

# Weapons Targeted at the Nervous System

Lecture No. 17  
Applied Version

# 1. Outline

- What is 'non-lethal' weapons?
  - Slides 2-4
- The search for 'non-lethal' chemical incapacitants during the Cold War
  - Slides 5-6
- The loophole in the CWC
  - Slide 7
- Emerging new weapons
  - Slides 13-14
- Neuroscience and new weapons
  - Slides 15-19
- Concluding Remarks
  - Slide 20

## 2. What are 'non-lethal' weapons?

*“Non-lethal weapons are discriminate weapons that are explicitly designed and employed so as to incapacitate personnel or material, while minimising fatalities and undesired damage to property and environment. Unlike weapons that permanently destroy targets through blast, fragmentation, or penetration, non-lethal weapons have relatively reversible effects on targets and/or are able to discriminate between targets and non-targets in the weapon's area of impact.”*

### 3. What are 'non-lethal' weapons?

Various types of 'non-lethal' weapons

- Tear Gas
- Vomiting agent, Sneeze gas
- Stun gun
- Rubber bullet
- Water cannon
- Sonic weaponry
- Active denial system
- Mobility denial system
- Blackout bombs etc.

## 4. What are 'non-lethal' weapons?

### Effects on humans

- Hypotension
- Emesis
- Altered Body Temperature
- Disturbances in Equilibrium
- Temporal Blindness
- Uncontrollable Muscle Tremor
- Psychotic symptoms

## 5. The search for 'non-lethal' chemical incapacitants during the Cold War

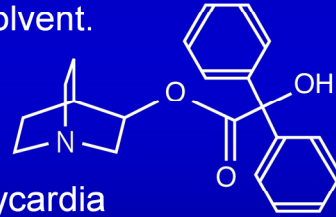
### BZ (3-Quinuclidinyl benzilate)

A typical 'non-lethal' weapon developed during the Cold War period. White powder at room temperature. Dispersed with solvent.

Inhibit acetylcholine receptors.

Effects on humans

- Dilatation of pupils, thirst, tachycardia followed by bradycardia or normal heart rate.
- Delusions, disturbances in consciousness and memory, disorientation, ataxia



## 6. The search for 'non-lethal' chemical incapacitants during the Cold War

### Fentanyl

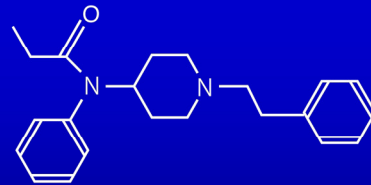
An opioid. Synthetic narcotic analgesic.

Normally used in anesthesia and analgesia.

About 100 times potent than morphin.

Effects on humans

- Anesthesia, analgesia
- Consciousness disturbances
- Respiratory depression
- vomiting



Notes: the image was retrieved from <http://en.wikipedia.org/wiki/Fentanyl>

## 7. Loophole in CWC

'non-lethal' weapons are loopholes in CWC

*"Each State Party to this Convention undertakes never under any circumstances:*

*(b) To use chemical weapons; "*

*(CWC Article I - 1)*

However,

*"Each State Party undertakes not to use riot control agents as a method of warfare."*

*(CWC Article I - 5)*



## 8. Fentanyl in Moscow

- In a Moscow theatre, 40-50 Chechens took 850 people hostage (2002/10/23-26)
- They demanded the withdrawal of Russian forces from Chechnya.
- The Chechens had grenades and mines on their bodies and deployed explosives throughout the theatre.

## 9. Fentanyl in Moscow

- Some hostages were shot by the night of October 25.
- On October 26, Russian special forces pumped an 'non-lethal' chemical agent into the theatre building and raided it.
- At least 129 hostages were killed, mostly due to intoxication for the gas.
- The gas was reported to be a derivative of fentanyl: aerosol version of carfentanyl.

## 10. Are 'non-lethal' weapons humane?

- It was hard to control the dose of the gas in a large space like a theatre.
- It may exceed the lethal dose at some places.
- There are also individual differences in vulnerability.
- The assault ended up in gun fire.

'Non-lethal' weapons are far from non-lethal.

## 11. 'Non-lethal' weapons are far from non-lethal.

Limited safety range

- Not 'non-lethal', but 'sub-lethal' or 'less than lethal'

Usually backed up by lethal weapons

- Guns or explosives are ready to be used following or in combination with 'non-lethal' weapons.

## 12. 'Non-lethal' weapons are far from non-lethal.

Still it might be better than conventional weapons.

If we prohibit 'non-lethal' weapons, can we counteract terrorists who do not care about such prohibitions?

We probably cannot stop development of 'non-lethal' weapons.

## 13. Emerging new weapons

To incapacitate humans without causing non-reversible damage, the target organs should be an integrative system in our body.

- Immune system
- Endocrine system
- Nervous system

## 14. Emerging new weapons

The most important target will be the nervous system because it matches the requirement for 'non-lethal weapons':

1. Rapid onset of the effects
2. Specificity of agents to a single functional subsystem

Particularly, innate bioregulator molecules and their related substances - neurotransmitters and their modulators for the nervous system - will be the candidates.

## 15. Neuroscience and new weapons

For example,

Agonists and antagonists to

- acetylcholine receptors: BZ,
- $\alpha$ -adrenoceptor: dexmedetomidine

Neuropeptides



## 16. Neuroscience and new weapons

Characteristics of bioregulator molecules:

- Rapid onset of the effects
- Difficult to diagnose
- Vaccines are not available
- Rapid progress in life science will discover countless candidate molecules every year.  
To make or up-date a list of molecules of concern is not possible.

Ref:

Kagan, E. (2001) Bioregulators as Instruments of Terror, *Clinics in Laboratory Medicine*, **22**(3), pp. 607 - 618. Available from

<http://www.labmed.theclinics.com/>

## 17. Neuroscience and new weapons

### Dexmedetomidine

- $\alpha$ 2-adrenoceptor agonist

- $\alpha$ 2A-adrenoceptor is an inhibitory autoreceptor at neurons in the locus ceruleus.

- Stimulation of  $\alpha$ 2A-adrenoceptor decreases the activities of noradrenergic neurons through the feedback mechanism.

### Effects on humans

Provide sedation without causing respiratory depression

## 18. Neuroscience and new weapons

### Substance P

- Peptide neurotransmitter
- binds to NK1 receptor
  - In the peripheral sensory system, substance P is involved in pain sensation.
  - Inhalation causes strong contraction of the smooth muscles of the respiratory tract

## 19. Neuroscience and new weapons

### Francisella tularensis with $\beta$ -endorphin gene

*Borzenkov, V.M., Pomerantsev, A.P. and Ashmarin, I.P. (1993) [The additive synthesis of a regulatory peptide in vivo: the administration of a vaccinal Francisella tularensis strain that produces beta-endorphin]. Biull Eksp Biol Med, 116, 151-153.*

Difficult diagnosis due to modified symptoms

Effects on the emotional system in the brain

Ref:

Borzenkov, V.M., Pomerantsev, A.P. and Ashmarin, I.P. (1993) [The additive synthesis of a regulatory peptide in vivo: the administration of a vaccinal Francisella tularensis strain that produces beta-endorphin]. *Biull Eksp Biol Med*, 116, pp. 151-153. Available from

<http://www.labmeeting.com/paper/20603235/borzenkov-1993-the-additive-synthesis-of-a-regulatory-peptide-in-vivo-the-administration-of-a-vaccinal-francisella-tularensis-strain-that-produces-beta-endorphin>

## 20. Concluding Remarks

- Research areas of dual-use concern are no more limited to infectious diseases or microbial pathogens.
- A wide variety of bioregulator molecules, particularly in the nervous system, can be used as weapons.
- We need to be aware that researchers in much wider areas have possibilities to be involved in dual-use research.