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Learning objectives
• To review and critically discuss plan optimization and procedure optimization
• To touch onto patient experience and outcome from a physicist perspective.

No conflict of interest
INTRO – OR “HOW DID WE GOT HERE”

- The brachytherapy practice of today has built on decades of successful clinical experience, relying on clinical knowledge sublimated in collections of rules called ‘systems’: Stockholm, Paris, Manchester, Fletcher.
- These systems described, sometimes in great details, how things should be done; they represent practice not theory.
- This approach had a lot to do with reproducibility of treatments that were clinically successful and little to do with understanding of how things work, why a certain placement of radioisotopes actually works and explaining the mechanism behind.

MODERN ERA – 3D and DVH

- The modern era pretty much coincides with the introduction of CT in the 1970s.
- We learned how to compute radiation transport through the body very accurately and to describe our plans by employing dose volume histograms (DVH).
- Having now a set of DVH parameters that describe a dose distribution, one is in the position of optimizing that distribution by simultaneously maximizing those parameters to some structures (anatomical or disease related) while minimizing other parameters to structures related to normal anatomy, which typically one tries to spare.

The term optimization refers to the sophisticated process of achieving certain dose values at points or volumes within the implant; it is not the simple generation of a standard dose distribution by using fixed dose points located around the applicator.
To optimize ...or not.

- "With 3D dosimetry, matching the dose distribution to the high-risk clinical target volume (HR-CTV) while simultaneously avoiding the OAR can be challenging."

- "Optimization should be performed with caution by observing changes in the dose, dose/volume parameters, and the spatial dose distribution that results from the modified loading patterns. The exclusive use of dose volume histogram (DVH)-based parameters to select a source loading is not recommended because substantial and perhaps undesirable changes in the spatial dose distribution may occur. Hot or cold spots in the target region and in non-contoured OAR, such as the vagina, connective tissue, nerves, vessels, or the ureters, may result."

- "With inverse or graphical optimization, the dwell times of the intracavitary and interstitial parts should be controlled by the physicist because most optimization algorithms do not take into account the spatial dose distribution."

Plan Optimization for Cervical Cancer

3.4 Optimization

"Manual optimization relies on the possibility to activate dwell positions and to modulate dwell times on different locations of the catheters and/or to add interstitial needles in order to improve the dosimetry."

"In order to provide fast and automatic solutions for dose optimization, inverse planning approaches have been proposed. However, this approach could generate heterogeneity in dwell time values with hot points. If used, caution is required. In general, inverse planning is not recommended and manual optimization is preferable. Chajon et al. reported comparison between manual optimization method and inverse planning simulated annealing on thirty patients [46]. They found similar D90, D100 and V100 with both methods but a heterogeneous distribution with inverse planning simulated annealing."
"The difficulty in pursuing an exclusive dose/volume based optimization stems from the fact that the structures involved explicitly in the planning (high-risk clinical target volume [HR-CTV], rectum, sigmoid, and bladder) and those involved implicitly (uterus, vagina, ureters, and connective tissue) are not enough to drive, by themselves, an optimizer toward a standard pear-shaped dose distribution."
Breast – Interstitial implants

- Image 1
- Image 2
- Image 3
- Image 4
Optimization - Do the best in the least amount of time

- Analyze the whole workflow and choose the one which minimizes the amount of time while also minimizing uncertainty and errors and maximizing the quality of the treatment.

US based insertion + CT based planning

TOTAL = 210min to 330min
US based insertion and planning

Pre-procedure Preparation

Positioning & Preparation

Placement of Needles & US stepper

US imaging of Structures and Applicator delineation

Treatment Planning QA

Treatment Delivery

Patient Recovery

30min

30-45min

20-45min

30-45min

TOTAL = 100min to 170min

US based insertion and planning

MR assisted
What matters most for patient: experience and outcome

- social needs
- spiritual needs
- practical needs
- daily living needs
- patient-clinician communication
- family-related needs
- physical needs
- psychological emotional needs
- interpersonal/intimacy needs and
- health system/information needs.

Patients' informational needs while undergoing brachytherapy for cervical cancer:

- Four themes with sub-themes were identified:
  - informational needs,
  - patient disposition towards treatment,
  - psychological experience and
  - physical experience.

- The informational needs included: providing patients with disease- and treatment-related information in their home language; adequate information concerning possible side-effects, sexual intercourse and pre-treatment preparation; and providing patients with informative material as standard procedure.
Nineteen studies were included for data extraction/synthesis. Twelve studies focused on psychological issues, seven on pharmacological aspects of women’s experiences. Themes of anxiety, distress, pain, informational needs and non-pharmacological interventions were found.

Nine out of ten psychological studies described brachytherapy as a distressing experience causing anxiety and distress for most women.

To improve women’s experiences there needs to be better pain management, patient information and the development of non-pharmacological interventions.

Future recommendations are to develop clinical support guidelines, audit the quality of services and develop effective interventions to improve women’s experiences of brachytherapy for locally advanced cervical cancer.

Studies show that men diagnosed with prostate cancer actively seek information to help them decide.

They are interested in three key types of knowledge:
- medical information (to learn about their cancer and treatment options),
- lived-experience information (to learn from other patients who had faced a similar decision), and
- medical administrative information (to learn about the logistics of their care and the experiences of their physicians).

They consult a variety of sources such as health care providers, other patients, family members, friends, support groups, decision aids, patient education materials, and the Internet.

Men with prostate cancer emphasize the importance of getting comfortable with their treatment choices. Having a chance to confirm their health care provider’s recommendations helps them with this. So does having the freedom to be involved in the decision-making process according to their own personal preferences. Men also said they particularly want information that is relevant and personalized to their specific disease status and treatment options.

A possible solution:

Interprofessional collaboration (IPC)

multiple health workers from different professional backgrounds work together with patients to deliver the highest quality of care. IPC can improve communication and knowledge sharing between collaborating professionals and can lead to an increase in efficient patient care. In the radiation therapy department, radiation oncologists, nurses, medical physicists, and radiation therapists are the key professionals involved in the multidisciplinary care team.
THANK YOU!

All slides and images are available by request

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