & Weinbroum, 2008).

Plague

The plague is caused by a bacterium called Yersinia Pestis. More commonly, humans are infected by rodent flea bites that carry the bacteria. This plague claimed many lives in Europe during the Middle Ages, while most cases today are seen in Africa and Asia and in some parts of the western United States. The symptoms of the Plague depend on the type of exposure. In the case of the Bubonic Plague, symptoms of the Plague depend on the type of exposure and can include fever, chills, and one or more painful, swollen lymph nodes. This type of plague typically results from a flea bite. Another type of Plague is the Septicemic Plague which can occur as a result of untreated Bubonic plague. These patients typically present with fever, chills, abdominal pain, and possible bleeding into the skin and other organs. Extremities can also become gangrenous and require amputation. Lastly, there is the pneumonic plague in which the patient rapidly develops pneumonia with bloody or watery secretions which can lead to respiratory failure. This type of plague can occur after inhaling infectious droplets and is the most severe form of the plague. The treatment of choice are commonly used antibiotics. The

Plague is a highly contagious disease that have been used in warfare strategies during the Cold War that including dropping infected fleas from airplanes, throwing infected corpses into the battle field, and aerosolizing the infected bacteria. Due to its potential to be used as a biological weapon, the plague remains a great concern for bioterrorism.

Botulinum

Botulinum neurotoxins (BoNTs) are protein neurotoxins produced by strains of anaerobic and spore forming bacteria of Clostridium. BoNTs cause flaccid paralysis by inhibiting acetylcholine release at peripheral cholinergic terminals of skeletal muscles and the autonomic nervous system (Pirazzini, Rosetto, Eleopra, & Montecucco, 2017). BoNTs are used in bioterrorism, but they are used much less than other viruses or anthrax. There most common use is for therapeutic treatment of dystonias, spasticity, autonomic disorders, urologic conditions, neuropathic pain, primary headaches, depression, and for cosmetic uses. Exposure to BoNTs can also come from eating animals infected with Botulinum. One to four days after exposure, patients present with bulbar palsies such as dysarthria, dysphonia and dysphagia, as well as diplopia and ptosis. These symptoms are followed with paralysis starting at ocular muscles and extending downward causing respiratory failure, therefore early intubation and mechanical ventilation is critical for survival (Pirazzini et al., 2017). Paralysis from BoNTs is completely reversible since this bacterium is neither cytotoxic or cause any axonal degeneration. The duration of paralysis depends on type of BoNT, dose, animal species, mode of administration, and type of nerve terminal. Diagnosis of botulinum intoxication is confirmed by identification of botulinum toxin in feces, vomitus, serum, or wounds. Management of patients with exposure to Botulinum includes supportive care such as mechanical ventilation and cardiac monitoring for dysrhythmias (Wenham & Cohen, 2008).

Sarin

Sarin, also known as GB, is a clear, colorless, tasteless organophosphate. Sarin is used as a chemical warfare agent and is classified as a nerve agent. Nerve agents work by irreversibly inhibiting acetylcholinesterase (AChE) at the neuromuscular junction resulting in a cholinergic crisis (Huebner & Arnold, 2019). Sarin is the most volatile of nerve agents, therefore it can evaporate and spread into the environment easily. Signs and symptoms of Sarin exposure is based on excess acetylcholine in the body. At muscarinic receptors, excess ACh causes miosis, glandular hypersecretion, bronchoconstriction, vomiting, diarrhea, urinary and fecal incontinence, and bradycardia (Huebner & Arnold, 2019). In contrast, excess ACh at the nicotinic receptors causes sweating, skeletal muscle weakness, and flaccid paralysis. Nerve agents also cause irritability, lethargy, amnesia, seizures, coma, and respiratory depression (Huebner & Arnold, 2019). Depending on amount of exposure, symptoms can vary from mild to life threatening. Nerve agents can cause death within 1-10 minutes by respiratory failure secondary to increased airway resistance, respiratory muscle paralysis, and loss of central respiratory drive (Huebner & Arnold, 2019). There are no lab tests that directly measure Sarin in the blood, but the percentage of nerve agent in the blood can be estimated by measuring the percent reduction in the activity of RBC cholinesterase. Severe clinical effects correlate with a 20-25% reduction in RBC cholinesterase activity (Huebner & Arnold, 2019). Before treatment, patient should be decontaminated with alkaline soap or 0.5% hypochlorite solution to stop spread of agent. PPE needs to be worn until decontamination complete. The bond between Sarin and AChE takes times to mature and become permanent. Treatment with the antidote,

pralidoxime, is critical and should be given during this window. Atropine should be given every 5 to 10 minutes until secretions dry up (Huebner & Arnold, 2019). There specific anesthesia interventions that the nurse anesthetist should be familiar with. EEG monitoring should be initiated with general anesthesia because seizures may be masked from paralysis. Benzodiazepines should be given to treat seizures. Early intubation and ventilation are indicated for severe cases. RSI is indicated for intubation, but providers should avoid succinylcholine as it is metabolized by plasma cholinesterase (Huebner & Arnold, 2019).

Conclusion

Although bioterrorism is a rare occurrence, preparedness is key to providing the best possible care to patients who have been exposed. Victims of 9/11 can testify to the importance of emergency drills and emergency preparedness. In the operating room, nurse anesthetists should be familiar with these conditions and be able to recognize bioterrorism. Early recognition and identification of bioterrorism agents can aid in treatment by allowing implementation of the necessary interventions in a timely matter.