Prostate Brachytherapy- Current Trends and Developments

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Overview

- What is brachytherapy?
- Types of prostate brachytherapy
- HDR brachytherapy procedure
- Developments
  - Monotherapy
  - Focal brachytherapy
  - Salvage brachytherapy

What is brachytherapy?

- ‘Brachy’ from Greek word meaning close or near to.
- Placed close to or inside tumour or tumour bed
- Use of sealed radioactive source eg iridium 192, iodine 125

Types of brachytherapy

- Intracavitary eg into vagina, uterus
- Intraluminal eg oesophagus, bronchus
- Interstitial eg prostate, breast
- Surface moulds, eg skin
- LDR, MDR, HDR and PDR
Pros and cons of brachytherapy

**Advantages**
- Conformal treatment
- Less normal tissue irradiated
- Lower geometric uncertainty

**Disadvantages**
- Radiation protection
- High dose gradient means unavoidable hot spots

Types of prostate brachytherapy

**LDR - Low Dose Rate**
- <2Gy/hour
- Uses Iodine seeds
- Permanent implant

**HDR - High Dose Rate**
- >12Gy/hour
- Iodine 192
- Temporary implant

LDR vs. HDR prostate brachytherapy

**LDR: permanent implant**
- Dose delivered over many months
- Used for earlier stage tumours
- May be combined with EBRT
- Many seeds used (Iodine 125) - cost implications (~£3k)
- Intrafraction motion
- Radiation protection issues

**HDR: temporary implant**
- Dose delivered in minutes
- Used for early and locally advanced tumours
- Easily combined with EBRT
- One radioactive pellet (Iodine 192) in afterloader unit. Cheaper?
- Minimal radiation protection issues
- Radiobiology better?

HDR Prostate Brachytherapy Boost

- BHOC started December 2007
- Other UK centres are UCLH, Exeter, Mount Vernon, Leeds, Christie, Northampton, Lincoln, Southend. Many others developing service.
- Can be used in combination with EBRT (brachy boost) or brachytherapy alone (monotherapy)
Selection criteria for HDR prostate brachytherapy boost

- Locally advanced / high risk prostate cancer
- Patient needs to be fit for procedure and anaesthesia
- No previous TURP
- Minimal urinary symptoms
- 3 months hormone therapy prior to implant
- Brachytherapy given in combination with 23 #/46Gy external beam radiotherapy (or 15 #/37.5Gy for smaller volumes other centres)

Procedure

- Pre-assmt, dietary preparation
- Admission 7.30 am, microenema, nil by mouth,
- Spinal anaesthetic
  - Bupivacaine instilled into CSF
  - Rapid onset
  - Dense block for ~3 hours
  - Addition of diamorphine extends analgesia to ~16:00

- Urinary catheter inserted and transrectal ultrasound positioned with stepper unit

- Plastic needles inserted through the template and perineum into prostate gland
- Transrectal ultrasound guided placement of needles to get even distribution throughout prostate and avoid urethra
After needle implant

- CT scan
- Patient back to ward during planning (approx 2 hours)
- Contouring organs at risk and prostate volume
Treatment delivery

- Treatment delivered at lunchtime (usually between 12 and 2pm) single fraction of 15 Gy
- Takes 30 minutes approx

Post treatment delivery

- Removal of implant needles and template (gas and air)
- Return to ward.
- Urinary catheter left in overnight patient, irrigation
  Pt can go home a few hours after catheter removal in the morning, if able to pass urine.
  EBRT starts 2 weeks later 46 Gy in 23 fractions
  Some centres do EBRT first then brachy boost
  Now with single fraction may be able to do as a day case

Toxicity

- Acute inflammation of urethra causing frequency and pain
- Occasionally urinary stricture (late)
- Urinary incontinence (rare)
- Erectile dysfunction
- Bowel problems (eg proctitis)
- Tiredness
1# HDR
- 15Gy single fraction HDR brachytherapy
- 37.5Gy 15# EBRT

Results (median F/U 1.14 years)
- No biochemical failures
- Acute grade 2 and 3 GU toxicity = 62% and 1.6%
- Acute grade 2 GI toxicity = 6.5%
- Late grade 2 GU toxicity = 47%
- Late grade 2 GI toxicity = 10%

**HDR Brachytherapy Boost**
- Provides convenient way of providing very high doses of radiotherapy as a boost to EBRT
- Exploits the potential biological advantages achieved with high fraction size
- Provides unrivalled means of sculpting dose around prostate, thereby minimising dose to surrounding normal structures
- Minimises risk of geographical miss

**What NICE have said about prostate HDR brachytherapy**
- “the procedure has less side effects compared with other treatments”
- “the benefits of the procedure include improved biochemical and overall survival”

(National Institute for Health and Clinical Excellence, 2006)

**Developments**
- UK National protocol for single fraction HDR brachy boost
- HDR monotherapy for low to intermediate risk prostate cancer, UK National protocol
- Focal brachytherapy
- Salvage brachytherapy
**Bristol experience of HDR monotherapy**

- **Patient selection**
  - Histologically confirmed, adenocarcinoma of the prostate
  - Low to intermediate risk localised prostate cancer
  - No previous Trans-Urethral Resection of Prostate (TURP)
  - No significant Pubic Arch Interference (PAI)
  - Prostate Volume ≤ 60 cm³ on MRI
  - International Prostate Symptom Score (IPSS) ≤ 18

- **HDR monotherapy**
  - Not usually on hormone therapy
  - Usually less urinary symptoms
  - Alternative to prostatectomy, seed brachy or EBRT
  - UK protocol 19 Gy single fraction
  - 20 cases to date
  - Started Nov 2013

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**Rationale for HDR monotherapy**

- Prostate cancer - sensitive (low $\alpha/\beta$) to radiation delivered at a large dose per fraction (dose escalation)
- Suggests that hypofractionated IMRT or HDR brachytherapy offers better tumour control rates

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**Dosimetric advantages of HDR Brachytherapy**

- More dose to the prostate
- Less dose to the bladder and rectum
Toxicity - 13 cases

All patients had self-limiting transient haematuria following HDR.

All patients were discharged home within 24 hrs.

One patient required re-catheterisation.

Grade 1 acute urinary toxicity at 2 weeks, returned to baseline 12 weeks after treatment.

Results - PSA trends - our 1st 13 cases

HDR: Infinite dose variation by altering dwell times.
Salvage brachytherapy

- Salvage after prostatectomy, or EBRT or seed brachy
- Sometimes in combination with EBRT
- A few UK centres – Christie, Mount Vernon
- Sometimes whole prostate, sometimes focal

Teamwork essential!

- Radiographers (HDR brachy, CT, ultrasound)
- Physicists
- Consultant Oncologists
- Theatre staff: Anaesthetists, ODPs, Theatre Nurses
- Ward Nurses