Original Article

Assessment of Parametrial Invasion in Cervical Carcinoma by Multi-Detector Computed Tomography

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Abstract

Background: *Multidetector computer tomography (MDCT) is the most widely used diagnostic modality for routine evaluation of loco-regional involvement and distant metastasis of disease. In this study we evaluate the role of MDCT in the assessment of parametrial involvement in cervical malignancies.*

Objective: *The objective of our study was to prospectively evaluate MDCT criteria for differentiating a cervical cancer confined to the cervix from a lesion that invades the parametrium.*

Materials and Methods: *The clinical records of 130 patients with newly diagnosed, untreated cervical cancer were prospectively studied who met the study requirements were reviewed for this study. Clinical stage was based on the International Federation of Gynecology and Obstetrics (FIGO) staging classification. All patients were pathologically proven. MDCT was done to evaluate loco-regional involvement and distant metastasis of disease. 55 patients had extensive loco-regional involvement and distal metastasis. These 55 patients were excluded from study. Rest 75 cases were underwent radical hysterectomy or Wertheim operation. After the operation, the specimens sent for histological confirmation and the correlation between the CT scan findings of the parametrium and the histopathology result was studied.*

Results: *The sensitivity and the specificity of CT scan in assessing parametrial involvement was 66.7% and 92.2%, respectively.*

Conclusion: *In cervical cancer, MDCT gave better results in staging of advanced cases as well as early-stage ones. Local staging was improved by the acquisition of post-contrast delayed scans.*

Key words: *Cervical cancer, Multidetector computer tomography, Parametrium, FIGO staging, Radical hysterectomy.*

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Introduction

Cervical cancer is the fourth most common malignancy worldwide affecting women after breast, lung and colorectal cancer. There is also a greater incidence in developing countries and in low socioeconomic classes.[1] In Bangladesh, cervical cancer is the second most common cancer of female (12%). The number of new cases was 8,068 (10.6 per 100,000 women) and deaths was 5.214 (7.1 per 100,00 women) in 2018. There were 604,000 new cases and 342,000 deaths worldwide from cervical cancer in 2020 .[2] FIGO staging of cervical cancer is entirely clinical and does not correlate with surgical-pathological findings. This is mainly to achieve a staging system that is universally available and as cervical cancer is more prevalent in developing countries only clinical methods are universally used. However for the first time the committee encourages the use of imaging techniques.[3,4] Consensus from FIGO clearly indicate that clinical staging which performed pre-treatment would be entirely reliable tool for staging of cervical carcinoma. This includes pelvic examination to evaluate rectovaginal, parametrium and pelvic side wall involvement.[5] Computed Tomography (CT) scan and Magnetic Resonant Imaging (MRI) can be used as an adjunct assessment tool prior to treatment. There are limitations in the FIGO clinical staging system in term of estimation of the size of the primary tumor, particularly in endocervical lesion. Accurate determination of the size is important because it is significantly correlated with lymphnode metastases and prognosis is very much dependent on the volume of the primary tumor. Other limitations include evaluation of tumor extension into the parametrium and pelvic sidewalls, presence of lymphadenopathy and distant metastasis.[5,6] Therefore, concerns rise on using

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CT and/ or MRI imaging as assessment tools combining with traditional clinical staging in cervical carcinoma. It is shown to be more reliable compared to clinical pelvic assessment alone in evaluating local tumor spread to the parametrium, pelvic side wall and even retroperitoneal lymph nodes.[6] In previous literature, many studies gave poor CT results in evaluating cervical carcinoma yet they had lacked the availability of high-quality reconstructed images. This study aimed to evaluate the added benefit of multidetector CT in the local staging of cervical carcinoma, predicting parametrial involvement in the early stage of cervical carcinoma. Further, the correlation between CT scan findings and histopathology results was determined.

Materials and Methods

This prospective study was carried out in the department of Radiology and Imaging, Khwaja Yunus Ali Medical College and Hospital, approved by the ethical committee of KYAMC. Included patients had given informed consent to use their data in research studies. The study performed during the period from June 2023 to August 2024. The study was undertaken on the subjects who were clinically and histopathologically diagnosed as cases of cervical carcinoma. The study included 130 patients of newly diagnosed, untreated, pathologically proven carcinoma cervix with their ages ranging from 32 to 78 years. The patient were referred from departments (Obstetrics and Gynecology, Oncology) based on their physician request to perform multidetector CT for staging prior to treatment start. Pre-contrast and Post contrast CT examination of the abdomen and pelvis was performed using Philips 128 slice Ingenuity Core CT scanner made in Netherlands with following parameters- tube voltage 120kv, tube current auto calculate mAs, collimation 64 mm (FOV). Prior scanning, patient was asked to drink 1000 ml of water 3 hours earlier for proper dilatation of bowel loops. Image acquisition was performed 70s after contrast administration. The contrast agent "Omnipaque (Omni 350) "was used, the dose is 1.1 ml/kg body weight, with a total dose ranging between 60 and 120 ml. The contrast was injected by the automated injector. Images were taken at three phases (arterial, portal and venous phases) and also obtained delayed (after 7 min) images for better ureteric visualization. All the CT image were independently evaluated by radiologist. Axial images with a slice thickness of 0.6 mm were obtained for each case. Coronal and sagittal MPR (multiplanner reconstruction) images were generated from the native axial images on the workstation with a slice thickness of 0.5mm. CT images were analyzed for the following parameters: (1) General configuration of the cervix (cervical margins-smooth and well defined vs. irregular and poorly defined). (2) parametrium involvement - normal uterine ligaments and parametrial fat containing minimal soft-tissue strands vs. prominent soft-tissue strands or an eccentric parametrial soft-tissue mass contiguous with the cervix (3) Detection of the focal soft tissue infiltration guided by its enhancement, loss of fat plan and estimation of its size (4) Involvement of distal ureters adjacent to the cervix preservation vs. loss of periureteral fat. (5) invasion of pelvic wall, vagina, urinary bladder and rectum. (6) Features suggestive of metastasis as adnexal masses and/or pathologically enlarged lymph nodes (Image 1-4).

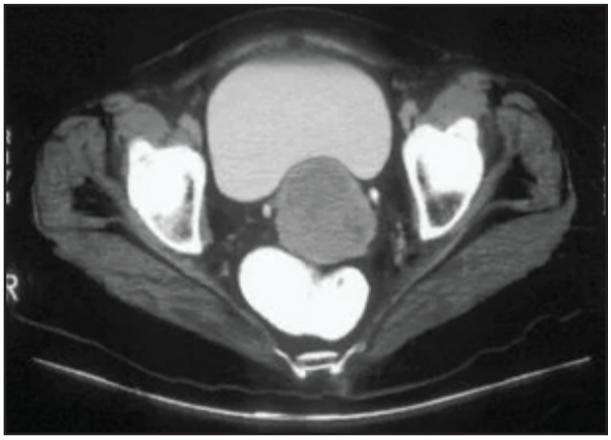

Image 1: CT of clinically visible carcinoma confined to the cervix (stage IB). The image shows a mass with slightly heterogeneous density that expands the cervix and is surrounded by a thin rim of relatively preserved stroma. The cervical margins are smooth, well-defined and intact without any parametrial soft tissue, periureteral stranding, or masses.

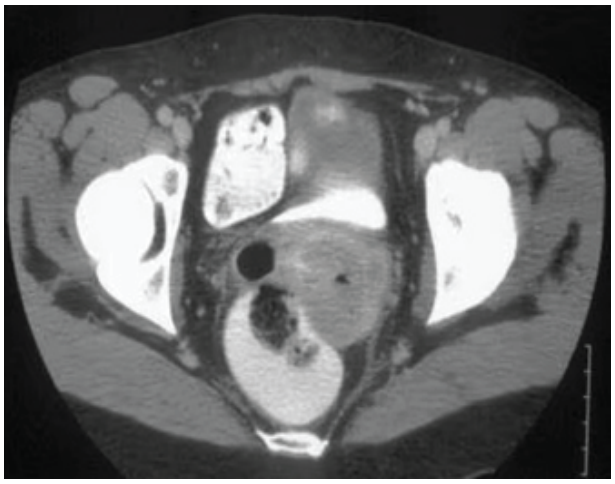

Image 2: CT image of clinical stage IIB cervical carcinoma. This image shows hypodense tumor occupying the entire cervix, extending to the outer posterior and right cervical margins. This finding is consistent with full-thickness stromal invasion.

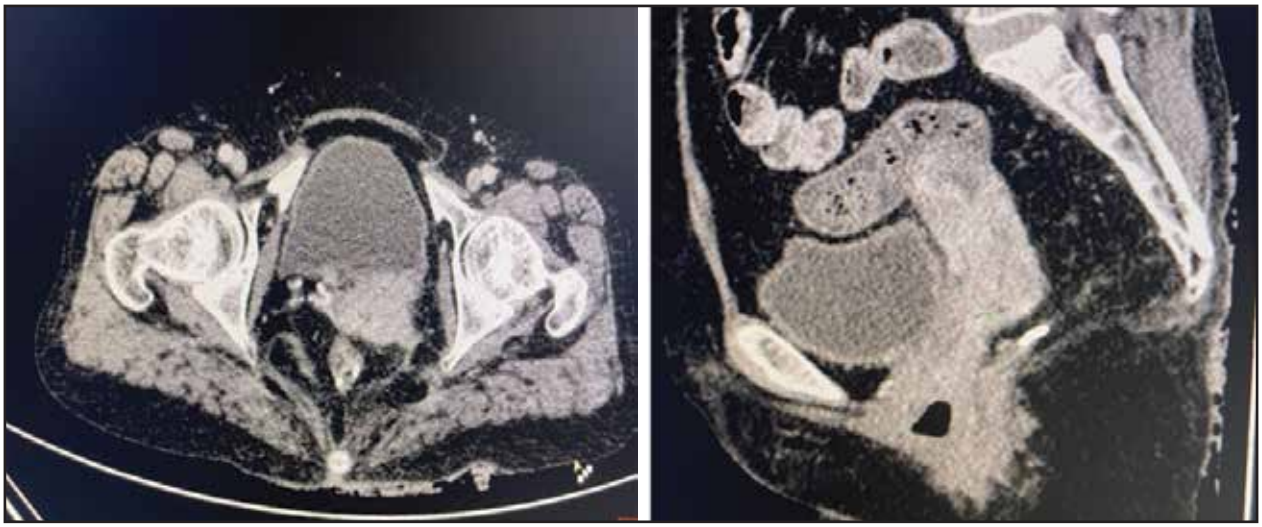

Image 3: CT images of clinical stage IVA cervical carcinoma. Axial and Sagittal post-contrast images show a heterogeneous enhancing hypodense mass extending to the fundus with infiltration of the posterior wall of bladder.

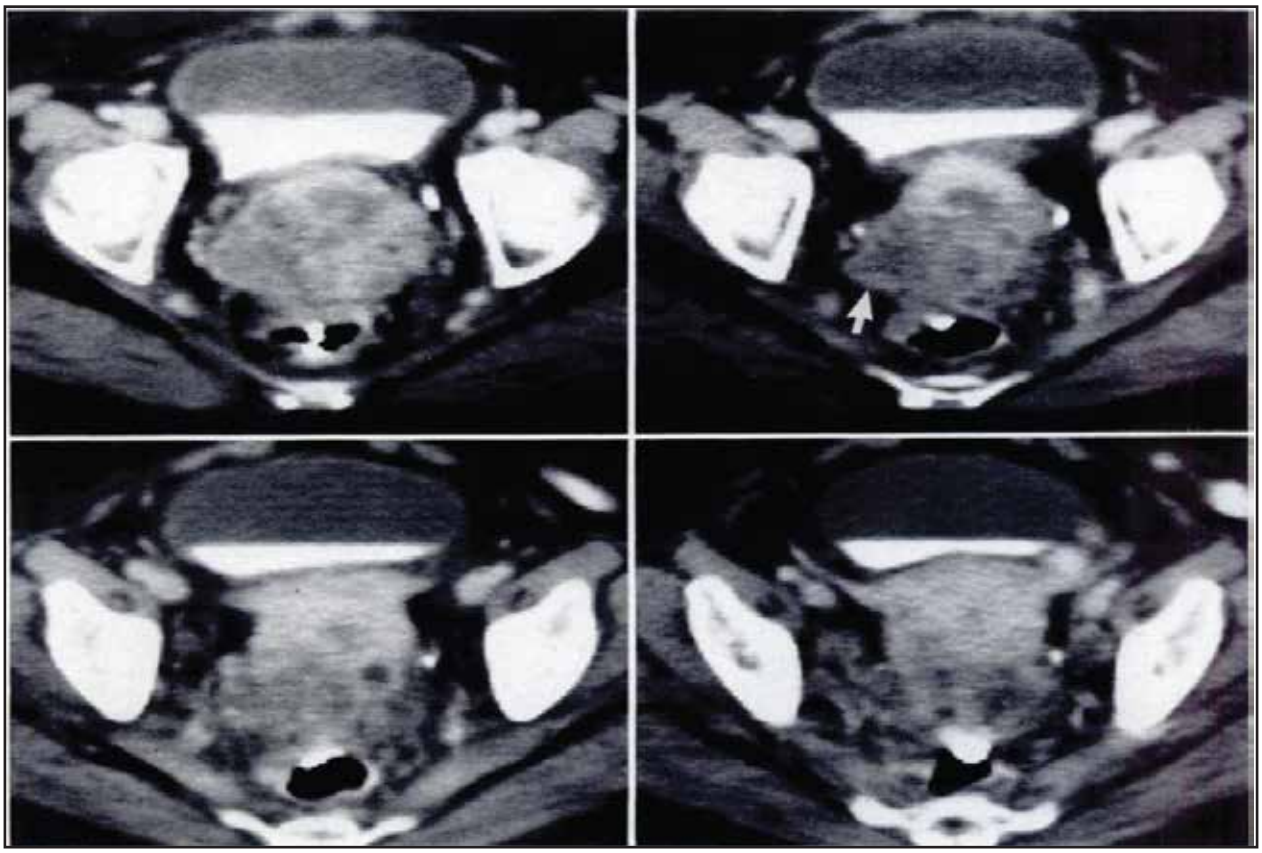

Image 4: CT images of clinical stage IVA cervical carcinoma. Sequential CT scan images show a heterogeneous enhancing hypodense cervical mass with right parametrial soft tissue, left parametrial fat stranding, obliteration of periureteric and pre-rectal fat plan with rectal wall invasion.

Clinical and per vaginal examination data supplied by referral physician. After radical hysterectomy, specimens were sent for histopathological examination, where the presence of parametrial involvement was confirmed. Correlation between radiological and histological findings was analyzed.

Results

During our study period, 130 patients of newly diagnosed, untreated, pathologically proven carcinoma cervix, with their ages ranging from 32 to 78 years, were evaluated. General complaint in the 130 patients was vaginal bleeding except in four cases, one had associated supra-clavicular mass and the others had inguinal mass as the only symptom. Regarding menstrual history 73 cases(56%) were postmenopausal and 57 cases(44%) were premenopausal (Figure 1)

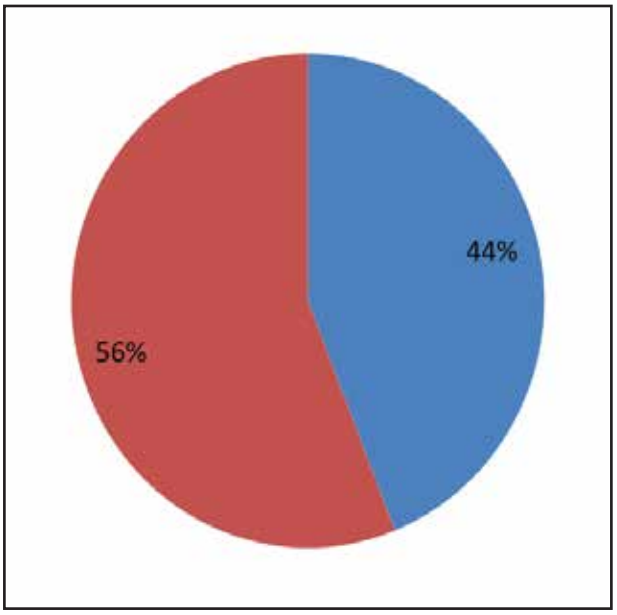

Figure 1: Pie chart showing postmenopausal and premenopausal cases of the study.

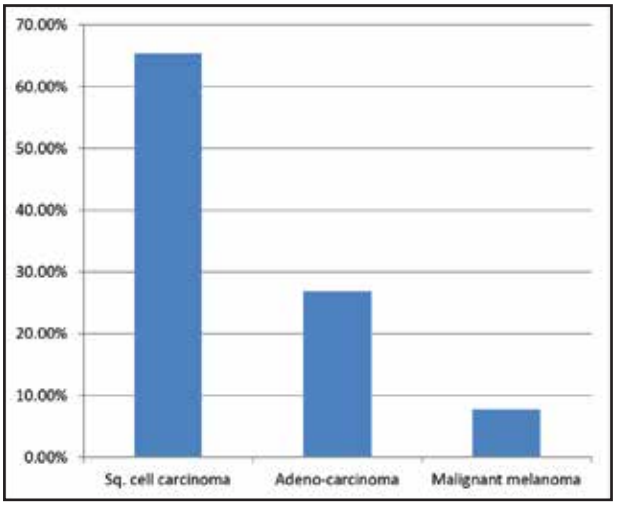

Figure 2: Bar diagram showing histopathological types of cervical masses.

Histological cervical masses were - squamous cell carcinoma (85 cases, representing 65.4%), adenocarcinoma (35 cases, representing 26.9%) and malignant melanoma (10 cases, 7.7%) (Figure 2). After that MDCT was done to evaluate loco-regional involvement and distant metastasis of disease. 55 patients had extensive loco-regional involvement and distal metastasis and FIGO Clinical stages 7 (Table I) were IIIA, IIIB, IVA, and IVB. These 55 patients were non-operable and were excluded from study.

Table I: Staging performed according to FIGO staging system [7]

Stage 0		No tumor present
Stage I	IA	No tumor present
	IB	No tumor present or doesn't alter cervical contour
Stage II	IIA	Thickening of vaginal wall (upper two thirds)
	IIB	Irregular lateral cervical wall , Parametrial mass or strands , Obliteration of periureteric fat
Stage III	IIIA	Thickening of vaginal wall (lower two thirds)
	IIIB	Tumor extends to obturator Internus, pyriformis , or levator ani muscles, Dilated ureter
Stage IV	IVA	Thickening, nodularity, serration of bladder or rectal wall, Obliteration of perivesical or perirectal fat
	IVB	Tumor in distant organs

The remaining 75 cases clinical stages were IA (02 cases represent 2.7%), IB (21 cases represent 28%), IIA (45 cases represent 60%), IIB (07 cases represent 9.3%). The distribution of the study population who had undergone radical hysterectomy or Wertheim operation were categorized according to the stage of disease as shown in Table II.

Table II: Pre-operative FIGO Clinical staging of operable cases

Clinical stage	No. of patient
IA	02 (2.7%)
IB	21 (28%)
IIA	45 (60%)
IIB	07 (9.3%)
Total	75 (100%)

According to CT criteria, among 75 study population, 55 cases had tumor-free parametrium and 20 cases had tumor invasion to the parametrium (Table III)

Table III: CT Evaluation of 75 Patients with Primary Cervical Cancer.

Tumor - free Parametrium	55
Tumor invasion into the parametrium	20

Post-operative histology result were 51 cases had no parametrial invation, on other hand 24 cases had tumor invasion to parametrium (Table IV).

Table IV: Post-operative histopathological results of 75 Patients with cervical cancer.

Tumor - free Parametrium	51
Tumor invasion into parametrium	24

From the statistical calculation, we found that the sensitivity of CT scan in detecting parametrial involvement was 66.7% but it had higher specificity of 92.2%. It showed CT scan had relatively poor detection rate in early stage of parametrial involvement but a negative test could exclude the disease better. The positive predictive and negative predictive values were 80% and 85.5% respectively (Table V).

Table V: Correlation between CT scan finding and Histopathological confirmation.

CT Scan	**Histopathology result**		
	Positive	**Negative**	**Total**
Positive	16 (TP)	4 (FP)	20
Negative	8 (FN)	47 (TN)	55
	24	51	75

	(TP/TP+FN)	16/24 = 0.667
Specificity	(TN/FP+TN)	47/51 = 0.922
PPV	(TP/TP+FP)	16/ 20 = 0.80
NPV	(TN/FN+TN)	47/55 = 0.8545

Discussion

Treatment for cervical cancer depends on the stage of the disease. Treatments include surgery, chemotherapy, radiation and immunotherapy. Radical hysterectomy or Wertheim operation is usually reserved for medically-fit patients with tumor confined to the cervix (stage I) or with minimal extension to the proximal vagina (stage IIA). Radiation therapy is the treatment of choice for a tumor that has spread to the parametria or beyond (stage IIB or greater). Previous reports have described the CT appearances of early cervical cancers in only a limited fashion. A tumor confined to the cervix has been characterized as being centrally contained with smooth lateral margins and normal parametrial fat. Features of parametrial tumor extension have included obliteration of normal fat, hazy soft-tissue density fat adjacent to the tumor, a parametrial mass triangular or lobulated outlined extension into parametrial fat.[8]

In our study, among 75 study population, 55 cases were tumor free parametrium and CT findings indicative of cancer confined to the cervix 46 cases (83.6%) are smooth, well defined cervical margins, lack of abnormal soft-tissue density in parametrial fat and preservation of the periureteral fat planes (Image-1) and rest 09 (16.4%) cases had full thickness wall involvement, parametria contained no prominent fat strands and none had a parametrial soft-tissue mass or obliteration of the periureteral fat plane (Image 2). In 20 tumor-positive parametria CT findings associated with parametrial tumor invasion were - irregularity or poor definition of the lateral cervical margins, prominent parametrial soft-tissue strands, obliteration of the periureteral fat plane and an eccentric parametrial soft-tissue mass (Image 3 & 4). At post-operative histopathological study showed 51 cases had tumor-free parametrium and there were parametrial invasion at 24 cases. The 04 cases only had parametrial lymphatic invasion that was not identified in contrast-enhanced CT images.

In our study group, among 75 patients with early-stage of cervical cancer CT scan showed 20 cases (26%) tumor tumor-positive parametrium and post-operative tumor-positive parametrial cases were 24 (32%). The sensitivity of CT scan in detecting parametrial involvement was 66.7% but it had a higher specificity of 92.2%. It showed CT scan had a relatively poor detection rate in the early stage of parametrial involvement but a negative test could exclude the disease better. The positive predictive and negative predictive values were 80% and 85.5%, respectively (Table V).

In 2012, a Malaysian study revealed that CT evaluation of parametrial invasion had overall accuracy of 78.7%, positive predictive value of 22.2% and negative predictive value of 90.7%. However, there are pitfalls and limitations of CT scan in the assessment of parametrium in the cervical cancer. Early lymphatic spread could not be detected by CT images. Normal parametrial vessels and/or uterine ligaments could be misinterpretated as evidence of parametrial tumor invasion. Parametritis secondary to surgical biopsy, cervical conization, uterine curettage or infection of the primary tumour have similar appearances of the irregular cervical margins and adjacent soft-tissue stranding due to parametrial tumor invasion. Therefore, adequate clinical information to the attending or reporting

radiologist is the utmost important for accurate correlation of the radiological findings.[9]

Studies of early-stage cervical cancer have reported that clinical staging is often inaccurate compared with surgical staging and the discrepancies can be as high as 25% of the population. The FIGO has suggested the FIGO classification system to assess the size of a primary tumor with diagnostic imaging modalities. Computed tomography and MRI are considered as the optimal imaging modalities to evaluate tumor extension. In particular, the accuracy of cervical cancer staging is reported to be 63% to 69% for CT and 77% to 90% for MRI. Moreover, MRI is more advantageous for tumor invasive parametrium assessment over clinical staging and CT with an accuracy between 74% and 96% .[10]

In 2021, an American study with 196 cervical cancer patient found that CT accuracy in detecting vaginal invasion, uterine invasion, bladder invasion and cervical invasion were 55%, 41.6%, 66.6% and 20%, respectively.[11]

CT imaging in cervical cancer allows for rapid and comprehensive evaluation with a good resolution of anatomical structures and the ability to identify any retroperitoneal and distant metastases. However, limitations include suboptimal ability to define the extent of pelvic tumors, with poor sensitivity in analyzing soft pelvic tissues and these disease-related features. In addition, X-ray exposure may be a concern, particularly in women of childbearing age.[12]

In cervical cancer, CT gave better results in staging of advanced cases as well as early staged ones. Local staging was improved by acquisition of delayed scans.

Conclusion

It is expected that understanding the CT appearances of normal and pathologic parametria will improve the accuracy of CT in staging early cervical cancer. Now-a-days development of MDCT with newer software and having facilities of reconstruction of images help to evaluate parametrium more accurately. By using CT criteria developed in this study, it is possible to differentiate stage lB from lIB tumors on the basis of objective findings. In evaluating suspected stage lB cancers, we currently recommend CT staging if the physical examination is equivocal or unsatisfactory due to obesity, pelvic pain or other problems. CT should also be considered as an alternative to pelvic examination under anesthesia and as a means to localize parametrial tumor for biopsy. Ultimately, the precise role of CT in early cervical cancer will require larger studies that compare the results of CT with conventional staging techniques.

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