Management of Depleted Uranium Casualties

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Depleted Uranium

- Introduction to Depleted Uranium (DU)
- Radiological Effects of DU
- Toxicological Effects of DU
- DU Casualty Management Policy
- DU Bioassay Policy
- Risk Management of DU Wounded Patients
- References
Depleted Uranium-Not New Substance

- Chemically same as natural uranium, 40% less radioactive
  - Internalize natural uranium
  - Eat, drink, breathe it daily
- One of many substances found in everyday life and on the battlefield
Properties of Depleted Uranium

- Toxicological - primary concern
  - Heavy metal like lead, tungsten and nickel
  - Kidney/Liver are the target organs
- Radiological - is a low level radioactive material
  - Alpha and beta
  - Low intensity gamma
OSHA Permissible Exposure Limits (PEL)

<table>
<thead>
<tr>
<th>Element</th>
<th>Soluble (mg/m³)</th>
<th>Insoluble (mg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Uranium</td>
<td>0.05</td>
<td>0.25</td>
</tr>
<tr>
<td>Nickel</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Tungsten</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

* mg/m³ is 1/1000 of a gram per cubic meter of air.
Uranium in the Body from Natural Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Intake - Food and Liquids</td>
<td>1.9 ug/day</td>
</tr>
<tr>
<td>Daily Intake - Inhalation</td>
<td>0.007 ug/day</td>
</tr>
<tr>
<td>Total Uranium in the Body</td>
<td>90 ug</td>
</tr>
<tr>
<td>Uranium in Urine</td>
<td>0.05-0.5 ug/day</td>
</tr>
<tr>
<td>Uranium in Feces</td>
<td>1.4-1.8 ug/day</td>
</tr>
</tbody>
</table>

* 1 ug is equal to one millionth of a gram
Military Uses

M1A1H Abrams Armor  Anti-Armor Munitions
Properties of Depleted Uranium

- High Density
- Self sharpening as it penetrates armor
- Pyrophoric - small particles ignite and burn at high temperatures
Friendly Fire Incidents
Retained Depleted Uranium

- Friendly fire incidents result in soldiers with retained DU fragments
  - Could not be readily removed surgically
  - First time
Actions Taken

- Armed Forces Radiobiology Research Inst. (AFRRI) initial assessment, 1992:
  - No change in fragment removal policies
  - Research and monitoring recommended
- Department of Veterans Affairs - personnel surveillance
- Research initiated in 1993 at AFRRI and the Inhalation Toxicology Research Institute
Summary of AFRRI and VA

- Results to date indicate
  - Only change to current fragment removal policies: large fragments (over 1 cm) should be removed unless medically contraindicated
  - Depleted uranium health effects are comparable to other heavy metals (lead, tungsten, nickel)

- Studies will be published in the open, peer-reviewed literature
Identification of DU Patients

- HX of vehicle struck by KE munition
- HX of vehicle struck by “friendly fire”
- HX of burning fragments “*sparkler*”
- HX of DU exposure on field medical card
Identification of DU Patients

- If DU contamination suspected:
  - Annotate Field Medical Card
    - “SUSPECTED DEPLETED URANIUM (DU) EXPOSURE”
    - Briefly describe exposure scenario (Block 19)
Identification of DU Patients

- **RADIAC Meter** - positive over wounds or fragments
- **Urine Bioassay** - most sensitive test for internalization of depleted uranium
- **XRAYS** - high density, highly visible
Clinical Treatment of DU Patients

• Wounded patients pose **NO Threat** to medical personnel

• **DO NOT DELAY TREATMENT!**

• “Universal Precautions” - surgical gloves, masks and throw-away gowns offer adequate protection to medical personnel
Clinical Treatment of DU Patients

- Debridement should follow standard surgical techniques
- Radiation meters may aid in management of wounds
- **DO NOT DELAY TREATMENT** to obtain radiation monitoring equipment!
Clinical Treatment of DU Patients

- Remove embedded DU fragments using standard surgical criteria
- Large fragments (>1cm) should be removed unless the medical risk is too great
Clinical Treatment of DU Patients

- Monitor Hepatic and Renal Function
  - BUN, Creatinine, Creatinine clearance, beta-2 microglobulin, urine Uranium
  - standard liver function tests: AST, ALT, GGT, Bilirubin, PT, PTT
Clinical Treatment of DU Patients

- Urine Uranium Bioassay:
  - Perform in all patients with suspected DU exposure

- Chelation therapy not indicated
Urine Uranium Bioassay

• **Baseline urine specimen:**
  - Start collection immediately after injury
  - Terminate @ 24 hours after exposure incident

• **Initial DU urine specimen:**
  - Start collection @24 hours after exposure incident
  - Terminate @ 24 hours

• **Follow up urine specimen:**
  - Collect a 24 hr urine @ 7-10 days post exposure
Urine Uranium Bioassay

- Urine Uranium bioassay specimens should be forwarded to AMEDD-specified DOD clinical laboratories

- Spot urine collections should be performed if tactical/logistical issues prevent the collection of 24 hour specimens
Risk Assessment

- Department of Veterans Affairs has followed 15(?) patients who have retained DU fragments in their bodies for over 7 years.
- Highest Uranium Urine = 30-40 mcg/L
- No evidence of renal, liver, reproductive abnormalities has been detected in this group of patients.
Summary

- Depleted Uranium - not a radiation threat!
- Heavy Metal Toxicity is the major concern
- Health Care Providers are not at risk
- Clinical Management is the same as other wounded patients
- Suspected exposures should have urine uranium bioassay performed
References

• Message, 141130Z Oct 93, DASG-PSP HQDA, Subject: Medical Management of Unusual Depleted Uranium Exposures.


• Army Regulation (AR) 40-5, 15 October 1990, Preventive Medicine.
References

- Draft AR 40-400, Patient Administration