C.U.R.E.

PRESENTS

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Radiation and Health:

Especially Effects on Children

Electromagnetic Spectrum Ionizing Radiation

Class	Wave Length
• Gamma Rays	10E-12 meter
• Hard X-ray	10E-10 to 10E-11 meter
• Soft X-ray	10E-8 to 10E-9 meter
• Ultra Violet	10E-7 meter

Electromagnetic Spectrum Non-Ionizing Radiation

- Visible Light 10E-6 meter
- Near Infrared 10E-5
- Infrared 10E-4 to 10E-3 meter
- Extremely High Frequency/1 10E-2 meter
- Microwave 10E-1 meter
- Ultra/Very High Frequency 10E0 = 1 meter (about 4 yard)
- High Frequency 10E1 to 10E2 = 100 meters
- Low Frequency 10E3, 10E4 to 10E5 (3 km to 100 km)
- Extra Low Frequency 10E6 to 10E7 (1,000 to 10,000 km)

Radioactive Particles

Atoms which periodically release particles or photons from their nuclei which are able to ionize other atoms. Photons are gamma rays. The particles released are called alpha or beta particles.

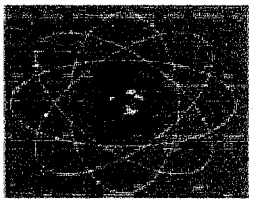
Alpha particle: 2 protons and 2 neutrons

Beta Particle: 1 electron

Ionization

- An atom is said to be ionized when an electron escapes from orbit, leaving two particles: the electron with one negative charge and the rest of the atom with one positive charge.
- These are called positive and negative ions.
- Energy capable to causing an electron to escape is called ionizing.

Atom



Some Radioactive Particles Emitters

- Uranium 238 releases alpha particles;
- Radium 226 releases alpha particles;
- Radon 222 releases alpha particles;
- Plutonium 239 releases alpha particles;
- Cesium 137*releases gamma radiation*;
- Strontium 90 releases beta particle radiation;
- Iodine 131 releases gamma radiation.

Alpha Particles

- A positively charged particle ejected spontaneously from the nuclei;
- It is identical to a helium nucleus that has a mass number of 4 and a charge of +2;
- It has low penetrating power and a short range (centimeters);
- It can be easily stopped by a sheet of paper;
- Alpha particles are hazardous when inside the body.

Beta Particles

- Beta particles have an electrical charge of -1.
- Beta particles have a mass which is about 1/2000 of the mass of a proton or neutron.
- *It is their excess energy, in the form of speed, that causes harm to living cells.*
- When transferred, this energy can break chemical bonds and form ions.

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SEPTEMBER 19, 2007- 6 TO 9 PM

Breaking the DNA

- 8 to 10 eV (electron volts) of energy will break a chemical bond of the DNA
- Medical X-ray is in the range of tens of thousands of electron volts (low KeV)
- Ionizing particles are usually in the hundreds of thousands (high KeV) or millions (MeV) of electron volts.

Decay Products

- When a radioactive particle loses alpha, beta or gamma radiation it is said to DECAY or to undergo transformation.
- The decay product is often also radioactive.

Uranium 238

- Uranium 238 decay products include Radium 226, Radon 222, and radioactive forms of Lead, Bismuth and Polonium
- If uranium 238 receives a neutron, it becomes Uranium 239 which decays to Plutonium 239.

Fission Products

- Uranium 235 (less than 1% of natural uranium), and Plutonium 239 will fission, that is, the atom can be divided into smaller atoms when it is impacted by neutrons. Both are used for nuclear reactors and nuclear weapons after enrichment or reprocessing.
- Fission creates more then 300 different radioactive atoms not natural to Earth.

External Radiation

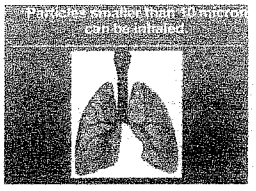
- X-ray machine;
- Radioactive particles in soil;
- Radioactive particles in water;
- Radioactive particles in air;
- Cosmic radiation.

(The body is not contaminated)

Internal Radiation

- Ingesting radioactive contaminated food or water and absorption of it through the gut;
- Inhalation and absorption of radioactive particulates;
- Absorbing radioactive particulates through the skin;
- Absorbing radioactive particulates through open sores or wounds.

Respiratory and Gastro-intestinal System are "Outside" the Body



Radiation Dose

Calculation of dose to human tissue rests on three characteristics:

- The strength of the source;
- The distance from the source; and
- The length of time exposed.

Radiation Measurement of Soil

- This measures primarily the strength of the source.
- Distance between the source and people is also important.
- Whether the source remains outside or moves inside of the body is important (distance changes)
- Length of time exposed is important.

Measurement Units

- One gram is the weight of one cubic centimeter of water.
- One microgram is one millionth of a gram.
- One nanogram is one billionth of a gram or one thousandth of a microgram.

Uranium Ingested or Inhaled

- **Once mined, milled and pulverized, it can be inhaled or ingested.**
- **The human body is normally (today) exposed to uranium in food and water at a rate of about 1.9 micrograms a day,**
- **only about 1 to 2 percent— between 0.019 and 0.038 micrograms (19 to 38 nanograms)—is absorbed through the intestines.**
- **The output in feces is 1.862 to 1.881 micrograms daily.**

U 238 Absorbed from the Intestines

- Goes into the hepatic portal and is transferred to the liver.
- Liver sends most soluble uranium to the kidneys for excretion in urine.
- Some is sent to blood where it circulates and becomes eventually stored in bone.

Uranium Inhaled

- Particles of aerodynamic diameter less than 10 micron can be inhaled;
- There is NO filter in the lungs;
- Particles less than 2.5 micron can migrate into the deep lung.
- They will then either dissolve in lung fluid and pass into the blood or be scavenged into the thoracic lymph nodes.

Internal Contamination

- Once radioactive particles are inside the body they can react chemically and radiologically with tissue;
- It may or may not spread homogeneously in body organs;
- Damage to tissue may or may not be repaired by the body.
- It may reside in the body for long periods.

Radioactive Heavy Metals

- Tend to be removed either by excreting them in urine or storing in bone.
- If small enough to enter the cells, they are removed by glutathione via the gall bladder, in bile released to the intestines.
- Their primary damage is to bone, bone marrow; liver; kidney tubules; or the gall bladder and bile ducts.

Looking for Reversing Damage

- If we can recognize early sign of internal contamination we may be able to remove uranium and other heavy metals from the body.
- Early signs will be much less severe than cancer!
- Early signs of internal contamination show up in blood and urine.

Damage to Bone Marrow

- The stem cells which form the various types of blood cells reside in the bone marrow.
- These stem cells can be damaged or destroyed by ionizing radiation.
- These are biological effects of exposure that pre-date the development of cancer.
- Damage at this point may be reversible.

Radioactive particles in Bone

Children exposed to inhalation or ingestion of radioactive heavy metals (radium 226,thorium 234, uranium 238, or plutonium 239) exhibit:

- Lowered white blood count;
- Lowered monocyte count (type of white blood cell);
- For radium or uranium, lead 210 in urine.

"Best" Cellular Indicator

- Most research has focused on Lymphocytes or Neutrophils (types of white cells) to monitor high doses of radiation from therapy.
- For low doses of radiation, the Monocytes are the best for monitoring damage.
- Note: Monocytes are wiped out at high doses.

Monocyte Stem Cells

- Monocytes are white blood cells which originate in bone marrow stem cells;
- About 400 million monocytes are delivered to our blood daily;
- They can divide outside of the bone marrow and are phagocytic.
- Their life span is several months.

Monocytes

- Are needed for clotting;
- Modulate the production and destruction of red blood cells, white blood cells (neutrophils & lymphocytes) and bone;
- Trigger cellular immune system;
- Their deficit can cause iron deficient anemia since they recycle heme (iron);
- They are highly sensitive to radioactivity.

Healthy Monocyte Counts

- For an individual: 0.20 to 0.80 ($X10^9$) monocytes per cubic millimeter of blood.
- For a group of individuals with normal environment: 0.35 to 0.40 ($X10^9$) monocytes per cubic millimeter of blood.

NOTE: Usually reported as % white cells.

McClure Crescent, Toronto

- Radium from WW II was buried in a residential neighborhood where subsequent low income housing was built.
- Some property had nothing buried, some had surface radioactivity only, and some had surface and sub-surface radioactivity.
- We tested children in the three exposure categories.

Average White Blood Counts

- Normal: 4.300 to 10.800 (per milliliter blood)
- Low Exposed: 7.552
- Medium Exposed: 6.409
- High Exposed: 6.323

Those children borderline normal become below normal when the average drops.

Average Monocyte Count

- Normal Average: 0.35 to 0.40 (per milliliter blood).
- Low Exposure: 0.386
- Medium Exposure: 0.346 (slightly low)
- Higher Exposure: 0.271 (low)

Verification of Monocyte Counts

Three counts were done one week apart for:

24 Children on uncontaminated property;

34 Children on contaminated property;

All children were check for fevers/colds.

Comparison of Monocyte Counts

No. of low Counts	Contaminated (34 children)	Uncontaminated (24 children)
One	15 (44.1%)	8(33.3%)
Two	11(32.4%)	2(8.3%)
Three	2(5.9)	NONE

Comparison of Children's Counts

- Normal Range for Monocyte Counts: 0.2 to 0.8 per milliliter (absolute)
- Total Number of Monocyte Counts:
  Contaminate: 101
  Uncontaminated: 64
- Number of Counts less than 0.2
  Contaminated: 39 (38.6%)
  Uncontaminated: 12 (18.8%)

Marshall Islands

- The first hydrogen bomb, BRAVO, tested in 1954.
- Fallout blanketed Rongelap Atoll.
- Highly exposed were moved out and returned three years later (Brookhaven).
- Government released monocyte counts of the CONTROL POPULATION returned to Rongelap with the exposed population.

US Study in Marshall Islands

Normal average: 0.35 to 0.40/milliliter

Date	Number Averaged	Monocytes
1957-'61	134	0.169/milliliter
1962-'66	158	0.203/milliliter
1982-'86	69	0.329/milliliter

Malaysian Children

Exposed to thorium waste from Asian Rare Earth Corporation in Ipoh, Malaysia by a Japanese Company.

The waste was in plastic bags, thrown outside of the factory.

Children exposed to waste.

Monocyte Counts of Children

Date	Months operation	Number	Monocyte Counts (milliliter)
1987	3 months	60	6 (10.0%) < 0.10
			19 (33.9%) 0.10-0.20
1988	15 months	44	19 (33.9%) <0.10
			12 (27.3%)0.10-0.20

Analysis of Malaysian Children

- 1987: 25/60 or 42% had below normal monocyte counts.
- 1988: 31/44 or 70% had below normal monocyte counts.

Note: We tested other children of comparable socio-economic status exposed to other chemicals as controls.

Problems with Monocyte Counts

New methodology, Coulter Counter, distorts the monocyte count and favors the lymphocyte and neutrophil counts.

Only older experienced laboratory technicians can give a reliable and repeatable hand count.

Using Urine Measurement

- Uranium in bone will decay to radium and radon (slow turnover to blood).
- Radon can escape from bone and enter the blood (decaying to lead 210).
- The lead 210 will be removed in the kidneys and excreted in urine.
- 24 hour urine sample (bled for radon gas), sealed and allowed to stand.

Long Term Testing of Urine

- After one year, if radon reoccurs in the sealed sample then radium was in the child's body (and urine).
- Testing for Lead 210, a decay product of both uranium and radium, and a gamma emitter, indicates internal contamination.

Urine Measurements

Cannonsberg PA (First Superfund Clean-up Site) Radium and Uranium processing (1916)

Home less than 2.5 miles from the dump:
20 children Av. (Pb 210) 0.247 pCi/sample

Home more than 2.5 miles from the dump:
16 children Av. (Pb 210) 0.188 pCi/sample

More Urine Measurements

Resident more than 5 years:
14 Children Av. (Pb 210) 0.320 pCi/sample

Resident les than 5 years:
6 children Av. (Pb 210) 0.078

More Urine Measurements

Eats backyard vegetables and less than 1.5 miles from dump:
9 children Av. (Pb 210) 0.307 pCi/sample

Eats backyard vegetables and more than 1.5 miles from dump:
7 children Av.(Pb 210) 0.087 pCi/sample

Expected contamination with Lead 210

- Control Adult: 0.10 pCi/sample
- Control Child: 0.00 pCi/sample
- Uranium workers: 0.47 – 5.0 pCi/sample Average: 1.16 pCi/sample

OBSERVED

- Low exposed child: 0.17 pCi/sample
- Medium exposed child: 0.40 pCi/sample
- High exposed child: 2.30 pCi/sample

Problems with Urine Testing

- Not easy to collect a 24 hour sample!
- Takes more than a year to get measurements.
- Too slow for most applications.

Clinical Signs in Children

- Depleted monocytes can cause iron deficient anemia.
- Monocytes recycle about 37% of the heme (iron) from dead red blood cells into new red blood cells.
- Iron deficient anemia could also be caused by internal bleeding or iron deficient diet.

Clinical signs in Adults

- Based on a study at the Hannan Chuo Hospital, Osaka, Japan. 1,233 atomic bomb survivors, average age 60 years.
- 554 males and 678 females.
- Compared with "The Basic National Life Survey", Japanese Ministry of Health data.

% Muscles & Joint Pains Above General Public

Symptoms	High Exposure	Low Exposure
Lumbago	30.0	23.0
Arthralgia of Extremities	24.5	18.5

Possible Reproductive Problems

- Molar pregnancy;
- Spontaneous abortion or in utero death;
- Still birth;
- Downs syndrome child;
- Congenital malformations and diseases;
- Childhood cancer.

What Can You Do?

- The body has two storage places: bone (for heavy metals) and fatty tissue (for fat soluble chemicals).
- DISTILLED WATER will pull heavy metals out of storage. (Three months for young children, about one year for adults).
- Radium can be stored in breast tissue (animal studies) and cause breast cancer.

Example at Mississauga

Children between the ages of 3 and 7 years, started using distilled water January '92

January 1992: 5 with low monocytes
4 probable iron deficient anemia

April 1992: 5 with low monocytes
1 probable iron deficient anemia

Sept. 1992: 4 with low monocytes

Dec. 1992: No problems

Excerpt from:
HEALTH PROFILE of AREA CHILDREN/Health 2000
Toronto, Ontario Canada
Citizens Group- (PACT)
Pickering-Ajax Citizens Together For The Environment

It is my position and that of many other health professionals that the burden of proof for environmenta! health should not rest on the victims but on government and the polluters. PACT has walked the extra mile and provided compelling evidence of both present harm and deteriorating health trends in the vicinity of the Brock West Municipal Landfill. It is only just that the burden of proving that this landfill is "safe and acceptable" now shift to the Province of Ontario. The Principle of Prudent Avoidance would dictate an immediate cessation of activity at the landfill until the question of harm is settled.
Rosalie BerteH, PhD, GNSH
International Institute of Concern for Public Health

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