Accidental exposure, clinical effects and their treatment

RPR 2002
Accident scenario?

- Industrial accident (source)?
  - Workers
  - Population
- Terrorism?
- War?
Tissue effects.

- Cells are killed
  Most tissues are not affected by some level of cell loss.
  If the loss is large, the function will be affected.
  A threshold exists: a minimal number of cell must be eliminated before and effect is observed.

- Cells are mutated
  Genetic effects or cancer induction
  Frequency increases with dose;
  There is no threshold;
  Severity does not depend on dose.
Example of a deterministic effect: lung fibrosis.
Second cancer

- To be treated like any other cancer.
- Except that:
  - Tissues already irradiated.
  - Surgery might be difficult.
  - Overall prognosis equal or less…
Acute tissue effects

- Infrequent in radioprotection.
- Always linked to a severe accident.
- Usually linked to a partial irradiation (except bone marrow).

- Peau : 15 Sv
- Moelle : 2,5-5 Sv
- Intestin : 5-12 Sv
- SNC : 100 Sv
Accidents

San Salvador, blocage source irradiateur industriel

Vol de source Co-60 en Thaïlande : 3 morts

Accident France linac industriel
• Risk = dose/time relationship.
• 4-5 Sv in a single acute exposure may be sufficient.
• Up to 20 Sv can be tolerated in protracted exposure (over years).
CNS syndrom

- In case of an accidental acute exposure of 100 Sv.
- Fast deterioration of consciousness (a few h), forecasted by nausea, vomiting, and intense fatigue.
- Very seldom… (you see some in
Supposes an accidental exposure of at least 10 Sv.
The victim may survive if part of the bowel was shielded.
Diarrhea, blood loss and vomiting first, soon followed by septicemia.
Hemopoietic syndrom

- From 2.5 Sv.
- The victim may survive if part of the bone marrow was shielded.
- First haemorrhages, followed by infection
- Bone marrow transplant is the treatment.
Internal contamination

- Iodine 131 in nuclear catastrophe...
Prophylaxy of iodine contamination

- Iodine accumulates quickly in the thyroid (a few hours), by inhalation or by ingestion of contaminated food.
- Stable iodine delivered according to « action levels ».
- Should be available beforehand.
Biological dosimetry?

- Usually an accident is not foreseen…
- Therefore the reconstruction of the conditions prevailing is not easy.
- Also, the actors do not always cooperate…
Dealing with an accident

After a few minutes:
- Chock, desorientation, convulsion...
  - If yes, very high dose
  - If no, low dose < 1 Gy

After 1-3 hours:
- Nausea & vomiting modification of blood cells
  - If no, low dose < 1 Gy

After 3 days:
- Lymphocyte dive < 300 granulocytes drop
  - If no, < 1-2.5 Gy

After 4-6 days:
- Granulocytes drop, platelets drop, diarrhea
  - If yes, BMT?
Accident Sterigenics 11 mars 2006

- Déclaré le 31 mars à l’AFCN!
- Un opérateur est entré dans la cellule d’irradiation pendant environ 20 sec. Par la suite, des nausées et une perte de cheveux l’amènent à consulter le médecin du travail 3 sem plus tard.
- La dose serait de 4,4 à 4,8 Gy.
Analyse sanguine
Accident infraclinique
Induction of chromosomal aberrations

% dicentric

25
20
15
10
5
0

0.5
1
2
dose (Gy)