Treatment of Actinide-Contaminated Injection Injuries

A consensus approach to protocol revision

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REFERENCES

- **Guidelines for Treatment of Radiation Accidents**, August 2004, LANL, LLNL
  - Pgs 1-4, 6-7
- **Some Considerations for Developing Criteria for Decorporation therapy of Intakes of Radionuclides**, Raymond A. Guilmitte, PhD, Team Leader, Internal Dosimeter, LANL
- **IAEA Publication 119, Handling of Radiation Accidents**, IAEA, 1969

Goals and Objectives: Developing a Protocol for Treatment of Radiation Accidents

- Goal: Prevent the uptake of radioactive materials by the body and/or enhance the excretion of radioactive materials, thereby reducing retention time and dose received.
- Objective: Develop a treatment protocol that could be adapted to all DOE facilities and provide guidance to medical staff.

Goals and Objectives: Developing a Protocol for Treatment of Radiation Accidents (cont'd)

- Intent: The intent of medical intervention is to minimize risk associated with possible radiation doses.

Summary of Guidelines

1. Method intervention shall be considered if, based on early information, it appears that the committed effective dose equivalent (CEDE) from the intake may exceed ***5 rem***.
2. Administration of chelating agents shall be considered if, based on early information, it appears that the CEDE from the intake may exceed ***5 rem***.

Summary of Guidelines

3. Excision of contaminated tissue shall be *considered* if, based on early information, the total plutonium or transuranic activity in the wound is greater than ***1 nCi***.

Assumptions underlying medical intervention of an actinide-contaminated injection injury

- Significant internal intakes are unplanned events.
- The are great uncertainties associated with the early estimates of dose.
- Risks associated with most medical interventions are minimal.

Assumptions underlying medical intervention (cont'd)

- The decision to use medical intervention shall be a joint decision between the patient and the Occupational Medicine (OM) Physician.
- Internal dosimetry is responsible for providing guidance to both the patient and to the OM physician to assist them in making this decision.

Criteria for medical intervention of an actinide-contaminated injection injury

- Strong suspicion of internal contamination
  - Good history plus injection injury
- Dosimetry evidence of significant internal contamination
- Early dose estimates often low, inaccurate & confusing!

Dose criteria for decision to treat: confounding elements

- Mass casualty (higher threshold to treat) vs limited (few people) incident (ALARA - lower threshold)
- nCi vs. REM vs. DPM
  - Need good HP help to assess (for most of us)
- Difficulty assessing alpha emitters
  - Need good HP help to assess (for most of us)
  - Tissue attenuation

Decision to treat: actinide injection injury limited to a few people

- Remember: Dose reading may represent minimum dose (because of tissue attenuation, incomplete calculations, other factors)!
  - Senior, experienced HP should assist physician in accessing contamination and making final decision to treat
- Final decision, however, is physician's.

Decision to treat: actinide injection injury limited to a few people

Consensus criteria

- >1 ALI (5 rem)- decon, chelation, excise, *
- <1 rem (.2 ALI)-decon; chelation dependent upon HP assessment and doctor/patient relationship, plus principles of ALARA.
  - 1 rem may represent only superficial/shallow dose with more nuclide deeper that does not register on regular survey instruments or even wound counters

** Mass casualty: decision to treat >5 ALI (25 rem)*

Treatment Modalities: internal actinide contamination of injection injuries

1. Irrigation of wound
2. Chelation Therapy: Ca- & Zn-DTPA*
   - Contraindicated for U and Np
   - Treat within first 6 hours
3. Excision of Contaminated Tissue

Treatment Modalities: risks

1. Irrigation of wound: depends on irrigant and vigor of treatment
2. Chelation (Ca- & Zn DTPA) therapy: risks
   - Good safety record. However, small total number of cases and administrations
   - NDA approved because of animal studies, DOE REAC/TS registry, and national security considerations

Treatment Modalities: risks

2. Chelation (Ca- & Zn DTPA) therapy:
   - Contra-indicated in pregnant women
     - May be fetotoxic
   - Pregnancy test if must give to women
   - Very high doses of DTPA have caused liver, kidney trouble in animals
   - Mass casualty event?

Treatment Modalities: risks

3. Excision
   - Risks of excision depend greatly upon the site of the wound and the nature and quantity of tissue involved
   - Most excisions involve small amounts of tissue
   - Consider excision if total Pu or transuranic is greater than **1 nCi**?
   - Chelate before start excision

Treatment of an Actinide Injection Injury

1. Irrigation of site with various fluids
   - water
   - Soap and water
   - Other solutions
2. Chelation: Ca- vs. Zn-DTPA
   - Who, what and when
3. Exploration/excision of contaminated area
   - Criteria?

Treatment of an Actinide Injection Injury

- Chemical characteristic of actinide often not definitely known within 6 hour “sweet” period
- Dose often not definitely known within first 24 hours. Final dose assessment often take days.
  - May require urine biodosimetry and body scan to determine effective dose

Treatment of an Actinide Injection Injury

So when do you treat?

- **Treat if what you know suggests significant internal contamination through injection**
- **When in doubt, treat with 1 dose Ca-DTPA and await further information**
- **Treat if patient under 45 yrs old**

When to Treat

- So when do you treat injection injuries contaminated with an actinide?
  - ASAP, but within 6 hours of the incident, if possible
  - Controversy: chelate before or after excision?

IAEA, NCRP: chelate as soon as possible

How to Treat

- Chelate asap: Ca- & Zn-DTPA for
  - FDA NDA (New Drug Application) Pu, Am, Cm
  - FDA IND (Investigational Drug), Pu, Am, Cm, Cf, Es, Th, many of Lanthanide series, Y.
  - Do not use DTPA to chelate U or Np
- Excise:
  - surgical experience helpful

How to Treat

- EFCOG-OM facilities:
  - both Ca- and Zn-DTPA is IND (investigational) product, therefore
  - Need informed consent form signed by patient
  - Need DTPA registry consent form signed by patient.

How to Treat

- **Give Ca-DTPA as first dose**.
  - Give Ca-DTPA within first 24 hours, preferably within first 6 hours following internal contamination, (stronger chelator), followed by Zn-DTPA on subsequent days, as needed.
  - (after first 24 hours, Ca- & Zn-DTPA have about the same efficacy)

Caveats

- **Do not give Ca-DTPA to pregnant women!**
- **Do not give more than 1 gm per day!**
- **Do not split doses or infuse DTPA!**
- If DTPA is used for irrigation of wound, still give 1 gm Ca-DTPA as initial dose.
- Children?

Administration of DTPA

NDA product:

- Inhalation
- IV infusion (mixed with water or saline over 20 minutes
- Slow IV push (5 minutes)

IND product

- As above, plus IM (with numbing agent, such as xylocaine

? ? ? QUESTIONS ? ? ?