Clinical Introduction and Use of LDR - the anatomy of a prostate case
Learning Objectives

- Review the isotopes in vogue, prescription ranges, and common clinical characteristics
- Review isotope manufacturing and calibration issues
- Review of current implant techniques (Mick ® versus stranded)
- Review radiation safety and release criteria
- Review post plans and lessons learned the hard way
Some Housekeeping

• Giving other folks due credit
• What I won’t talk about but is still important
  – The Manchester system, Paterson-Parker tables, the Quimby method
  – Un-sealed source & alternative particle implants: P-32 (β emitters), Gliasite™, Cf-252 (neutron sources)

• The handout
  http://www.aapm.org/meetings/08AM/PRHandouts.asp
  has the slides in this talk

• What is LDR (low dose rate brachytherapy)?
  – Per ICRU report #38 LDR is in the range of 0.4 to 2.0 Gy/hr
    compared to HDR which is > 12 Gy/hr
Resources

• The Web
  – AAPM Virtual library
  – Medical Physics list server (global & USA)

• Meetings/Symposia/
  AAPM Summer Schools/Courses

• Books

• Journal articles

• Colleagues & friends

• Vendors & vendor web pages

2008 AAPM Annual Meeting
Let's not forget AAPM reports

- Report #46, 1994: Comprehensive QA for Radiation Oncology (Reprinted from Medical Physics, Vol. 21, Issue 4) aka TG40
- Report #51, 1995: Dosimetry of Interstitial Brachytherapy Sources (Reprinted from Medical Physics, Vol. 22, Issue 2) aka TG 43 This report has been updated - see AAPM Report #84

This list may not be wholly complete........

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Your turn

• How many of y’all do LDR?
• Two flavors of LDR: temporary and permanent
  – Common types of Implants
  – Intracavitary, Interstitial, Intraluminal, & Surface
    • Tandem and Ovoid & cylinders (Gyn)
    • Syed implants (Gyn)
    • Eye plaques
    • IVBT
    • Surface molds
  • LDR prostate
    – Mick users
    – Stranded/pre-loaded needles
    – Strand your own
    – A combination
Low Dose Rate Brachytherapy
When Did it begin?

Opening paragraph from Chapter XII, Radium and Radon Therapy, Basic Physics of Radiation Therapy by Joseph Selman, MD © 1960

“In 1901, five years after Becquerel discovered the emission of radiation by uranium, he accidentally incurred a skin burn while carrying a radium sample in his vest pocket. This is believed to be the first instance of biologic effect resulting from this type of radiation. Soon afterward, Pierre Curie produced an experimental skin reaction on his arm by the application of radium, proving Becquerel’s accidental observation.”
The Comparative Cost of LDR

Medicare costs for prostate treatment modalities

(TS Quang et al., Oncology, 2007;21(13))

Wayne Butler, PhD
Learning Objectives

• Review the isotopes in vogue, prescription ranges, and common clinical characteristics
  • Review isotope manufacturing and calibration issues
  • Review of current implant techniques (Mick ® versus stranded)
  • Review radiation safety and release criteria
  • Review post plans and lessons learned the hard way
Common Isotopes used for prostate implants

- **I-125**
  - circa 1970’s, originally manufactured by the Lawrence Soft X-ray Company then the 3M Company who then sold to Amersham Health/MediPhysics and Oncura; models 6701, 6702, 6711 & more recently 6733*

- **Pd-103**
  - circa 1987-1988, Theragenics Corporation model 200; in 1999 NASI released model MED 3933*

- **Cs-131**
  - circa 2003, IsoRay, Inc. model CS-1†


† Mark Murphy et al., Evaluation of the new cesium-131 seed for use in low energy x-ray brachytherapy. *Med Phys* 31 (6), June 2004
Some dosimetric history

- Changes in dosimetry parameters have led to prescription change
  - Publication in 1995 of TG 43 protocol for brachytherapy dosimetry led to change in $^{125}$I prescription from 160 Gy to 145 Gy
  - A NIST WAFAC standard was not available for $^{103}$Pd until 1999
Variation of $^{103}\text{Pd}$ delivered dose for a prescribed dose of 115 Gy which was actually 125 Gy after 2000
Variation of $^{103}$Pd prescribed dose and administered doses as a function of time (*Theragenics Model 200*)

<table>
<thead>
<tr>
<th>Time period</th>
<th>Prescribed dose (Gy)</th>
<th>Administered dose (Gy)</th>
<th>Dosimetric parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000–2005</td>
<td>125</td>
<td>120</td>
<td>2000 AAPM report</td>
</tr>
<tr>
<td>&gt; 2005</td>
<td>125</td>
<td>125</td>
<td>2004 AAPM TG-43 U1</td>
</tr>
</tbody>
</table>
## Comparing Isotopes

<table>
<thead>
<tr>
<th>Isotope</th>
<th>T 1/2 (days)</th>
<th>Energy (KeV)</th>
<th>90% Dose delivered (days)</th>
<th>Implant Alone</th>
<th>Boost *</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{125}$I</td>
<td>$\sim$60</td>
<td>28</td>
<td>204</td>
<td>145</td>
<td>100-110</td>
</tr>
<tr>
<td>$^{103}$Pd</td>
<td>$\sim$17</td>
<td>22</td>
<td>58</td>
<td>120 or 125</td>
<td>90-100</td>
</tr>
<tr>
<td>$^{131}$Cs</td>
<td>$\sim$10</td>
<td>29</td>
<td>33</td>
<td>115</td>
<td>85</td>
</tr>
</tbody>
</table>

*Boost: (not necessarily prior) XRT 40 - 45 Gy

Dose rate (cGy/day) as a function of time since implant for monotherapy

- Cs-131 115 Gy
- Pd-103 125 Gy
- I-125 145 Gy
Seed Vendors

- Bard
- Theragenics
- Core Oncology (used to be Mentor)
- North American Scientific
- Best Medical
- IsoRay
- Oncura (GE Healthcare)
- IsoAid

This may not be a complete list.....
Learning Objectives

• Review the isotopes in vogue, prescription ranges, and common clinical characteristics

• **Review isotope manufacturing and calibration issues**
  
  • Review of current implant techniques (Mick ® versus stranded)

• Review radiation safety and release criteria

• Review post plans and lessons learned the hard way
Manufacturing

- seeds contain some sort of x-ray marker, radioactive material, and typically a titanium capsule

From Cs -131 package insert

2008 AAPM Annual Meeting
Calibration or seed assay

- Responsibilities of the brachytherapy physicist are outlined in TG-40, TG-56, and TG-64
  - TG40 “…it is unwise to rely solely on this [commercial suppliers] value [source strength] for patient dose calculations…”
  - TG56 “…every institution practicing brachytherapy shall have a system for measuring source strength with secondary traceability for all source types used in its practice.” “For groupings with a large number of loose seeds, we recommend that a random sample containing at least 10% of the seeds be calibrated…”
  - TG64 “As recommended by AAPM TG 56, a random sample of at least 10% should be checked. Discrepancies of 3% or more between the mean of the assay & the manufacturer’s calibration should be investigated. Unresolved discrepancies of 5% or more should be reported to the manufacturer....”
Calibration

- New report coming soon

Third-party brachytherapy source calibrations and physicist responsibilities: Report of the AAPM Low Energy Brachytherapy Source Calibration Working Group

Wayne M. Butler
Chair, LEBSC; Schiffler Cancer Center, Wheeling Hospital and Jesuit University, Wheeling, West Virginia 26003

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International Medical Physics, San Antonio, Texas 78239

Larry A. DeWerd
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James M. Hevezi
South Texas Oncology & Hematology, San Antonio, Texas 78229

M. Saiful Huq
Chair, Task Group 100; University of Pittsburgh Cancer Institute, Pittsburgh, Pennsylvania 15232

Geoffrey S. Ibbott
Radiological Physics Center; M. D. Anderson Cancer Center, Houston, Texas 77030

Jatinder R. Palta
University of Florida, Gainesville, Florida 32610

Mark J. Rivard
Chair, Brachytherapy Subcommittee; Tufts University School of Medicine, Boston, Massachusetts 02111

Jan P. Scanttjens
Chair, Calibration Laboratory Accreditation Subcommittee; McGill University, Montreal, Quebec, CANADA

Bruce R. Thomadsen
Vice Chair, Brachytherapy Subcommittee; University of Wisconsin, Madison, Wisconsin 53706

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Source strength verification – role of 3rd party assay services

- 3rd party services pre-load sources into sterile needles or as sterile strands in addition to assay of sources
- Assays are often more comprehensive (> 10% of sources) than AAPM guidance
- Assay services are not overseen by any regulatory body
  - No requirement of NIST traceability
  - No assurance of independence from manufacturers
- **Responsibility for source assay rests with the end-user medical physicist**
- Methods are available to assay some sterile assemblies
  - S Furutani et al, IJROBP 2006;**66**:603-609
Make your own autoradiograph

V film for 10 minutes
Learning Objectives

• Review the isotopes in vogue, prescription ranges, and common clinical characteristics
• Review isotope manufacturing and calibration issues

• **Review of current implant techniques (Mick ® versus stranded)**
• Review radiation safety and release criteria
• Review post plans and lessons learned the hard way

2008 AAPM Annual Meeting
2057 Yu et al.: Task Group No. 64

Fig. 1. Process flow diagram for a preoperatively planned prostate seed implant.

2059

Fig. 2. Process flow diagram for an intraoperatively planned prostate seed implant.
Seattle criteria

- Pre-plan
- Modified uniform loading
- V100: 98-100%
- V150: I-125 30-40%
- V200: 10-20%
- Urethra max: 100-125% (definitely <150%)
- Rectum point: <80%
- Margin: 3-5 mm
Schiffler Cancer Center plan evaluation criteria

<table>
<thead>
<tr>
<th>Evaluated quantity</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient specific needs</td>
<td>PTV, TURP dose, etc.</td>
<td>Primary importance</td>
</tr>
<tr>
<td>Planning volume coverage</td>
<td>$V_{100}$</td>
<td>$&gt;99.8%$ volume</td>
</tr>
<tr>
<td>Urethral volume coverage</td>
<td>Urethral $V_{15}$</td>
<td>10% – 50% volume</td>
</tr>
<tr>
<td></td>
<td>Urethral $V_{15}$</td>
<td>$&lt;15%$ volume</td>
</tr>
<tr>
<td>Urethra dose</td>
<td>Mean</td>
<td>110% – 140% mPD</td>
</tr>
<tr>
<td>Homogeneity</td>
<td>$V_{150}$</td>
<td>35% – 45% plan vol, 121</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45% – 55% plan vol, 108Pd</td>
</tr>
<tr>
<td>High dose volume</td>
<td>$V_{200}$</td>
<td>$&lt;15%$ plan volume, 121</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$&lt;25%$ plan volume, 121</td>
</tr>
<tr>
<td>Number of needles</td>
<td>Minimize</td>
<td>30±14 4.1</td>
</tr>
<tr>
<td>Number of seeds</td>
<td>Minimize</td>
<td>130±18 4.1</td>
</tr>
<tr>
<td>No. of especially loaded needles</td>
<td>Minimize</td>
<td>5±2 4.1</td>
</tr>
<tr>
<td>Target volume / US volume</td>
<td>Ratio</td>
<td>1.75±0.22 4.1</td>
</tr>
</tbody>
</table>

$V_{100}, V_{150}$ and $V_{200}$ are the percentage of the planning volume covered by 100, 150, and 200\% of the prescribed dose (mPD), respectively.

* There is no statistically significant difference in these parameters between radionuclides, monotherapy, or boost therapy.

† Typically, 3 or 4 extra needles and 7\% extra seeds are used at the time of implant beyond those called for in the plan.

* Wayne M Butler & Gregory Merrick, *Brachytherapy Physics, 2nd Ed*, 2005
  Summer School proceedings, chapter 29, Permanent Prostate Brachytherapy
  Treatment Planning
  2008 AAPM Annual Meeting
CPCC Criteria for Cs-131 for implant alone (115 Gy)

- Target D90 127-137 Gy
- Target V100 >98%
- Target V110 >95%
- Target V150 22-32%
- Urethra V150 <5%
Implant techniques

OR Equipment:
Clean versus Sterile Procedure
U/S unit
Stepper/Stabilizer/Template
TPS (if real time planning)
Seeds (Mick gun, needles, strands, strand making system)
  needle safe?
  anchor needles?
  basin for sharps
C Arm & Pb Aprons?
Survey Meter
Paperwork

PROSTATE WRITTEN DIRECTIVE AND REGULATORY COMPLIANCE DATA

PATIENT NAME: ___________________________ Implant Date: ___________________________

PRELIMINARY WRITTEN DIRECTIVE TO BE COMPLETED PRIOR TO IMPLANT DATE

Treatment Site: PROSTATE

Prescribed Dose: ______________________ cGy Isotope to Implant: □ Pd-103 □ Ir-192 □ Cs-137

Physician Authorized User: ___________________________ Date Signed: ___________________________

FINAL WRITTEN DIRECTIVE TO BE COMPLETED PRIOR TO PROCEDURE COMPLETION

Treatment Site: PROSTATE Isotope: □ Pd-103 □ Ir-192 □ Cs-137 Total # of sources: ______

Activity per source: ______ mCi Total Activity Implanted: ______ mCi

Prescribed Total Dose: ______ cGy Exposure Time: ______ Permanent Implant

Physician Authorized User: ___________________________ Date Signed: ___________________________

ROOM SURVEY AND PATIENT RELEASE SURVEY DATA

Survey Performed By: ___________________________ Date of Survey: ___________________________

Meter Model and SN: ___________________________

Patient at 1 m: ______ mc/mHr Patient at 10 m: ______ mc/mHr Patient at 100 m: ______ mc/mHr

Linear: ______ mc/mHr Table: ______ mc/mHr OR Table/Floor: ______ mc/mHr

SEED INVENTORY DATA COMPLETED IMMEDIATELY AFTER IMPLANT

# of Seeds Omited: ______ # of Seeds Implantd: ______ # of Seeds Recovered: ______ # of Seeds Re-Implanted: ______

# of Seeds Returned to Nuclear Medicine: ______ Performed by: ___________________________

QMP REVIEW OF CASE

Review of this case showed that the written directive was prepared as required and that the implant was performed in compliance with the physician's written directive. The review included verification that the prescribed dose, source isotope, dose activity, patient identity, number of seeds, and seed orientation from the treatment plan were in accordance with the written directive. Also reviewed was documentation that correct data for the patient was contained in the treatment plan. This case review was performed after conclusion of the procedure by:

Physician: ___________________________ Date: ___________________________

Form Title: Radiation Oncology Review Form

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In the OR

Frank and Ernest

POETRY READING

PHYSICS LECTURE

WHICH’LL IT BE--
RHYME OR REASON?

Copyright (c) 1985 by Thaves. Distributed from www.thecomics.com.
Mick applicator

Mick® 200-TPV Applicator
The “Third” Generation of Mick Applicators
The Complete Instrumentation Package for “Real-Time” Transperineal / Ultrasound-Guided I-125 / Pd-103 Prostate Seed Implantations.

Photos Courtesy: Jay Friedland, M.D., Tampa, FL
The “Optimal” and Clinically Proven Prostate Seeding System Utilized Worldwide, Enhancing Seed Placement Accuracy, Efficiency and Radiation Protection!

http://www.micknuclear.com/page_prostate_ldr/prostate_ldr.asp
New in the Mick world

AnchorSeed’s™ unique patent pending design is intended to give existing low dose rate prostate brachytherapy sources enhanced ability to maintain their position within tissue, thereby allowing physicians to confidently place seeds in more strategic and beneficial locations than in the past. It is designed for use both with Mick® Applicators as well as with pre-loaded needles.

Utilizing the same bioabsorbable polymer as in BrachySciences’ portfolio of strand products, AnchorSeed’s™ proprietary design was devised to offer a true “anchoring effect” to help reduce seed misalignment, migration and unwanted seed displacement.
Stranded Pre-loaded (3rd party)
Types of needles

- Choices: Round or Square hub?
- Steering a needle
  - Grid position/time
- Obdurators have ruler markings
- Needles have ruler markings
Start Anterior

Our process:

Reproduce/verify height, width, and length of prostate
One row at a time, the urologist puts in the needles to mid-gland
Less “diddling” if the template is snug against the perineum
Prostate swells during the procedure; verify base plane

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Look for the “hamburger” sign on the axial or transverse slice (this is the needle bevel edge) – per Peter Grimm, MD

Visualize the needle on the sagittal slice

Know where the first seed is – bone wax versus “plug” in needle tip

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Seattle uses aerated KY in a catheter in the urethra for better visualization; we use a Foley catheter and fill the balloon with 150-180 cc’s of water. You may need to push the balloon away from prostate lest you pop it.
To Cysto or not

Can visualize evidence of bladder trauma (optimally you “tent” the bladder)

“Plugs” or Bone wax are not an issue

Spacers are not an issue

Our spacers are purple

Seeds are silver
Fishing for “treasure”

Planning technique tips:

Load, but do not strand needles around the urethra

Baseline loading option

Disconnect leading spacers

“Tenting” the bladder

If you pull a seed or strand from the bladder or prostatic urethra:

what to do with those seeds

Decay? Return to vendor?

2008 AAPM Annual Meeting
Learning Objectives

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• **Review radiation safety and release criteria**
• Review post plans and lessons learned the hard way
Radiation Safety and release criteria

- Release criteria are based on exposure to the general public
- Where to measure @ 1 meter?
- What meter are you using?
- Who wears a badge
A quick note on RAM licenses

Georgia Department of Natural Resources
4255 International Parkway, Suite 100, Atlanta, Georgia 30334

RADIOACTIVE MATERIALS PROGRAM
GEORGIA RADIOACTIVE MATERIALS LICENSE

Page 1 of 5 Pages
License Number 079
Amendment Number 00

License (1. Name and 2. Address)

In accordance with the letter dated November 29, 2008, License Number 079 is hereby amended in its entirety to read as follows:

Expiration Date: August 31, 2009

5. Telephone Number

6. RADIOACTIVE MATERIAL (ELEMENT AND MASS NUMBER)

7. CHEMICAL AND/OR PHYSICAL FORM

8. MAXIMUM QUANTITY LICENSEE MAY POSSESS AT ANY ONE TIME

A. Iodine 123
   A. Sealed sources (Models which are in accordance with Rule 391-3-17.011(10) or equivalent, regulations of the US NRC or another Agreement State)
   A. 500 millicuries

B. Palladium 103
   B. Sealed sources (Models which are in accordance with Rule 391-3-17.011(10) or equivalent, regulations of the US NRC or another Agreement State)
   B. 500 millicuries

9. AUTHORIZED USE
   A. and B. Brachytherapy procedures as permitted by (55) of Rule 391-3-17-.05 for the interstitial treatment of cancer.

10. CONDITIONS
   A. The license holder’s address shall be stated in item 2 above.
   B. The license holder shall comply with the provisions of Georgia Department of Natural Resources Rule 391-3-17-.40, “Standards for Protection Against Radiation, Amended”, Rule 391-3-17-.05, “Use of Radioactivity in the Mining Arts, Amended”, Rule 391-3-17-.04, “Transportation of Radioactive Materials, Amended”, and Rule 391-3-17-.07, “Nuisances, Instructions and Reports to Wildlife Inspections, Amended.”
### Written directive/QMP

#### Prostate Written Directive and Regulatory Compliance Data

**Patient Name:**

**Implant Date:**

#### Preliminary Written Directive to Be Completed Prior to Implant Date

- **Treatment Site:** Prostate
- **Prescribed Dose:** 
  - $^{60}Co$
  - $^{125}I$
  - $^{131}I$
- **Isotope to Implant:** $^{125}I 
  - $^{131}I$
- **Activity per Source:** 
  - $mCi$
  - Total Activity Implanted: 
    - $mCi$
- **Prescribed Total Dose:** 
  - $cGy$
  - **Exposure Time:** Permanent Implant
- **Physician Authorized User:** 
  - 
  - **Date Signed:**

#### Final Written Directive to Be Completed Prior to Procedure Completion

- **Treatment Site:** Prostate
- **Isotope:** $^{125}I$
- **Total Activity Implanted:** $mCi$
- **Activity per Source:** $mCi$
- **Prescribed Total Dose:** $cGy$
- **Exposure Time:** Permanent Implant
- **Physician Authorized User:** 
  - 
  - **Date Signed:**

#### Room Survey and Patient Release Survey Data

- **Survey Performed By:** 
  - 
  - **Date of Survey:**
- **Meter Model and SN:** 
  - 
  - **Patient at 1 m:** 
    - 
  - **Date:**
  - **Patient Position:** 
    - 
  - **Date and Time:**
  - **Signed by:**

#### Seed Inventory Data Completed Immediately After Implant

- **# of Seeds Ordered:** 
  - $^{125}I$
  - $^{131}I$
- **# of Seeds Implanted:** 
  - 
  - **# Recovered:** 
    - 
  - **# Re-implanted:** 
    - 
- **# of Seeds Returned to Nuclear Medicine**

#### QMP Review of Case

- **Information included in the written directive as required:** 
  - 
  - **Physician:** 
    - 
    - **Date:**

---

2008 AAPM Annual Meeting
Integral dose calculation

NUREG -1556 vol 9 (2005) supersedes reg guide 8.35

You can release based on activity or dose rate (appendix U) for I-125 it is 1 mrem/hr @ 1 meter

1 rrem/hr X (60 days/9.69 days)x(115 Gy/145Gy) = 4.9 mrem/hr at one meter for Cs -131

Assuming a 25% occupancy factor (per appendix U recommendations)

I-125
1 mrem/hr X 24 hrs/day X (60 days/0.693) X 0.25 OF
=519.48 mrem

Cs-131
4.9 mrem/hr X 24 hrs/day X (9.69 days/0.693) X 0.25 OF
=411.1 mrem
Let’s talk about meters

**MODEL 44-9 Pancake G-M Detector**

The Model 44-9 is a pancake G-M detector that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters.

- **PART NUMBER:** 47-1539

**INDICATED USE:** Alpha beta gamma survey; Floaking

**DETECTOR:** Pancake type halogen quenched G-M

- **WINDOW:** 1.7 x 0.3 m/s/cm² meter
- **WINDOW AREA:**
  - Active: 10 cm²
  - Open: 12 cm²

**EFFICIENCY (4π geometry):** Typically 5% Co, 22% 90Sr; 19% 137Cs; 32% 60Co; 35% 32P

**SENSITIVITY:** Typically 3300 counts/μA(60Co gamma)

**ENERGY RESPONSE:** Energy dependent

**DEAD TIME:** Typically 80 microseconds

**COMPATIBLE INSTRUMENTS:** General purpose survey meters, ratemeters, and scalers.

**OPERATING VOLTAGE:** 500 volts

**CONNECTOR:** Same 13 (cables available)

**CONSTRUCTION:** Aluminum housing with beryllium polycarbonate control panel

**TEMPERATURE RANGE:** -40°F (−40°C) to 122°F (50°C)

**SIZE:** 11” (0.4 cm) X 2.2” (6.9 cm) X 10.7” (27.2 cm²)

**WEIGHT:** 1 lb (0.53 kg)

2008 AAPM Annual Meeting
Learning Objectives

- Review the isotopes in vogue, prescription ranges, and common clinical characteristics
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- Review post plans and lessons learned the hard way
Post Plans

- CT day 0, day 1, day 15, day 30? Stereo shift films?
- Chest X-ray?
- Correlation with the U/S?
  - Who draws the prostate
  - Post plan evaluation (statistics)
Post Plans

DAY 0 POST IMPLANT CT
VARISEED 7.1

http://www.micknuclear.com/

2008 AAPM Annual Meeting
## Self Assessment

<table>
<thead>
<tr>
<th>Date of Implant</th>
<th>Isotope</th>
<th>Rx</th>
<th>Gy</th>
<th>No of seeds</th>
<th>Activity mCi</th>
<th>Volume V100</th>
<th>Volume V150</th>
<th>D90 (Gy)</th>
<th>D90 (%)</th>
<th>V100 rectum</th>
<th>V100 (%)</th>
<th>V30 rectum</th>
<th>V30 (%)</th>
<th>Urologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/14/2008</td>
<td>I-125</td>
<td>110</td>
<td>103</td>
<td>0.313</td>
<td>60.21</td>
<td>91.48%</td>
<td>46.26%</td>
<td>112.95</td>
<td>0.24%</td>
<td>1.30</td>
<td>22.47%</td>
<td>60.21</td>
<td>59.44%</td>
<td></td>
</tr>
<tr>
<td>3/24/2008</td>
<td>Cs-131</td>
<td>115</td>
<td>106</td>
<td>3.19</td>
<td>57.73</td>
<td>90.11%</td>
<td>45.33%</td>
<td>115.30</td>
<td>0.15%</td>
<td>0.05</td>
<td>26.62%</td>
<td>57.73</td>
<td>59.05%</td>
<td></td>
</tr>
<tr>
<td>3/24/2008</td>
<td>Cs-131</td>
<td>115</td>
<td>85</td>
<td>2.89</td>
<td>39</td>
<td>84.17%</td>
<td>44.66%</td>
<td>103.61</td>
<td>2.63%</td>
<td>1.24</td>
<td>30.79%</td>
<td>39.00</td>
<td>39.21%</td>
<td></td>
</tr>
<tr>
<td>3/31/2008</td>
<td>Cs-131</td>
<td>85</td>
<td>63</td>
<td>2.863</td>
<td>31.53</td>
<td>80.51%</td>
<td>36.57%</td>
<td>71.66</td>
<td>1.79%</td>
<td>1.18</td>
<td>30.53%</td>
<td>31.53</td>
<td>31.90%</td>
<td></td>
</tr>
<tr>
<td>4/1/2008</td>
<td>I-125</td>
<td>110</td>
<td>67</td>
<td>0.31</td>
<td>25</td>
<td>62.61%</td>
<td>38.30%</td>
<td>113.96</td>
<td>0.60%</td>
<td>0.25</td>
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Cautionary tales

- Medical mistakes are common
  - misadministration
- Anticipate mistakes
- Have a process in place
An actual case

- New prostate brachytherapy implant program—physician and physicist attend Seattle course
- An early patient received an implant as a boost to external beam radiation
- Following 45 Gy of external beam, the physician prescribed a full dose implant (145 Gy) rather than a boost dose (108 Gy)
- Patient developed severe urethral and rectal complications
- The physician defendant admitted fault and settled quickly with the plaintiff
- The physicist / hospital defendants were left “holding the bag”
- Eventually all defendants settled
- Lessons
  - No BFF among co-defendants
  - The physicist was “negligent” for delivering the wrong dose, even though it was prescribed by the physician
  - AAPM Report 38 *The Role of a Physicist in Radiation Oncology (1993)*
  - AAPM Report 79 *Academic Program Recommendations for Graduate Degrees in Medical Physics (Revision of AAPM Report No. 44)*
Thank you