Review Article

Literature review with PGI guidelines for delineation of clinical target volume for intact carcinoma cervix

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ABSTRACT

For definitive treatment of carcinoma cervix with conformal radiation techniques, accurate target delineation is vitally important, yet a consensus definition of clinical target volume (CTV) remains variable within the literature. The aim of the present article is to review the guidelines for CTV delineation published in the literature and to present the guidelines practiced at our institute. For this a literature pub med/medline search was performed from January 2000 to December 2012 and reviewed to identify published articles on guidelines for CTV primary and pelvic lymph node (LN) delineation for carcinoma cervix. Taking into consideration the traditional bony landmark based fields for treating cancer cervix, the knowledge of the patterns of disease spread and recurrence and the findings from imaging studies identifying typical anatomic distributions of areas at risk of harbouring subclinical disease, the differences in various guidelines have been analyzed and discussed. The CTV in cervical cancer consists of the CTV nodal and CTV primary. In all the published guidelines, CTV nodal consists of common iliac, external iliac, internal iliac, pre-sacral and obturator group of lymph nodes, and CTV primary consists of the gross tumor volume, uterine cervix, uterine corpus, parametrium, upper third of vagina and uterosacral ligaments. The various guidelines differ however, in the definition for these individual component structures. This is the first report to provide the complete set of guidelines for delineating both the CTV primary and CTV nodal in combination.

KEY WORDS: Carcinoma cervix, clinical target volume, conformal radiation therapy, delineation, guidelines, pelvic lymph node

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INTRODUCTION

Radiotherapy for cervical cancer patients consist of external beam whole pelvic radiotherapy (EBRT) and intra-cavitary brachy therapy.[1] EBRT, traditionally delivered using four-field box technique defined by bony landmarks, is associated with dose-limiting incidence of acute and late toxicity.[2-4] In addition, conventional planning increases the risk of geographic miss.[5,6] Over the years, treatment planning has shifted from conventional two-dimensional planning to three-dimensional (3D) planning.[7] Although, reduced toxicity has been reported with Intensity-modulated radiation therapy (IMRT) in cancer cervix,[8-10] a uniform and reproducible contouring of clinical target volume (CTV) is essential to correctly deliver the same. Though guidelines have been proposed for CTV primary and CTV lymph node (LN) delineation by various authors,[11-16] there still remains a degree of non-uniformity and consensus in defining the same.[17] Besides the variations in the guidelines, these are individually restricted either to CTV primary or CTV LN only, whereas while planning a patient, we need to combine both the CTV's. At our institute, patients with cancer cervix are routinely treated with conformal radiotherapy. Since majority of patients present with locally advanced disease, we felt there was need to redefine the guidelines in context to our patients. This article in addition to reviewing the published guidelines, describes the guidelines being followed at our institute and is probably the first report in the literature to provide for the complete 3D planning for an intact case of carcinoma cervix.

MATERIALS AND METHODS

We carried out literature search from January 2000 to December 2012, through the pub med/medline central database at National center for biotechnology information (NCBI) website (http://www.ncbi.nlm.nih.gov/pmc) using the search terms, 'carcinoma cervix', 'clinical target volume', 'pelvic lymph nodes', 'delineation', 'guidelines', 'conformal radiation therapy', and selected those articles that provided consensus guidelines for CTV delineation for intact carcinoma cervix. In this manner we located 6 articles (Taylor *et al.*,[11,12] Small *et al.*,[13] Toita *et al.*,[14,15], Lim *et al.*,[16]), which have been thoroughly reviewed.

In addition to this, CT images of cervix cancer patients (both pre and post treatment), treated

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at our institute with conformal radiation from January 2009 to December 2009 were reviewed. The areas with grossly visible disease and areas at risk of harboring subclinical disease were extensively studied on those images. In addition, pattern of cervix disease spread and recurrence were kept in consideration.[18-21] Thereafter minor changes in the definition of CTV primary and CTV LN have been made at our institute to maintain uniformity in target delineation.

RESULTS

The protocol followed for conformal planning of cervix cancer patients at our institute is as follows:

CT Simulation: Patients are kept fasting for minimum 4 hours prior to planning CT scan. They are given oral and rectal contrast for delineating critical structures. Oral contrast constitutes 20 ml urograffin dissolved in 1 litre water given over 1 hour, before CT scan. Rectal contrast is given by dissolving 20 ml urograffin in 50 ml normal saline. Patients are asked to void urine 15 minutes prior to CT. Similar fluid intake and bladder voiding instructions are given while treating patients, so as to ensure a consistent and reproducible bladder filling status. For intravenous contrast, 100 ml of omnipaque is used according to Cross method of intravenous contrast administration.[22] After preparation, patient is made to lie supine on couch in CT simulator. Knee wedge is used as positioning device to maintain position reproducibility. CT scan is obtained from T10-T11 interspace to upper third of femur, with 3.75 mm slice thickness. These images are transferred to Eclipse treatment planning system (TPS) Varian associates, Palo Alto, CA, USA workstation, and contouring is done.

OAR delineation: OAR includes bowel, bladder, rectum and bone marrow and these are contoured according to the RTOG normal tissue contouring guidelines.[23]

CTV nodal (CTV 1)

CTV 1 [Figure 1a-h] includes involved nodes and relevant draining nodal groups (common iliac, internal iliac, external iliac, obturator and presacral LN). Inclusion of para-aortic LN depends on the extent of disease and results of staging investigations. At our institute, pelvic LN CTV is contoured in accordance with the latest Taylor's guidelines[11,12] with some modifications, and is summarized below:

1. Start contouring iliac vessels from aortic bifurcation down till the appearance of femoral head
2. Uniformly, pelvic blood vessels are given a margin of 7mm however; the upper border is maintained at aortic bifurcation
3. The contour is extended around common iliac vessels posteriorly and laterally so as to include connective tissue between iliopsoas muscles and lateral surface of vertebral body
4. No additional 10mm anterolateral extension is given around external iliac vessels along the iliopsoas muscle
5. To cover obturator nodes, a strip 17 mm wide is created medial to the pelvic sidewall, by joining the contour of external iliac vessels with internal iliac vessels. Contouring of obturator nodes with 17 mm brush is continued lower down along pelvic side wall, till superior part of obturator foramen
6. The posterior margin of CTV 1 contour over internal iliac vessels lies along anterior edge of piriformis muscle
7. Pre-sacral region is covered by connecting the volumes on each side of pelvis with a 10-mm strip over the anterior sacrum starting from aortic bifurcation till S2-S3 junction. Sacral foramina are not included in CTV 1
8. All visible nodes (contoured as GTV node) are given a margin of 10mm to create CTV node and are included in CTV 1
9. Muscle and bone are excluded from CTV 1.

CTV primary (CTV 2 and CTV 3)

CTV [Figure 2] primary for intact carcinoma cervix consists of gross tumor volume of the primary tumor (GTV primary), uterine cervix, uterine corpus, parametrium, vagina and ovaries.

Definitions for each component structure of the CTV primary

Uterus (CTV 2)

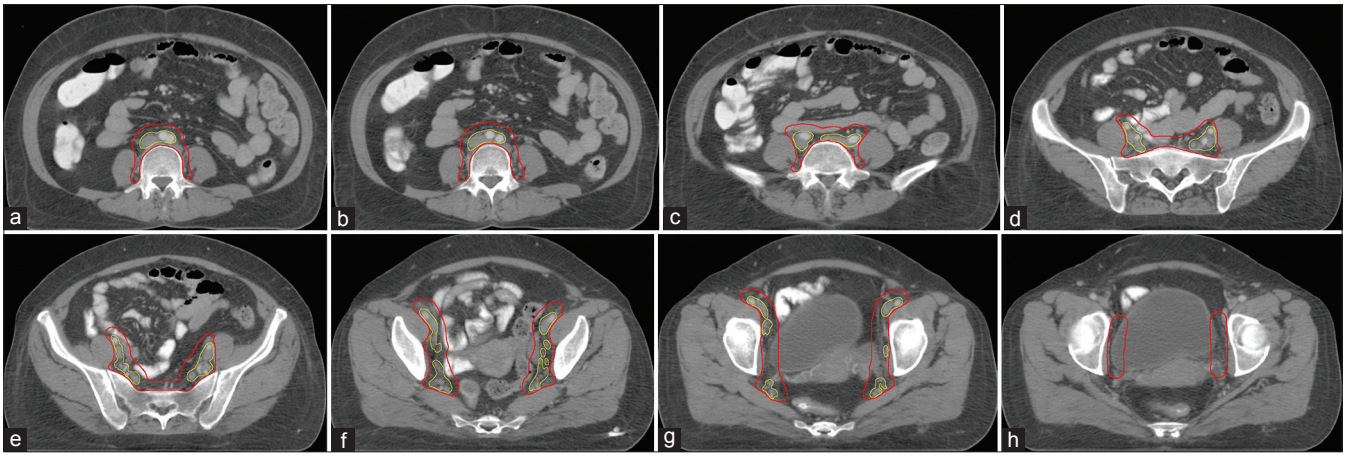

Figure 1: An atlas of clinical target volume for pelvic lymph nodes for uterine cervical cancer (a-h), vessels (yellow), CTV 1 (red)

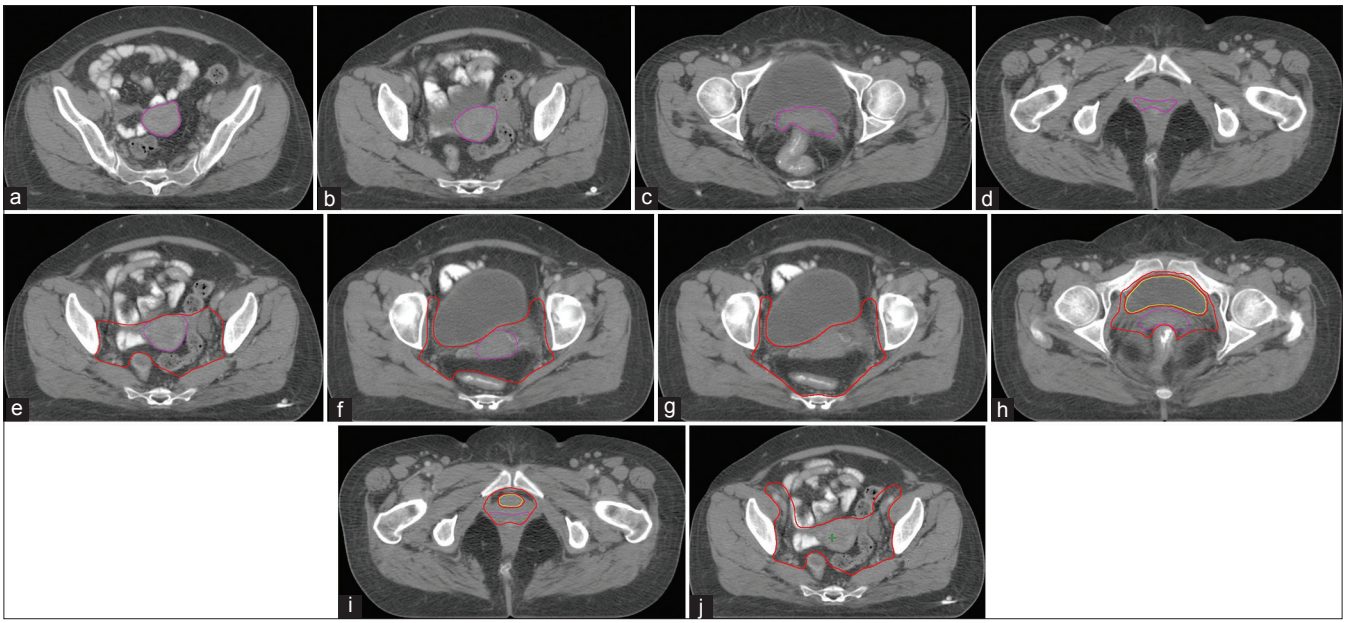

Figure 2: An atlas of clinical target volume (CTV) for primary for uterine cervical cancer, (a-d) represent delineation of CTV 2 (pink), (e-i) represent delineation of CTV 3(red), where 2 f shows parametrial contouring for cervix cancer stage II B, and 2 g shows parametrial contouring for bulky stage III B, and (j) represents Total CTV (red)

The uterine corpus, entire cervix and the vagina are contoured along with the gross disease (GTV primary) as a single structure, the uterus (CTV 2) [Figure 2a-d]. For vagina, paravaginal tissue is included along with the vaginal wall. In cases with minimal or no vaginal wall involvement, the contouring is stopped four slices above the lower border of obturator foramen, so that when 1.5 cm ITV (internal target volume) margin is given over the uterus, the lower border does not extend beyond the lower border of obturator foramen.

However; for cases with vaginal wall involvement, the caudal level of vagina is individually determined based on findings of both the MRI and clinical examinations. A vaginal marker is placed at the lower extent of vaginal disease while taking CT and as per RTOG guidelines,[13] the following extent of vagina is taken: Upper vaginal involvement: Upper two-thirds of vagina; Extensive vaginal involvement: Entire vagina.

Parametrium (CTV 3)

To delineate the parametrium [Figure 2e-i], connective tissue extending from the cervix to the pelvic wall are included, along with the visible linear structures that run laterally (e.g. vessels, nerves and fibrous structures).

Cranial border of parametrium is defined at the level where the true pelvis begins.

Anteriorly, contouring is done up to the level of posterior border of bladder in the central region, while, in periphery it extends till the anterior end of lateral pelvic bony wall, as the parametrium is attached till here.

Posteriorly, the parametrial contouring is different in two different sets of patients. In patients with Federation Internationale de Gynecologie et d'Obstetrique (FIGO) stage III B or greater disease, or who have clinical or radiological evidence of involvement of uterosacral ligaments, or have extensive nodal involvement, the parametrial volumes would extend up to the rectal contour to include the entire mesorectum and uterosacral ligaments within the parametrium [Figure 2 g]. In all other patients who do not have the advanced disease, the posterior boundary of parametrium is contoured only till the anterior part (semicircular) of mesorectal fascia [Figure 2 f].

Laterally, the parametrium is contoured till the lateral pelvic wall, upto the medial edge of internal obturator muscle.

Caudal border of parametrium is taken at the medial border of levator ani or at the pelvic floor.

The CTV primary finally includes the uterus (CTV 2) and the parametrium (CTV 3). Ovaries visible on CT are included within the CTV primary.

The Internal target volume (ITV) margin

The uterine motion is accounted for by giving an ITV margin [Figure 3] on the uterus. An asymmetrical margin with CTV 2 – ITV expansion of 15 mm antero-posteriorly, 15mm superoinferiorly and 7 mm laterally, is taken from the uterus.

Total target volume

CTV 1 and the CTV primary are combined and named as total CTV [Figure 2j], which is further given a margin of 10 mm

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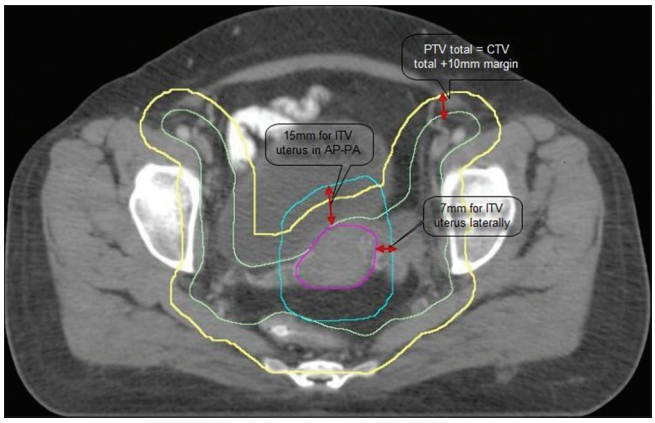

Fugure 3: Axial slice showing different margins given over CTV 2 (blue) and total CTV (light green)

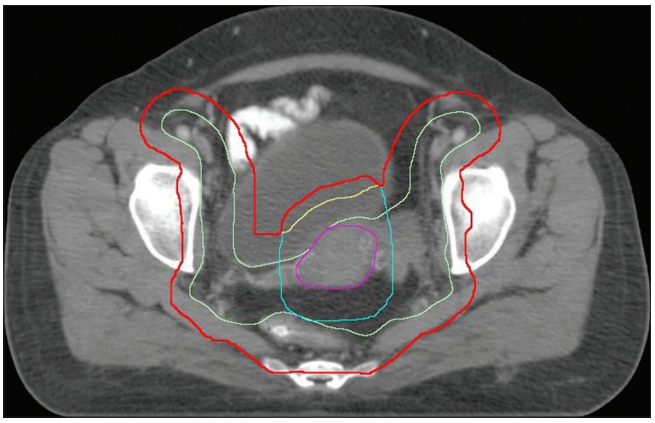

Figure 4: Axial slice showing final PTV (red)

all around for the total PTV [Figure 3] to account for setup errors. The ITV margin given over CTV 2 for uterine motion is added to the total PTV and this is taken as the total target volume (final PTV) to be treated [Figure 4]. Thus, in the final PTV, the margin from the uterine surface remains same as given for ITV, i.e., 15mm in both anteroposterior and superior-inferior direction. The final PTV is manually or automatically trimmed up to 3mm from the skin surface, if necessary to spare skin, provided that the CTV is still included entirely within the PTV.

Figure 5a-e represent the digitally reconstructed radiographs of CTV 1, CTV 2, CTV 3, total CTV and final PTV.

DISCUSSION

Traditional four field box technique for cervical cancer determined by bony anatomy has contributed excellent tumor control with acceptable toxicities. However, without using individual patient's CTV, this may result in suboptimal nodal CTV coverage. The study of 50 patients conducted at our own institute showed that in only 2 patients out of 50, was the whole of target volume encompassed by standard four field box.[24]

This inadequacy in target volume coverage has significantly been overcome by the use of conformal techniques like 3DCRT and IMRT, as shown by the favorable outcome data from several institutional series.[9,10,25-27]

The most significant factor in IMRT planning is however, the standardization of consistent and accurate target volume definition. Since, majority of patients in India present with locally advanced disease, there was a need to redefine CTV delineation guidelines which would allow an adequate treatment volume, along with an acceptable toxicity profile.

Bladder filling

Though advancements in image guidance have largely decreased the setup errors, internal body organ motion has always been an impedance in accurate radiation delivery. In pelvic malignancies treated with IMRT, bladder filling status has largely been the matter of debate. George *et al.*,[28] and Pinkawa *et al.*,[29] recommended a full bladder for treatment of gynecological malignancies, as the dose-volume-load to bladder and cranially displaced sigmoid colon/small bowel loops can be reduced significantly. However; Pinkawa in another study[30] found that bladder wall displacements are reduced significantly ($P < 0.01$) at superior and anterior border while treating empty bladder compared to full bladder and also there is less variability in bladder volume in an empty bladder state. Still, the ideal bladder filling status has not been ensured by any study so far. We therefore at our institute follow a consistent bladder filling protocol of voiding urine 15 min prior to both imaging and treatment.

CTV NODAL (CTV 1)

While there is general agreement on what constitutes CTV, defining these different components are problematic because of inadequacy of CT scan in accurately delineating the boundaries. In various guidelines, blood vessels have been taken as surrogate for delineatig regional nodes.[11,13,14] Chao[31] showed that 10-15 mm margins over iliac vessels adequately cover pelvic nodal regions, however later these were found to be unnecessarily large. Taylor *et al.*,[11] demonstrated using intravenous ultra small particles of iron oxide (USPIO) MRI that 7mm margin around vessels achieved 88% nodal coverage. Uno *et al.*,[32] showed 7-10 mm margin proved to be an adequate coverage in 50 cervix cancer patients in whom none developed marginal recurrence. Similar; practice of giving 7mm margin is followed by guidelines by Small *et al.*,[13] Toita *et al.*,[14] and Lim *et al.*[16]

Taylor's guidelines[11] recommend to start contouring common iliac vessels from aortic bifurcation. This is in contrast to RTOG guidelines[13] for post operative patients, which follow definition based upon bony anatomy, keeping superior border at L4-L5 interspace irrespective of aortic bifurcation level. Recent guidelines by Toita *et al.*,[14] also recommend the definition of nodal group to be based solely on vessel anatomy. Toita guidelines actually define delineation of each

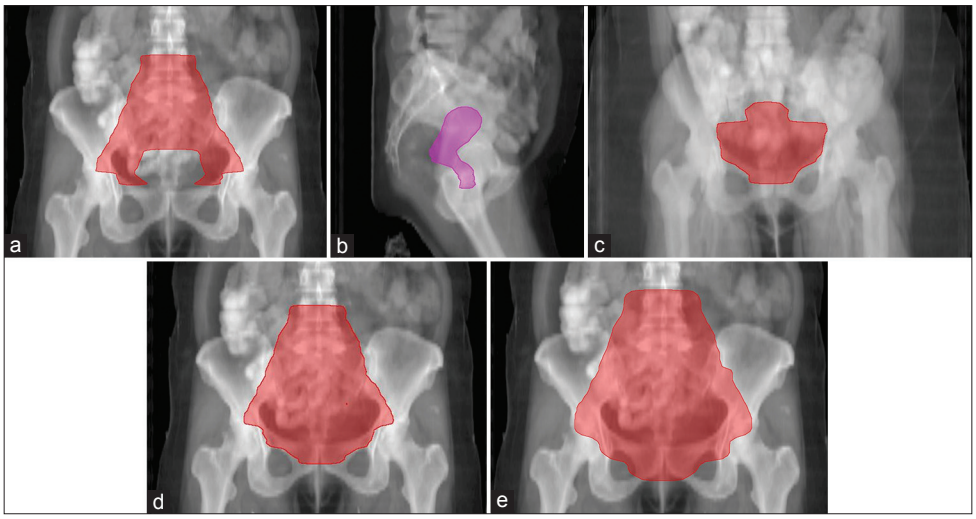

Figure 5: Digitally reconstructed radiographs showing CTV for: CTV 1 (a), CTV 2 (b), CTV 3 (c), CTV total (d), PTV final (e)

subcategorized nodal group in following six directions on 3D images: Anterior, posterior, lateral, medial, cranial, caudal.

Since; common iliac nodes are the elective target volume to be irradiated, so ideally they should be defined based on vessel anatomy at the level of aortic bifurcation. Previously at our institute, we did not want to deviate significantly from conventional 2D whole pelvic fields. Therefore, we used keep upper border of CTV 1, 7mm below L4-L5 junction. By decreasing CTV nodal volume at superior border as above, we also anticipated less acute bowel toxicity and less treatment breaks to locally advanced patients being treated at our institute. However; from the study conducted at our institute, we found that in 48 out of 50 patients, the level of aortic bifurcation was above L4-L5 level and by keeping upper border according to conventional fields, median target volume miss at superior border of the fields was 2.95 cm and maximum was upto 7.27 cm.[24]

When these patients were followed up clinically, it was found that three out of 50 patients developed local recurrence and three developed lymph node recurrences at a median duration of 6 mand all lymph node recurrences were outside the radiation field. On close evaluation, it was observed that in all, the level of aortic bifurcation was above L4-L5 junction. Also, the site of lymph nodal recurrence was just above the upper border of our radiation portal (L4-L5 junction), which corresponded to the area below the aortic bifurcation *i.e.* in the common iliac region, not covered by our radiation portals. None of the patient had in field pelvic nodal or inguinal nodal recurrence (unpublished data).

Beadle *et al.*,[33] studied patterns of regional recurrence in 180 cervical cancer patients after definitive radiotherapy and correlated it to the radiation fields. Radiation was planned with conventional fields, keeping upper border at L4-L5 junction. In 119 (66%) patients, there was a component of a marginal failure. Seventy five patients (42%) had marginal recurrences without any evidence of in-field recurrence. Of these 75 patients, 71 patients had above field recurrence only.

Based on these, we modified our institutional guidelines and presently common iliac region is contoured in accordance with Taylor's guidelines. As defined by Taylors, the contoured common iliac region is further extended laterally and posteriorly to psoas and vertebral body.

For the external iliac LN, Taylor recommends contouring external iliac nodes around external iliac vessels until they pass through inguinal ligament. And further recommend extending the external iliac contours antero-laterally along the iliopsoas by 10 mm (a total of 17mm from the vessel) for covering lateral external iliac group of LNs. Toita however exactly defines the caudal margin of external iliac region at the level of superior border of femoral head, as beyond this, external iliac vessels pass through inguinal ligament and continue as femoral vessels. Following these guidelines, large area of femoral head and neck irradiation can be avoided.

However, studies in literature do not give enough evidence of failures at this group of LNs.[34,35] Sakuragi *et al.*,[35] analyzed 208 patients with Stage I/II cervical cancer treated with radical hysterectomy and pelvic node dissection and reported that, only 3.8% of the patients had pelvic nodal metastases in the external iliac region. In a modified recommendation in 2007, Taylor *et al.*, have recommended to encompass these nodes only if there are other external iliac lymph nodes involved, or if the target volume also include the inguinal regions. Both Toita and Small *et al*. also do not follow this anterolateral extension. Also, out of the three groups of LNs, the medial groups of nodes are the one which are considered to be the main channel of drainage, collecting lymph from uterine cervix and upper vagina.[35] We therefore; do not follow and recommend such anterolateral extension to external iliac region.

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The caudal margin of internal iliac vessels is defined by Toita at cranial section of coccygeus muscle, spine of ischium or uterine artery/vein (connecting to parametrial region). The posterior margin of internal iliac lymph node region is defined at wing of sacrum or anterior edge of piriformis muscle. The lateral margin of internal iliac lymph node region is defined by iliac bone, psoas muscle or medial edge of Iliacus muscle in cranial slices and obturator internus muscle or piriformis muscle in caudal slices. However, Taylor *et al.*, simply defines internal iliac nodes in relation to internal iliac vessels.

Taylors guidelines recommend to cover obturator nodes with a strip of 17mm created medial to the pelvic sidewall, by joining the contour of external iliac vessels with internal iliac vessels. However; it does not define the caudal extent to which the contour should be continued. From anatomical knowledge of the course of obturator vessels within the pelvis,[36] caudal border of obturator nodes is defined at upper level of obturator foramen, since obturator artery leaves and obturator vein enters pelvis at this level. Toita defines the caudal extent of obturator lymph node till superior border of obturator foramen.

Presacral region is covered by connecting the volumes on each side of pelvis with a 10-mm strip over sacral promontory. The lower pre-sacral nodes/mesorectal nodes are also included if there is tumour extension along the uterosacral ligaments or if there is rectal involvement. Small *et al*. and Toita *et al.*, guidelines however specified the cranial and caudal extent of presacral region to be contoured starting from common iliac artery bifurcation till lower level of S2. Sacral foramina are not included in CTV 1 as recommended by Small *et al*.

In case of pathological LN involvement, Taylor and Small recommend to include the node in the CTV 1, which was previously obtained by giving 7mm margin over pelvic vessels. No additional margin over the involved lymph node has been recommended by any guideline given so far. But according to International commission on radiation units and measurements (ICRU) guidelines, gross disease must receive a CTV margin of 1 cm over GTV. The same is followed at our institute.

All guidelines recommended excluding bones and muscles from CTV 1. However, bowel was not routinely excluded by any of the guideline except the guideline by Small *et al.*[13] This is because the later guidelines are for post operative cases of carcinoma cervix and endometrium, where bowel loops fall into pelvis after surgery. So they excluded bowel loops from CTV 1 to decrease normal tissue toxicity. All other guidelines also do not exclude bladder and bowel from the nodal contour, due to the daily changes in their shape and position.

CTV PRIMARY (CTV 2 and CTV 3)

The definition of CTV primary for intact carcinoma cervix is extrapolated from the surgical management of cervix cancer.[34,35,37,38] There is a difference in the definition for some component structures of the CTV primary by the two consensus guidelines (Toita *et al.*,[15] and Lim *et al*.,[16]) which have defined them.

GTV primary

The definition of GTV primary is same in both the guidelines. It includes gross disease visible on MRI and lesions detected by clinical examinations. MR imaging was strongly recommended by the group to aid in target delineation due to the difficulty in distinguishing soft tissue components on CT. Fusion of the T2-weighted axial MR images to the planning CT was recommended. However in Indian setup, most of the centres utilize CT only, rather than MRI, due to cost constraints. But on CT, the extent of disease into uterus cannot be distinguished accurately. Therefore, at our institute, GTV primary is not contoured separately, rather it is contoured in continuation with the uterus.

Cervix

Lim recommends including entire cervix into CTV, if not already included in GTV. Toita defines the cranial margin at the level at which the uterine arteries enter the uterus (same level of the superior border of the parametrium CTV).

Uterine corpus

The volume of uterus to be included in CTV is another controversy. Guidelines by Lim recommend including the entire uterus in the CTV in view of uterus and cervix being embryologically one unit with interconnected lymphatics and no clear separating fascial plane. Also, published outcomes of radical trachelectomy for early-stage disease have demonstrated uterine recurrence rate of 2%, although the exact location of these recurrences (fundal *vs.* corpus) have not been stated.[39-41]

According to Toita, the CTV primary consists of GTV primary, uterine cervix, uterine corpus, parametrium, vagina and ovaries. No margin is added to uterine corpus for the CTV, as anatomically, the uterine corpus is suspended in pelvis and no surrounding connective tissues are visible around it on CT.

At our institute, the uterine corpus, entire cervix and the vagina are contoured along with the gross disease as a single structure, CTV 2.

Parametrium (CTV 3)

The main difficulty lies in defining the parametrium, as CT scan poorly defines its anatomical boundaries. The cranial border of parametrium is defined by Lim *et al.*,[16] at the top of the fallopian tubes, in view of broad ligament starting from there, however Toita *et al.*,[15] defines uterine isthmus as the superior border and recommended to stop contouring at the level where bowel loops are seen. However, in bulky locally advanced disease, even with contrast, the uterine vessels are not distinguishable from gross disease on CT scans. Also by anatomical definition, the superior border of parametrium is defined at the level where the true pelvis begins.[36] In view of the fact that the bony walls

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of false pelvis form the part of the walls of the lower abdomen and the lateral parametrial attachment cannot be above the true pelvic bony walls at our institute therefore, the cranial boundary is defined where the true pelvis begins.

All other boundaries of parametrium are however defined similarly by both the guidelines and at our institute also no modification is done.

The difference in contouring the posterior boundry of parametrium in stage II and III patients is because the uterosacral ligaments are the potential areas of disease spread in cervix cancer and if involved the pararectal lymph nodes would also be at risk in advanced stages.[42] In all other early stage patients, the posterior boundary of parametrium is contoured only till the anterior part (semicircular) of mesorectal fascia, in view of uterosacral ligaments not identifiable on CT images and also because the literature shows an adequate local control even when uterosacral ligaments were not given the required dose.[42]

Ovary

Another area of discussion is whether to include or exclude ovaries. Patterns of ovarian metastasis in surgical cervix cancer cases have demonstrated variable results depending on histology and stage at presentation. Italian data by Landoni *et al*., in stage IA2-IIA cervical cancer reported the metastatic rate of 0.9%.[43] However, data in Japan and Korea (Shimada *et al.*, 2006[44]; Kim *et al.*, 2008[45]) stated the rates were in range of 1.5-2.2% but they included the stage IIB patients also.

In Gynecologic Oncology Group (GOG) report of 990 stage IB cervical cancer patients, ovarian metastasis rate was not statistically different between Squamous cell carcinoma (SCCA) and adenocarcinoma histology (0.5 and 1.7%, respectively, *P* 0.19).[46] However, the retrospective study in 1,695 patients with stage IA2-IIA cervical cancer by Landoni *et al.*,[44] the rate were statistically different with histologic type (0.5% in SCCA and 2.4% in adenocarcinoma, $P = 0.0014$).

The guidelines by Lim and Toita recommend to include ovary in CTV primary, however did not form a consensus regarding the possibility of excluding the ovaries in selected cases (*i.e.* non-bulky Stage I or II cases with squamous cell carcinoma). Also, excluding ovaries from CTV primary can significantly decrease the PTV to be treated.[15]

Therefore, at our institute, the ovaries visible on CT are included within the CTV 3.

ITV margin

Tumor and normal organ motion and patient setup uncertainty remain an unexplored confounder in treatment planning with IMRT. Studies using orthogonal X-rays and fiducial markers (either gold seeds or a uterine sleeve) have reported maximum inter-fraction displacements of cervix of up to 36 mm during EBRT.[47] Buchali *et al.*,[48] in 29 cervix cancer patients took two CT scans, with empty and full bladder-rectum and found the median superior movement of cervix and uterus to be 4mm and 7 mm respectively. Lee *et al.*,[49], on comparing weekly CTs with planning CT, found uterus motion to range up to 45mm in supero-inferior direction and 28mm in antero-posterior direction. Chan *et al.*,[50] using weekly cine-MRIs found uterine inter-fraction motion upto 40mm. Taylor and Powell[51] performed MRI scans on 33 gynecological cancer patients on two consecutive days and found mean displacement of uterine body point of interest (POIs) to be 7mm antero-posterior and supero-inferior. For cervix POI, mean displacements were 40mm supero-inferior and 27mm antero-posterior. Based on these studies, an asymmetrical margin with CTV 2 – ITV expansion of 15mm both antero-posterior and supero-inferior and 7mm laterally given at our institute.

Total target volume

Although no consensus PTV margin has been advocated for 3D-CRT and IMRT, we use 10mm uniform CTV to PTV expansion. Image-guided RT (IGRT) is receiving attention as a method to reduce setup uncertainty and account for interfraction organ motion.[52] It could reduce required PTV margins, permitting more normal tissue sparing and obviate the need for an ITV, by allowing daily imaging of bladder and rectal filling.

CONCLUSION

This review article provides standard definitions for nodal CTV and CTV primary in cervical cancer as defined in literature. More importantly, it brings out the major differences in CTV delineation among the guidelines provided before and how these have been adopted at our institute with minor modifications.

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