

Treatment for Internal Contamination

REAC/TS

Oak Ridge Institute for Science and Education

OBJECTIVES

- Discuss the body's mechanisms for the internalization of radionuclides.
- Discuss the procedures for treatment of internal contamination and methods for assessing the efficacy of that treatment.

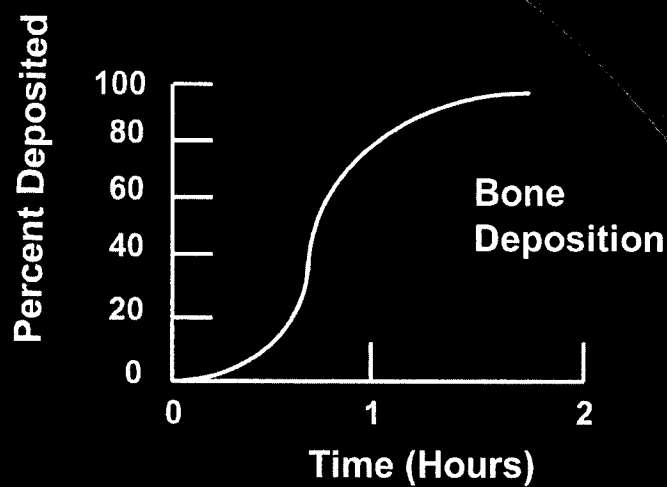
Definition of Internal Contamination

- The deposition of radioactive material inside the body.

Common Routes of Entry

- Inhalation
- Ingestion
- Absorption through wounds or skin
- Injection

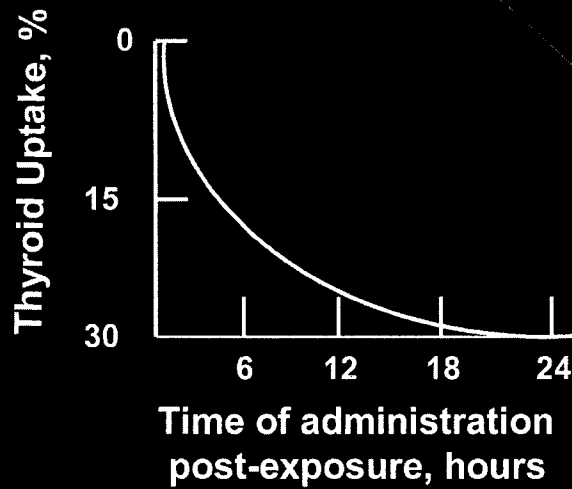
Uptake of Actinides is Remarkably Rapid



Prompt DTPA Treatment of ^{239}Pu Intake is Highly Effective

	Control	Retention (% of Uptake)
Liver	14.0	0.47
Skeleton	57.0	5.9

Prompt KI Treatment of ^{131}I Intake is Highly Effective



Immediate Diagnosis

- Nasal swipes
- Nasal blows
- Sputum
- When all else fails - get a good history!

Diagnosis: Bioassay of Limited Value

1. Slow
2. Must have total collection of both urine and feces
3. May overestimate uptake by factor of 3-5
4. Specimen may get contaminated

Diagnosis: Whole Body Counting Difficult When Actinides Involved

- Residual skin contamination
- Calibration of phantoms difficult
- Lung distribution varies with time
- Variable thickness of chest wall

Clearance Time - Nasopharynx

Time in Minutes
to Swallowing

Anterior Nares

60

Nasopharynx

10 (10 mm/min)

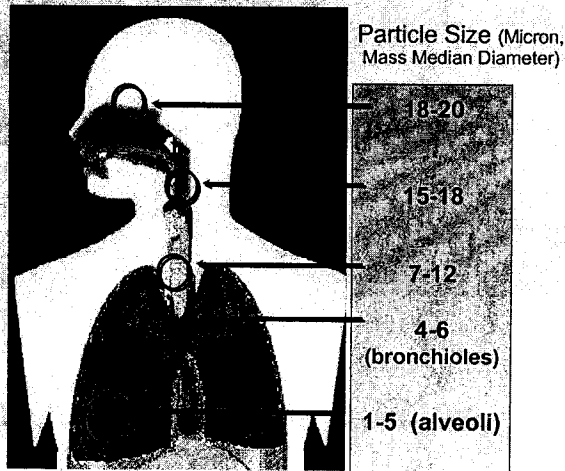
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Clearance Time of Respiratory Tract

	Hours
Trachea	.1
Bronchi	1.0
Bronchioles	4.0
Terminal Bronchioles	10.0
Alveoli	100.0 Days+

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Particle Size Distribution in the Respiratory Tree



Clearance Time of Gastrointestinal Tract

	Occupancy Time (Hours)
Stomach	6
Small Intestine	14
Upper Large Intestine	18
Lower Large Intestine	22

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Absorption of Ingested Radionuclides

GROUP	RADIOACTIVE ELEMENTS OF	%ABSORBED
Alkali Metals	Na, K, Rb, Cs	High ~90
Group VIII Metals	Fe Co Ru	10 30-90 3

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Absorption of Ingested Radionuclides

GROUP	ELEMENTS	%ABSORBED
Lanthanides	^{144}Ce , ^{147}Pm , ^{156}Eu , ^{160}Tb	<0.1
Actinides	^{228}Th , ^{235}U , ^{237}Np , ^{239}Pu	<0.1

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Reduction of Absorption From Gastrointestinal Tract

1. Antacid
2. Precipitation into insoluble salt
3. Catharsis

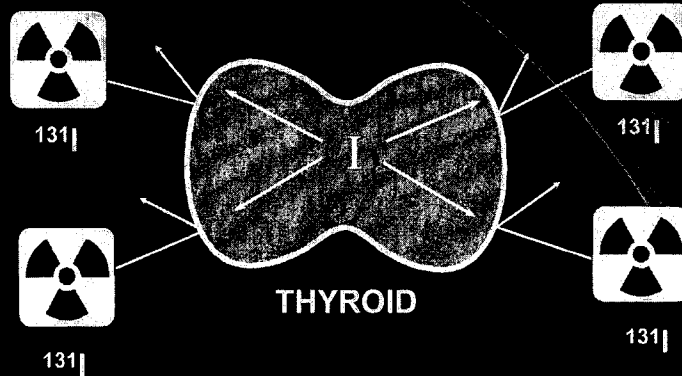
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Prussian Blue is Highly Effective in Rx of Cesium or Thallium Uptake

- Binds ions in gut
- Reduces biological half life to one third of untreated value
- Not absorbed
- Reduces recycling
- Complete IND information available at www.orau.gov/reacts/resources.htm

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Saturate the Critical Organ with the Stable Isotope



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FDA Recommendations for Potassium Iodide

- A daily dose of:
 - 16 mg of KI for infants <1 month
 - 32 mg of KI for children 1 month to 3 years
 - 65 mg of KI for children and teenagers 3 years to 18 years
 - 130 mg of KI for adults including pregnant and lactating women and adolescents over 150 pounds
- Daily dosing should continue until the risk of exposure has passed and/or until other measures (evacuation, sheltering, control of the food and milk supply) have been successfully implemented

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Isotopically Dilute

BEER



TRITIUM

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Displace

**USE CALCIUM TO COMPETE WITH
RADIOSTRONTIUM**

**USE STABLE IODIDE TO COMPETE
WITH RADIOTECHNETIUM**

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Chelate

- **DTPA - Diethylenetriaminepentaacetic
Acid**
- **EDTA - Versene**
- **BAL - Dimercaprol**
- **DFOA - Deferoxamine**
- **PCA - Penicillamine**

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How to Administer DTPA

- IV injection of DTPA (1 gm/4ml) with 6 ml saline over 5-10 minutes.
- IV Piggyback (1 gm DTPA in 100ml saline) over 20 minutes.
- Aerosol: 1 gram undiluted via hand-held nebulizer; inhalation takes 10-15 minutes.
- IM injection (painful)
- Complete IND information available at www.orau.gov/reacts/resources.htm

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Common Medications that have Chelating Effects

- Anti-Inflammatory Drugs
 - Salicylates
 - Indocin
 - Aminopyrine
 - Tylenol
 - Butazolidin Group
- Steroids
 - Cortisone, Hydrocortisone, etc.
- Psychic Drugs
 - Chlorpromazine
 - Dilantin

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Common Medications that have Chelating Effects (cont.)

• Antimicrobial Drugs that Chelate

– p-Aminosalicylic Acid	Fe, Cu
– Bacitracin	Zn
– Isoniazid	Fe, Cu, Mn, Co
– Kanamycin	Ca
– Neomycin	Fe, Al
– Novobiocin	Mg
– Penicillin	Co
– Polymyxin	Mg, Mn, Ca, Fe
– Streptomycin	Mn
– Tetracycline	Fe, Mg, Mn, Mo, Al, Ca

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Uranium

PROBLEM: Chemical toxicity to kidney

TREATMENT:

- Sodium bicarbonate to alkalinize urine
- Oral dosage:
 - Adults:* Initially, 4 g PO then 1-2 g every 4 hours. Titrate dosage based on urinary pH.
 - Children:* 1-10 mEq/kg/day (84-840 mg/kg/day) PO, given in divided doses every 4-6 hours. Titrate dosage based on urinary pH.
- May need renal dialysis until renal recovery from injury.

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Keep the Patient Busy!

- Cabbage for ^{131}I , ^{99}Mo , ^{75}Se
- Eggs for ^{59}Fe
- Soybean flour for ^{65}Zn , ^{59}Fe
- Stop Vitamin C for ^{59}Fe

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Common Drugs Useful

- Hygroton ^{86}Ru
- Phosphajel ^{85}Sr , ^{90}Sr
- Gaviscon ^{85}Sr , ^{90}Sr
- Neutraphos ^{32}P

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