

Ionising radiation and skin lesions

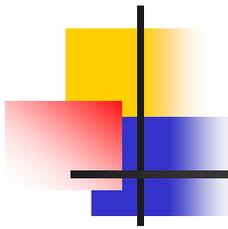
WORKSHOP RADIOBIOLOGY

17/06/2004

Dr. I. Boesman

Occupational Health

IKMO External Service for Prevention and Protection at Work



Ionising radiation injuries

A real concern?

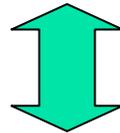
Turai I. , BMJ 328, March 2004:*

‘Events that expose people to radiation are rare, but the threat of radiation injury is increasing. Doctors should know how to recognize and manage suspected exposure or contamination’

** Medical officer, Department of Protection of the Human Environment, WHO*

Health effects induced by ionising radiation

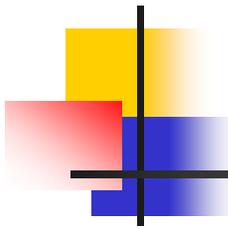
Stochastic effects



Deterministic effects

Skin injuries: deterministic!

- threshold
- severity of effect increases with dose



Health effects induced by ionising radiation

Deterministic effects (actually mostly due to accidents – industrial or medical):

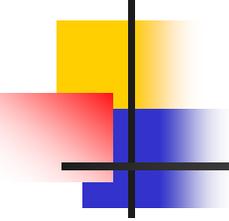
- **radiation sickness**

 - whole body (or a large part) exposure to high doses of ionising radiation

- **radiation (skin) injury**

 - exposure of a small part of the body (skin) to high doses of ionising radiation

→ presentation of an accidental case

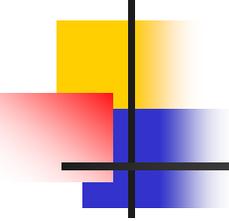


Case: dose estimation?

Result filmbadge dosimeter: doubtful!!!

→ Biological dose estimation

1. Blood cell count (lymphocytes)
2. Cytogenetic examination (*H. Thierens, UG*)
 - 2.a. metafase analysis (dicentric chromosomes)
 - 2.b. micronucleustest
3. Clinical signs: skin lesions



Biological dosimetry

Clinical: skin lesions

Reconstruction:

> 1-3 week(s): localised erythema
(back, abdomen)

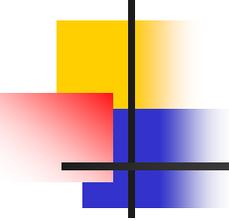
>> later: blisters, wet desquamation

>>> later: ulceration (+ infection) back

Therapy:

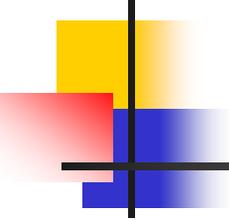
- surgery?

- conservative (wound care)



Radiation accidents: statistics

- Publications IAEA (www.iaea.org)
- Turai e.a., BMJ, 2004:
 - Between 1944 and 2002:
 - 420 incidents worldwide
 - 134 deaths (28 deaths Chernobyl 1986)
 - 50% radiations incidents in industry (NDC)
 - 10% medical incidents (diagnose/therapy)
 - 50% of fatal exposures due to calibration errors in medical equipment or because of insecure storage of spent sources for radiotherapy



Radiation induced skin lesions

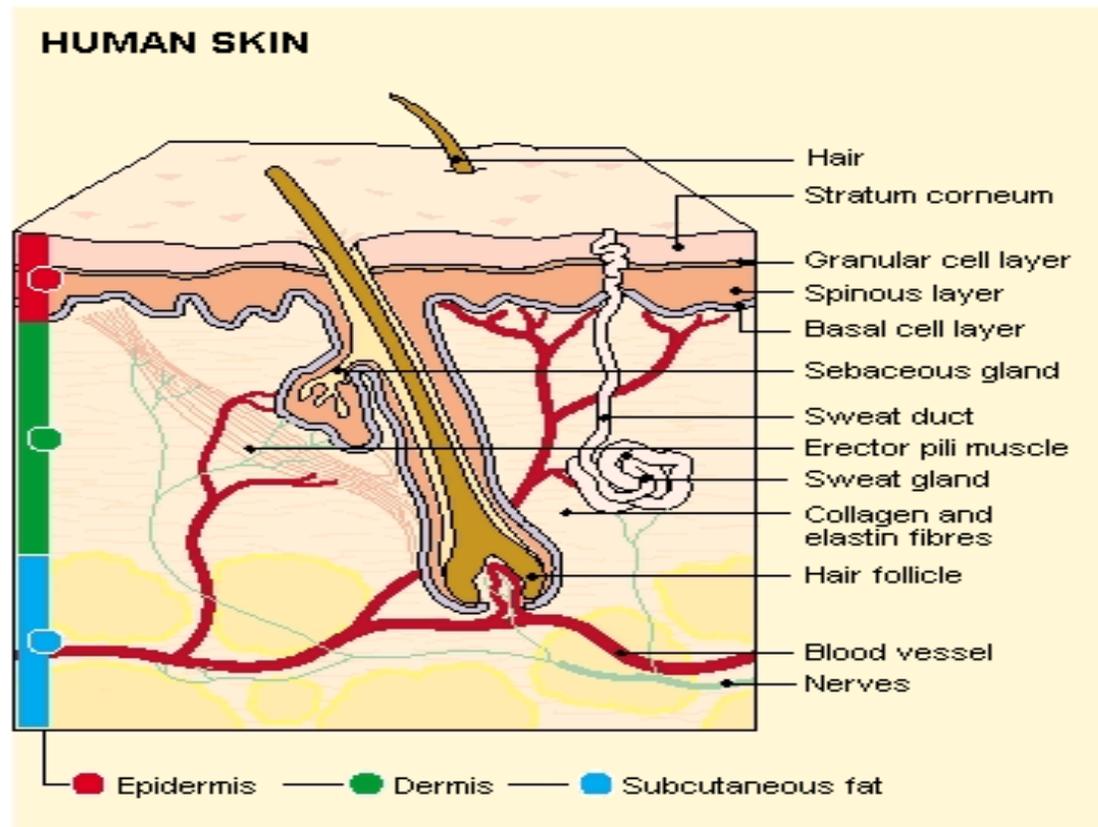
Radiodermatitis

Radiation dermatitis

Cutaneous radiation syndrome

- Acute
- Chronic
- Late stage/long term risks

The normal skin



More sensitive to radiation: keratocytes, hair follicles, sebaceous glands
More resistant: sweat glands, connective tissue

Acute radiation dermatitis

(single exposure RX, γ ; β contamination)

> 2 à 3 Gy	Epilation (temp.; def > 7 à 10 Gy)
> 3 Gy	Erythema (\geq 1 week) Heals with (dry) desquamation and hyperpigmentation
> 10 à 20 Gy	Erythema, oedema, large painful blisters, wet desquamation, ulceration (weeks–months), radionecrosis. Heals slowly with atrophy, telangiectasia, irregular pigmentation Some lesions may never completely heal \rightarrow chronic stage

Acute radiation dermatitis

6,5 h. local exposure to Iridium-192 source



day 2: early blister, erythema



day 9: extended erosion, inflammation

Turai e.a., BMJ 2004, 328: 568-572

Acute radiation dermatitis

Accidental overexposure X-ray diffractiometer



Fig. 2



Fig. 3



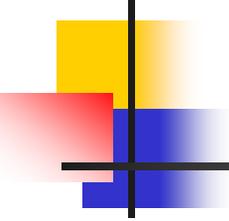
Fig. 4



Fig. 5

Evolução do paciente

Valverde NJ Rev. Assoc. Med. Bras., 2000; 46:81-7



Chronic radiation dermatitis

■ Occurrence:

- In de past: radiologists and radiations technicians whose hands were constantly exposed
- Today: rarely? Can reappear!
 - patients with multiple cardiac catheterisations
 - professional overexposure of the hands of interventional radiologists

Chronic radiation dermatitis

After multiple coronary angiography and angioplasty procedures



> 6-8 weeks
redness, peeling



16-18 weeks
Small ulcerated area



18-21 month
Tissue necrosis

Shope T. Radiation-induced skin injuries from fluoroscopy. FDA/CDRH, 1995

Chronic radiation dermatitis

Professional overexposure: interventional RX

Artignan e.a., Arch. mal. prof. 2003, case study: chronic radiodermatitis on the hands of an interventional radiologist

Estimated cumulative skin dose > 10 Gy (20 y) = > 500 mSv/y

Observations:

- nail abnormalities (grooves in nails of thumb & index)
- hyperkeratotic lesions around the nails
- cyclic keratosis – ulcerations – keratosis - desquamation
- capillary microscopy: specific abnormalities of the cutaneous capillary network of the nailfold region

Chronic radiation dermatitis

Features

- Months to years after initial dose of radiation
- Skin atrophy, telangiectasia, hypo- and hyperpigmentation (poikiloderma)
- Hyperkeratosis, desquamation
- Chronic post-radiation ulcers

Chronic radiation dermatitis

Features



Shane Chapman M. Medscape Dermatology 2(2), 2001

Chronic radiation dermatitis

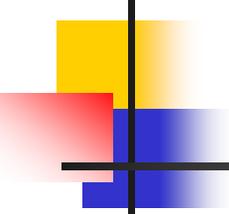
Post-radiation ulcer



Lopez A. e.a. *Wounds* 10(4) 1998: 132-135

Radiation dermatitis

long term risks

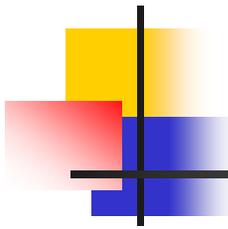


Chernobyl experience: Steinert M, 2003:

Reassessment of 99 long term survivors from 237 most exposed individuals

- 22/99 patients: radiation induced cutaneous lesions
 - 22/22: epidermal atrophy, telangiectases, pigment alterations
 - 14/22: keratotic lesions
 - 8/22: cutaneous fibrosis
 - 5/22: radiation ulcer
 - 1/22: 2 basal cell carcinoma

Steinert M e.a. J Am Acad Dermatol. 2003; 49:417-23



Radiation dermatitis

Long term risks

Long term risk: skin cancer!

IARC Monographs, vol 75, 2000

'X-radiation and γ -radiation:
carcinogenic to humans (Group 1)'

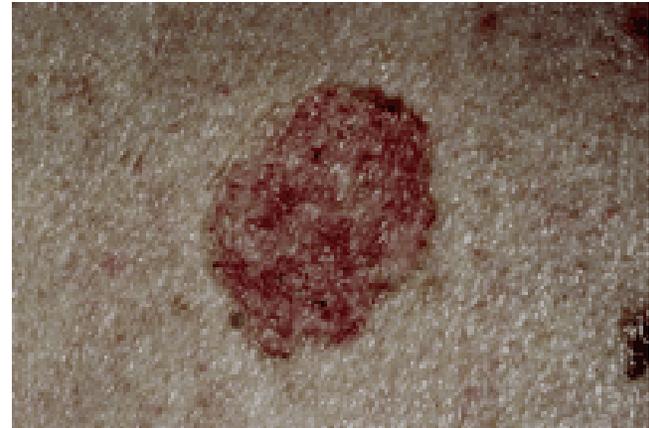
- Squamous cell carcinoma
- Basal cell carcinoma

- Long-term follow-up of skin lesions is necessary!

Radiation dermatitis

Long term risks

- Basal cell carcinoma



Wong C e.a. Basal cell carcinoma.
Clinical review. *BMJ* 2003; 327:794-798

Radiation dermatitis

Long term risks

- Squamous cell carcinoma



Rinker M. e.a Cancer Control 2001; 8(4): 354-363

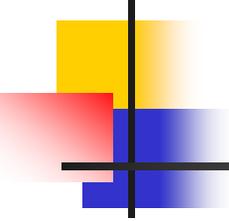
Radiation dermatitis

Long term risks

- Squamous cell carcinoma



Ratner D. SKINmed 2003; 2(4):251-252



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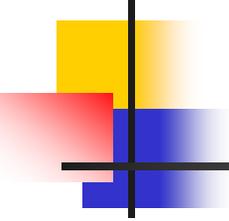
A real concern?

Turai e.a. BMJ 328, march 2004: Medical response to radiation incidents and radionuclear threats.

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→ **Prevention is better dan healing!**
Especially for ‘preventable’ professional applications!

References



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