

Medicine for Managers

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Radiation Sickness

The last three generations of the world population will now have lived with the possibility of a nuclear holocaust. It is eighty years last week since American bombers launched nuclear attacks on the Japanese cities of Hiroshima and Nagasaki. Parts of a beautiful country were laid waste with absolute devastation and huge loss of life.

On August 6th 1945 a B-29 bomber dropped the first nuclear bomb on Hiroshima, killing 90% of



painful deaths from what has come to be known as **radiation sickness**.

The bombings brought to an end World War II in the Pacific, with Japan's unconditional surrender.

However, those affected by the radiation would provide the horror of lingering remembrance of what Emperor Hirohito called "*a new and most cruel bomb*".

The allies justified the use of the weapon by citing the 'hawks' in the Japanese military and in the civilian leadership who would not accept unconditional surrender and would fight to the very end.

the population, an estimated 120,000 people within four days of the blast.

Many were vaporised immediately and others died of the effects of burns and radiation.

Three days later another B-29 dropped a second bomb on Nagasaki, this time killing another 73,000 people. However unspeakably terrible the acute loss of life, tens of thousands were to die slow,



The use of atomic weapons had been tacitly approved by US President Truman, Russia's Joseph Stalin and the UK's Prime Minister Winston Churchill at the

Potsdam conference a month earlier in July 1945.

The threat of the **nuclear option** has defined global politics and the superpower stand-offs since that time.

Hiroshima and Nagasaki have raised the spectre of Mutually Assured Destruction which continues to haunt the world.

It is estimated that about 12,000 nuclear weapons are now held by the various global nuclear powers.

Since the second world war, radiation damage has generally occurred after nuclear accidents, such as that at Chernobyl in 1986 or the tsunami that followed the earthquake which damaged Fukushima nuclear power station on the east coast of Japan in 2011.

Radiation sickness is damage to the body caused by exposure to radiation, often over a short period of time.

The amount of radiation must be above a certain level and is influenced by a variety of factors; the nature of the radiation, the amount of radiation absorbed, the distance between the individual and the source of the radiation, whether the exposure is to the whole body or just to a part and the degree of sensitivity of the individual body tissue to the irradiation.

When an individual is exposed to a high level of radiation, it results in illness which may occur rapidly.

It may produce local effects such as burns and sloughing of skin or systemic effects such as vomiting and diarrhoea, bleeding, dizziness, headache and fever. The higher the dose sustained the greater the damage and potentially any bodily system can be disrupted.

If the individual's dose of radiation is not too high and he or she survives long enough, they will experience weakness and fatigue within four weeks and such effects as hair loss, skin ulceration, bloody vomit, infections, poor wound healing, anaemia, heart failure and low blood pressure.

Other complications occur over the medium to long term in survivors.

Absorption of radiation is measured in units called **millisieverts (mSv)**.

To give some sort of perspective to the measurement:

Diagnostic test using radiation e.g.:

- a single chest X-ray – 0.02 mSv.
- a mammogram – 2 to 5 mSv

Someone working in an environment with radiation such as a nuclear power station – 20 mSv, which is the UK limit of exposure set by the Ionising Radiations Regulations.

A dose of 100 mSv doubles the risk of cancer within twenty years.

To put the exposure into perspective, we are all

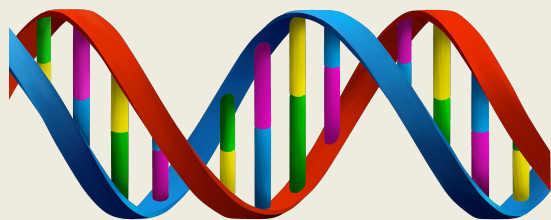
subject to radiation from natural sources and the average annual dosage received by an individual is 2.2 mSv.

Radiation comes from **Radon**, a naturally occurring radioactive gas present in the atmosphere, cosmic rays emanating from space, the earth which contains various radioactive rocks and food and water which contain minute traces of radiation in things such as meat, potatoes, nuts and bananas.

The fundamental question is 'what happens when radiation reaches a body cell'.

In simple terms radiation is composed of rapidly travelling electrons which may be highly charged. When these electrons penetrate the cell, they cause scattering of cellular molecules and the most serious damage is breakage of the DNA strand (the genetic code of the cell).

You may recall that the DNA molecule is in the form of a double helix.



The two strands which form each helix are linked across by four proteins. They are **Adenine**, **Guanine**, **Thymine** and **Cytosine**.

Any of the four proteins is found in each strand of the double helix and may be in any order. The proteins are each linked across the helix.

However, Adenine can only link with Thymine and Guanine can only link with Cytosine. If only one of the two strands is broken then it will have the remaining, undamaged strand to use as a template and may be restored as before. If there is a double-strand break healing is much

more difficult and the result is often erroneous joining of damaged fragments. These 'mis-repairs' result in mutations, chromosome aberrations and cell death.

The damage to the DNA explains various post-immediate effects of radiation damage.

Firstly it explains why the damage is most profound on the gut, the skin and hair, the blood and the reproductive organs.

It is because the body cells which are dividing most rapidly are those that line the gut, that replace the skin, that manufacture in the bone marrow and in other locations the various types of blood cells and that prepare the sperm and the female genital tract.

Consequently virtually all people injured by higher doses of radiation will have diarrhoea and vomiting with loss of blood in both, a variety of skin diseases resulting from failure of normal cell maturation and turnover, chronic anaemia, poor infection defence and failure of immune systems with decreased clotting ability and failure of reproduction.

Healing is impaired in all affected tissues because of cellular destruction which prevents repair and development of new cells.

The risk of cancer is increased and the level by which it is increased depends on the dose of radiation absorbed and the tissues affected.

The Hiroshima and Nagasaki survivors had an increased incidence of cancers until they died.

Of course it is important not to forget the effects on children which are exaggerated because they are growing rapidly and therefore their body cells are dividing more prolifically and are more vulnerable to radiation damage.

The detonation of a so-called 'dirty bomb' in the UK or anywhere in the world would be unimaginably worse than a conventional bomb of the same size because of the morbidity that would inevitably follow.

Perhaps one of the most difficult aspects in such circumstances is knowing whether a bomb is

radioactive. If suitable warnings are broadcast, there are certain procedures which are of benefit.

1. Remove yourself as far from the source of the contamination as possible. Stay indoors and close all windows and doors.
2. Remove as many external radiation particles as possible by removing all clothing and shoes which will eliminate about 90% of the contamination. Washing with soap and water (without scrubbing) will remove further contamination.
3. If you are not ill, stay where you are.
4. If you are ill, it is likely to be difficult to get medical attention in the post-incident period involving any radiation exposure. There are various drugs that can bind to radiation particles in the body and allow the body to eliminate them. Other medication will be required for supportive treatment, such as to fight infections with antibiotics, treat bleeding etc.
5. For people exposed to very high radiation levels, much will involve end-of-life care, keeping them comfortable without sickness or diarrhoea and pain free. Death may be rapid or much slower depending on radiation dosages and type.

Perhaps for some exposed to radiation, the most profound effect might be on mental health.

Not only would the experience be horrific, but friends would die, symptoms would be sporadic and unpredictable and the individual would have to live with the ever present possibility of developing cancer.

It is always good to conclude an article with encouraging news.

In this case it is difficult because information on radiation, whether for business and industry, therapeutic use or for terrorism is very sparse because of the value it has as intelligence and for business competition.

I am sure we are all extremely glad that no 'dirty bomb' has been exploded in the UK and, God willing, our defence and intelligence services will continue to ensure that it doesn't.

I'll raise a glass for MI5.

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