Common Dosimetry Errors in Cervix Patients treated with Brachytherapy on Clinical Trials

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Purpose:

The mission of the Radiological Physics Center (RPC) is to assure NCI and the Cooperative Groups that institutions participating in clinical trials deliver radiation doses that are clinically comparable and consistent. Records of patients treated with brachytherapy on a cervix trial were reviewed for completeness, consistency with the protocol, and dosimetric accuracy. Independent dose calculations were performed at points A, B, vaginal surface, bladder and rectum.

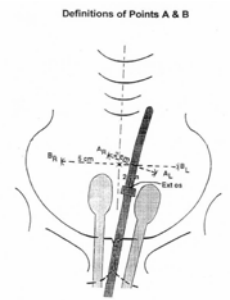
Methods and Materials:

The RPC reviewed 482 HDR and LDR implants. Doses were calculated to points A, B, bladder, rectum and the vaginal surface as defined by the protocol in accordance with ICRU–38.

ICRU – 38 Definitions

Point A – Defined as 2 cm along the intrauterine tandem in the superior direction from the flange, and 2 cm perpendicular to the tandem in the lateral direction.

Point B – Defined as 2 cm along the intrauterine tandem in the superior direction from the flange, and 5 cm lateral from the midline of the patient



Method and Materials continued:

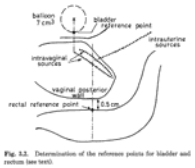
Bladder Reference Point

A Foley catheter is used. The balloon must be filled with 7 cm^3 of radio-opaque fluid. The catheter is pulled downwards to bring the balloon against the urethra. On the lateral radiograph, the reference point is obtained on an anterior-posterior line drawn through the center of the balloon. The reference point is taken on this line at the posterior surface of the balloon. On the AP radiograph the reference point is taken at the center of the balloon.

Rectal Reference Point

On the lateral radiograph, an anteroposterior line is drawn from the inferior end of the intrauterine sources (or from the middle of the intravaginal sources). The point is located on this line 5 mm behind the posterior vaginal wall. The posterior vaginal wall is visualized, depending upon the technique, by means of an intravaginal mould or by opacification of the vaginal cavity with a radio-opaque gauze used for the packing. On the AP radiograph, this reference point is at the inferior end of the intrauterine sources or at the middle of the intravaginal source(s).

Description of ICRU Bladder/Rectum Reference Points



Vaginal Surface Dose

The Vaginal Surface Dose is defined by RTOG as the dose at the surface of the ovoid.

Results:

Dosimetry dose reporting errors were discovered in 78% of the implants. Most errors resulted from incorrectly defining the calculation points. Other errors were caused by planning only the first implant and not subsequent implants. When the calculation points were defined correctly, the RPC agreed with the institutions' calculations in the majority of cases. The following shows the number of deviations found for each point and the common reasons why those errors occurred.

Results continued:

Table 1: The results of 482 implants that were reviewed by the RPC.

Point of Calculation	Total # of Points recalculated	# Dose Deviations	% Deviations
A	687	45	6.6
B	559	184	32.9
Bladder	470	78	16.6
Rectum	431	161	37.4
Vaginal Surface	116	80	69.0

- The number of calculation points is fewer than might be expected because:
  - – Some institutions only calculated the first of several implants for the same patient
  - – Only one of several protocols required calculation of vaginal surface dose
  - – Bladder contrast was not used in some patients
  - – The rectum could not be identified clearly in some patients
- 3% of the calculations at Point A were revised by the institutions after errors were identified by the RPC, improving the agreement at this point.

Common dosimetric errors for each point of calculation

Point A:

- Incorrectly determining the location of the external os.
- Using a distance other than 2 cm from the tandem to define the point.

Point B:

- Incorrectly determining the location of the external os.
- Using a distance other than 5 cm from the midline to define the point.
- Determining the point on a line perpendicular to the tandem rather than from the midline of the patient.
- Determining the point at the pelvic rim rather than at 5 cm from midline of the patient.

Bladder Point:

- Contrast was not used, therefore could not locate the bladder.
- On the AP view the point was not placed at the center of the bladder.
- On the lateral view the point was not placed on the midpoint of the bladder wall proximal to the implant.

Results continued:

Rectal point:

- Radio-opaque gauze, or other vaginal contrast, was not used.
- The institution's own rectal markers or contrast were used to determine the rectal point.
- A distance other than 5 mm from the vaginal wall was used to define the point.
- On the AP view, attempting to match the location of the point from the lateral view.

Vaginal Surface:

- Defined at a distance rather than at the surface of the ovoid.

Conclusions:

Points A, B, bladder, rectum and vaginal surface have been defined in clinical protocols, but a significant percentage of the community did not use these definitions to calculate patient doses.

These reporting errors lead to inconsistencies in reported doses for the trial.

Participants in clinical trials should follow the protocols carefully to avoid making errors that can result in protocol deviations.

Credentialing of institutions to participate in clinical trials has been shown to reduce the frequency of calculation errors.

References

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