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Original Article

Patterns of definitive radiotherapy practice for cervical cancer in South Korea: a survey endorsed by the Korean Radiation Oncology Group (KROG 20-06)

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Conflict of Interest
No potential conflict of interest relevant to this article was reported.

ABSTRACT

Objective: The Korean Radiation Oncology Group conducted a nationwide questionnaire survey to evaluate the patterns of clinical practice for patients with cervical cancer receiving definitive radiation therapy (RT) in South Korea.
Methods: Practicing radiation oncologists from 93 centers in South Korea were administered a questionnaire survey via e-mail. The survey focused on demographic characteristics, diagnostic evaluation, indications for definitive RT, RT techniques, RT field and dose prescription, lymph node (LN) boost RT, brachytherapy, and chemotherapy.
Results: The response rate was 62.4% (58/93 institutions). Of the 2,134 patients treated at the radiation oncology department in 2019, 48.8% underwent definitive RT. The selection of patients for definitive concurrent chemoradiation therapy and RT field, and RT dose prescription varied greatly. The upper border of the pelvis was commonly used as the bony landmark for external beam RT (81%–88% of respondents). Most (96.6%) centers performed LN boost RT with median total doses of 59 Gy and 59.2 Gy for pelvic and retroperitoneal LN, respectively. With 50% of the centers offering brachytherapy, image-guided brachytherapy and volume-based prescription were applied in 48.3% and 37.9%, respectively. Upfront concurrent chemoradiation therapy with varying prescription doses was considered by 60.4% respondents in cases of supraclavicular LN metastasis.
Conclusion: Most differences were noted in the indications for treatment, RT field, and prescription dose. This finding can serve as a reference for establishing practical RT guidelines for the management of locally advanced cervical cancer.

Keywords: Practice Patterns; Cervical Cancer; Survey; Radiation Therapy

INTRODUCTION

Despite the decreasing incidence of cervical cancer in South Korea, cervical cancer is the second most common type of malignancy in women treated with radiation therapy (RT) [1,2]. RT is indicated for patients with adverse pathological features after radical hysterectomy or those with locally advanced disease.

Author Contributions
Conceptualization: P.W.; Data curation: K.N., P.W.; Formal analysis: K.N.; Investigation: K.N., P.W.; Methodology: K.N., P.W.; Supervision: P.W.; Writing - original draft: K.N., P.W.; Writing - review & editing: K.N., P.W.

Although several guidelines have been endorsed by the American Society for Radiation Oncology (ASTRO) and European Society for Radiotherapy and Oncology (ESTRO) [3,4], survey on the recent patterns of care in the Netherlands and Italy showed that various imaging modalities for treatment planning, delineation of target volume, and adaptive planning were applied [5,6].

The Korean Radiation Oncology Group (KROG) has conducted several studies on the patterns of care for breast, hepatocellular carcinoma, and prostate cancer [7-9]. Although we have reported the current practice of brachytherapy in South Korea, there is no available feedback regarding the different practices of performing RT after the introduction of the Korean Society of Gynecologic Oncology guidelines [10,11]. Since intensity-modulated RT (IMRT) enables the application of various dose fractionation schemes, detailed field and dose prescriptions need to be investigated to establish updated guidelines. In addition, therapeutic approaches used in patients with lymph node (LN) involvement (such as pelvic, retroperitoneal, or supraclavicular node [SCN] involvement) should be reviewed thoroughly across institutions after adopting the revised 2018 Fédération Internationale de Gynécologie et d'Obstétrique staging system for cervical cancer.

Herein, the current study aimed to assess the patterns of definitive RT in current practice for patients with cervical cancer in South Korea.

MATERIALS AND METHODS

1. Survey participants

In October 2020, practicing radiation oncologists from 93 centers of the Korean Society of Radiation Oncology were invited to participate in a survey via email. Participants with a valid e-mail address who were actively working at the institution and did not have a suspended membership were eligible for the study.

2. Clinical survey questions

The survey focused on the clinical aspects of definitive RT in patients with cervical cancer. It included multiple-choice questions as well as several open-ended questions to effectively elicit the participants' description of clinical practice. The questionnaire comprised items related to the following topics: demographics in 2019, diagnostic evaluation, indications, RT techniques, RT field and total prescription dose, LN boost RT, brachytherapy, and chemotherapy (Appendix 1). A follow-up survey with one clinical scenario of stage IV disease with SCN metastasis was sent through e-mail (Appendix 1). The current study was conducted under the authorization and cooperation of the KROG (KROG 20-06).

RESULTS

Radiation oncologists from 58 (62.4%) of 93 centers responded, and the survey data were collected and analyzed.

1. Demographics

Of the 2,134 patients who started RT in 2019 from 58 centers, 1,042 (48.8%) underwent definitive RT/concurrent chemoradiation therapy (CCRT). With a median of 11 patients

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Table 1. Demographics of patients treated with radiation therapy

Category	Value
Total No. of patients treated with radiation therapy	21 (11–42)
0–25	32 (55.2)
26–50	13 (22.4)
51–75	6 (10.3)
76–100	2 (3.4)
>100	5 (8.6)
No. of patients treated with definitive radiation therapy	11 (6–20)
0–10	27 (46.6)
11–20	17 (29.3)
21–30	6 (10.3)
31–50	2 (3.4)
>50	6 (10.3)
Proportion of definitive radiation therapy	51.0 (40.0–62.5)
0%–25%	8 (13.8)
>25%, ≤50%	20 (34.5)
>50%, ≤75%	25 (43.1)
>75%	5 (8.6)

Values are presented as median (interquartile range) or number of centers (%).

who received definitive RT per institution, 44/58 (75.9%) centers reported that ≤20 patients received definitive RT (**Table 1**). However, 30/58 (51.7%) institutions performed definitive RT in >50% patients with cervical cancer treated at department of radiation oncology.

2. Diagnosis workup

Details of the preferred diagnostic evaluation are summarized in **Supplementary Table 1**. Mostly, abdominopelvic computed tomography (CT) (n=46, 79.3%), pelvic magnetic resonance imaging (MRI) (n=57, 98.3%), and positron emission tomography (PET)/PET-CT (n=57, 98.3%) were performed before RT. In addition, 36 (62.1%) and 34 (58.6%) institutions routinely performed colonoscopy and cystoscopy, respectively.

3. Indications

Definitive CCRT was considered in most patients with parametrial extension (55/58, 94.8%), followed by those with LN involvement (48/58, 82.8%) and those with low vaginal involvement (40/58, 69.0%, **Table 2**). Respondents evaluated the parametrial extension using MRI (n=53/58, 91.4%) and pelvic examination (n=30/58, 51.7%). To assess for LN involvement, the respondents chose the following imaging modalities: PET/PET-CT (n=43/48, 89.6%), CT (n=38/48, 79.2%), and MRI (n=37/48, 77.1%). Of the 24 (41.4%) respondents who

Table 2. Preferred indications for definitive CCRT and radiation therapy alone

Variables	Value
Criteria for CCRT	
No specific criteria	1 (1.7)
Tumor size	24 (41.4)
Parametrium involvement	55 (94.8)
Low vagina involvement	40 (69.0)
Lymph node involvement	48 (82.8)
Criteria for RT alone	
Age	19 (32.8)
Performance status or comorbidity	57 (98.3)
Poor kidney function	42 (72.4)

Values are presented as number of centers (%).
CCRT, concurrent chemoradiation therapy; RT, radiation therapy.

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valued the significance of tumor size in determining the need for definitive CCRT, 83.3% (n=20) preferred the tumor size of 4 cm as the cutoff criterion. Of 58 centers, 57 (98.3%) valued patients' performance status and comorbidity as significant factors for determining the need for RT alone, while 42 (72.4%) included kidney function status as a determinant factor (**Table 2**). Among 19 institutions that used age as a criterion for implementing RT alone, more than half of the institutions (11/19, 57.9%) regarded 80 as the cutoff value of patients' age.

4. Techniques of RT

With regard to RT planning, 35/58 (60.3%) centers adopted IMRT in more than 50% of the cases. Among 35 IMRT planning centers, only 15/35 (42.9%) centers performed adaptive planning during RT: after fixed-dose RT (range: 36–45 Gy) in 9 centers and after improper image guidance using kV or MV cone-beam CT conducted before each fraction in 6 centers. During RT, 45/58 (77.6%) respondents performed imaging evaluation: using MRI (n=26, 44.8%), CT and MRI (n=12, 20.7%), CT (n=4, 6.9%), MRI and PET/PET-CT (n=2, 3.4%), and CT, MRI, and PET/PET-CT (n=1, 1.7%).

5. Field and dose fractionation

Details regarding the upper border of external beam RT (EBRT) according to LN status are summarized in **Table 3**. In patients without LN involvement, 34/58 (58.7%) respondents preferred the L4–5 levels as the upper borders. In the subgroup of patients with pelvic LN

Table 3. Radiation therapy field and dose schedule preferences according to the level of lymph node involvement

Variables	Value
Upper border of RT field	
If no LN involvement	
Sacral promontory	14 (24.1)
L4–5	34 (58.7)
Common iliac artery	10 (17.2)
If pelvic LN involvement	
Sacral promontory	6 (10.3)
L4–5	28 (48.3)
L3–4	6 (10.3)
L2–3	3 (5.2)
L1–2	1 (1.7)
T12–L1	1 (1.7)
Common iliac artery	11 (19.0)
Involved node + margin	2 (3.4)
If retroperitoneal LN involvement	
L1–2	2 (3.4)
T12–L1	40 (69.0)
T11–12	1 (1.7)
T10–11	1 (1.7)
Renal vessel	4 (6.9)
Celiac axis	3 (5.2)
Involved node + margin	7 (12.1)
Dose schedule for whole pelvic RT	
45 Gy/25 Fxs	25 (43.1)
50.4 Gy/28 Fxs	24 (41.4)
50 Gy/25 Fxs	5 (8.6)
46 Gy/23 Fxs	2 (3.4)
Not uniform	2 (3.4)
50.4 Gy/28 Fxs or 46 Gy/23 Fxs	1
50.4 Gy/28 Fxs or 45 Gy/25 Fxs	1

Values are presented as number of centers (%).
Fxs, fractions; Gy, gray; LN, lymph nodes; RT, radiation therapy.

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metastasis, the bony landmarks were most commonly used (77.6%), except in 11 (19.0%) and 2 (3.4%) centers, which utilized the vascular anatomical margin (i.e., aortic bifurcation) and the involved nodal area, respectively. Specifically, the L4–5 levels were the most frequently (n=28, 48.3%) used upper borders, followed by the sacral promontory (n=6, 10.3%) and the L3–4 levels (n=6, 10.3%). For patients with retroperitoneal LN metastasis, 44/58 (75.8%) institutions using bony landmarks, the T12–L1 levels (n=40, 69.0%) was mostly selected. In addition, 7 (12.1%) and 7 (12.1%) centers chose the vascular anatomy and involved nodal level, respectively, as the upper borders of EBRT.

The most frequently implemented dose fractionation schedules for pelvic EBRT were 45 Gy in 25 fractions (n=25, 43.1%) and 50.4 Gy in 28 fractions (n=24, 41.4%, **Table 3**).

6. LN boost

Fifty-six physicians (96.6%) reported that they performed LN boost in routine practice. However, results indicate that each physician adopted various LN boost strategies (**Table 4**).

Table 4. Lymph node boost preferences

Variables	Value
LN boost	
Yes	56 (96.6)
No	2 (3.4)
Criteria	
LN size	38 (65.5)
PET-avidity	42 (72.4)
Residual LN after external beam RT	26 (45.6)
Sequence	
SIB only	11 (19.6)
Sequential boost only	37 (66.1)
SIB followed by sequential boost	3 (5.4)
SIB or sequential boost	5 (8.9)
Cumulative RT dose*	
Total prescription dose to pelvic LN	59.0 (55.0–62.0)
45–54 Gy	10 (17.2)
55–59 Gy	20 (34.5)
60–62 Gy	15 (25.9)
≥63 Gy	13 (22.4)
Total BED to pelvic LN	71.0 (66.0–74.0)
<65 Gy	9 (15.5)
65–69 Gy	15 (25.9)
70–74 Gy	20 (34.5)
75–79 Gy	12 (20.7)
≥80 Gy	2 (3.4)
Total prescription dose to retroperitoneal LN	59.2 (55.0–60.0)
45–54 Gy	12 (20.7)
55–59 Gy	23 (39.7)
60–62 Gy	14 (24.1)
≥63 Gy	9 (15.5)
Total BED to retroperitoneal LN	70.0 (66.0–72.0)
<65 Gy	11 (19.0)
65–69 Gy	15 (25.9)
70–74 Gy	24 (41.4)
75–79 Gy	6 (10.3)
≥80 Gy	2 (3.4)

Values are presented as median (interquartile range) or number of centers (%).
BED, biologically effective dose (α/β ratio of 10 is used for tumor control); Gy, gray; LN, lymph nodes; PET, positron emission tomography; RT, radiation therapy; SIB, simultaneous integrated boost.
*Only considered external beam radiation therapy.

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Most physicians (42/56, 72.4%) considered PET-avidity of LN as the criteria for boost RT, followed by size (38/56, 65.5%) and residual disease after initial EBRT (26/56, 45.6%). Among 38 physicians using LN size as a criterion, either short-axis diameter of 1 cm (28/38, 73.7%) or 2 cm (5/38, 13.2%) was frequently considered as a criterion for LN involvement. In addition, more than half of the centers (37/56, 66.1%) performed sequential LN boost following initial EBRT: 11 centers performed simultaneous integrated boost, 5 centers performed either sequential or simultaneous integrated boost, and 3 centers performed both methods.

Among the prescribed doses for LN boost, 10 (17.9%) institutions performed individualized LN boost using various dose schemes. Considering the initial EBRT and LN boost dose, 28/56 (48.3%) and 23/56 (39.6%) respondents declared that ≥60 Gy was prescribed for pelvic LN and retroperitoneal LN, respectively. The median total doses administered for pelvic and retroperitoneal LN were 59.0 (interquartile range, 55.0–62.0) Gy and 59.2 (interquartile range, 55.0–60.0) Gy, respectively.

7. Brachytherapy

Brachytherapy was available in 29/58 (50.0%) institutions; all centers performed high-dose rate brachytherapy using either iridium-192 (n=27) or cobalt-60 (n=2). Half of the institutions (n=14, 48.3%) performed image-guided brachytherapy planning using CT (n=9, 31.0%), MRI (n=4, 13.8%), or PET-CT (n=1, 3.4%) (**Fig. 1A**). Either point A or volume-based prescription was used in 18 (62.1%) and 11 (37.9%) of the 29 centers, respectively (**Fig. 1B**). A total dose of 30 Gy in 5–6 fractions administered 2–3 times per week was the widely accepted dose scheme (n=17, 58.6%), followed by 24–25 Gy in 5–6 fractions (n=8, 27.6%, **Supplementary Table 2**).

8. Chemotherapy

Most respondents (53/58, 91.2%) preferred platinum as the chemotherapy regimen: 3 respondents opted for either platinum or a combination of platinum and 5-fluorouracil, while 2 respondents opted for a combination of platinum and 5-fluorouracil. In addition, 51/58 (87.9%) centers do not routinely prescribe adjuvant chemotherapy after RT; four centers performed adjuvant chemotherapy based on physicians' discretion, while three centers routinely prescribed adjuvant chemotherapy. Additionally, 9/58 (15.5%) institutions preferred neoadjuvant chemotherapy for patients with bulky primary tumor size.

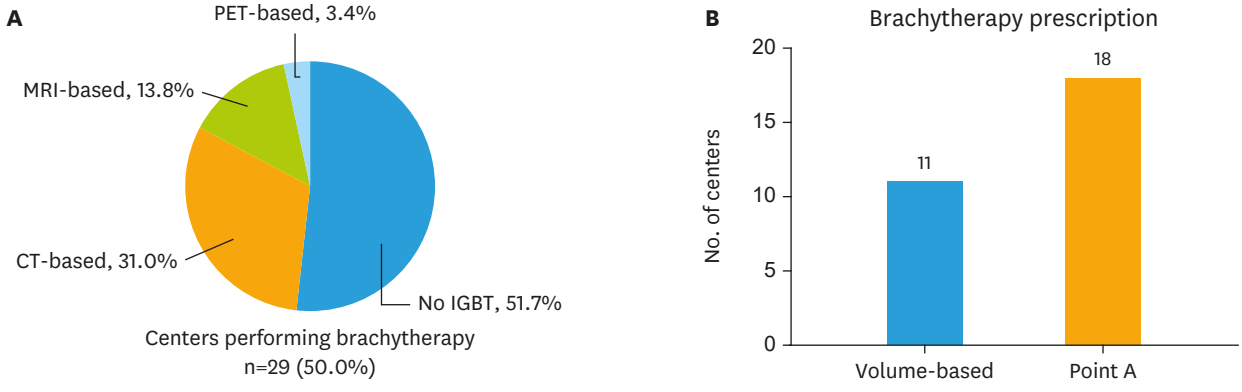

Fig. 1. Distribution of image-guided brachytherapy (A) and prescription methods (B) for brachytherapy in each center.
CT, computed tomography; IGBT, image-guided brachytherapy; MRI, magnetic resonance imaging; PET, positron emission tomography.

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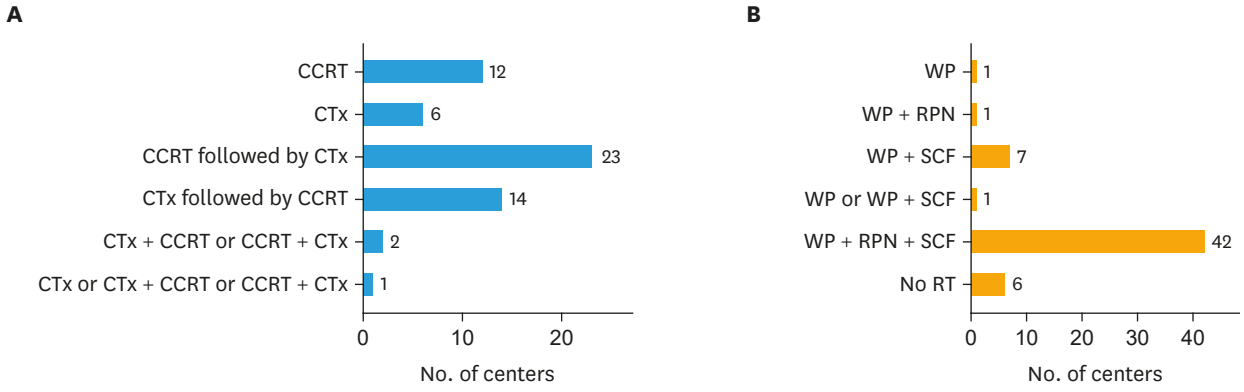

Fig. 2. Treatment modality (A) and radiotherapy field (B) preferences of respondents for a 60-year-old woman with a 5.5-cm primary cervix cancer diagnosed with biopsy-proven-supraclavicular lymph node metastasis.
CCRT, concurrent chemoradiation therapy; CTx, chemotherapy; RPN, retroperitoneal lymph node; RT, radiation therapy; SCF, supraclavicular fossa; WP, whole pelvis.

9. Comparison according to the number of patients treated with definitive RT in 2019

With a cutoff value of 20 patients treated with definitive RT in 2019, there were 14 and 44 institutions categorized as high-volume and low-volume centers, respectively (**Supplementary Table 3**). Brachytherapy was available in all high-volume centers, whereas 15/44 (34.1%) low-volume centers could perform brachytherapy within their facilities. Other treatment strategies including indications, techniques, RT field, RT dose fractionation, LN boost, and chemotherapy were comparable between high-volume and low-volume centers.

10. Clinical scenario of SCN metastasis

As shown in **Fig. 2**, 35/58 (60.3%) respondents preferred upfront CCRT, whereas 20/58 (34.5%) respondents preferred upfront chemotherapy. Other three institutions adopted an individualized approach (i.e., upfront chemotherapy or CCRT). Among 20 institutions adopting upfront chemotherapy, 14 centers preferred CCRT after upfront chemotherapy. Fifty (86.2%) institutions reported that the supraclavicular fossa would be included in the RT field. Various dose fractionation schedules were also adopted, and a total dose of 60 Gy in 30 fractions was the most frequently adopted fractionation schedule (18/47, 31.0%, **Supplementary Fig. 1**).

DISCUSSION

In the current study, we explored the patterns of definitive RT approaches in South Korea. To the best of our knowledge, this is the first study to investigate the current status of definitive RT in South Korea. Various risk group stratifications for determining definitive RT have been embraced across institutions. Although all participating institutions implemented CT-based EBRT planning, various bony landmarks were used as the cranial border of EBRT. In addition to various indications and sequence for LN boost RT, numerous dose fractionation schedules were used for boost RT at each center. Additionally, the treatment strategy significantly differed among respondents in cases of supraclavicular LN metastasis.

Current guidelines endorsed nodal region-based clinical target volume recommendations [3,4]. Briefly, a whole pelvic RT should include the obturator, internal, external, presacral, and common iliac LN. For an extended field, the para-aortic region up to the renal vessel should

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be included in the target volume. However, only 12%–19% respondents in the current survey determined the specific RT fields based on the vessel structures (i.e., aortic bifurcation and renal vessel). Although the aortic bifurcation is apparent at the L4–5 interspace and the renal vessel is located at the T12–L1 or L1–L2 interspace in 70%–93% patients based on previous radiologic anatomy studies, RT fields were selected based on vertebral landmarks according to conventional two-dimensional practice [12,13]. Rai et al. [14] reported that only 29% of the RT field based on L3–S1 vertebral landmarks covered the common iliac artery in 116 patients. Moreover, half of the recurrences outside the RT field occurred between the aortic bifurcation and L4–5 interspace. A recent dummy-run study of a phase II study and KROG 15-06 showed somewhat disagreement in the clinical target volume for pelvic EBRT [15,16]. Given the frequent implementation of IMRT for cervical cancer, the selection of RT fields based on vascular anatomy needs to be standardized in order to develop personalized RT approaches.

Given the contiguous and orderly lymphatic spread of cervical cancer, eradication of micrometastatic disease at the next echelon of nodes could improve patient outcomes [17]. In this context, the prophylactic irradiation of the para-aortic area has been advocated and has showed a clinical benefit in previous studies [18-20]. Current guidelines endorsed by ASTRO and ESTRO suggest that irradiation should cover up to the renal vessel area using a dose of 45 Gy in patients with an increased risk of para-aortic LN metastasis[3,4]. However, the use of CCRT as prophylaxis for locally advanced cervical cancer remains controversial as chemotherapy can be administered to control subclinical para-aortic metastasis. Several retrospective studies including patients treated with CCRT showed little additional benefit of prophylactic irradiation [21-23]. In the current survey, only 13 (22.4%) respondents preferred the administration of prophylactic RT to paraaortic area for patients with pelvic LN metastasis. Lee et al. [24] reported the benefit of risk-adaptive sub-renal vein RT on para-aortic LN recurrence-free survival and cancer-specific survival in patients with common iliac LN or 3 or more pelvic LN involvements. A recent RetroEMBRACE analysis also revealed that patients diagnosed with common iliac LN or 3 or more iliac LN involvement have an increased risk of para-aortic LN progression and the ongoing EMBRACE II study has adopted this criteria for para-aortic irradiation [25,26]. Therefore, the method of stratifying risk groups to identify appropriate candidates needs to be redefined.

Recent guidelines recommend the administration of 55–65 Gy (ASTRO) or 55–60 Gy (ESTRO) for metastatic LNs [3,4]. In the current study, 82.3% and 79.3% of the respondents preferred the administration of ≥55 Gy to pelvic and retroperitoneal LN, respectively. To date, it is inconclusive which patients should be treated with LN boost RT. Hata et al. [27] proposed an optional LN boost using a dose of 55.8 Gy for LN ≥24 mm after analysis of 111 LNs. Kim et al. [28] stratified 80 patients who did not receive LN boost RT into various risk groups based on the following risk factors: SCC antigen >6.8 ng/mL and >2 LNs. They observed a significant difference in pelvic nodal failure-free survival according to the number of these risk factors (0 vs. 1 vs. 2; 100% vs. 78.3% vs. 44.4%, respectively). In addition, several studies suggested that poor mid-RT response after administering a radiation dose of 45–50 Gy could be a surrogate for determining potential candidates of high-dose boost RT [29,30]. Wakatsuki et al. [29] demonstrated different pelvic LN control rates according to LN size (10 mm) in patients receiving a radiation dose of 50 Gy (96.7% vs. 75.7%) and proposed the administration of >58 Gy in patients with an LN size of ≥10 mm after receiving an RT dose of 50 Gy. Non-metabolic complete response after 50 Gy is also considered as an indicator for further LN boost [30]. With regard to boost methods, a recent study on simultaneous integrated boost with 55 Gy in 25 fractions for 61 patients demonstrated a complete response of 77% and a 3-year disease-

free survival of 57% [31]. Furthermore, the ESTRO Guideline also recommends concurrent LN boost to reduce the overall treatment time [4]. However, further investigations on the use of LN boost RT are needed to establish standardized guidelines for selection of appropriate candidates, sequence, and total prescription dose.

As reported previously, the proportion of patients who received brachytherapy or institutions that offer brachytherapy has decreased so far [10,32]. Various factors, such as replacement with IMRT, use of particle therapy, financial reimbursement, or lack of personnel resources, possibly caused the decline in the use of brachytherapy [10,33]. However, along with the advances in image-guided brachytherapy, brachytherapy continues to play an integral role in the management of cervical cancer [33-35]. In addition, volume-based prescription showed meaningful 5-year LC rates of 89%–94% [36]. With 50.0% of centers available for brachytherapy, only 11 (37.9%) centers were able to provide volume-based brachytherapy. Due to the regional imbalance and decreasing availability of facilities in South Korea, referral networks have been suggested [10]. In addition, the importance of volume-based brachytherapy should be recognized by physicians through a continuing educational program. Also, various prescription dose for brachytherapy needs to be standardized as suggested by EMBRACE II study protocol (28 Gy in 4 fractions) [26].

In the case of advanced disease with supraclavicular LN metastasis, 51/58 (87.9%) respondents preferred to endorse treatment strategies that incorporate RT. In addition, most of them usually include the supraclavicular fossa in the RT field using a dose of ≥45 Gy. Although there are no consensus guidelines on the management of oligometastatic disease for cervical cancer, upfront RT/CCRT to the primary cervix and/or metastatic LN sites is integrated in the therapeutic approach due to the radiosensitive nature of squamous cell carcinoma. Recent multi-institutional retrospective analysis revealed that pelvic RT in addition to chemotherapy improved the median progression-free survival (13.0 vs. 5.9 months) and overall survival (41.6 vs. 17.6 months) for cervical cancer patients with distant metastasis [37]. In addition, previous case series of oligometastatic cervical cancer frequently with supraclavicular LN presented favorable 3-year overall survival outcomes (46%–65%) after curative CCRT to both pelvic and metastatic sites [38,39]. Although no study has examined the optimal RT dose to metastatic sites, Ioffe et al. [40] reported an improvement in the overall survival after curative RT to supraclavicular LN compared to that after palliative RT to the corresponding region or supportive care (no RT) (median, 12 vs. 7 vs. 3 months). Results of future studies on this topic may help in establishing a therapeutic strategy for metastatic cervical cancer based on proper patient selection and optimal RT dose.

There are several limitations that need to be acknowledged. First, surveys of patterns of care have inherent recall, memory decay, and non-response bias. In addition, each questionnaire could not reflect a sophisticated clinical situation. And current questionnaire-based survey could not identify the discrepancy between preferred and actual practice patterns of each clinicians. Further investigation of real and preferred practice patterns is needed. However, the results of current analysis could be used as a basis for conducting further multi-institutional clinical trials and consequently improve treatment outcomes.

In conclusion, this survey showed that the current definitive RT practice in South Korea varies among institutions. Specifically, most differences were noted in the indications for treatment, RT field, and prescription dose. Hence, the current guidelines for definitive RT should be redefined to achieve a standardized practice.

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SUPPLEMENTARY MATERIALS

Supplementary Table 1
Preferred methods for diagnosis

Click here to view

Supplementary Table 2
Dose schedule preferences for brachytherapy

Click here to view

Supplementary Table 3
Preferred treatment according to the number of patients treated in 2019

Click here to view

Supplementary Fig. 1
Respondents' preferred dose fractionation scheme to supraclavicular fossa for a 60-year-old woman with a 5.5-cm primary cervix cancer diagnosed with biopsy-proven-supraclavicular lymph node metastasis.

Click here to view

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Appendix 1. Supplementary information 1. Detailed questionnaires for survey

I. Demographics

1) How many patients with cervix cancer were treated in 2019?

Total ( )

Definitive ( ) Adjuvant ( ) Salvage ( ) Palliative ( )

II. Diagnosis

1) Which workups do you prefer to perform for patients with cervix cancer in your institution? (Choose all that apply)

☐ Abdomen-pelvis CT

☐ Pelvis MRI

☐ Chest CT

☐ PET/PET-CT

☐ Intravenous pyelogram

☐ Colonoscopy/sigmoidoscopy

☐ Cystoscopy

☐ Other (detailed information _____)

2) Which diagnostic criteria do you apply for diagnosis of adenocarcinoma?

No specific criteria ( )

2014 World Health Organization criteria ( )

2018 International Endocervical Adenocarcinoma Criteria and Classification ( )

III. Indication

1) Please select the preferred criteria for definitive concurrent chemoradiation therapy (Choose all that apply).

☐ Tumor size (___ cm)

☐ Parametrium extension

Based on: ☐ Pelvic examination ☐ MRI or CT

☐ Lymph node involvement

Based on: ☐ MRI ☐ CT ☐ PET or PET-CT

☐ Low vagina involvement

☐ Patient preference

☐ Other (detailed information _____)

2) Please select the preferred criteria for definitive radiation therapy alone (Choose all that apply).

☐ Age (___years)

☐ Comorbidity

☐ Poor kidney function

☐ Performance status

☐ Other (detailed information _____)

IV. Techniques for radiation therapy

1) Is CT simulation routinely performed?

Yes ( ) No ( )

2) How many patients were treated with intensity-modulated radiation therapy?

Definitive ( )%, Adjuvant ( )%

3) What imaging modalities during radiation therapy would you recommend?

☐ No image evaluation ☐ CT

☐ MRI ☐ PET or PET-CT

4) Would you perform adaptive radiation therapy planning?

Yes ( ) No ( )

4-1) When do you perform adaptive planning?

☐ After ( ) cGy

☐ Other ( )

V. Radiation therapy field and dose fractionation

1) Please select your recommended upper border of external beam radiation therapy for patients without pelvic/retroperitoneal lymph node metastasis.

L4/5 ( ), sacral promontory ( ), and other ( )

2) Please describe your recommended upper border of external beam radiation therapy for patients with pelvic lymph node metastasis.

_____

3) Please describe your recommended upper border of external beam radiation therapy for patients with retroperitoneal lymph node metastasis.

_____

4) Please provide the total and fractional prescription dose.

Total dose ( ) cGy Fractional dose ( ) cGy

VI. Lymph node boost

1) Do you perform lymph node boost?

Yes ( ) No ( )

2) Please select the preferred criteria for lymph node boost RT (Choose all that apply).

☐ Size (___cm) of lymph node

☐ PET-avid lymph node

☐ Residual lymph nodes after initial RT

☐ Other (detailed information _____)

3) When do you perform lymph node boost RT?

☐ Simultaneous integrated boost

☐ Sequential boost followed by whole pelvis (or extended field) EBRT

4) How do you determine the need for lymph node boost RT?

① Initial diagnostic CT ② Adaptive planning CT ③ Boost planning CT

5) Please provide the total and fractional prescription dose for lymph node boost.

Pelvic lymph node: total dose ( ) cGy fractional dose ( ) cGy

Retroperitoneal lymph node: total dose ( ) cGy fractional dose ( ) cGy

VII. Brachytherapy

1) Do you perform brachytherapy for patients with cervix cancer?

Yes ( ) No ( )

2) What source do you have in your institution?

Iridium-192 ( ) Cobalt-60 ( ) Other (detailed information _____)

3) Do you perform image-guided brachytherapy?

No ( ) CT based ( ) MRI based ( ) PET based ( )

4) Please select prescription method for brachytherapy.

Point A prescription ( ) Volume-based prescription ( )

5) Please provide the total and fractional prescription dose.

Total dose ( ) cGy fractional dose ( ) cGy ( ) days in 1 week

VIII. Chemotherapy

1) What regimen do you prefer?

Platinum alone ( ) Platinum + 5-fluorouracil ( ) Other ( )

https://doi.org/10.3802/jgo.2021.32.e43

2) Please select the preferred schedule for chemotherapy.

Weekly ( ) Every 3 weeks ( ) Every 4 weeks ( )

3) Is adjuvant chemotherapy routinely prescribed for patients?

Yes ( ) No ( )

IX. Surveillance

1) Do you recommend patients to visit your clinic (radiation oncology department) after treatment?

Yes ( ) No ( )

2) Please select the candidates for surveillance (Choose all that apply).

☐ All patients after radiation therapy (definitive + adjuvant + palliative + salvage)

☐ After definitive treatment

☐ After adjuvant treatment

☐ After salvage treatment

☐ After palliative treatment

☐ Other (detailed informationc _____)

3) How often do you recommend patients to visit your clinic?

After 1-month follow-up

Every ( ) months up to ( ) years

Every ( ) months up to ( ) years

Every ( ) months up to ( ) years

4) Which workups do you prefer to perform for surveillance? (Choose all that apply)

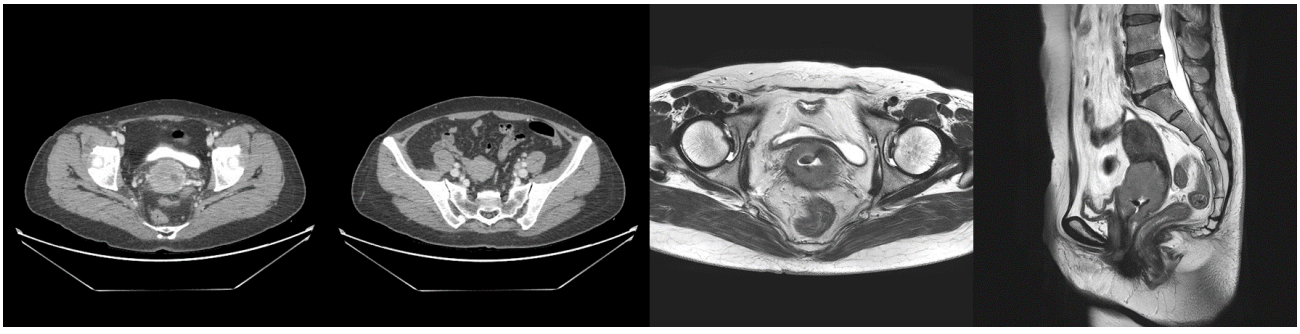
☐ Abdomen-pelvis CT ☐ Pelvis MRI ☐ Chest CT

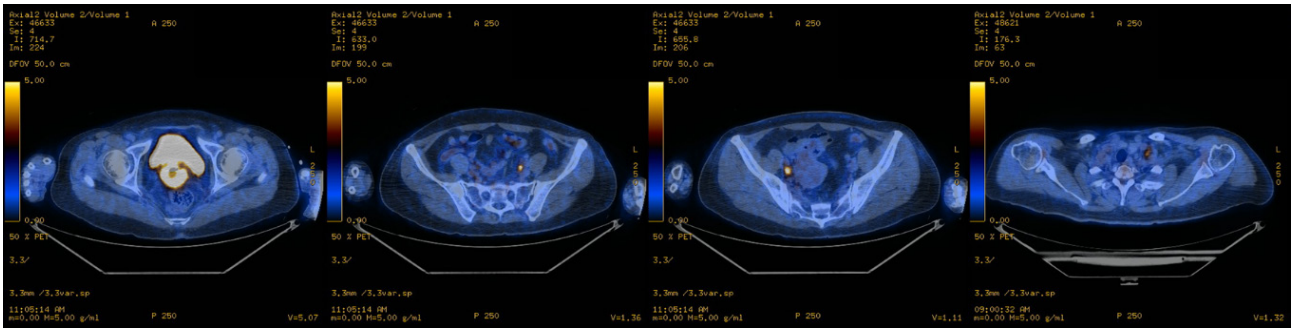
☐ Tumor marker ☐ CBC ☐ Chemistry

☐ Bone scan ☐ PET/PET-CT ☐ Other (detailed information _____)

Case scenario

A 60-year-old woman diagnosed with cervical squamous cell carcinoma had a cervical mass measuring 5.5 cm with parametrial extension and bilateral iliac lymph node metastases. After fine-needle aspiration biopsy, **left supraclavicular lymph node metastasis from cervical cancer was reported**.





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1) Please select your recommended treatment strategy.

☐ Upfront chemotherapy

☐ Chemotherapy followed by CCRT

☐ Definitive CCRT

☐ Definitive CCRT followed by adjuvant chemotherapy

☐ Other (detailed information _____)

2) Please select your recommended radiation therapy field.

☐ Whole pelvis

☐ Whole pelvis + retroperitoneal lymph node

☐ Whole pelvis + left supraclavicular region

☐ Whole pelvis + retroperitoneal lymph node + left supraclavicular region

☐ Not performing radiation therapy

3) What prescription dose would you recommend for left supraclavicular metastasis?

Total dose ( ) cGy Fractional dose ( ) cGy

https://doi.org/10.3802/jgo.2021.32.e43