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ORIGINAL ARTICLE

Comparison of clinical outcomes and toxicity in endometrial cancer patients treated with adjuvant intensity-modulated radiation therapy or conventional radiotherapy

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KEYWORDS
conventional radiotherapy;
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toxicity

Purpose: To evaluate the treatment outcomes and toxicity in endometrial cancer patients treated with hysterectomy and adjuvant intensity-modulated radiation therapy (IMRT) or conventional radiotherapy (CRT).
Methods: There were 101 patients with stage IA-IIIC2 endometrial carcinoma treated with hysterectomy and adjuvant radiotherapy. In total, 36 patients received adjuvant CRT and 65 were treated with adjuvant IMRT. The endpoints were overall survival, local failure-free survival, and disease-free survival. Patients were assessed for acute toxicity weekly according to the Common Terminology Criteria for Adverse Events version 3.0. Late toxicity was evaluated according to the Radiation Therapy Oncology Group and the European Organization for Research and Treatment of Cancer Late Radiation Morbidity Scoring Schema.
Results: The 5-year overall survival, local failure-free survival, and disease-free survival for the CRT group and the IMRT group were 82.9% versus 93.5% ($p = 0.26$), 93.7% versus 89.3% ($p = 0.68$), and 88.0% versus 82.8% ($p = 0.83$), respectively. Four (11.1%) patients had Grade 3 or greater acute gastrointestinal (GI) toxicity and three (8.3%) patients had Grade 3 or greater acute genitourinary (GU) toxicity in the CRT group, whereas four (6.2%) patients had Grade 3 or greater acute GI toxicity in the IMRT group and no patient had severe GU toxicity. There was one (2.8%) patient who had Grade 3 or greater late GI toxicity and one (2.8%) patient had Grade 3 or greater late GU toxicity in the CRT group, whereas no patient had severe GI or GU toxicity in the IMRT group.

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Conclusion: Adjuvant IMRT for endometrial cancer patients had comparable clinical outcomes with CRT and had less acute and late toxicity.
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Introduction

Endometrial cancer is one of the most common gynecologic cancers. The mainstay treatment for endometrial cancer is total abdominal hysterectomy and bilateral salpingo-oophorectomy. The Postoperative Radiation Therapy in Endometrial Carcinoma (PORTEC)-1 study[1] found that adjuvant whole pelvis radiotherapy (WPRT) had the greatest loco-regional benefit in endometrial cancer patients who had two or more risk factors, including age $\geq$60 years, Grade 3 disease, and $\geq$50% myometrial invasion. The Gynecologic Oncology Group (GOG)-99 study[2] defined high intermediate risk patients as: (1) moderate to poorly differentiated tumor, presence of lymphovascular invasion, and outer third myometrial invasion; (2) age 50 years or greater with any two risk factors listed above; or (3) age of at least 70 years with any risk factor listed above, and they showed that adjuvant WPRT improved loco-regional control for high intermediate risk patients. Aalders et al[3] found that poor prognostic factors were International Federation of Obstetrics and Gynecology (FIGO) Stage Ic disease, Grade 3 disease, lymph-vascular invasion, and age >60 years and showed that adjuvant WPRT decreased pelvis and vaginal recurrence. WPRT is commonly used in postoperative treatment in endometrial cancer in previous randomized trials. Conventional WPRT determines the field by bony landmark alone and is capable of including most of the normal organs of the pelvis in the area of the prescribed dose. After surgery, a significant portion of the small bowel falls into the vacated space in the pelvis, thereby increasing the volume of bowel that receives a high dose. A large portion of the urinary bladder is also included in the field of radiotherapy. This increases the risk of acute and late gastrointestinal (GI) and genitourinary (GU) toxicity. Several studies[4–8] showed that intensity-modulated radiotherapy (IMRT) reduces the irradiated volume of normal tissue in gynecologic malignancies and this tends to lessen the acute and late GI and GU toxicity. To the best of our knowledge, only two studies[9,10] have compared WPRT and IMRT and the results showed a potential dosimetric advantage of IMRT over WPRT in postoperative endometrial cancer patients. To date, few studies[11–13] have evaluated the clinical outcomes of IMRT in endometrial cancer.

The purpose of this study was to evaluate and compare treatment outcomes and toxicity of IMRT and conventional radiotherapy (CRT).

Methods and materials

Patients

From January 2000 to October 2010, there were 101 eligible patients with endometrial cancer documented at the radiation oncology department of Taichung Veterans General Hospital, Taiwan. The inclusion criteria were: (1) pathologically proven adenocarcinoma or endometrioid carcinoma of endometrium; (2) no evidence of distant metastasis at diagnosis; (3) patients receiving complete surgical staging with hysterectomy, bilateral pelvic lymph nodes dissection, and bilateral salpingo-oophorectomy; and (4) patients receiving a full course of adjuvant radiotherapy. The exclusion criteria were: (1) pathology with serous carcinoma, mucinous carcinoma, clear cell carcinoma and sarcoma; and (2) no surgical staging.

In this institution, adjuvant radiotherapy was indicated for endometrial cancer patients with one or more risk features, including: (1) age $\geq$60 years; (2) FIGO Stage Ib or more advanced stage; (3) Grade 2–3; (4) $\geq$50% myometrial invasion; (5) cervical involvement; (6) lymph–vascular invasion; (7) pelvic and/or para-aortic lymph nodes metastasis; (8) close (<5 mm) or involved resection margin; and (9) incomplete pelvic lymph nodes dissection, to improve the locoregional control rate. Complete lymph node dissection was defined as common, internal, external, and obturator lymph node dissection and sampling para-aortic lymph nodes.

Thirty-six patients received adjuvant CRT between January 2000 and October 2003. Sixty-five patients were treated with adjuvant IMRT from October 2003 to October 2010. Twenty-eight patients received a high dose rate brachytherapy of 8–24 Gy to the vagina vault as a local boost, which included four patients in the CRT group and 24 patients in the IMRT group. Brachytherapy was given based on the physician's decision according to the patient's individual clinical situation, such as involvement of lower uterine segment or cervix and/or vaginal invasion.

The pathological staging was performed according to the 2010, 7th edition FIGO staging system. Written informed consent was obtained from each patient before treatment. The study was approved by the Institutional Review Board of Taichung Veterans General Hospital (CE11304).

RT technique

All patients were scheduled to undergo adjuvant radiotherapy. CRT included two- and three-dimensional radiotherapy. CRT was delivered either through the anterior–posterior and posterior–anterior field or with a four-field treatment plan. The field covered the entire pelvis, including the upper half of the vagina, paravaginal area, parametrium, uterosacral tissues, and external iliac, hypogastric and obturator lymph nodes. The superior border was defined at the L4–5 interspace, the inferior border was at the mid-portion of the obturator foramen, and the lateral borders were set at 1.5–2.0 cm beyond the lateral margins of the bony pelvic wall at the widest plane of the pelvis. The posterior border of lateral field was the anterior border of the S3 vertebral body and the anterior

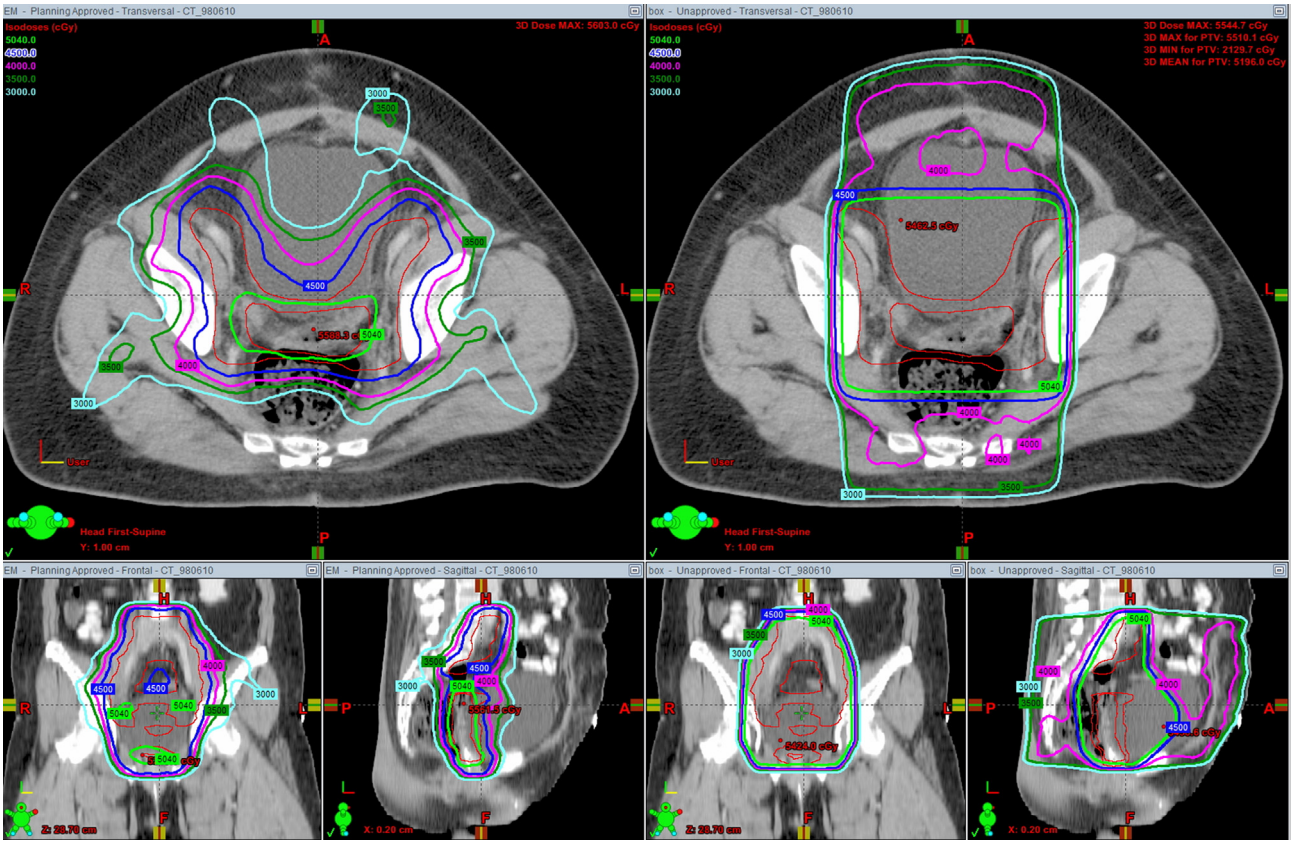

Figure 1 This 43-year-old female had International Federation of Obstetrics and Gynecology Stage Ib endometrial cancer and received hysterectomy, bilateral pelvic lymph nodes dissection, bilateral salpingo-oophorectomy, and para-aortic lymph nodes dissection. A total dose of 50.4 Gy was planned by Eclipse software. The isodose curve was compared for intensity modulated radiotherapy (IMRT) and cradiotherapy (CRT). This figure shows the different dose distributions of CRT (right) and IMRT (left). In axis view and sagittal view, the bowel and the bladder received a significantly lower dose in the IMRT plan than in the CRT plan.

border of the symphysis pubis. No pelvic structures were blocked during the radiotherapy treatment course. The dose of CRT was usually 50.4 Gy in 28 fractions, 1.8 Gy/fraction, and five fractions/week. Patients received CRT in the supine position and immobilized by a custom vacuum lock bag.

The IMRT planning and all treatments were performed in the supine position with a full bladder. This was achieved by asking patients to empty their bladder 30 minutes before computed tomography (CT) simulation and daily treatment and drink 300 mL of water. A custom vacuum lock bag was used for pelvic immobilization for CT simulation and daily treatment. IMRT treatment was delivered using a dynamic multileaf linear accelerator with photon energy of 10 MV. Eclipse software was used for treatment planning of intensity-modulated radiotherapy. The gross target volume (GTV) was defined as parametrium, upper vagina, and paravaginal tissues. The clinical target volume (CTV) was delineated including a 0.5—1.0 cm margin to GTV radially and the pelvic lymph node regions (common, internal, external iliacs, and obturator lymph nodes), for all the patients. For patients with cervical stromal invasion, the presacral lymph node region was also contoured to the inferior border of S2. A margin of 0.5—1 cm was added to the "vessels" contour in all dimensions and modified by anatomic boundaries to create the nodal clinical target volume, from which the pelvic bones, femoral heads, and vertebral bodies were excluded. Planned target volume (PTV) with a 0.7—1 cm margin superiorly, inferiorly, and radially was given to the CTV. A total dose of 50.4—60 Gy in 28—30 fractions, 1.8—2.0 Gy/fraction, and five fractions/week, was delivered to the GTV, and the isodose curve of 50.4—60 Gy encompassed 100% of the GTV. A total dose of 45—48 Gy in 28—30 fractions was given to the PTV, and the isodose curve of 45—48 Gy encompassed 100% of the CTV and >99% of the PTV.

If patients had para-aortic lymph node metastasis, extended field radiotherapy with IMRT technique was given. CTV encompassed the para-aortic lymph nodes area and pelvic lymph nodes region with the superior border extending to the T12—L1 interspace. CTV was expanded by 0.7—1 cm to create the PTV and a total dose of 45—48 Gy in 28—30 fractions was given to PTV.

The critical organs contoured included the bladder, rectum, small intestine, and colon on every slice. The rectum is usually defined from the level of anus to the sigmoid flexure and received a dose of V30 <50%. The small bowel loops and colon were outlined with the treatment field plus a 2 cm margin and a dose of V30 <15% was given. The received dose of bladder was restricted to V45 <35%. Fig. 1 shows the different dose distributions of CRT and IMRT.

Table 1 Patient's characteristics.

		CRT (n = 36)	IMRT (n = 65)
Age (y)	Median	59	54
	Range	32–81	27–79
Age ≥60 y		17 (47.2)	17 (26.2)
FIGO Stage	Ia	6 (16.7)	14 (21.5)
	Ib	11 (30.5)	24 (37.0)
	II	9 (25.0)	9 (13.8)
	IIIa	5 (13.9)	6 (9.2)
	IIIb	0	0
	IIIc	5 (13.9)	12 (18.5)
	IV	0	0
LVSI		4 (11.1)	19 (29.2)
Grade	1	3 (8.3)	11 (16.9)
	2	20 (55.6)	33 (50.8)
	3	13 (36.1)	21 (32.3)
Incomplete LN dissection		2 (5.6)	5 (7.7)
Margin[a]		3 (8.3)	10 (15.4)
RT field	Pelvis	32 (88.9)	57 (87.7)
	Extended	4 (11.1)	8 (12.3)
RT dose, Gy		50.4	45–60
Chemotherapy		2 (5.6)	9 (13.8)
Brachytherapy		4 (11.1)	24 (36.9)

Data are presented as n (%), unless otherwise indicated.
CRT = conventional radiotherapy; FIGO = International Federation of Obstetrics and Gynecology; IMRT = intensity-modulated radiotherapy; LVSI = lymph vascular space invasion; LN = lymph nodes.
[a] Margin included close margin (<5 mm) and involved margin.

The source used in high-dose rate brachytherapy was iridium-192. A cumulative dose of 8–24 Gy was prescribed at a depth of 0.5 cm from vaginal surface in 2–6 fractions, two fractions/week. Four patients received brachytherapy after CRT, ranging from 10–16 Gy. Brachytherapy, ranging from 8–24 Gy, was delivered in 24 patients after IMRT.

Sequential chemotherapy with a cisplatin, doxorubicin, and taxel-based regimen was considered in patients with FIGO Stage III disease before and/or after adjuvant radiotherapy. Chemotherapy was delivered according to the patients' clinical condition. Chemotherapy was given in 11 patients, which included two in the CRT group and nine in the IMRT group.

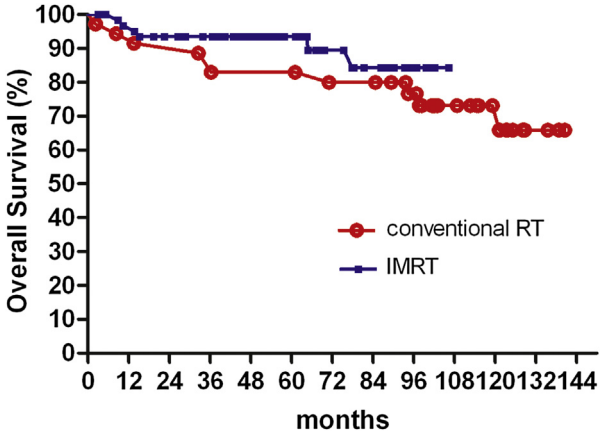

Figure 2 Overall survival.

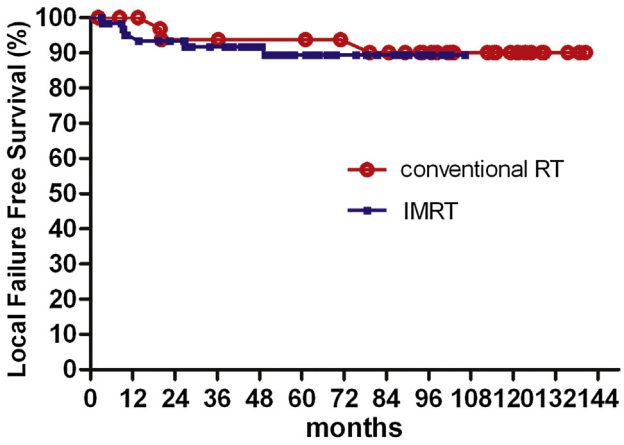

Figure 3 Local failure-free survival.

Statistical analysis

The endpoints were overall survival (OS), local failure-free survival (LFFS), and disease-free survival (DFS). OS was defined as the time from the date of operation to the date of death from any cause or last follow-up. LFFS was measured from the date of operation to the date of any evidence of local recurrence or last follow-up. The DFS was calculated from the date of operation to the date of any evidence of local recurrence, or distant metastasis or last follow-up. Survival times were estimated using the Kaplan–Meier method. Univariate comparison of survival curves were performed using the log-rank test. The statistical analyses were performed using SPSS software, version 10.0 (SPSS Inc., Chicago, IL, USA). A p value of <0.05 was regarded as statistically significant.

Acute GI and hematological toxicity were assessed weekly using the Common Terminology Criteria for Adverse

Table 2 Acute toxicity.

		CRT (n = 36)	IMRT (n = 65)
Skin	Grade 1	1 (2.8)	3 (4.6)
	2	0	5 (7.7)
	3	0	0
	4	0	0
GI	Grade 1	5 (13.9)	25 (38.5)
	2	20 (55.6)	18 (27.7)
	3	4 (11.1)	2 (3.1)
	4	0	2 (3.1)
GU	Grade 1	2 (5.6)	10 (15.4)
	2	7 (19.4)	11 (16.9)
	3	3 (8.3)	0
	4	0	0
Hematological	1	2 (5.6)	8 (12.3)
	2	1 (2.8)	3 (4.6)
	3	0	2 (3.1)
	4	0	0

Data are presented as n (%).
CRT = conventional radiotherapy; GI = gastrointestinal; GU = genitourinary; IMRT = intensity-modulated radiotherapy.

Table 3 Late toxicity.

	CRT (n = 36)			IMRT (n = 65)		
	Skin	GI	GU	Skin	GI	GU
Grade 1	2 (5.6)	3 (8.3)	1 (2.8)	2 (3.1)	0	4 (6.2)
2	0	7 (19.4)	1 (2.8)	1 (1.5)	2 (3.1)	4 (6.2)
3	0	1 (2.8)	1 (2.8)	0	0	0
4	0	0	0	0	0	0

Data are presented as n (%).
CRT = conventional radiotherapy; GI = gastrointestinal; GU = genitourinary; IMRT = intensity-modulated radiotherapy.

Events (CTCAE) version 3.0. To assess the late toxicity, physical examinations or imaging studies were performed every 3 months for the first 2 years, and every 6 months during Years 3—5, according to Radiation Therapy Oncology Group criteria.

Results

Table 1 summarizes the patients' characteristics. The median age of the CRT group was 59 years, ranging from 32 years to 81 years; and that of the IMRT group was 54 years, ranging from 27 years to 79 years. In the CRT group, 17 patients had FIGO Stage I disease, nine patients had Stage II disease, and 10 patients had FIGO Stage III. In the IMRT group, 38 patients had FIGO Stage I disease, nine patients had Stage II disease, and 18 patients had Stage III disease. Of 36 patients receiving CRT, 32 patients received pelvis radiation field and four patients received extended field radiotherapy. In 65 patients receiving IMRT, pelvis radiation fields were delivered in 57 of them and eight patients received extended field radiotherapy. Brachytherapy was given after CRT in four patients and after IMRT in 24 patients.

The median follow-up time was 101 months for the CRT group patients, ranging from 2 months to 134 months; and 61 months for the IMRT group patients, ranging from 3 months to 106 months. The 5-year OS, LFFS, and DFS for all patients were 89.5%, 91.0%, and 84.9%, respectively. The 5-year OS, LFFS, and DFS for the CRT group and the IMRT group were 82.9% vs. 93.5% (p = 0.26, Fig. 2), 93.7% vs. 89.3% (p = 0.68, Fig. 3), and 88.0% vs. 82.8% (p = 0.83), respectively.

In the CRT group, six (16.7%) patients had tumor relapse and five (13.9%) patients died of disease. Three (8.3%) patients experienced local and/or regional failure. One patient had vaginal recurrence; one patient had lymph node recurrence; and one patient had both vaginal and lymph node recurrence. Of these three patients, local radiotherapy was chosen as salvage treatment. Three (8.3%) patients had distant metastasis in CRT group. Two patients had lung metastasis and one experienced spleen metastasis. All these three patients received chemotherapy.

In the IMRT group, 10 (15.4%) patients experienced tumor relapse and six (9.2%) patients died of disease. Four patients had locoregional recurrence; four patients experienced distant metastasis; and two patients had both locoregional and distant metastasis. Of these six (9.2%) patients had local and/or regional failure, three patients had peritoneal carcinomatosis; two patients had vaginal recurrence; and one patient had lymph node recurrence. Two patients received local radiotherapy as a salvage treatment and the other four patients used chemotherapy. Of six (9.2%) patients with distant metastasis, three had lung metastasis, two had brain metastasis, and one experienced liver metastasis. Operation and/or radiotherapy were chosen as a salvage treatment for brain metastasis lesions. Patients with lung or liver metastasis received salvage chemotherapy.

Acute toxicity is summarized in Table 2. There were four (11.1%) patients who had Grade 3 acute GI toxicity and three (8.3%) patients had Grade 3 acute GU toxicity in the CRT group. In six patients who experienced Grade 3 acute toxicity and one of them had both Grade 3 GI and GU toxicity, four had FIGO Stage III disease and received extended field radiotherapy and two had Stage II disease. Four patients (6.2%) had Grade 3 or 4 acute GI toxicity in the IMRT group; two patients had Stage II disease and the other two patients had Stage I disease. No patient had Grade 3 or 4 acute GU toxicity in the IMRT group.

Late toxicity is summarized in Table 3. In the CRT group, one (2.8%) patient had Grade 3 late GI toxicity and received

Table 4 Summary of studies on toxicity of adjuvant radiotherapy.

Study	Acute Grade 3 or 4 GI toxicity	Acute Grade 3 or 4 GU toxicity	Late Grade 3 or 4 GI toxicity	Late Grade 3 or 4 GU toxicity	Technique
Tierney et al[12]	0	0	NA	NA	IMRT
Beriwal et al[13]	0	0	2.1	0	IMRT
Bouchard et al[11]	6.6	0	0	0	IMRT
Creutzberg et al[1]	NA	NA	2	NA	Conventional RT
Keys et al[2]	7.9	0	NA	NA	Conventional RT
Sutton et al[14]	15	0	NA	NA	Conventional RT
Martinez et al[15]	NA	NA	14	3.5	Conventional RT
Current study					
CRT	11.1	8.3	2.8	2.8	Conventional RT
IMRT	6.2	0	0	0	IMRT

Data are presented as %.
CRT = conventional radiotherapy; GI = gastrointestinal; GU = genitourinary; IMRT = intensity-modulated radiotherapy; NA = not available.

long-term treatment with medication, and one (2.8%) patient had Grade 3 late GU toxicity for which surgical intervention was performed to relieve the symptom. No patient had Grade 3 or 4 late GI and GU toxicity in the IMRT group.

Discussion

Creutzberg et al[1] found that the LFFS was 95.8% for FIGO Stage I endometrial cancer patients who received postoperative conventional pelvic radiotherapy. In studies by Keys et al[2] on Stage I—II and by Aalders et al[3] on Stage I, endometrial cancer patients were treated with CRT and the locoregional control rate was over 90%. Bouchard et al[11] compared IMRT and CRT and showed that the 3-year disease control rates for IMRT and CRT were 100% and 82%, respectively. In our study, we analyzed 101 patients with Stage I—III endometrial cancer and showed that the 5-year locoregional control rate (91%) was excellent. The FIGO stage and adjuvant brachytherapy are thought to be factors that affect local and regional control, but there was no significant difference in LFFS between the IMRT group and the CRT group ($p = 0.62$).

Table 4[1,2,11–15] summarizes acute and late GI and GU toxicity of our and previous studies. Keys et al[2] also treated patients with adjuvant CRT and found that 3.2% (6 of 190) of patients had Grade 3 or 4 GI obstruction and 4.7% (9 of 190) of patients had other Grade 3 or greater GI complications. They also reported that there was no Grade 3 or 4 late GU toxicity. Tierney et al[12] reported the acute toxicity of postoperative IMRT for endometrial cancer and showed that 13 of 19 patients (68%) experienced Grade 1 or 2 acute GI toxicity and 5 of 19 patients (26%) had Grade 1 or 2 acute GU toxicity, but none of them developed Grade 3 or 4 acute GI and GU toxicity during irradiation. Beriwal et al[13] analyzed 47 endometrial cancer patients treated with IMRT and found that 46 patients (97.9%) had Grade 1 or 2 acute GI toxicity and nine patients (19.1%) had Grade 1 or 2 acute GU toxicity, whereas no patients experienced Grade 3 or 4 acute GI and GU toxicity. In this study, 29 of 36 patients (80.6%) had acute GI toxicity and four (11.1%) of them had Grade 3 acute GI toxicity in the CRT group; 47 of 65 patients (72.3%) had acute GI toxicity and 4 (6.2%) of them experienced Grade 3 or 4 acute GI toxicity in the IMRT group. Of the four patients of the IMRT group with severe acute GI toxicity, two patients received pelvic radiotherapy 50.4 Gy plus brachytherapy 8 Gy; one patient received 50.4 Gy external beam radiotherapy alone; and one patient received 55.8 Gy external beam radiotherapy alone. There were no significant difference of the dose-volume histogram between these four patients and the other patients who did not have severe GI toxicity. Of these four patients, two had wound infection and poor wound healing, one had abdominal pain and intractable watery diarrhea after radical surgery, and the other patient had severe abdominal pain after surgery. They had GI symptoms, including diarrhea and abdominal pain, and local wound problems prior to when adjuvant radiotherapy was given. Thirteen patients (36.1%) developed acute GU toxicity and three (8.3%) of them had Grade 3 acute GU toxicity in the CRT group; 21 (32.3%) patients had acute GU toxicity and none of them had Grade 3 or 4 GU toxicity in the IMRT group. According to the results of previous studies[12,13] and the findings of the present study, the most common acute side effects were GI and GU toxicity, and IMRT had the potential to reduce Grade 3 or 4 acute GI and GU toxicity.

Creutzberg et al[1] treated patients with postoperative CRT and reported that 25% of patients had late complications. The most common complications were GI toxicity and they also found that only 2.0% (7 of 354) had Grade 3 or greater complications. Bouchard et al[11] treated patients with adjuvant IMRT and showed that there were no Grade 3 or 4 late GI or GU toxicity. Beriwal et al[13] also treated patients with postoperative IMRT and reported that 2.1% (1 of 47) of patients experienced Grade 3 late GI toxicity and none of them had Grade 3 or 4 late GU toxicity. In our study, most common late toxicity in the CRT group was GI complication. There were 11 patients (30.6%) who had late GI toxicity and one (2.8%) of them experienced Grade 3 toxicity. In the IMRT group, there was less late GI toxicity. Only two patients (3.1%) had late GI complication and no patients experienced Grade 3 or greater GI toxicity. We also found that late GU complications were comparable in the CRT group and the IMRT group. In the CRT group, three patients (8.3%) had GU complications and one (2.8%) of them experienced Grade 3 GU complication. Eight patients (12.3%) had late GU complication in the IMRT group, but none of them had Grade 3 or greater GU toxicity. There was no significant reduction of GU toxicity in the IMRT group, but the incidence of Grade 3 or 4 late GU toxicity was less in the IMRT group.

In the IMRT group, eight patients had Stage III disease and received extended field radiotherapy. Five of them had acute Grade 2 GI toxicity and two patients experienced Grade 1 GI toxicity; two patients had Grade 1 GU toxicity and Grade 2 GU toxicity occurred in one patient. None of them had Grade 3 or 4 acute GI and GU toxicity. In CRT group, four patients with Stage III received extended field radiotherapy and one of them had Grade 3 GI toxicity. The IMRT technique has the potential benefit to lower the dose of intestine and decrease GI toxicity, especially when the radiotherapy field is extended.

There were more patients receiving chemotherapy (5.6% vs. 13.8%) and brachytherapy (11.1% vs. 36.9%) in the IMRT group in the retrospective study. The treatment protocol varied according to the physicians' preference and the different time. There were more FIGO Stage IIIc patients (13.9% vs. 18.5%), more lymph vascular space invasion (11.1% vs. 29.2%), and more close margin status (8.3% vs. 15.4%) in the IMRT group. These three factors could also affect the LFFS and DFS. These could be the reasons for IMRT having slightly lower LFFS and DFS.

There were some limitations in this study and these include the use of a retrospective study design and the small sample size. The small number of patients limited our ability to perform multiple adjustments for potential confounders and the power of our analysis to detect small differences. In addition, the combination of chemotherapy and adjuvant brachytherapy for postoperative endometrial cancer could have affected the clinical outcomes and toxicity. A large, prospective, and randomized trial is needed to evaluate and compare the toxicity and clinical outcomes of endometrial cancer patients treated with adjuvant IMRT or CRT.

In conclusion, adjuvant IMRT for endometrial cancer patients had comparable clinical outcomes with CRT and had less acute and late toxicity. IMRT is a better choice for adjuvant treatment of endometrial cancer patients to avoid severe acute and late radiation complications.

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