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Stereotactic Body Radiotherapy: Prostate Cancer

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Prostate Cancer

- Occurs when the cells grow out of control in the prostate gland
- Most prostate cancers are slow to grow and spread
- Develops in older men, average age of diagnosis is 66
- Second most common cancer in American men
- 1 in 8 men have prostate cancer

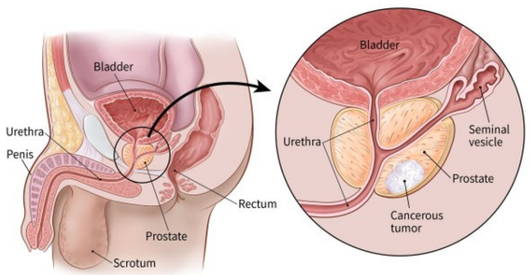
(American Cancer Society, 2021, para. 2-4)

(American Cancer Society, 2019, para. 1-2)

Types of Prostate Cancer

- Adenocarcinoma is the most common type
- Other types are small cell carcinomas, neuroendocrine tumors, sarcomas, but these are rare and unlikely

(American Cancer Society, 2019, para. 5)



(American Cancer Society, 2021, para. 3)

Treatment Options

- Radical prostatectomy
- External beam radiotherapy
- Brachytherapy
- Stereotactic body radiotherapy (Kothari et al, 2018, p. 2)

Stereotactic Body Radiotherapy (SBRT)

- "administers very high doses of radiation, using several beams of various intensities aimed at different angles to precisely target the tumor" (MD Anderson Cancer Center, n.d., para. 1)
- Treatment is typically either one or five doses once a day but can be different based on type and location of the cancer (MD Anderson Cancer Center, n.d., para. 3)

Treatment Planning

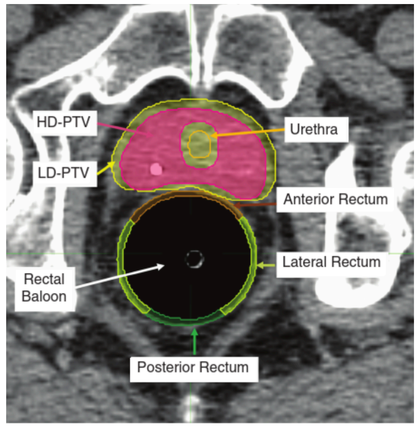
Target Volumes:

- Computed tomography simulation (CT-sim), and magnetic resonance imaging (MRI) are used to set up treatment plans
- Primary clinical target volume (CTV-P) could include the whole prostate including seminal vesicle, and are only included if believed to be cancerous
- If seminal vesicle aren't involved the CTV-P will include typically 2cm of the seminal vesicles

(Telkhade et al., 2021 p. 173)

- Planning Target Volumes (PTVs) are 3 to 5mm, and in order to avoid the rectum the restrictions tend to be stricter posteriorly (Kothari et al,, 2018, p. 8)
- PTVs can be broken down into high dose (HD-PTV) and low dose (LD-PTVs)

Treatment Plan: Contouring of PTVs



(Xia, Godley, Shah, Videtic, & Suh, 2018, p. 176)

Organs at Risk (OARs):

- Healthy organs and tissues that can be damaged due to proximity of cancerous site treated
- Bladder wall
- Rectum
- Ureter
- Penile Bulb
- Femoral Head
- Colon

(Xia, et al., 2018, p. 177)

Treatment

Procedures:

- Patient should be simulated with full bladder and empty rectum every treatment
- The bladder and rectum restrictions help push the bowel out the field and reduce radiation to the bladder (Xia, et al., 2018, p. 175)
- A rectal balloon can be placed to immobilized the rectum which allows for better separation between anterior wall & prostate (Xia, et al., 2018, p. 172)
- SpaceOAR hydrogel can also be used to move the rectum farther away from the prostate (Kothari et al., 2018, p. 8)

Motion monitoring:

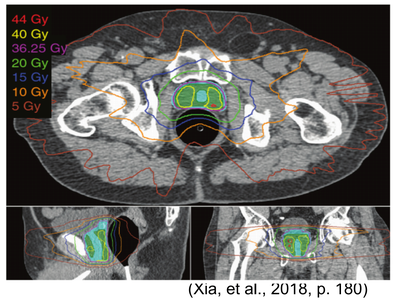
- Fiducial markers can be placed in order to track movement using triggered imaging. When movement is out of allowed parameters, treatment will automatically stop until mark is placed back into the right position (Xia ,et al., 2018, p.172)
- Real time motion monitoring such as Calypso, and RayPilot are used to continuously monitor the prostate, which allows for beam-gating and patient realignment to ensure proper areas are being treated
- The use of continuous motion monitoring allows for lower PTVs, and less exposure to OARs at risk

(Vanhanen, Poulsen, & Kapen, 2020 p. 58)

Dose:

- Commonly around 35 to 36.25 Gray (Gy).
- 40 Gy is also an acceptable dose for treatment
- Treatment is typically, around 5 fractions, 1 per day (Kothari et al., 2018, p. 5)

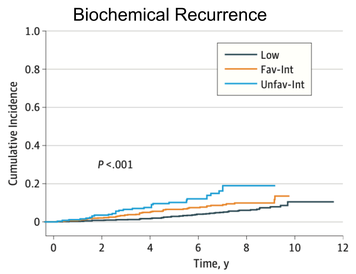
Treatment Plan: Isodose lines



(Xia, et al., 2018, p. 180)

Why SBRT for Treatment?

- SBRT is noninvasive compared to other treatment options such as surgery and brachytherapy
- Prostate cancer has a low alpha/beta ratio making it very sensitive to high doses of radiation (Vanhanen, Poulsen, & Kapen, 2020 p. 58)
- Low rates of serve toxic events and good biochemical control
- A study done on 2142 men with low-risk and intermediate-risk prostate cancer, showed SBRT treatment had good outcomes, low rate of severe toxic events, and high rates had biochemical control (Kishan et al., 2019, p. 1)
- Biochemical control rates were "less than 10% for low-risk and favorable intermediate-risk disease and just 15% for unfavorable intermediate-risk disease" (Kishan et al., 2019, p. 8)



(Kishan et al., 2019, p. 6)

- Due to higher dose, there are less treatments making SBRT more time and cost efficient (Kothari et al., 2018, p. 3)
- Time efficiency leads to better satisfied patients, because it shortens length of treatment, a common complaint among patients (Kothari et al., 2018, p. 3)
- SBRT is a safe and efficient way to treat pelvic-node in node-positive prostate cancer according to a study done on 60 lymph node positive prostate cancer patients (Telkhade et al., 2021 p. 179)

Conclusion

- Stereotactic body radiotherapy is an acceptable treatment for low-risk, intermediate-risk, and lymph node positive prostate cancer
- Continuous motion monitoring of the prostate is crucial to lower exposure to organs at risk, and to lower planning target volumes

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