**Introduction:**

Biological warfare has been existing since ancient times. Outbreaks of Plague, Smallpox, Cholera, Influenza has played a major role in decimating human population. Such catastrophes were described as “Evil spirits”, “wrath of God”, “deserving retribution to evil ways”.

**Evolution of Chemical and Biological Weapons**

**Phase I:** Gaseous chemicals like chlorine and phosgene were used in World War I.

**Phase II:** Use of nerve agents - Tabum and acholine - esterase inhibitors mark beginning of anthrax and plague in World War II.

**Phase III:** Herbicides were used causing crops destruction.

**Phase IV:** In recent time, biotechnological and genetic engineering revolutions are in progress.

**Merits:**

- Low cost-“Poor man’s atomic bomb”.
- Large quantities can be produced in short time with small facilities.
- Non detection by routine security system (biosensor), access to a wide range of agents and their dispersal can be made silently.
- Very toxic, hence small quantities will kill large number of persons.
- Destroys the enemy leaving his infrastructure intact as booty for the winter.

**Demerits:**

- Difficulty of protecting workers during production, transportation and delivery.
- Difficulty in maintaining quality control, contamination during growth and harvesting.
- Effective delivery system.
- May be destroyed after delivery.
- May disperse in unexpected ways aided by the wind.
- Need specific conditions for storage; hence difficult to maintain in weapons.
- Difficult to control once released.

**Top Biological Weapons**

- **Bacillus Anthracis**
  - It is a gram positive organism, affecting sheep and cattle. Human get the disease either by inhalation of spores, where it is called Wool sorter’s disease (Pulmonary anthrax) or by cutaneous infection. Man to man transmission does not occur. Pulmonary anthrax is characterized by an incubation period of one day to eight weeks, flu like symptoms, abrupt onset of respiratory distress, cyanosis, shock, septicemia and death.
  - Treatment is by ciprofloxacin, 400-800 mg, given IV twice a day.
  - Vaccination is given by 6 subcutaneous doses at 0, 2 and 4 weeks, followed by 6, 12 and 18 months.
  - Chemoprophylaxis is either by ciprofloxacin or doxycycline. Bacteria are extremely stable and can be stored as powder, used as aerosol sprays.

- **Yersinia Pestis**
  - Results in plague, which is a zoonotic disease, disease of rodents, mainly rats, It is transmitted from rats to rats and rats to humans accidently by the bite of infected rat- fleas.
There are three forms of plague - bubonic, pneumonic and septicemic, of which last two forms are serious.
Useful antibiotics are streptomycin, Chloramphenicol, Doxycycline, Tetracycline and Sulphonamide.
A formalin killed vaccine is available. Adult male 1.0 ml and 1.5 ml Female 0.75 ml & 1.0 ml with an interval of 1 to 2 weeks, Subcutaneous. Booster doses are recommended once in 6 months regularly who are at risk. Immunity develops after 1 week of inoculation and lasts for 6 months. Infants < 6 months and children do not require vaccination.
The bacilli are used as an aerosol spraying biological weapon. It loses its infectivity quickly in aerosol preparation.

**Smallpox Virus**
It is also called as variola virus. Smallpox has been declared eradicated by WHO in 1980. Since then vaccination has been discontinued. Virtually everyone is now susceptible and therefore feared as the greatest threat.
Virus is highly infectious. Genetic recombination may enhance the virulence. The disease is characterized by high fever, followed by cutaneous eruptions in the stages of macules, papules, vesicles and pustules, which on drying leave behind permanent pock-marks. Case fatality rate being 40 percent. Effective chemotherapy is not available. Vaccine now exists only in selected WHO laboratories.

**Clostridium Botulinum**
These bacilli are gram-negative, anaerobic and spore forming.
The bacilli release an endotoxin, which is a powerful neurotoxin, resulting in a condition called Botulism, characterized by the paralysis of parasympathetic system, the features being ptosis, dysphagia, dysarthria, diplopia and constipation.
Lethal doses of the toxin are 1-2 ng, which is absorbed from the intestine.

Polyvalent antitoxin can neutralize the toxin. Immunization is by 3 doses of toxoid at 2 months interval.
Contamination of food, water or aerosol is methods of Biological Weapon.

**Vibrio Cholerae**
These bacteriae cause gastro-enteritis characterized by sudden onset of severe diarrhea, dehydration, acidosis, renal failure, shock and death by contamination of water and food.
The best way of control of cholera is by providing chlorinated water supply to the community.
Parenteral vaccine 1.0 ml single dose, I.M. Use of this vaccine after the outbreak of cholera is very short, does not serve the purpose to control the epidemic because individual develops the antibodies after 15 days of immunization and incubation of cholera is very short, the individual may develop the disease much before he develops...

**Ebola virus**
It is a highly contagious virus. These viruses target small capillaries, causing leak of blood and serum, 2-3 days after infection. Conjunctival hemorrhage and multi-organ failure ensues.
These patients are treated by pressor agents, antiviral agents, fresh plasma and clotting factors. Incubation period and death is rapid. No vaccine is available.

**Mycotoxin:** This is the toxic product of fungi such as aspergillus, penicillium, fusarium which when contaminate grain and agriculture products, results in disease. It is usually delivered by air as “Yellow rain.”

It occurs by eating Amanita mushrooms. It produced five toxins in that amanitin, phallolidin are most potent hepatotoxins. Ergotamine causes purpura. Lysergic acid diethylamide cause vascular - neurologic effect.
Aflatoxins cause liver damage, hepatic carcinoma.
Newer Trends

- Products of microbes that can kill or incapacitate targeted hosts, eg. Hormones, neuropeptides and cytokines, called as “designer substances” to target a particular organ or a type of enemy.
- Russia seems to have a new type of genetically modified anthrax or elude the vaccine used by America.
- Rumors are that Israelis are working to prepare “Ethnic bomb.”
- Parasite Biological Weapon is under trial to affect cash crops and cause huge economic loss.

Delivery of Biological Weapons:

- Scud missiles
- Motor vehicles with a spray
- Hand pump sprayers
- By an individual
- Book or letter
- Guns
- Remote control devices
- Robotic delivery

Combating Biological Weapons Incident /At Risk Group

The first responders are physicians, infectious disease specialists, epidemiologists, hospital and public health administrators and laboratory experts.

Steps to be Taken

- Detection: A microbiologic confirmation is needed.
- Case definition: To be formulated by health care personnel.
- Notification: To proper civilian and military authorities.
  - Natural – gradual rise in cases.
  - Terrorist- sudden rise in cases, in hours or days.
- Investigation: A quick identification of the source and consequence of the outbreak.
- Medical intervention: Diagnosis, Isolation and Treatment.
- Prophylaxis: Immunization of health care professionals and contacts - actively or passively.

Public awareness: It needs to be created to ensure that the incident does not turn into public hysteria.

Future Suggestions (Prevention and Control Measures)

- To create awareness among the public and health care professionals.
- To stock pile drugs and vaccine.
- Allocation of separate funds.
- Preparedness: This is not a cause for panic - It is a cause for serious, deliberate long-term concern.
- International collaboration is required as Biological Weapon do not respect “boundaries, culture, language or territory,” hence solution has to be global.
- Microbiologists are the main focal point of action, because the Biological Weapon is the products of their specialty.

Finally Conclusion:

- Biological warfare is reality. We have a large pool of microbiological technology. We have to put these resources into use. There is an urgency to develop out the bioterrorism capabilities of human, agricultural and veterinary bioterrorism. Hence we should have a clear vision, political will, careful planning and organization by integrating local, state and central capabilities and to remember that we can deal with bioterrorism and not overreact to it.

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