Role of Transvaginal Contrast Enhanced MRI in Early Detection and Staging of Cervical Cancer: A Review

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ABSTRACT

Cervical cancer is the second most common gynecologic malignancy. It usually takes years for pre-cancerous changes to turn into cervical cancer. This pre-cancerous changes when detected is 100% treatable. Accurate cervical cancer staging is crucial for appropriate treatment selection and treatment planning. The greatest difficulties in the clinical staging are the estimation of tumor size, especially if the tumor is primarily endocervical in location. MRI has excellent soft-tissue contrast resolution, which exceeds that of CT and US. Consequently, MRI is significantly more valuable in the assessment of the size of the tumor, the depth of cervical invasion, and the local-regional extent of the disease.

Aim of the Study: to highlight the role of transvaginal contrast enhanced MRI in the early detection& staging of cervical cancer to guide for accurate management.

Conclusion: High-resolution MRI is accepted as optimal for evaluation of the main prognostic factors and selection of therapeutic strategy for cervical cancer.

Keywords: Cervical cancer, MRI, oncologic imaging, gynecologic carcinoma.

INTRODUCTION

Cervical cancer is the most frequent gynecologic carcinoma in women under 50 years of age and the third most common gynecologic malignancy in postmenopausal women following endometrial and ovarian cancer [1].

Staging and early detection of cervical carcinoma have a great importance in management. The most widely used staging system is the FIGO (International Federation of Gynecology and Obstetrics), which distinguishes four stages of cervical cancer This staging system was introduced before the advent of modern imaging modalities and hence differs from all other classifications of gynecologic tumors in which it is still based on the results of bimanual palpation[2].

MRI has been shown by a number of studies to be the most reliable imaging modality in the evaluation of cervical cancer and in treatment planning. It has the advantages of direct tumor visualization, accurate assessment of the depth of stromal invasion, tumor volume, and lymph node evaluation[3].

MRI has been considered to play a significant role for more detailed and non-invasive mapping. It has increasingly been utilized in cervical cancer staging ,MRI presents an excellent imaging resolution for the different densities of pelvic structures, does not require ionizing radiation is comfortable for the patient improves the staging, allowing the early detection of recurrence[4].

MRI staging in early cervical cancer may be difficult and overestimated, especially if the tumor is slightly extending into the proximal vagina. Use of

vaginal contrast medium is an easy, well tolerated, and effective method to better delineate the borders of the tumor. It increases the specificity and accuracy of MR staging by showing the exact relation of the tumor with the vaginal wall [5].

Application of endovaginal coil MRI is useful for obtaining high resolution images of the cervix, important in defining tumors less than 1cm3 volume and clarifying the extent of tumor invasion [6].

Using high-resolution magnetic resonance imaging (MRI) with a special vaginal coil was designed specifically to image the cervix and enabled measurement of diffusion of water within the tissue cells. The researchers found that the diffusion of water was reduced in cancerous tissue compared to normal tissue . This remarkably eases the early detection of early stage cervical cancer [7].

The study was approved by the Ethics Board of Ain Shams University.

Pathology of Uterine Cervical Carcinoma
Incidence statistics

Worldwide, uterine cervical carcinoma is the second most common gynecologic malignancy. The incidence of invasive cervical cancer is higher in low-income countries due to lack of screening programs. In developed countries [8] .The incidence of invasive cervical cancer dropped after implementation of the

Papanicolaou smear test. Indeed, cervix uterine cancer represents only 0.8% of all new cancer cases. It affects mostly women of reproductive age; 14.0% of patients diagnosed with cervical cancer are between 20 and 34 and 25.9% between 35 and 44 years of age.

Invasive cervical cancer remains, however, a fatal disease with no significant improvement of survival rates for patients with advanced disease. It is estimated that 275000 die annually from cervical cancer. In the United States, 4100 women with invasive cervical cancer were expected to die from the disease in 2015, according to Surveillance, Epidemiology and end Results data [9].

Local statistics

Egypt has a population of 30.55 million women ages 15 years and older who are at risk of developing cervical cancer. Current estimates indicate that every year 866 women are diagnosed with cervical cancer and 373 die from the disease. Cervical cancer ranks as the 13th most frequent cancer among women in Egypt and the 10th most frequent cancer among women between 15 and 44 years of age. Data is not yet available on the HPV burden in the general population of Egypt. The region Egypt belongs to, about 2.7% of women in the general population are estimated to harbour cervical HPV-16/18 infection at a given time, and 78.9% of invasive cervical cancers are attributed to HPVs 16 or 18. According to Human Papillomavirus and Related Cancers[10].
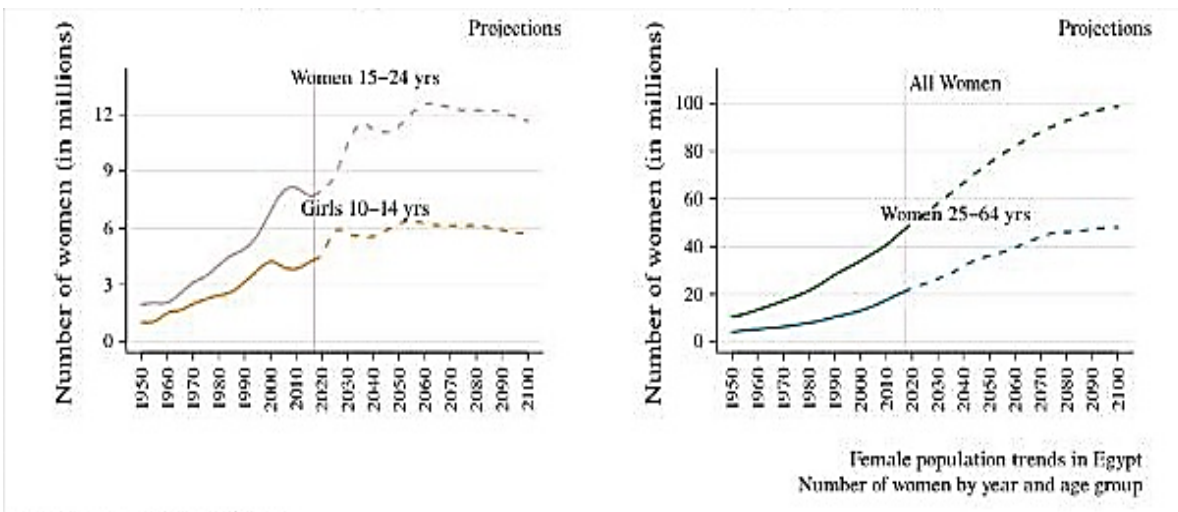

Fig (1): Female population trends in Egypt number of women by year and age group[10].

MRI Protocol for Uterine Cervix Imaging

Patient Positioning: MRI is performed with the patient in the supine position.

Coil Selection

1. Conventional Pelvic MRI coils

Phased Array coils

These coils improve the SNR compared with standard body coils.

2. Endovaginal MRI coils

Intracavitary coils yield a better image quality by improving the local SNR.

Types of endovaginal coils

a. Ring solenoid (standard endovaginal coils): Intravaginal enveloping cervical receiver coils designed for use at 0.5 T, 1.0 T and 1.5 T. A ring solenoid receiver coil mounted on acetal homopolymer (Delrin) former (internal diameter)[11].

b. Endorectal coils: Considerably improve visualization of the posterior cervical lip, but the anterior cervical margin and the fascial planes between the cervix and bladder are poorly visualized [12].

Sequences

1) T2-weighted sequences:

T2W sequences have the highest soft-tissue contrast and thus provide most of the information on the localization and extent of a cervical carcinoma. They are the basis of any pelvic MRI examination. T2W pelvic imaging is nearly exclusively performed using turbo or fast spin echo (TSE or FSE) sequences, either with classical TSE sequences with the patient breathing freely or with single-shot TSE sequences during breath-hold (e.g. HAST E). Sagittal and transverse

T2W sequences serve to determine the localization and size of the tumor as well as the depth of cervical stroma infiltration.

These sequences are also crucial for excluding extracervical extension and infiltration of the parametria, vagina, bladder, and rectum[13].

Types of T2W images

1. *Sagittal T2W images:* The first T2W sequence should be acquired in the sagittal plane and covers the uterus and vagina to the pelvic floor. This sequence should be acquired with a high resolution using thin slices and a small FOV, i.e., a 512 matrix, a phase resolution of a least 75%, and a slice thickness of 4–5 mm.

2. *Transverse oblique T2W images:* The transverse sequence should be angulated for alignment perpendicular to the axis of the cervical canal. The two critical issues – **(depth)** of infiltration and **(parametrial involvement)** – can be assessed most reliably on transverse images angulated perpendicular to the cervical axis. It is important that the angulation does not exceed 45° to avoid acquisition in coronal orientation with reversal of left and right. As with the sagittal sequence, the imaging field in transverse orientation extends from the fundus uteri to the pelvic floor. Images should be acquired with a slice thickness of 4–5 mm, a 512 matrix, and a phase-resolution of at least 75% [13].

3. *Optional T2W sequences:*

a- **High-resolution respiratory triggered transverse T2W sequences from the renal hili to the aortic bifurcation:**

Cervical cancer extending beyond the cervix and recurrent tumors are associated with a significantly higher risk of metastatic spread to para-aortic lymph nodes. These lymph nodes are best evaluated with *high-resolution respiratory triggered T2W sequences* for imaging of the abdomen in *transverse orientation* from the renal hili to the aortic bifurcation [13].

b- **Coronal T2W image**s:

Involvement of the pelvic floor muscles in advanced tumors is evaluated on coronal *T2W images*, which is especially suited for evaluation of the levator ani muscle. Information on muscle involvement is important for planning the surgical procedure[13].

2) Diffusion-weighted MRI (DWI)

DWI is a potentially useful adjunct to conventional MRI in the evaluation of gynecologic tumors, thus improving the overall diagnostic accuracy, tumor staging, prediction of response to therapy and treatment follow-up[14].

3) T1-weighted sequences:

1-Transverse T1W sequences: For evaluation of the pelvic sidewall and lymph node staging. The acquisition starts at the level of the aortic bifurcation and extends to below the pelvic floor. A slice thickness of 6 mm is used, with a 512 matrix and a phase resolution of at least 60%. Complete coverage of the inguinal lymph nodes should be attempted in patients with cervical cancers involving the lower third of the vagina (stage IIIA or higher), which may be associated with inguinal lymph node metastasis[13].

2-Optional T1W sequences:

a- **Post contrast T1W imaging:** Intravenous (IV) contrast medium administration is rarely necessary for primary staging of cervical cancer, as the contrast medium does not improve tumor delineation from surrounding tissue compared with the unenhanced T2-weighted images in most patients. Often, contrast enhancement even impairs differentiation of the tumor from parametrial tissue[15].Contrast-enhanced images can, however, improve the diagnostic accuracy of identifying tumorous infiltration of the urinary bladder or rectum. The extent of infiltration is visualized as a disruption of the muscular wall of these organs, which is of lower signal intensity on T1-WIs. It has been shown that contrast-enhanced MRI can improve the differentiation of an edematous stromal reaction (no enhancement) of the vesical or rectal wall from tumor infiltration (positive enhancement), Also CM administration is indicated to differentiate recurrent tumor and to follow-up postoperative. The contrast medium that is usually used is an unspecific gadolinium-based low-molecular agent administered at a dose of 0.5-mmol/kg body weight[15].b- **Dynamic T1W contrast-enhanced MRI:** It is performed to evaluate the course of contrast enhancement in a region-of-interest (ROI) placed in a suspicious area. [15]*Endovaginal MRI Protocol.*

b- The MRI examination begins with a localizer scan in transverse, sagittal and coronal orientation. Imaging requires both *T1W and T2W sequences* in two planes. Choice of imaging plane is influenced by preference of individual radiologist, but in general the *Sagittal and Transverse planes* provide best delineation of tumor extent and parametrial spread. Imaging parameters also may be varied and fast spin-echo sequences used whenever available.

The sagittal plane is most useful for imaging the tumor and assessing the distance from the edge of the cervix. It is also used to assess the vaginal involvement with tumor. Because the ring of the coil neatly encompasses the cervix, a plane transverse to the cervix and also to the ring of the coil can also easily be selected from the pilot images. This plane is critical for assessing parametrial involvement[16].

Table (1): The comparison of endovaginal vs. external techniques without and with the addition of diffusion-weighted magnetic resonance imaging (DW-MRI) to T2-w

N=50 regions (25 patients)		Sens %	Spec %	PPV %	NPV %
T2-W	Independent rad. endovaginal	100	100	100	100
	Independent rad. external array	100	95	33.3	100
T2-W+DWI	Independent rad..endovaginal	100	100	100	100
	Independent rad. external array	100	97.9	50	100

Sensitivity, specificity, and positive (PPV) and negative (NPV) predictive values for detecting parametrial extension by an independent radiologist [14].

MRI PROTOCOL IMAGING OF CERVICAL CANCER

Table (2): Sequence parameters used for imaging of cervical cancer [14].

Parameter	T2-weighted coronal, sagittal	DWI coronal	T2-weighted	DWI
Coil selection	Dual: Endovaginal+FLEX-L 2 element	Single: Endovaginal	SENSE-XL torso	SENSE-XL torso
	phased array body			
Sequence	Turbo Spin Echo-Multi Shot	Spin-Echo Echo Planar	TSE (TSE Factor 13)	EPI
	(TSE factor 10)	Imaging-Single Shot		
TR (ms)	2750 (coronal)	6500	2100	3230
	2500 (sagittal)			
TE (ms)	80	54	90	53
Flip angle	90°	90°	90°	90°
Bandwidth (Hz/Px)	217.7	9.6	217.3	9.6
FOV (mm)	100×100	100×100	120×200	110×100
Acq pixel size (mm)	0.42×0.42	1.25×1.25	1.0×1.0	1.25×1.25
Acq matrix	238	80	120	88
Recon matrix	288	224	400	224
Acq voxel size (mm^3)	0.35 [0.42×0.42×2]	3.125 [1.25×1.25×2]	3.00 [1×1×3]	4.69 [1.25×1.25×3]
Slice thickness (mm)	2 (0.1 separation)	2 (0.1 separation)	3	3
Recon voxel size (mm^3)	0.24 [0.35×0.35×2]	0.40 [0.45×0.45×2]	0.75 [0.5×0.5×3]	0.72 [0.49×0.49×3]
Number of slices	24 (coronal)	24	16	16
	22 (sagittal)			
NSA	2	1	4	2
Included b-values s/mm^2	n/a	0, 100, 300, 500, 800	n/a	0, 100, 300, 500, 800
isotropic				
Acquisition time	4 min 18 s (coronal)	4 min 33 s	3 min 58 s	3 min 50 s
	4 min 0 s (sagittal)			

Signal in gel (T1=500 ms,	Flex-L elements 15 cm apart, gel sited	Gel sited centrally within	Coil elements 15 cm apart,	Coil elements 15 cm apart,
T2=50 ms) to background noise	centrally within endovaginal coil ring	endovaginal coil ring	gel sited centrally	gel sited centrally
	135	51	130	7

MRI imaging of uterine cervical carcinoma with pathological correlation

Classification of cervical tumors
A) Epithelial neoplasm
1) Squamous Cell Carcinoma:
Squamous cell carcinoma is by far the most common type of cervical cancer. It often manifests in its early stages as a poorly defined, granular, eroded lesion or as a nodular and exophytic mass [17].

MR imaging can provide highly accurate information on the exactextent of tumors because of its fine contrast resolution. On T2W image it appear as well defined hyperintens mass in the uterine cervix surrounded by hypointens cervical stroma ,the mass shows either exophytic or endophytic growth [17].

2) Neuro-endocrine tumors of the cervix
Another histologic type of epithelial carcinoma of the uterine cervix in addition to squamous cell carcinoma or adenocarcinoma is classified by the World Health Organization as small cell carcinoma. It is similar to pulmonary small cell carcinoma and contains neuroendocrine granules [18].Carcinoid is a rare neuroendocrine tumor arising in the uterine cervix. Most cases show nonspecific symptoms Indistinguishable from those of squamous cell carcinoma [18].

MR imaging findings of uterine carcinoid have not been reported, to the anthers knowledge. They have studied a single case of uterine cervical carcinoid with MR imaging. The tumor showed slightly heterogeneous high signal Intensity on T2-weighted images and was well enhanced with gadolinium-based contrast material. As these findings are not particularly different from those of squamous cell carcinoma, it could not be differentiated from other types; of cervical carcinoma [18].

3) Malignant Melanoma
Malignant melanoma of the feniale genital tract accounts for 1%-5% of all melanoma cases it usually occurs in the vaginal mucosa and occasionally involves the uterine cervix. Malignant melanoma arising in the uterine cervix is extremely rare [16].

MR imaging characteristics have been reported in other organs and consist of high signal intensity on both T1-weighted and T2-welghted images. T1 shortening is attributed to either the paramagnetic effects of stable free radicals within melanin granules or the methemoglobin within the intratumoral hemorrhage. However, malignant melanoma may have different signal intensity characteristics according to the melanin concentration and the presence of hemorrhage [16].

4) Adenoma Malignum:
Adenoma malignum (also known as minimal deviation adenocarcinoma) Is a special subtype of mucinous adenocarcinoma of the cervix. Its prevalence is about 3% of all cervical adenocarcinomas. The most common initial symptom is a watery discharge. The prognosis of this tumor has been reported to be unfavorable, as it disseminates into the peritoneal cavity even in the early stage of the disease and its response to radiation or chemotherapy is poor [16].

At histopathologic analysis, the tumor is composed of well-differentiated endocervical glands that extend from the surface to the deeper portion of the cervical wall. They form an annular or nodular mass5 with cystic spaces filled with mucin) [16].

5) Clear cell carcinoma: Clear cell carcinoma is of a high-signal intensity plaque on T2w image. 'This result may have been attributable to the quality and amount of tumor secretion [7].

Nonepithelial Neoplasms
1) Cervical Lymphoma
Malignant lymphomas in the female genital tract are rare, and those arising from this tissue system are extremely uncommon. The most frequent type of lymphoma proved to be diffuse large B-cell lymphoma, closely followed by follicular lymphoma, including all 3 grades of malignancy. Burkitt lymphoma showed a rather

similar frequency. Marginal zone lymphoma occurred exclusively as primary lesions In the uterine mucosa, Lymphoplasmacytic lymphoma was restricted to the vulvo-vaginal area and occurred in women over 60 years of age [17].

MR imaging, although the tumor tends to be hypointense on T1-weighted images and relatively hyperintense on T2-we.ighted images. MR imaging findings of uterine cervical lymphoma closely resemble those of carcinoma of the cervix. However, preserved cervical epithelium in the presence of extensive involvement of the cervical stroma may be a clue to the diagnosis of malignant lymphoma. Diffuse enlargement of the uterus without disruption of the endometrial epithelium is also reported to be a characteristic finding for lymphoma involving the uterine body [17].

2) Cervical Lymphoma

As about 90% of uterine leiomyomas occur in the uterine body, cervical leiomyoma is relatively rare. Its prevalence is reported to be less than 10% of all leiomyomas of the uterus . It occasionally form protrude into line cervical canal or even the vagina when they grow in the submucosal region. Because they are located along the birth canal, they occasionally cause maternal dystocia [17].

Role of MRI in cancer of the uterine cervix

MRI is already widely accepted as the most reliable imaging technique for the diagnosis, staging, treatment planning, and follow-up of both endometrial and cervical cancer. MRI protocols need to be optimized to obtain the best results[19].In evaluating the stage of cervical cancer, MRI was found to have an accuracy of up to 90%, whereas clinical staging according to the FIGO system shows errors of 20–40% depending on the stage of the disease[20].Sagittal T1-weighted and T2-weighted images and oblique axial T2-weighted images obtained perpendicular to the uterine axis are sufficient for staging in most cases[21].The most important issue in staging is to distinguish early disease (stages I and IIa) that can be treated with surgery from advanced disease (stage IIb or greater) that must be treated with radiation alone or combined with [22].Understaging is actually more important because surgery would be an inadequate treatment if the uterus is removed in someone with advanced disease, and curative radiative doses cannot be achieved because In general ,staging of cervical carcinoma with MR imaging is based on the classification system of FIGO [23].

Table (3): Revised FIGO staging of cervical carcinoma[24].

Stage	Revised FIGO staging
Stage o	Carcinoma in situ, intraepithelial carcinoma
Stage I:	Carcinoma strictly confined to cervix (extension to the corpus should be disregarded)
	Preclinical carcinoma of cervix (microinvasive)
Ia	Invasion of stroma < 3 mm in depth and < 7 mm in width
Ia1	Invasion of stroma > 3 mm but < 5 mm in depth and no wider than 7 mm
Ia2	Lesions confined to cervix or preclinical lesions greater than stage IA
Ib	Clinical lesions 4 cm or smaller
Ib1	Clinical lesions larger than 4 cm
Ib2	
Stage II:	Carcinoma extending beyond the cervix but not to the pelvic wall; carcinoma involves the upper two third of the vagina
IIa	No obvious parametrial involvement
IIb	Obvious parametrial involvement
Stage III:	Carcinoma extending to pelvic wall; on rectal examination, there is no cancer-free space between tumor and pelvic wall, and tumor involves lower third of vagina (all cases with hydronephrosis or nonfunctioning kidney should be included until proven otherwise)
IIIa	Involvement of lower third of vagina
IIIb	Extension to pelvic side wall or presence of hydronephrosis or nonfunctioning kidney
Stage IV:	Carcinoma extending beyond true pelvis or involving bladder or rectum

| IVa | Spread to adjacent organs |
| IVb | Spread to distant org |

Stage Ib cervical carcinoma is the earliest stage that can be demonstrated by MRI. The average MRI detection rate is 95%. Stage Ib1 (diameter <4 cm) and stage Ib2 (diameter >4 cm) are distinguished on the basis of their size. Transverse and sagittal T2 weighted images depict cervical carcinoma as a high-signal-intensity lesion within the low-signal-intensity oval cervical stroma. Cervical cancer at this stage is fairly smoothly marginated and completely surrounded by low-signal-intensity cervical stroma (Fig. 2) [24].

Fig. (2): a, b Stage Ib cervical carcinoma. T2 weighted images in sagittal and transverse orientation. The small cervical cancer is seen as a high-signal-intensity lesion primarily growing within the cervix. The cancer is surrounded by low-signal-intensity cervical stroma on both sagittal and transverse images. Accessory finding: uterine prolapse and leiomyomas of the anterior wall of the uterus [25]. Since Stage Ib does not disrupt the stroma and can thus be difficult to depict. Therefore, small tumors may be more readily identified by their early homogenous enhancement after dynamic injection of contrast material *(Engin, 2006).*

In stage IIa cervical cancer, infiltration involves up to two-thirds of the proximal vagina while sparing the lower third. On T2-weighted MR images, vaginal involvement is seen as hyperintense segmental disruption or lesion in the otherwise low-signal-intensity vaginal wall. Infiltration of the anterior and posterior fornix and of the wall is best seen in sagittal orientation (Fig. 3)[24].
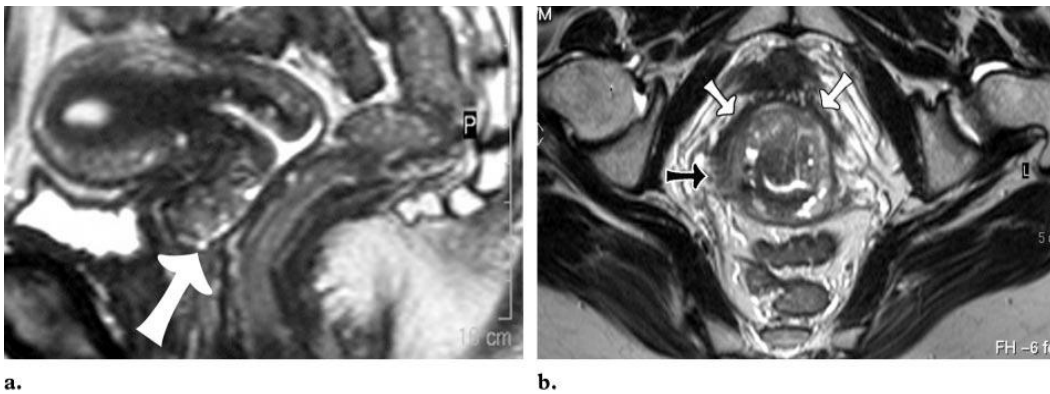

Fig. (3): Stage IIa cervical carcinoma, **a.**Sagittal and **b.**TransverseT2-weighted MR images show a slightly hyperintense mass that protrudes into the vaginal canal (arrow in **a**). Most of the vaginal wall surrounding the tumor seems intact (white arrows in **b**); although the low signal intensity of the vaginal wall is disrupted on the right side (black arrow in **b**). Parametrial invasion is not seen[25]. Presence of an intact low signal intensity rim surrounding the cervical tumor in high-

resolution transverse T2 weighted MR images is a generally accepted indicator of negative parametrial invasion. On the other hand, full thickness stromal invasion on MRI with loss of the low signal intensity rim of the cervix together with nodular or irregular tumor signal intensity extending into the parametrium are associated with parametrial invasion (Fig. 4). The most reliable MRI criterion of parametrial infiltration is the direct visualization of a tumor mass extending into the parametria (Fig. 5)[27].
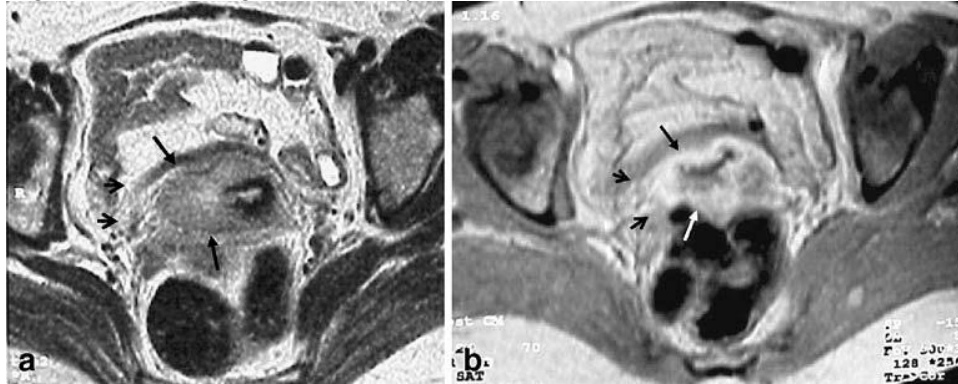

Fig. (4): Stage IIb cervical carcinoma. (a) Axial T2-weighted and (b) axial T1-weighted contrast-enhanced MR images show a necrotic cervical mass (arrows) with right parametrial invasion (short arrows)[28].
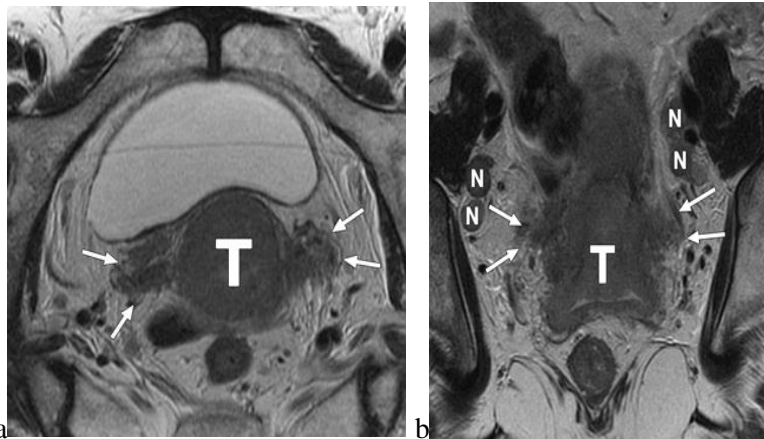

Fig. (5): Stage IIb cervical carcinoma in 42-year-old woman.(**a**) axial and (**b**) coronal T2-weighted images show cervical cancer (T) involving both lips of cervix. Tumor invades cervical stroma bilaterally, as shown by loss of low-signal-intensity ring, and extends to both parametria (*arrows* in a&b). Enlarged lymph nodes (N in b)[15].

MR imaging findings that are suggestive of pelvic sidewall involvement (Stage IIIb) include tumor within 3 mm of or abutment to the pelvic floor muscles and the iliac vessels. Loss of normal parametrial signal intensity in T1- weighted images and increased signal intensity in pelvic musculature on T2-weighted images are other suggestive findings. Ureteral obstruction and hydronephrosis at the level of the tumor is also considered to be an indication of wall invasion[28].Once tumor invades the adjacent organs, such as the bladder and rectal mucosa, or distant metastasis occurs, the stage is defined as IV. One of the real advantages of MR imaging is excellent negative predictive value for stage IVa disease, thus safely obviating the need of invasive ystoscopic or endoscopic staging with reduction in staging costs. Bladder or rectal invasion is frequently underestimated in the FIGO staging system, since it only concerns mucosal invasion identifiable on endoscopy[17].Lymph node metastasis is the most important prognostic factor in early stage cervical cancer, although it is not incorporated in the FIGO staging system. CT and MR imaging perform with similar accuracies of 70–80% in the evaluation of nodal involvement. Accurate cervical cancer staging is crucial for appropriate treatment selection and treatment planning[29].

On MRI, lymph node with a transverse diameter greater than 10 mm is usually considered as malignant. However, the specificity of this finding is

very low. Enlarged lymph nodes may be hyperplasic, and lymph nodes smaller than 1 cm may contain metastatic disease. However, central necrosis within a lymph node is a useful predictor of metastatic disease. Central necrosis has a positive predictive value of 100% in the diagnosis of metastasis[28].

Challenges in staging cervical carcinoma with MR imaging:

Pitfalls in pre-treatment staging of cervical carcinoma with MRI include: technical, patient, and tumor-related characteristics.

Table (4):Pearls and pitfalls of MRI for Staging of cervical Carcinoma[15].

Pearls	Pitfalls
Accurate estimation of tumor size by MRI (within 0.5 cm of measurement at pathology).	Parametria are located lateral and only lateral to the cervix.
Intact low-signal-intensity stromal ring excludes parametrial invasion.	Loss of low-signal-intensity stromal ring indicates full stromal but not parametrial invasion.
Recurrent vaginal vault tumor has the same signal intensity as the primary tumor.	Overestimation of parametrial invasion on T2-weighted images due to post biopsy haemorrhage or with large tumors due to stromal oedema.
Reconstitution of normal cervical anatomy and low-signal-intensity cervical stroma indicate complete response to radio- or chemotherapy. Dynamic contrast-enhanced MRI improves detection of small tumors and helps in differentiating tumor recurrence from radiation fibrosis	Early radiation change (within 6 months) and presence of infection may show enhancement

CONCLUSION

• High-resolution MRI of the cervix using an endovaginal coil provides accurate assessment of the intra and extra cervical extents

of early stage cervical neoplasia and correctly identifies lesions ≤ 2 cm³ with high sensitivity. As a complementary study pelvic phased MRI is performed in every case for pre-therapeutic evaluation of the pelvic organs, pelvic sidewall and for lymph node staging .

• In patients without prior cone/LLETZ biopsy, endovaginal T2 weighted images detected cervical tumors <0.9cm3 with 100% sensitivity, 100% specificity.

• H-MRS used in conjunction with endovaginal MR imaging for early detection of cervical cancer& Phosphorous-31 MRS used in detection of tumour response to radiotherapy.

• The high-spatial-resolution images obtained with an endovaginal coil together with DW MR give an ultrafast sequence without oral or IV contrast material used in early detection & staging of cervical cancer.

• High-resolution MRI of the cervix using an endovaginal coil has important role in Selection of best treatment modality for each patient

• High-resolution MRI of the cervix using an endovaginal coil used for Detection of local tumor recurrence, it enables differentiation of postoperative or radiation-induced scars from recurrent tumor.

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