Recent Experiences with I-125 Seeds

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Radiology Services
Carolinas Healthcare System:

- Radiation Safety provides services to 4 CMC Charlotte Hospitals:
  - CMC
  - CMC Mercy
  - CMC Pineville
  - CMC University

- Approximately 60 prostate implants completed in 2007 at CMC
  - 82% of implants used $^{125}$I
  - 18% of implants used $^{103}$Pd

Carolinas Medical Center
1000 Blythe Boulevard
Charlotte, North Carolina
Seed Receipt

• Seeds are received in sterile package
• Seeds are assayed and sterilized by outside independent Radiopharmacy
• Seed manufacturer ships seeds to outside Radiopharmacy for assay and sterilization
• Seeds are received packaged in cartridges
• Mick applicator used to implant seeds
Seed Receipt

• Seeds are received in CMC Radiopharmacy
• Box is surveyed
• Leak test certificate is copied
• Seed information is entered into Radiation Safety inventory records
• Sterile package is delivered to Radiation Oncology. Stored in hot lab until implant date
FlatPack

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Prostate Implants

• Completed by Radiation Oncologist in OR
• Assisted by Dosimetrist
• Dosimetrist completes survey at end of procedure
• Dosimetrist counts seeds remaining from procedure
Seed Control

• At end of implant, dosimetrist places unused seeds in a lead pig
• Lead pig transferred to source storage room in Radiation Oncology
• Seeds in cartridges are unloaded by dosimetrist
• Final seed count, patient name, and date indicated on pig label
• Radiation Safety retrieves pig, counts seeds and places them in radioactive waste storage
First Incident

• October 15, 2007:
  - 5 seeds remaining from implant completed on 10/12/07
  - Contamination found on storage pig
  - Identified as $^{125}\text{I}$
  - Contaminated items found in Radiation Oncology, including empty cartridge, V-Block, and tweezers
  - Seeds separated
  - One (1) damaged seed isolated
  - 0.02 uCi detected
Initial Response

- Notified Authorized User
- Surveyed Radiation Oncology
- Surveyed OR autoclave
- Authorized User called patient
- Patient returned to CMC for bioassay
- Notified NC RPS
- Notified manufacturer and contract radiopharmacy
Follow-up

- Returned seed to manufacturer
- Spoke with patient
- Requested analysis of damage from manufacturer
- Reviewed case with Authorized User and dosimetrist
- Reported to Isotope Usage and Radiation Safety Committee
- Filed written report with NCRPS
Damaged Seed – October 2007

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Additional Investigation

• NC RPS requested additional review of CMC seed handling process

• *Isolated incident specific to CMC*

• Reviewed everything with Radiation Oncologist and Dosimetrist

• “*There was one seed . . . ”*

• No problems uncovered
Second Incident

- March 13, 2008 – 2 Lot Numbers
- 2 Separate Patients
- Consecutive implant dates
- 8 Seeds Visibly Damaged
  - 5 of 5 remaining seeds from 1st Lot
  - 3 of 31 remaining seeds from 2nd Lot
  - 20 of 31 seeds were not removed from cartridge until unloaded by dosimetrist
- Contamination ranging from 0.001 uCi to 0.05 uCi
- No contamination in Radiation Oncology
- Same contract radiopharmacy as October 2007 incident
Damaged Seeds – March 2008
Damaged Seed Comparison

October 2007

March 2008
Second Incident

• Reported incident to NC RPS
• Different response from CMC
• Different response from manufacturer
• Field sales representative observed Radiation Oncology seed handling techniques. No problems were found.
• Patients were called back to CMC for bioassay. Negative results obtained. Urine samples also analyzed.
• Authorized User more involved with manufacturer
• Contract radiopharmacy was inspected by Florida regulatory personnel. No problems revealed.
• All unused seeds were returned to manufacturer. Confirmed 2 leaking seeds and 8 damaged seeds.
CMC Response

• Damage too extensive to be our fault
• Long discussion with Radiation Oncologist
• Physicist obtained dummy seeds from manufacturer
• Repeated our process using dummy seeds
• Reproduced seed damage when hemostat used
• Reverse action tweezers did not damage seeds
• Reported results to manufacturer and waited on their investigation results
CMC Response

- Visually inspected all $^{125}$I seeds prior to additional implants
- Leak tested all $^{125}$I seeds prior to implants
- Re-sterilized seeds
Manufacturer Investigation

• Reviewed wipe test methods – wet vs. dry wipe
• Reviewed incoming wipe test records at contract radiopharmacy
• Reviewed contract radiopharmacy’s handling procedures
• Reviewed contract radiopharmacy’s leak test procedures
• Reviewed all historical complaints regarding damaged seeds.
Wipe Test Methods

• Manufacturer had not performed leak tests prior to seed distribution. Used area survey results to document “undamaged seeds”.
  – Changed policy to include leak tests of seeds prior to distribution
  – Found that cotton swab moistened with isopropyl alcohol is most effective

• Reviewed incoming wipe test records at contract radiopharmacy
  – No problems found
Wipe Test Methods

• Reviewed contract radiopharmacy’s handling and leak test procedures
  – Found that contract radiopharmacy’s wipe tests of exposed seed area in cartridge was not adequate to detect contamination, especially if seed is the last seed loaded in the cartridge
  – Seeds are normally batch wipe tested
  – Instrument efficiency is 1.07% for $^{125}\text{I}$
  – Trigger level for seed rejection from clinical use is 0.005 uCi, which is high, considering the limited wipe area of the seed
  – Ensured CMC that trigger level established by contract radiopharmacy will be lowered
Review of CMC Seed Damage

• 2 types of damage:
  - Rounded dents, caused by round object impacting seed
  - Flat dents extending length of seed; identical on 2 opposite sides

• Attempted to reproduce damage. Damage could not be reproduced by:
  - Reverse action tweezers
  - Mick applicator – Unless excessive force used to push seed through the exit hole
Damage from Mick Applicator

CMC Seed Damage
Review of CMC Seed Damage

• Damaged seeds in loaded cartridge
  - Seeds stacked horizontally
  - Cartridge contained 20 seeds
  - One cartridge per lot was emptied and assayed by contract radiopharmacy, then reloaded manually into cartridge using tweezers
  - Damage reproduced by:
    • Hitting stem of cartridge containing loaded seeds
    • Forcefully screwing upper housing of cartridge into place
Damage from Cartridge

CMC Seed Damage

Significant Damage: Rounded dent, length of tubing is flat.

(Significant damage pictures are of the same source.)
Review of Historical Complaints

• Reviewed complaints from September 2004 to March 2008 – seeds processed by contract radiopharmacies
• 1,204,519 seeds shipped from manufacturer
• 13,500 $^{125}$I seed orders
• 11 reports of leaking and/or damaged seeds
• Actual number of damaged seeds not specified
Review of Historical Complaints

• Radiopharmacy 1:
  - Processed 10% of seed orders
    • 1350 orders
  - Responsible for 6 of 11 reported seed damage (55%)
    • 0.44% of their seed orders

• Radiopharmacy 2:
  - Processed remaining 90% of seed orders
    • 12,150 orders
  - Responsible for 5 of 11 reported seed damage (45%)
    • 0.04% of their seed orders
Damage Reported March 2006

CMC Seed Damage
Review of Historical Complaints

• CMC seeds were processed by Radiopharmacy 1
• Significantly higher reported damage rate
• Prior damage not disclosed to CMC during our first incident
• Account promptly changed to use Radiopharmacy 2
• No problems since change
Final Report from Manufacturer

- 13 page report received
- Provided images of damaged seeds
- Concluded that Radiopharmacy 1 had much higher rate of reported damaged seeds
- Did not specifically conclude that Radiopharmacy 1 caused damage, but:
  - Concluded that damage was not likely to have been caused by CMC personnel
  - Concluded that manufacturing process did not cause damage
- Implemented the following action:
  - Wipe tests of seed orders prior to distribution to contract radiopharmacies
Patient Impact

• Radiation Oncologist made initial contact with patient
• Patient convenience important
• Patient re-assurance extremely important
• Requested his assistance in solving our problem
• Honestly explained situation in simple terms
• Worked with Nuclear Medicine supervisor to obtain thyroid counts and urine samples
Lessons Learned

• Manufacturing standard QA reports did not provide any explanation of damage
• Observation of standard practices at radiopharmacy not really helpful. Varied levels of technical expertise involved.
• Second incident prompted manufacturer to investigate problem
• Batch leak test results sometimes questionable
• Answers lie in DETAILS of historical review
Lessons Learned

• If seed looks damaged, it’s probably leaking
• Damage will never be seen with seed in loaded cartridge
• Dosimetrists watch for damaged seeds upon unloading cartridges
• Radiation Safety is more vigilant in looking at seeds
• NC RPS helpful