Adjuvant radiotherapy for endometrial cancer in a renal transplant patient - a case report

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ABSTRACT

Background: Treatment of locally advanced endometrial cancer in patients with transplanted pelvic kidney requires precautions because of its anatomical position next to target volumes.

Case Presentation: We report a case of 42-year-old woman with a right renal transplant for 3 years diagnosed with endometrial cancer for which she underwent total abdominal hysterectomy with bilateral salpingo-oophorectomy and pelvic lymphadenectomy. Adjuvant Radiotherapy (RT) was planned through intensity modulated RT (IMRT) with 45 Gy in 25 fractions followed by vaginal brachytherapy (5 Gy × 2 sessions) . Planning with IMRT quantified a mean dose of 2 Gy and maximum dose of 10 Gy over the transplanted kidney. This dose was further reduced with a comparative plan of three-dimensional conformal RT (3DCRT), recording a mean dose of 1 Gy and maximum dose of 5 Gy to the transplanted kidney. 3DCRT plan was accepted and delivered. At 2-year follow-up, patient is disease free with normal renal function.

Conclusion: In the presence of advanced techniques, 3DCRT is still a valid radiation technique to keep the critical organ dose under acceptable dose-volume constraints without compromising the target volume.

Keywords: Renal transplant, endometrium carcinoma, 3DCRT, IMRT, case report.

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Background

Randomized trials have shown that adjuvant pelvic Radiotherapy (RT) for endometrial cancer improves loco-regional control. Intensity modulated RT (IMRT) is an advanced and most efficient type of three-dimensional radiotherapy in which multiple beams of various intensities are aimed at the tumor from many angles. It has the potential to deliver adequate dose to the target structures while minimizing delivered dose to critical organs. The treatment of locally advanced endometrial cancer in patients with transplanted pelvic kidney requires precautions because of its anatomical position next to target volumes.

Case Presentation

A 42-year-old premenopausal woman underwent a right renal transplant 3 years back due to bilateral renal failure. She presented to the emergency department with a complaint of metrorrhagia. Her initial workup involved pelvic ultrasound. Later, pelvic magnetic resonance imaging was performed and demonstrated heterogeneously thickened endometrium involving more than half of myometrium. Hysteroscopy was performed along with biopsy from endometrium reported as endometrial adenocarcinoma grade II. Staging workup was negative for distant metastasis, while showing a normally enhancing transplanted kidney in the right hemi pelvis.

After consensus in the site-specific gynecological tumor board meeting, she underwent total abdominal hysterectomy with bilateral salpingo-oophorectomy and pelvic lymphadenectomy. Her histopathology was reported as endometroid adenocarcinoma, grade II, International Federation of Gynecology and Obstetrics stage II disease. She was evaluated for radiation to the pelvis. We planned external beam radiation therapy (EBRT) (45 Gy at 1.8 Gy per fraction) followed by intracavitary vaginal brachytherapy 2 sessions of 5 Gy . Risks and benefits were explained to the patient.

For treatment planning, computed tomography (CT) scan with 3-mm slices was obtained. The major concern was right transplanted pelvic kidney so during radiation planning CT scan, a vaginal cylinder mimicking the brachytherapy apparatus was inserted in the vagina. This helped in defining the anatomical relation of the vaginal stump with the transplanted pelvic kidney on radiation

planning CT scan. The clinical target volume and organs at risk (bladder, rectum, renal graft, femoral heads and bowel bag) were contoured according to Radiation Therapy Oncology Group 0418 [1]. The volumes were discussed in the peer review meeting. Initially, an IMRT plan was generated and reviewed but the doses to the transplanted kidney were higher for the criteria but still acceptable. Later, another comparative plan was generated with three-dimensional conformal radiation therapy (3DCRT) to compare the doses received by the transplanted kidney. Table 1 shows doses received by planning target volume (PTV) and transplanted right kidney.

The patient was planned to use IMRT technique. On transplanted right kidney, the mean dose was 2 Gy and the maximum dose was 10 Gy. Another plan was made using 3DCRT technique. In comparison with IMRT, the doses were reduced in 3DCRT plan. The mean dose was 1 Gy and the maximum dose was reduced to 5 Gy as shown in Figure 1. Both plans allowed delivery of a therapeutic dose to the target volume of the PTV and reduced dose to organs as shown in Figure 2.

Both plans were discussed in the peer review meetings and 3DCRT plan was accepted for treatment. On completion of EBRT, the patient received high dose rate vaginal brachytherapy with 5 Gy in 2 sessions. Radiation was well tolerated by the patient.

After 2 years of follow-up, the patient is free of disease and maintaining a normal renal function with a creatinine of 0.8 mg/dl and no graft failure.

Discussion

RT is constantly evolving with time, showing its dynamic nature. Technology plays an important role in the advancement of this field revolutionizing it from conventional two dimensional based planning to 3DCRT guided planning; to the introduction of beam modulation and beamlets through inverse planning called IMRT. These advancements have allowed in the improvement of tumor control, decreased side effects and toxicities due to better conformity of radiation plans allowing dose escalation to tumors and sparing organ at risk (OAR) [2].

IMRT has been time-tested , in pelvic gynecological malignancies making it a smart choice for radiation oncologists. Multiple studies showed advantages of IMRT over 3DCRT plans including better coverage of (PTV) and better OAR sparing but increased integral dose to normal

Table 1. *Dose to target volume and OAR.*

ORGANS	VOLUME CM^3	IMRT			3DCRT		
		MINIMUM DOSE CGY	MAXIMUM DOSE CGY	MEAN DOSE CGY	MINIMUM DOSE CGY	MAXIMUM DOSE CGY	MEAN DOSE CGY
PTV	902.6	2,014.2	5,081.1	4,500	1,019.5	2,987	4,530
Right kidney	228.6	54	1,084.3	254	20.1	595	104.7

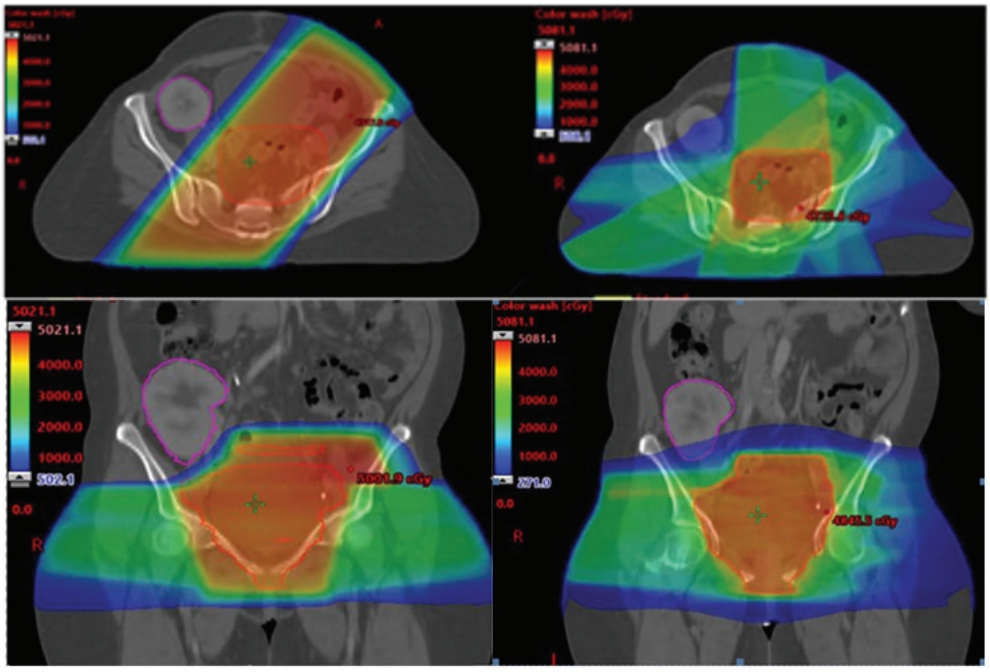


Figure-1. *Axial and coronal images of whole pelvis field demonstrating the right kidney (magenta) and PTV (red). Isodose distribution for 3DCRT (left) showing rapid dose fall off and with IMRT (right) low dose spillage.*

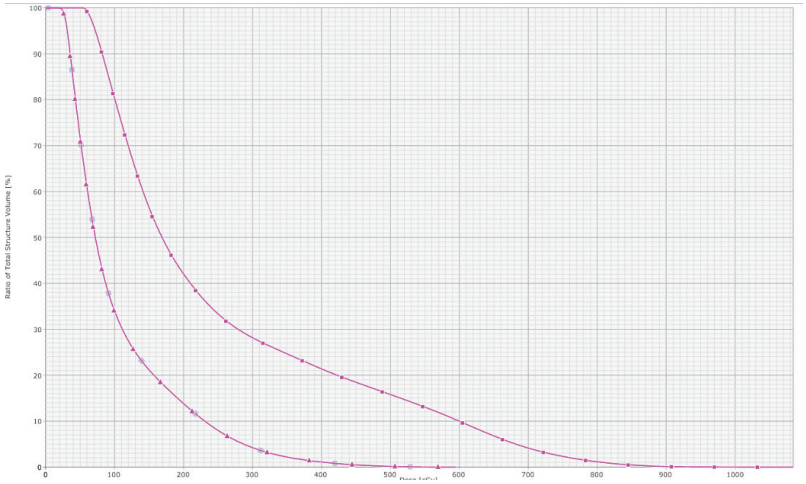


Figure 2. *DVH of percentage dose to right transplanted kidney comparing IMRT (square) and 3DCRT (triangle) technique.*

Table 2. *Summary of published case reports.*

AUTHOR	YEAR	SITE	DOSE DELIVERED (GY)	CASE REPORT/ SERIES	3DCRT/IMRT	GRAFT DOSE	TRANSPLANTED RENAL FUNCTION
Mouzin et al. [9]	2004	Prostate	70	Series (*N* = 8)	3DCRT	<20 Gy	One patient developed renal failure
Detti et al. [10]	2011	Prostate	70	Case report	IMRT	Maximum = 1.88 Gy Mean = 0.36 Gy	Normal renal
Mohiuddin et al. [11]	2012	Cervix	59.4	Case report	IMRT	15 Gy	Normal renal function
Rosenfelder et al. [12]	2014	Prostate	74	Case report	IMRT	Mean = (2.1-3.05) Gy Maximum = (27.9-34.1) Gy	Normal renal function
Pedro et al. [13]	2018	Endometrium	45	Case report	IMRT	Mean = 6.4 Gy	Normal renal function

tissues around the target volumes and pelvic bones [3,4]. With time and development of technology, several studies were published starting transforming from tolerance doses (TD) as from the concept of TD 5/5 to the volumetric analysis of OAR with dose-volume histogram (DVH) with the introduction of quantitative analyses of normal tissue effects in the clinic study.[5,6]. The transplanted kidney is an uncommon presentation for patients receiving EBRT for pelvic malignancy and poses a great challenge during the planning of radiation therapy. As per the International Commission of Radiation Units and Measurements (62), the kidney is considered both a serial and parallel organ. Generally, a mean dose of <15 to 18 Gy is considered a safe dose for normal bilateral kidney causing <5% of relevant clinical dysfunction; but for transplanted kidney dose limits are not defined. A literature search from studies showed multiple doses starting from 4- < 12 Gy extrapolated from total body irradiation to define minimum tolerance dose for the transplanted kidney [7,8]. Few case reports and series have been published for the transplanted kidney as shown in Table 2.

To obtain an optimal PTV coverage along with a reduced dose to OAR especially to the graft was pertinent and challenging. Dose reduction or exclusion of the graft from a radiation field could result in compromising the efficacy of treatment. A max dose of <5 Gy seems to be well-tolerated by the graft.

Conclusion

Renal transplant is not a contraindication to radical pelvic RT. Despite the presence of advanced techniques, 3DCRT is still a valid radiation technique to keep the collateral dose to neighboring tissue under acceptable dose-volume constraints without compromising the target volume and comparable outcomes with IMRT. RT facilities are limited in lower middle-income countries and every plan needs justification in terms of technique used. Technological advancement (hardware and software) does matter but methodology is an important core to optimize the use of upgraded technology as we have described in our case report.

What is new?

Radiotherapy to pelvis in a known patient of transplanted kidney is a challenge. In the presence of advanced techniques, 3DCRT is still a valid radiation technique to keep the critical organ dose under acceptable dose-volume constraints without compromising the target volume.

List of Abbreviations

3DCRT	Three-dimensional conformal radiation therapy
DVH	Dose-volume histogram
EBRT	External beam radiation therapy
IMRT	Intensity modulated radiation therapy
OAR	Organ at risk
PTV	Planning target volume
RT	Radiotherapy
TD	Tolerance dose

Conflicts of interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent for publication

Written informed consent was obtained from the patient .

Ethical approval

Ethical approval obtained at our institution to publish this case report.

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Summary of the case

1	**Patient (gender, age)**	Female, 42 years old
2	**Final diagnosis**	Locally advanced endometrial cancer with transplanted kidney
3	**Symptoms**	metrorrhagia
4	**Medications**	None
5	**Clinical procedure**	Adjuvant radiotherapy: external beam radiotherapy and brachytherapy
6	**Specialty**	Radiation Oncology