

Brachytherapy workflow for locally advanced cervical cancer: A survey of Canadian Medical Physicists

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INTRODUCTION

- Recently, several enhancements have been made to the brachytherapy (BT) treatments of locally advanced cervical cancer (CC), namely:
 - use of MRI during planning for better soft tissue contrast
 - innovative applicator designs and use of interstitial catheters
 - guidelines/recommendations for BT planning and delivery¹⁻³
 - use of equivalent radiobiological dose for BT dose calculation
- Many Canadian centres are gradually implementing these changes into routine practice.
- This survey was undertaken to gauge the differences in CC-BT practices in Canada.

AIM

To report on the patterns of practice and workflows for CC-BT treatments in Canada from a physicist's perspective.

METHOD

- Participants:
 - Medical physicists in 33 Canadian cancer centres were contacted between December, 2019 and February, 2020:
 - 21 participated; representation from all provinces
 - 8 offered no CC-BT
 - 4 did not respond
- Survey on CC-BT workflow:
 - 44-item electronic questionnaire
 - surveyed questions included details of:
 - External beam radiotherapy (EBRT) dose & fractionation
 - BT equipment: afterloaders & treatment planning systems
 - BT patient workload
 - BT imaging to aid applicator insertion, contouring, & planning
 - BT planning: personnel involved, dose & fractionation, planning strategy
- Descriptive analyses was used to evaluate the data.

PLANNING GUIDELINES FOR EBRT & BT

- 15 centres followed the EMBRACE guidelines;
 - other guidelines used were from RTOG, GEC-ESTRO, QUANTEC, CCO, & ABS.
- 2 centres used in-house guidelines.

WORKLOAD

*shown as median [minimum – maximum]

- Number of BT procedure days/week:
 - 1.75 [1 – 5] days
- Number of patients/procedure day:
 - 2 [1 – 3]
- Overall treatment times, including EBRT, was 50.5±5.6 days.

RESULTS

Table 1: Details of BT afterloaders and treatment planning software (TPS)

	Vendor	Model	# of centres
Afterloaders	Elekta	Flexitron	6
		microSelectron	6
	Varian	VariSource	2
		GammaMed	6
	Eckert & Ziegler	BEBIG	1
Treatment planning systems	Elekta	Oncentra	12
	Varian	BrachyVision	8
	Eckert & Ziegler	HDR plus 3 & SagiPlan	1

Table 2: BT dose-fractionation regimens used by the respondents following EBRT treatment of 45 Gy in 25 fr (n=20) or 46 Gy in 23 fr (n=1)

Afterloader type	Fractions (HDR) or Pulses (PDR)	Planning aim dose per BT fraction or pulse (Gy)	# of centres	Total planning aim dose (EQD2 ₁₀)
HDR	3	8	2	36.0
	3	9.5 – 10	1	46.3 – 50.0
	4	6	1	32.0
	4	7	13	39.7
	4	7.75	1	45.9
	5	6 – 7	1	40.0 – 49.6
	6	4.6	1	33.6
PDR	58	0.73	1	46.1

Table 3: Imaging modalities used to assist applicator insertion and for planning

	Imaging modality	# of centres
During applicator insertion in the operating room	US only	14
	US & CT	1
	US, MRI, & C-arm	1
	CT & C-arm	1
	None	4
For contouring and planning	MRI (for contouring & planning)	4
	MRI (for contouring) & CT (for planning)	8
	CT (for contouring & planning)	8
	CBCT	1

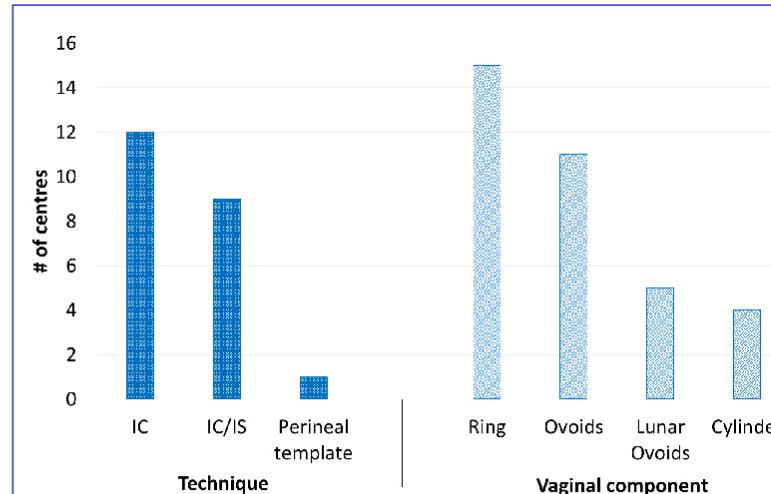


Figure 1: Techniques and vaginal components used. IC: Intracavitary, IS: Interstitial
 > n = 9 centres performed IC/IS treatments for 25 – 75% of their patients.
 > Most common vaginal components used with the tandem were ring and ovoids.
 > n=10 centres used ≥ 2 vaginal components including the lunar ovoids (Venezia) and cylinders.

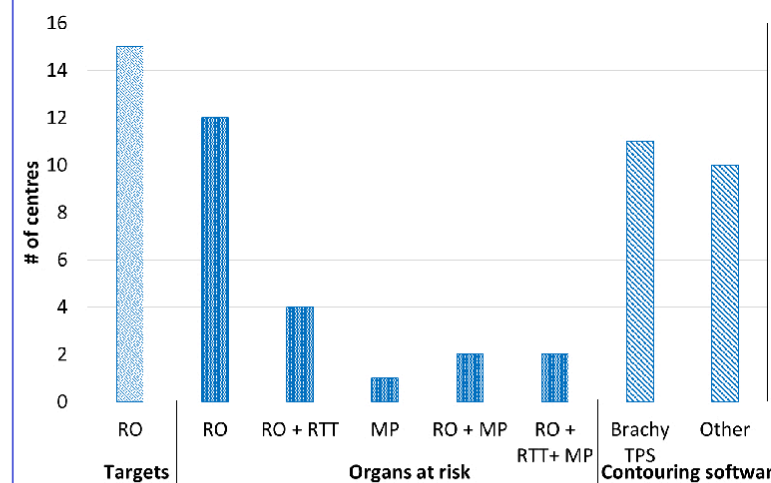


Figure 2: Contouring responsibilities and software used. RO = Radiation Oncologist, RTT = Radiation therapist / Dosimetrist / Dedicated brachy therapist, MP = Medical Physicist
 > Targets were contoured (always by ROs) only by centres performing volume-based planning.
 > 10 centres used a separate software to contour (mostly when using MR images) while catheter reconstruction proceeded concurrently on the BT TPS.

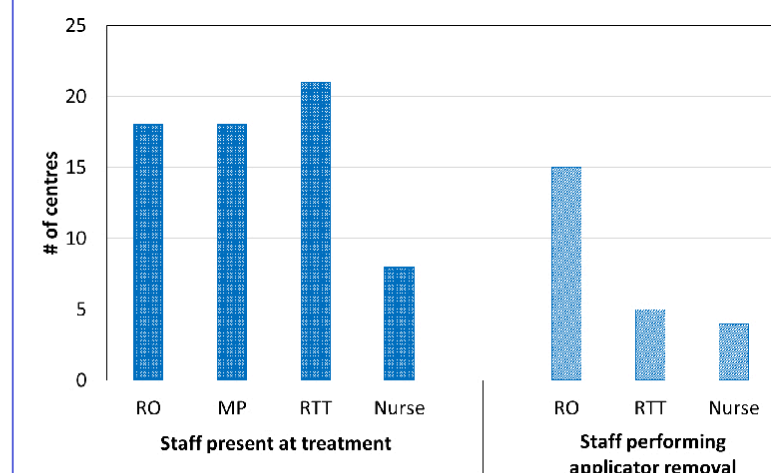


Figure 3: Clinical responsibilities during and after treatment.
 > During treatment delivery, a multi-disciplinary team is typically present.
 > Applicator removal is usually done by ROs, but both trained RTTs and nurses may take on this responsibility.

PLANNING VARIANCES

- 15 centres performed volume-based planning and 6 used prescription to Pts A.
- Contoured structures included:
 - Targets: GTV-B, CTV-HR, CTV-IR
 - Organs-at-risk (OARs): bladder, bowel, rectum, sigmoid
 - 4 centres, doing Pt A based planning, contoured only the OARs.
- 12 centres use MRI for contouring the first fraction of insertion 1.
 - Insertion 2 or higher were mostly based on CT; only 4 centres used MRI
- Planning process began with standard loading followed by manual/graphical optimization
 - n=2 used inverse planning.
- Planning was done either by physicists (n=12) or with assistance from BT dosimetrists/RTTs (n=7).
- Most common HDR dose-fractionation schedule was 7 [4.6 – 10] Gy in 4 [3 – 6] fractions aiming for a total median radiobiological CTV-HR dose (calculated in n=14 centres) of 85 [80 – 95] Gy₁₀.
- Typical planning times (including contouring, catheter reconstruction, and planning) was 2.00 [0.33 – 4.00] hours.
- Quality assurance following plan acceptance:
 - Manual second check: n = 13 by another physicist, n = 1 by an RTT, n = 7 had no checks.
 - Using another software: RadCalc (12), in-house (6), None (3).

CONCLUSIONS

- This work will inform the Canadian brachytherapy community of the changes and trends in the brachytherapy treatment of locally advanced cervical cancer.
- It shows the migration towards MRI-based volumetric treatment planning, personalizing BT treatments using hybrid intracavitary (IC)/interstitial (IS) applicators, and the adoption of international treatment guidelines (e.g. Embrace II) as standard of practice.
- Cervical cancer brachytherapy in Canada is becoming more streamlined with use of international practice guidelines.

REFERENCES

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