

Low Dose Rate Brachytherapy for Prostate Cancer

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Prostate Cancer Facts

- One of the leading causes of death among men (Laprise-Pelletier et al., 2017, para. 1)
- Most common malignancy in men in the developed world (Yamazaki et al., 2021, sec. introduction, para. 1)
- More than 180,000 new cases diagnosed every year in the United States alone (Laprise-Pelletier et al., 2017, para. 1)
- About 14% of men will be diagnosed at some point in their lifetime (Laprise-Pelletier et al., 2017, para. 1)

Risk Factors

- Older age— rare in men younger than 40, chances rise after age 50 (American Cancer Society, 2023a)
- Race/ethnicity— more often in African American men and Caribbean men of African ancestry. Less common in Asian American, Hispanic and Latino men other than non-Hispanic White (American Cancer Society, 2023a)
- Family history— may be inherited or genetic factor however most occur in men without a family history (American Cancer Society, 2023a)
- Inherited gene changes (American Cancer Society, 2023a)
- Factors with less clear effects— diet, obesity, smoking, chemical exposure, inflammation of the prostate, sexually transmitted infections, vasectomy (American Cancer Society, 2023a)

Signs and Symptoms

- Early stage prostate cancer is often asymptomatic (Ali & Esper, 2021, para. 3)
- Detected based on elevated prostate-specific antigen (PSA) levels on blood test or abnormal digital rectal examination (DRE) (Ali & Esper, 2021, para. 3)
- Early prostate cancer symptoms include:
 - Problems urinating
 - Blood in the urine or semen
- More advanced symptoms include:
 - Trouble getting an erection
 - Pain in hips, back, and chest
 - Weakness or numbness in legs or feet
 - Loss of bladder or bowel control
 - Weight loss & lethargy

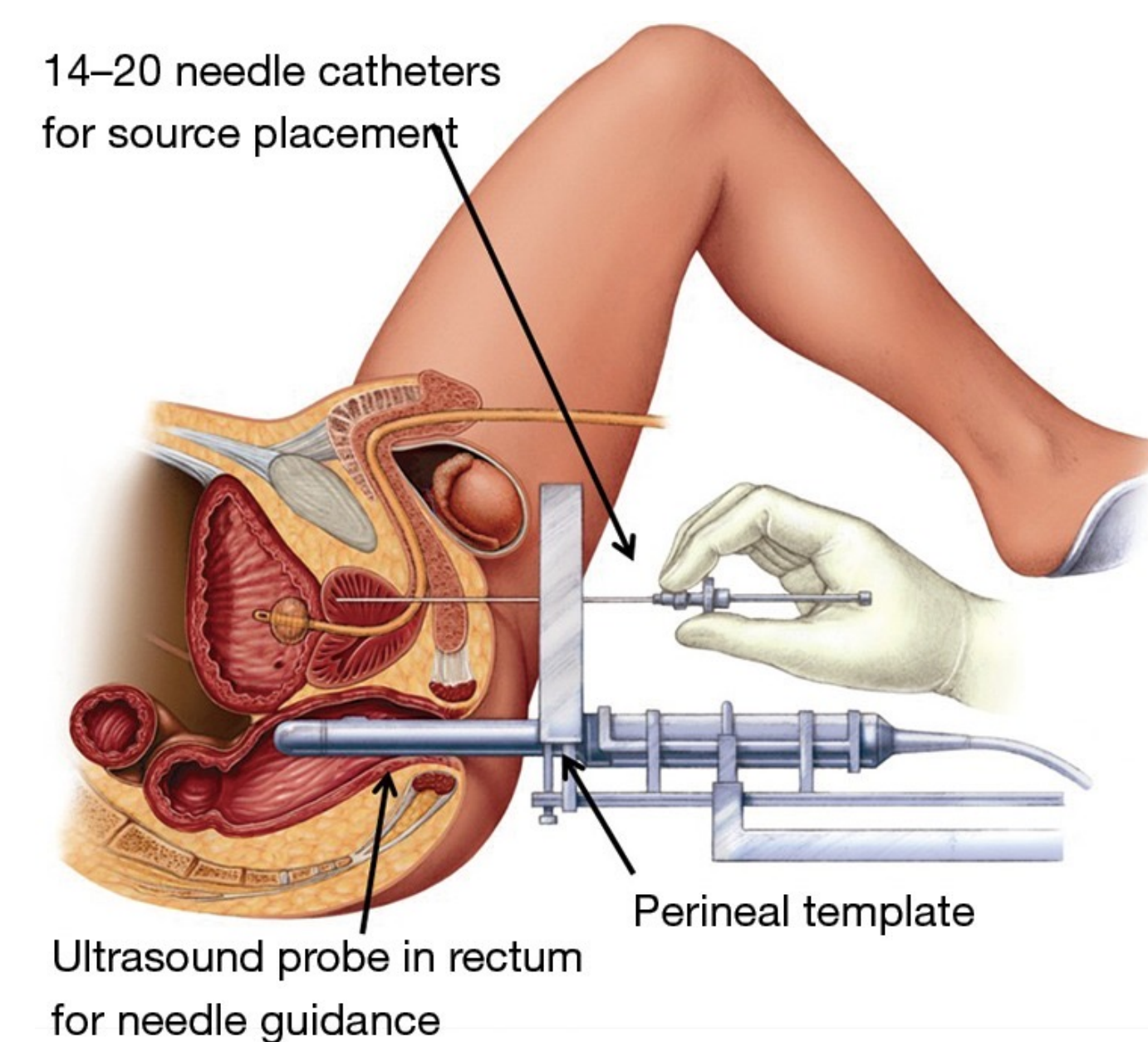
(American Cancer Society, 2023b)

What is Radiation Therapy?

- “A type of cancer treatment that uses high doses of radiation to kill cancer cells and shrink tumors. At high doses, radiation kills cancer cells or slows growth by damaging their DNA. Cancer cells, whose DNA is damaged beyond repair, stop dividing or die” (National Cancer Institute, 2019, para. 1-3).
- “Radiation therapy does not kill cancer cells right away. It takes days to weeks of treatment before DNA is damaged enough for cancer cells to die. Then, cancer cells keep dying for weeks or months after radiation therapy ends” (National Cancer Institute, 2019, para. 1-3).

What is Brachytherapy?

- A type of radiation therapy used to treat prostate cancer
- Radioactive sources are placed within or very close to the cancer, allowing a high cancer-to-normal tissue dose ratio (Devlin et al., 2016, chapter 2, para. 2)
- Most common type of radiation therapy, which uses high-energy x-rays that are delivered from outside of the body (MD Anderson Cancer Center. 2024, para. 1)
- Compared to external beam radiotherapy (EBRT) brachytherapy delivers higher doses of radiation to the target lesion without excessive irradiation of the adjacent organs (Laprise-Pelletier et al, 2017, para. 1)
- Brachytherapy seeds bypass superficial tissues and release most of their dose close to the intended target (Ali & Esper, 2021, sec. treatment modalities, para. 3)
- Treats a smaller volume with an extremely heterogenous dose distribution (Devlin et al., 2016, chapter 2, para. 4)



Schematic illustration of a typical LDR prostate brachytherapy procedure. LDR, low dose rate (Stish et al., 2018, figure 2). [Image]

Types of Brachytherapy

- Low-dose rate
 - Low dose of radiation over time delivered in treatment (Ali & Esper, 2021, table 1)
 - Places the radioactive pellets in or near the tumor for a few weeks to several months (MD Anderson Cancer Center. 2024, para. 6)
- Pulsed-dose
 - Radiation Oncologist places an applicator device in or near the tumor (MD Anderson Cancer Center. 2024, para. 7)
 - A machine sends the radioactive pellets into the applicator for 10-15 minutes every hour for about two days (MD Anderson Cancer Center. 2024, para. 7)
- High-dose rate
 - Radiation delivered through catheters, then removed (Ali & Esper, 2021, table 1)
 - Uses an applicator device (MD Anderson Cancer Center. 2024, para. 8)
 - Radiation from the pellet is more powerful than pulsed-dose, so the patient receives just one, 10-minutes every few days, for two to three weeks (MD Anderson Cancer Center. 2024, para. 9)

Diagnosis

- Prostate screening tests may include:
 - Digital rectal exam (DRE) or Prostate-specific antigen (PSA) test
- If prostate cancer screening detects an abnormality, one of these tests is recommended to determine prostate cancer:
 - Ultrasound, Magnetic resonance imaging (MRI), or collecting a sample of prostate tissue
- When a biopsy confirms cancer, next step is to determine grade of cancer cells.
 - Gleason score and Genomic testing
- Once diagnosis is made, determine stage of the cancer through one of imaging studies:
 - Bone scan, Ultrasound, Computed tomography (CT) scan, Magnetic resonance imaging (MRI), Positron emission tomography (PET) scan

(MFMER, 2022, sec. diagnosis, para. 4-12)

Treatment

- “Before treatment starts, brachytherapy involves placing radioactive sources in prostate tissue. Most often, the radiation is contained in rice-sized radioactive seeds that are inserted into prostate tissue. The seeds deliver a low dose of radiation over a long period of time” (MFMER, 2022, sec. radiation therapy, para. 4).
- “Lie on the treatment table, while the machine moves around the patient’s body, directing high-powered energy beams such as x-rays or protons to the prostate cancer” (MFMER, 2022, sec. radiation therapy, para. 2).
- “Typically undergo external beam radiation treatments five days a week for several weeks” (MFMER, 2022, sec. radiation therapy, para. 2).

Prostate brachytherapy beads. (Bickle, 2020, Case study). [Image]

Brachytherapy seeds



Brachytherapy seeds

Sclerotic skeletal metastases (prostate cancer) with brachytherapy seeds. (Knipe, 2014, Case study) [Image]

Conclusion

- “Low dose rate (LDR) prostate brachytherapy is an evidence-based radiation technique with excellent oncologic outcomes by utilizing direct image guidance. LDR brachytherapy has been proven, with decades of reported outcomes, to be safe, convenient & a highly efficacious approach in management & cure of localized prostate cancer that should remain an option for all patients” (Stish et al., 2018, sec. conclusion, para. 1).
- “LDR brachytherapy is associated with statistically significant improvements in relapse-free survival (RFS) when compared to EBRT in intermediate-risk prostate cancer, but not overall survival” (Yaxley et al., 2022, sec. introduction, para. 1).