



## Acute Radiation Injury: Local



## Acute Partial Body Exposure

- In many cases, one portion of the body receives a much higher dose than the rest of the body
- Severe injury to skin and underlying tissues may occur
- Diagnosis is difficult; initial presentation is often misleading
- ARS may or may not be present

## Diagnosis

- History
- Signs and symptoms
- Verify local versus whole body exposure
- Accident mock-up is helpful in dosimetry

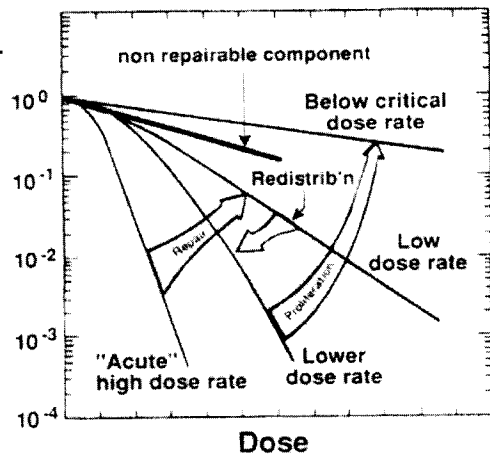
Note: During initial assessment, take photographs and obtain baseline information on involved area (ex. slit lamp exam for facial exposure).

## Common Sources Inducing Radiation Injury

- Radiography sources, e.g.,  $^{192}\text{Ir}$
- Therapy/irradiation sources, e.g.,  $^{60}\text{Co}$
- Fission product betas, e.g., Chernobyl
- Medical applicators, e.g.,  $^{90}\text{Sr}$
- X-ray machines
- X-ray diffraction units
- X-ray fluorescence units
- Accelerators

## Approximate Surface Dose from Common Gamma Emitters

- $^{60}\text{Co}$  – 3100 rad/min/Ci (0.84 Sv/min-GBq)
- $^{137}\text{Cs}$  – 770 rad/min/Ci (0.21 Sv/min-GBq)
- $^{192}\text{Ir}$  – 1200 rad/min/Ci (0.32 Sv/min-GBq)
- $^{226}\text{Ra}$  – 1900 rad/min/Ci (0.51 Sv/min-GBq)

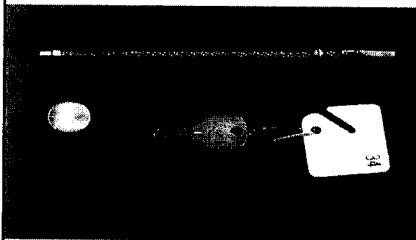


Radiobiology Text/Hall

## External Dose Thresholds for Skin

- 300 cGy – epilation beginning around day 17
- 600 cGy threshold – erythema; distinguish from thermal burn; minutes to weeks post-exposure, depending on dose
- 1,000 – 1,500 cGy – dry desquamation
- 2,000 – 5,000 cGy – wet desquamation, 2-3 weeks post-exposure, depending upon dose
- >>5,000 cGy – radionecrosis, deep ulceration

## Radiography Dose Rates



Consider a 5 Ci  $^{192}\text{Ir}$  radiography source at contact.  
(1200rad/min/Ci)

Surface dose = 6,000 rad/min

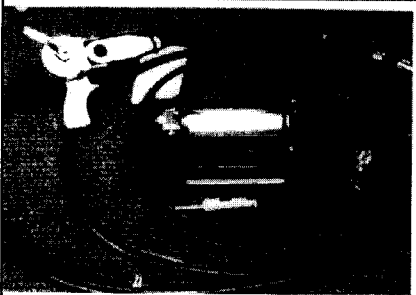
at 1 cm - dose rate = 400 rad/min

at 2 cm - dose rate = 100 rad/min

at 3 cm - dose rate = 45 rad/min

at 4 cm - dose rate = 25 rad/min

at 5 cm - dose rate = 16 rad/min



D+10. Extended superficial erosion (Mar 1,1999).  
 D+15 Genital herpes eruption (Mar 6,1999). Zinnet 500mg tid &  
 Acyclovir tid. Cipro stopped.



Absorbed doses in Gy  
 Normalized to 30 Gy at the rim of the lesion (radius = 5 cm)

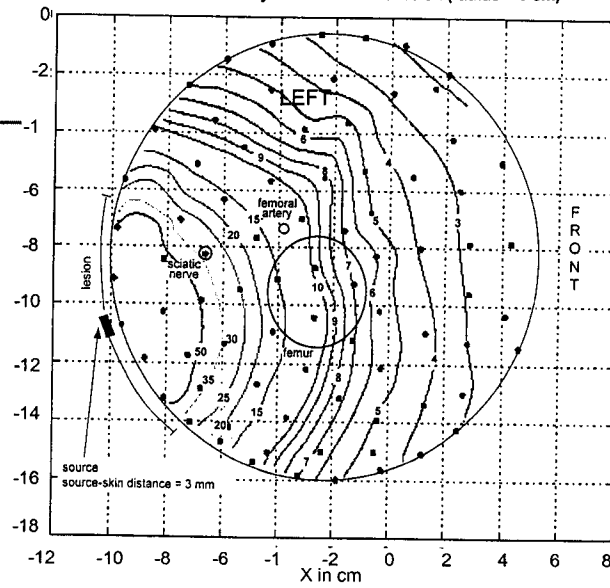
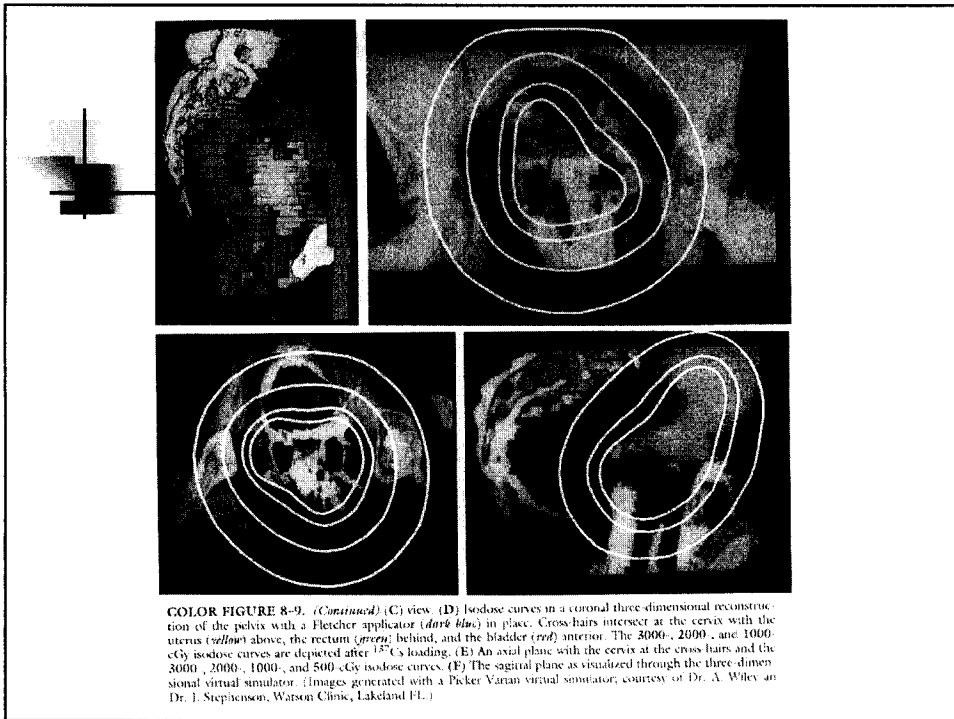
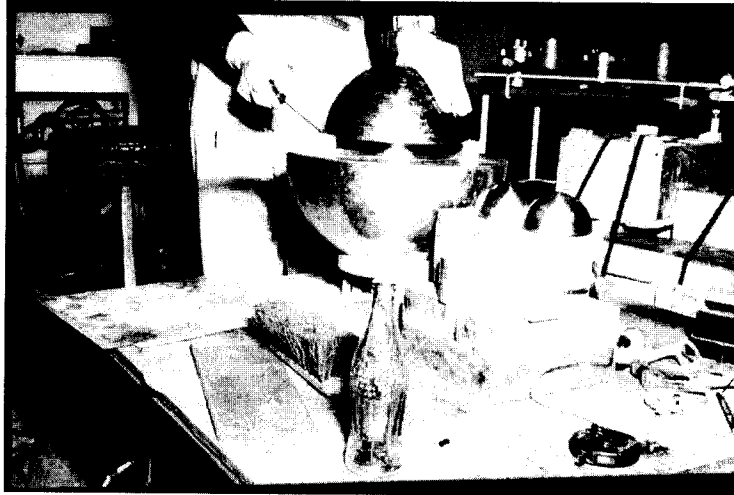


Figure 4 - Absorbed dose distribution for horizontal cross-section at source level  
 With source-skin distance of 3 mm





# 1946 Los Alamos – Criticality Accident



CASE 1. DORSAL VIEW OF HANDS  
3 1/2 DAYS AFTER EXPOSURE

FIG. 3  
CASE 1. DORSAL VIEW OF RIGHT  
HAND 7 DAYS AFTER EXPOSURE

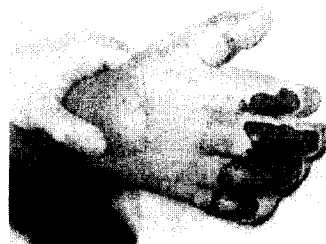


FIG. 4  
CASE 1. DORSAL VIEW OF RIGHT  
HAND ON DAY BEFORE DEATH

## Effects on the Vascular Endothelium

- Endothelial cells swell, pull-up or detach from basement membrane.
- Edema occurs as leaks in denuded areas of microvasculature allow extravasation of fluids and cells.
- Platelets fill in areas of denuded basement membrane and microthrombi form.

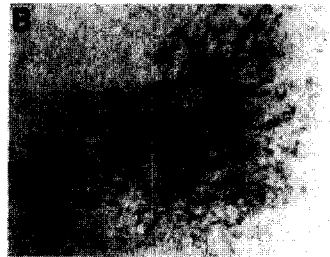
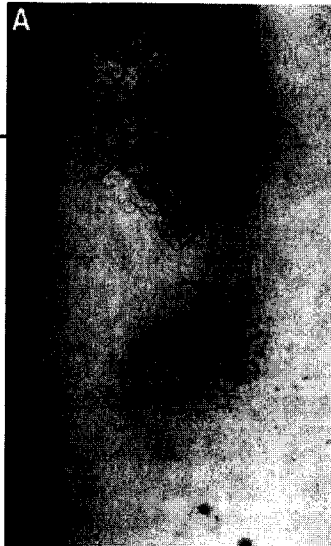
## Criticality Accident - Japan

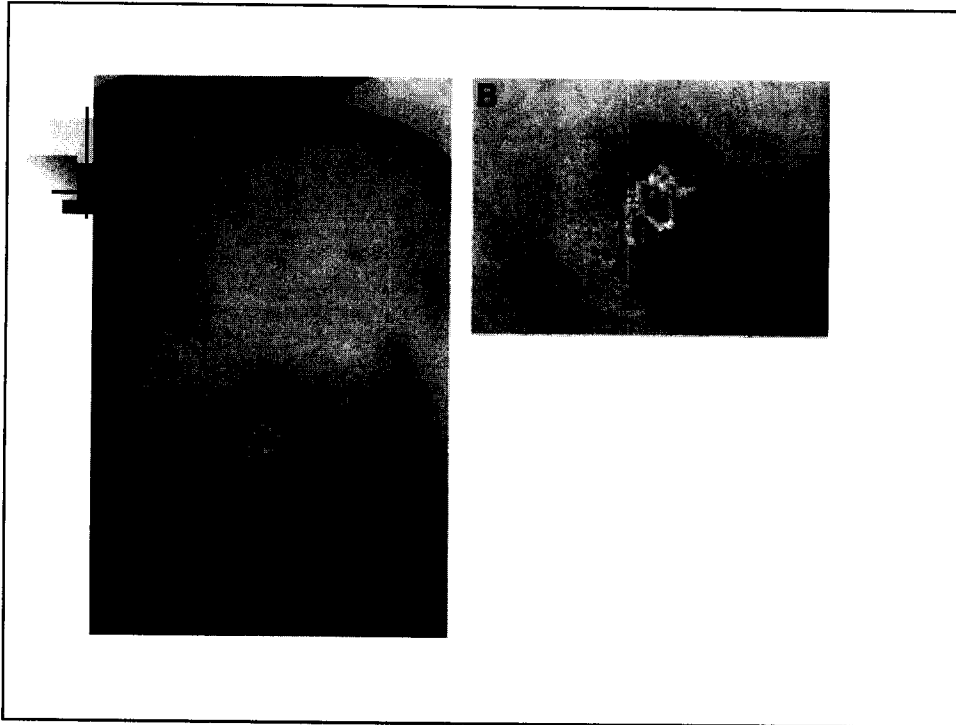


## Cutaneous Syndrome



Color Photo C-1. ARS with Cutaneous Syndrome: A case of beta-gamma exposure (Chernobyl accident) with injury of 50% of the skin surface.





## Acute Local Radiation Injury: Evaluation and Diagnosis

- History
- Laboratory tests
  - hematological profile; ESR; thermography
- Physical exam
- Radiographic studies as indicated
- Slit lamp ophthalmoscopy
- Serial color photos



## Management

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- Recommendation: consult with experts!
- Protect area
- Avoid nicotine
- Assure nutritional requirements
- Prevent/treat infections
- Cover to control pain
- Consider new techniques in wound management



## Problems in Management

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- Wounds evolve slowly
- Healing is very prolonged
- Lesions can be intensely painful
- Dosimetry is frequently imprecise
- Healed epidermis is fragile and easily traumatized

## Radiation Repair Process in Skin

- Effectiveness of the repair process depends on:
  - severity of injury to the epidermal precursor or stem cells
  - adequacy of the microvasculature
  - structural support of the damaged dermis
  - avoidance of infection and trauma
- The epidermis is renewed by the proliferation of epithelium at the edges of denuded areas, from islands of surviving cells in the damaged zone, and from epithelium of the hair follicles.

## Some New Techniques in Wound Management

- Artificial skin (bi-layered)
- Bioengineered skin (epidermal/dermal constructs)
- Pharmaceutical agents
- Growth factors for topical administration