Current staging of endometrial carcinoma with MR imaging

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Learning objectives

1. To provide an educational and pictorial review of the magnetic resonance imaging (MRI) findings of endometrial carcinoma
2. To present the new revised *International Federation of Gynecology and Obstetrics (FIGO)* staging system for endometrial carcinoma, demonstrating how to apply it in clinical practice, illustrating with cases of our service.

Background

Endometrial cancer is the fourth most common malignancy in females and the most common malignancy of the female reproductive tract, and the incidence is rising, mainly due to increased life expectancy and higher levels of obesity, as well as other risk factors (Fig 1) [1, 2, 3].

Approximately 75% of cases occur in postmenopausal women, with mean age at presentation of 63 years, and more than 90% of women are older than 50 [3, 4].

Most commonly, women with endometrial carcinoma present with inter-menstrual or post-menopausal bleeding.

Cancer staging is constantly in evolution because it must adapt to significant scientific changes [5]. Staging of endometrial carcinoma is performed using FIGO system, which was revised in 2009. Endometrial cancer staging enables appropriate treatment planning and allows superior prognostic accuracy. MRI is fundamental in the preoperative staging, since it can evaluate the extent of the tumor and combined with the tumor grade and histologic subtype helps risk stratification, which will determine the therapeutic course [1,2]

Images for this section:

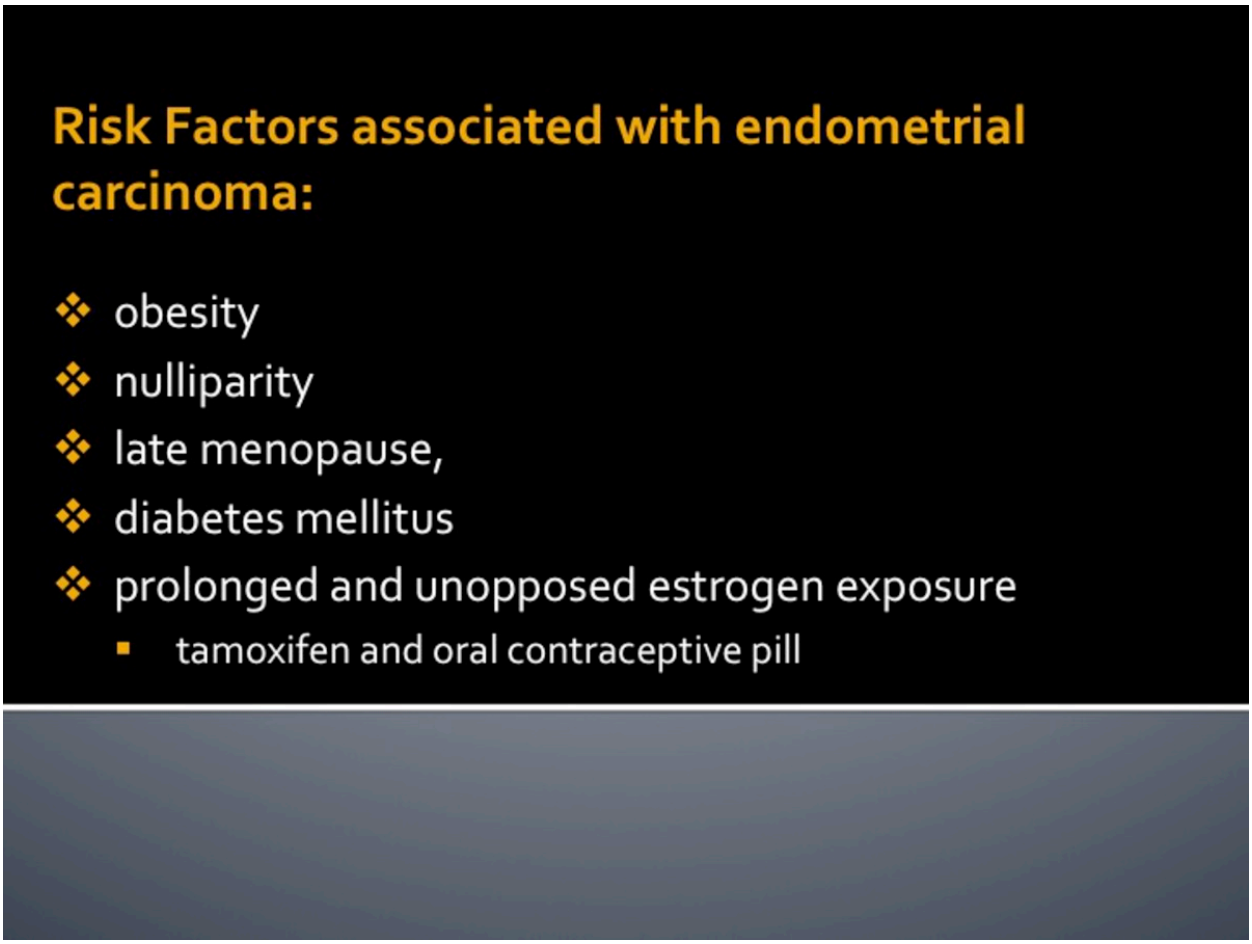

Fig. 1: Risk Factors associated with endometrial carcinoma

Findings and procedure details

Protocol for MRI in endometrial cancer staging (used in our department):

- Urinary bladder moderately filled (patient should void approximately 1 hour before the examination)
- Fasting 3-6 hours.
- A spasmolytic agent#(hyoscine butyl bromide or glucagon) is administered to reduce artifact from small bowel peristalsis.
- Use of a multichannel pelvic phased array coil

Sequences(in our department acquired on a 1.5T Siemens Symphony scanner):

- T2-weighted images (without fat suppression) in two planes:

o Sagittal and Axial oblique (perpendicular to long uterine axis) - to accurately assess myometrial invasion by tumour.

o Axial perpendicular to the long axis of the endocervical canal -when cervical invasion is suspected.

- Axial T1-weighted images of the pelvis with a large field of view - helps identification of lymphadenopathy;
- Axial T2 weighted half-Fourier acquisition single-shot turbo spin-echo (HASTE) of the abdomen - to assess para-aortic lymph node enlargement and complications (e.g. hydronephrosis);
- Axial oblique diffusion-weighted imaging (DWI) of the pelvis is performed with *b* values of 0, 100 and 700 and ADC maps are calculated - DWI increases tumor conspicuity and aids in image interpretation;
- Sagittal and oblique axial multiphase IV gadolinium-enhanced 3D T1-weighted fat-suppressed sequences through the uterine corpus - to evaluate the extent of myometrial and cervical involvement.

FIGO Staging of Endometrial Carcinoma

Table 1:

Stage I	Tumor confined to the corpus uteri
IA	No or <50% invasion of the myometrium
IB	Invasion #50% invasion of the myometrium
Stage II	Tumor invades cervical stroma, but does not extend beyond the uterus
Stage III	Local and/or regional spread of the tumor
IIIA	Tumor invades the serosa and/or adnexa
IIIB	Vaginal and/or parametrial involvement
IIIC	Metastases to pelvic and/or para-aortic lymph nodes
IIIC1	Positive pelvic nodes
IIIC2	Positive para-aortic lymph nodes with or without positive pelvic lymph nodes
Stage IV	Tumor invades bladder and/or bowel mucosa, and/or distant metastases
IVA	Tumor invasion of bladder and/or bowel mucosa
IVB	Distant metastases, including intra-abdominal metastases and/or inguinal lymph nodes

We will describe the different stages, highlighting the key differences in the revised FIGO staging system (2009) when compared to the previous one.

Stage I:

Stage I is subdivided in two groups: stage IA reflecting tumors that involve less than 50% of the myometrial thickness and stage IB representing tumor invasion into more than 50% of the myometrial thickness. In contrast to the previous FIGO classification, the latest does not differentiate between tumors that are confined to the endometrium and those that invade the inner myometrium (they are both included in stage IA) (Fig.2, 3, 4, 5 and 6).

It is important to distinguish between stages IA and IB because they have different risk stratifications when combined with the tumor grade and histologic subtype. The extent of myometrial invasion may be used as a surrogate imaging marker for potential

lymphovascular space invasion, which correlates with the presence of lymph node metastases and a higher relapse rate [4].

T2-weighted sagittal and axial oblique imaging can be used to determine the degree of myometrial invasion, as well as T1-weighted post-contrast imaging: the tumor demonstrates poor enhancement and can be identified within the avidly enhancing myometrium (Fig.2, 3 and 4).

Stage II:

Stage II represents stromal invasion of the cervix.

Stromal invasion is best detected on sagittal and axial oblique T2-weighted images as a disruption of the low signal intensity area (the cervical stroma) by the intermediate or high signal intensity tumor (Fig.7 and 8).

Tumors with endocervical glandular invasion, but with preservation of the normal low signal intensity cervical stroma are classified as stage I, in opposite to the previous FIGO classification (was included in stage II).

Stage III:

Stage III reflects local or regional tumor spread.

Tumors that invade the serosa (stage IIIA) present as a disruption of the contour of the outer myometrium. In stage IIIA are also included tumors that involve the adnexa. In these cases, DWI is useful because it improves detection of tumoral deposits outside the uterus (Fig.9 and 10).

In stage IIIB, tumor invades the vagina or parametrium. Vagina involvement presents as segmental loss of low signal intensity on T2- weighted images in the vaginal wall (Fig.11), and may occur by direct invasion or metastatic spread.

Stage IIIC disease is characterized by lymph node involvement and is subdivided into stage IIIC1 (pelvic node involvement) and stage IIIC2 (para-aortic node involvement below the renal vessels) (Fig.12), instead of a single group including any lymphadenopathy (pelvic or retroperitoneal) as in the previous classification. This division is based on the fact that there is a worse outcome in patients with involvement of para-aortic nodes than in those only with pelvic nodes involvement [2].

Lymph node involvement must be suspected when larger than 1 cm, multiple, with an irregular contour, necrosis and/or abnormal signal intensity similar to that of the primary tumor.

Stage IV

Stage IV disease is subdivided in two groups:

- Stage IVA is characterized by invasion of the bladder or rectum, which is best depicted on T2-weighted images by direct extension of tumor into the normally hyperintense vesical or rectal mucosa;
- Stage IVB, which presents with distant metastases, including inguinal lymph node metastases, para-aortic lymphadenopathy above the renal vessels and also metastases to the liver, lungs, and bone.

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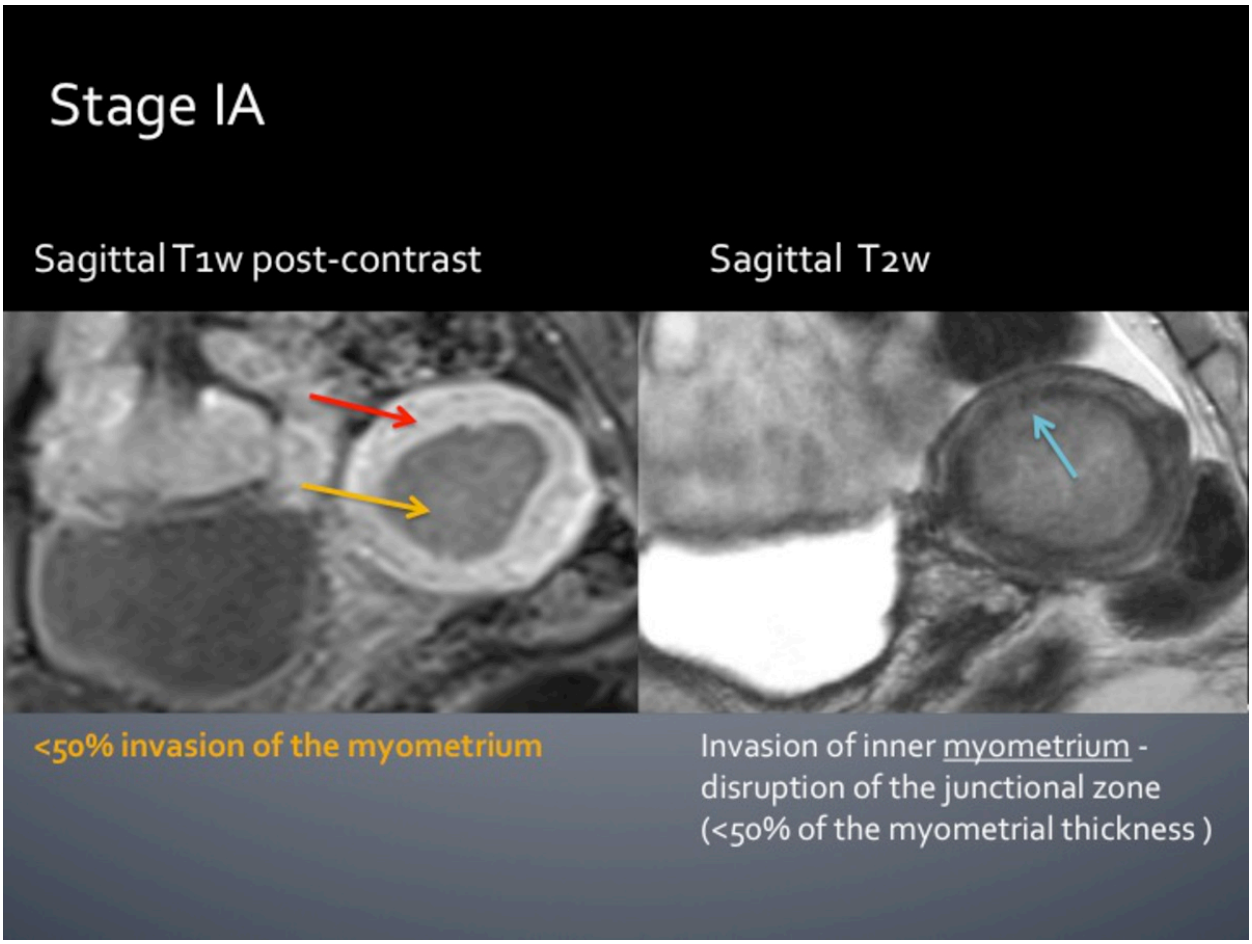

Fig. 2: Stage IA - In post-contrast imaging tumor shows poor enhancement (yellow arrow) in contrast to the avidly enhancing myometrium (red arrow), with invasion < 50% of the myometrium. On the T2-weighted image there is Invasion of inner myometrium, shown by disruption of the junctional zone (blue arrow), but the tumor is classified as stage IA, since myometrial invasion is <50% of its thickness)

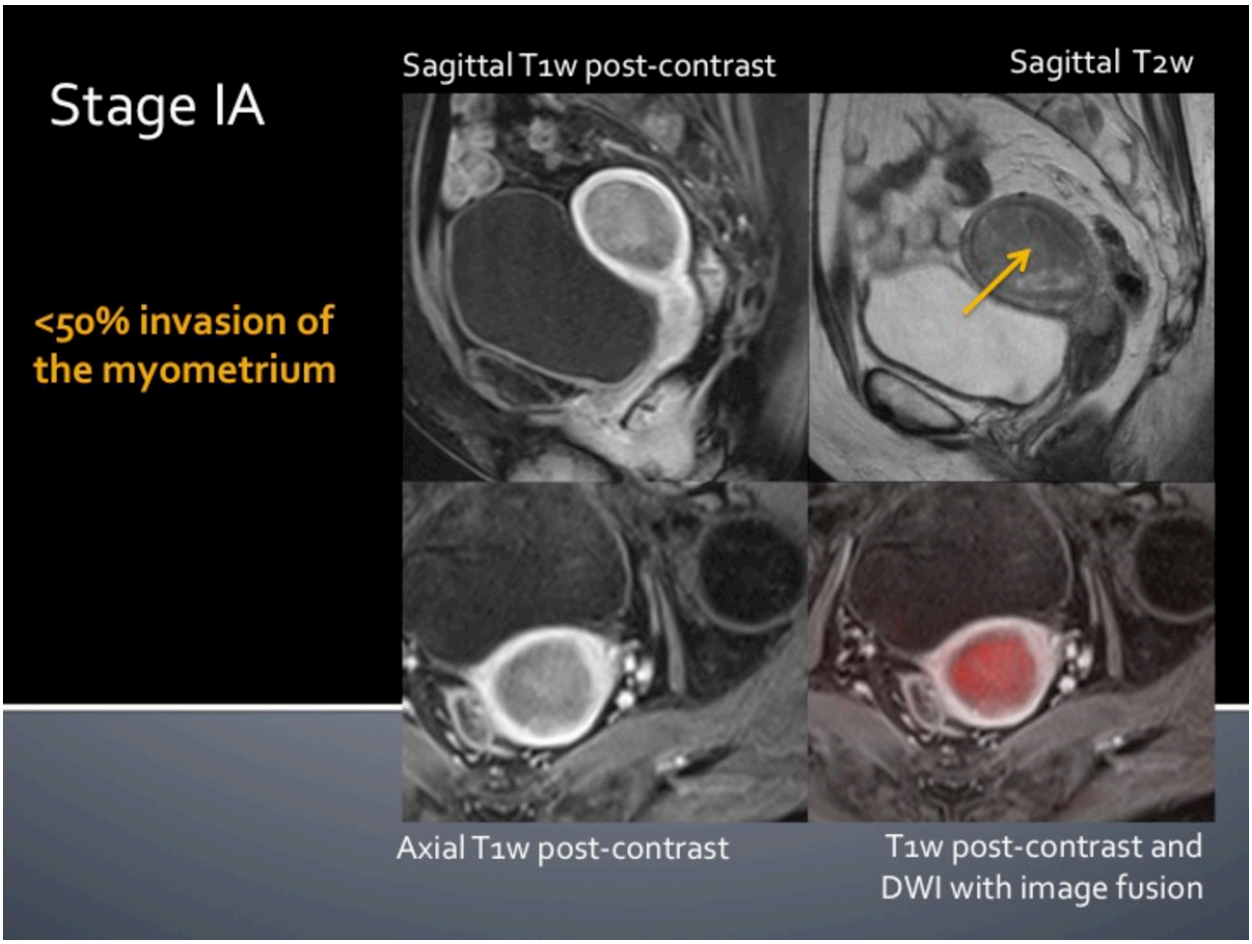

Fig. 3: Stage IA - On the T2-weighted image the endometrial cavity is distended with intermediate signal intensity tumor (yellow arrow). On post contrast images and DWI, the tumor does not exceed 50% of myometrium thickness.

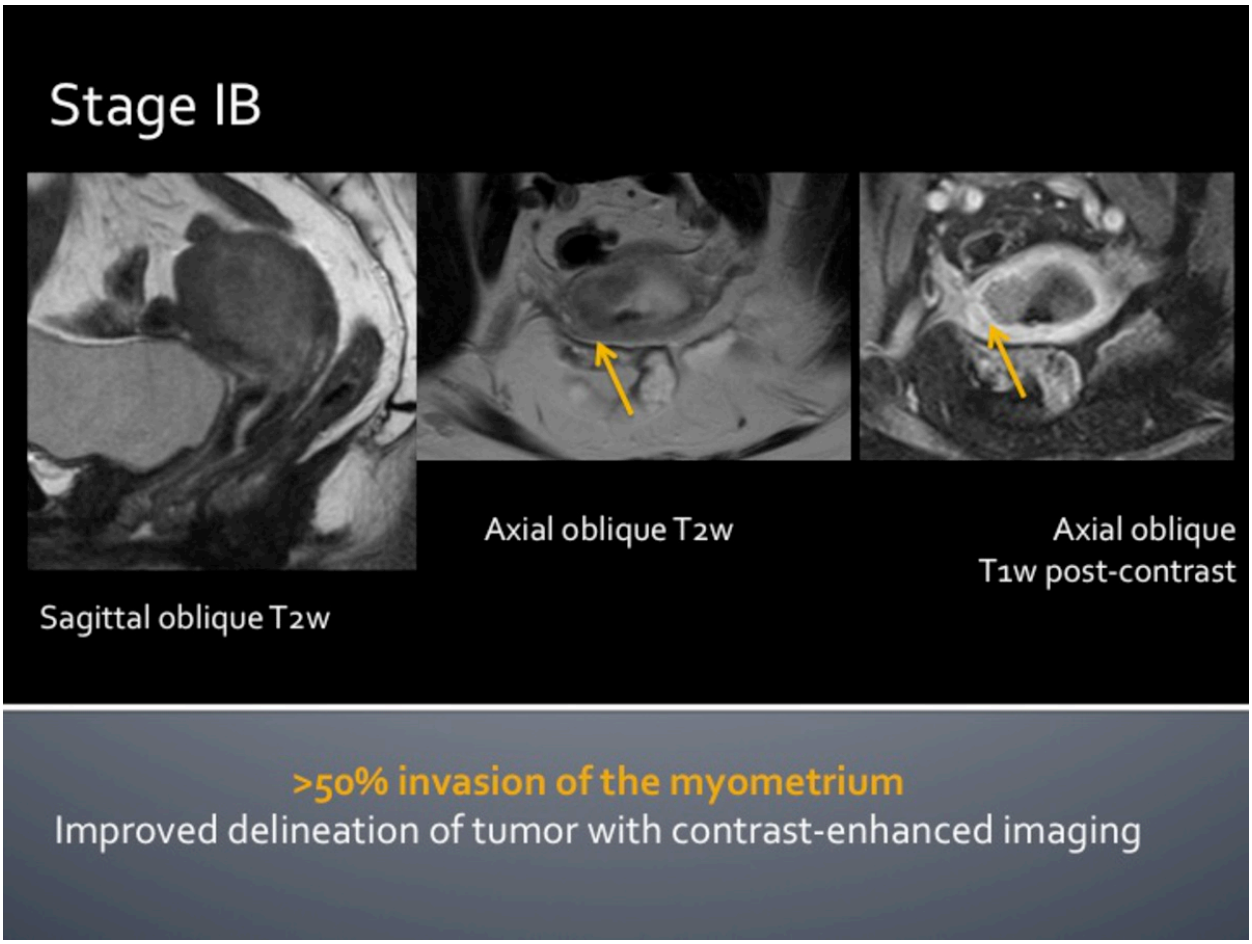

Fig. 4: Stage IB - Intermediate signal intensity tumor is seen to extend through greater than 50% of the myometrium (yellow arrows), but does not breach the uterine serosa.

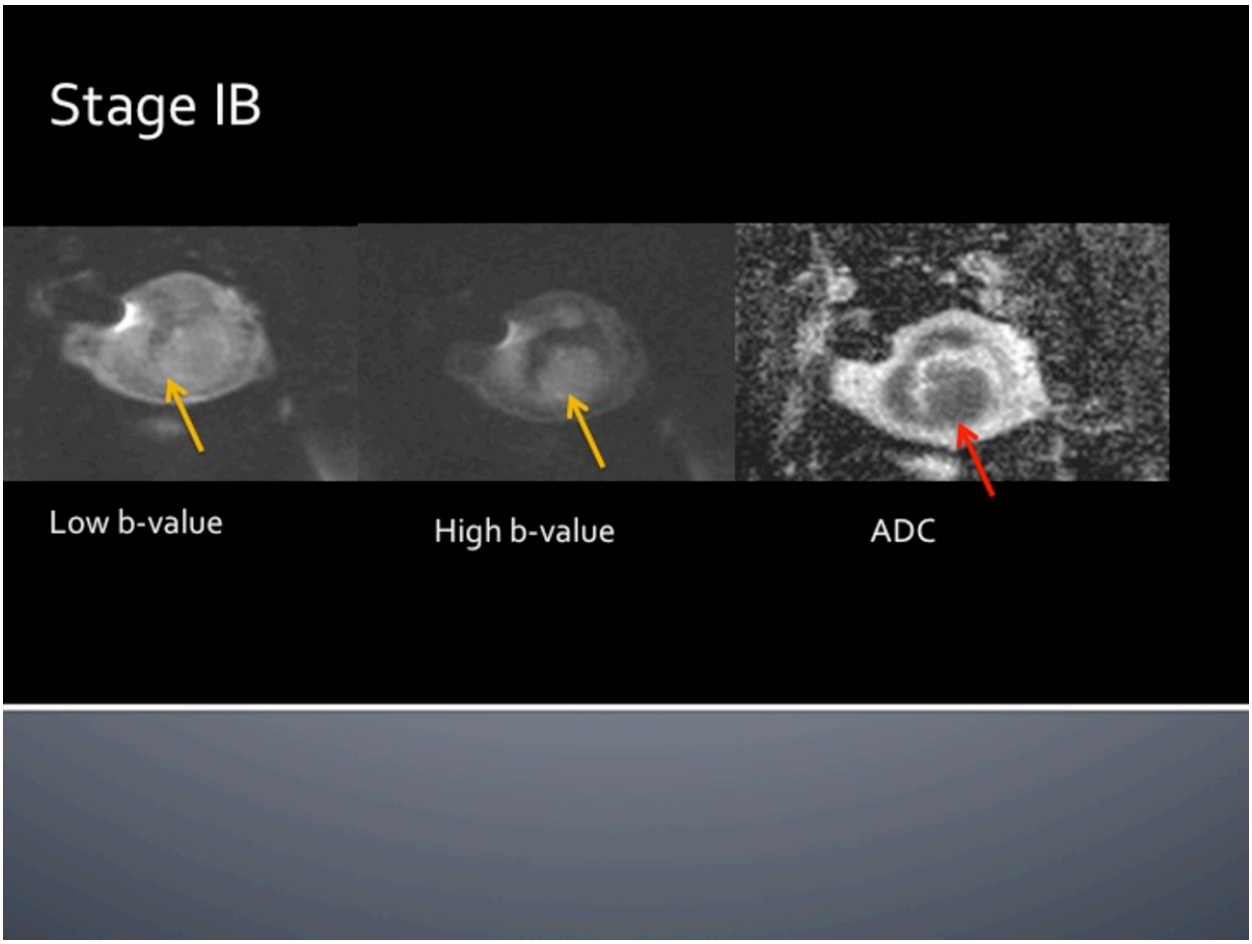

Fig. 5: Axial Diffusion Weighted Imaging obtained from the same patient used in Figure 4. The uterine cavity is distended with high signal intensity material on the low b-value series which remains of high signal intensity on the high b-value series (yellow arrows). On the corresponding Apparent Diffusion Coefficient (ADC) map the lesion is of low signal intensity (red arrow).

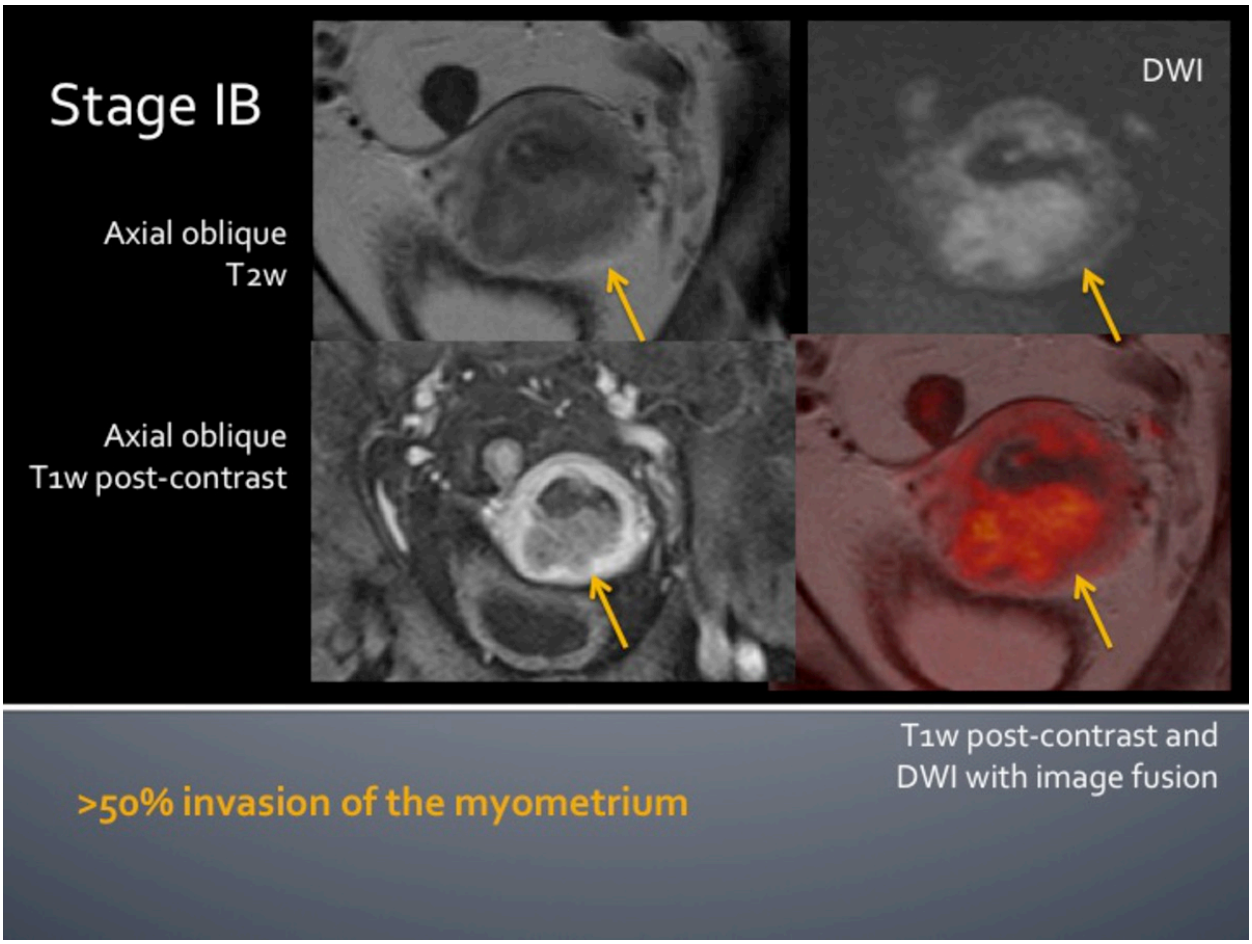

Fig. 6: Stage IB - tumor is seen to extend through greater than 50% of the myometrium on T2-weighted, diffusion-weighted and post-contrast images (arrows).

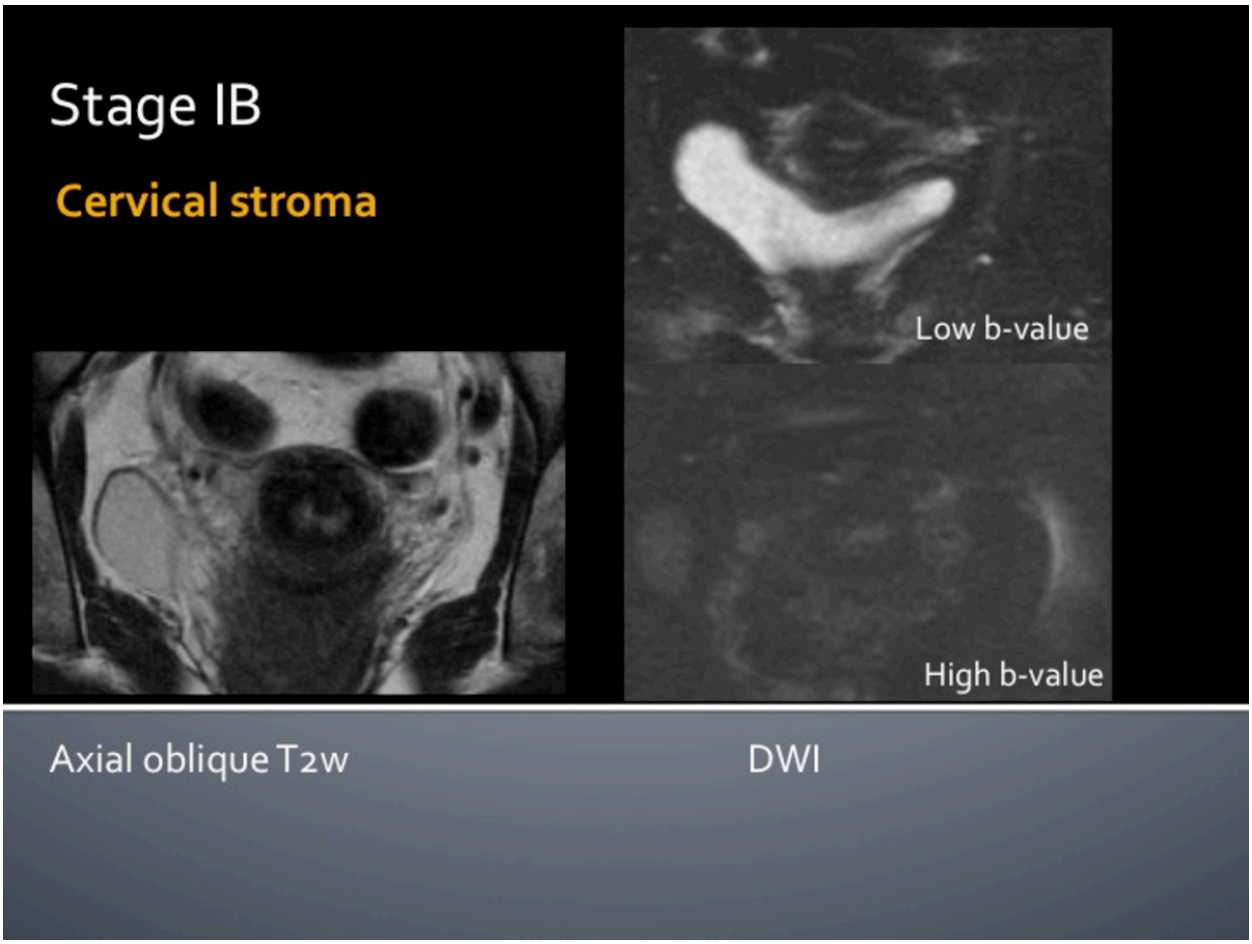

Fig. 7: Imaging has been obtained from the same patient used in Figures 4 and 5 at the cervix level. There is preservation of the normal low signal intensity cervical stroma, and there is no hyperintense area in DWI (classified as stage I).

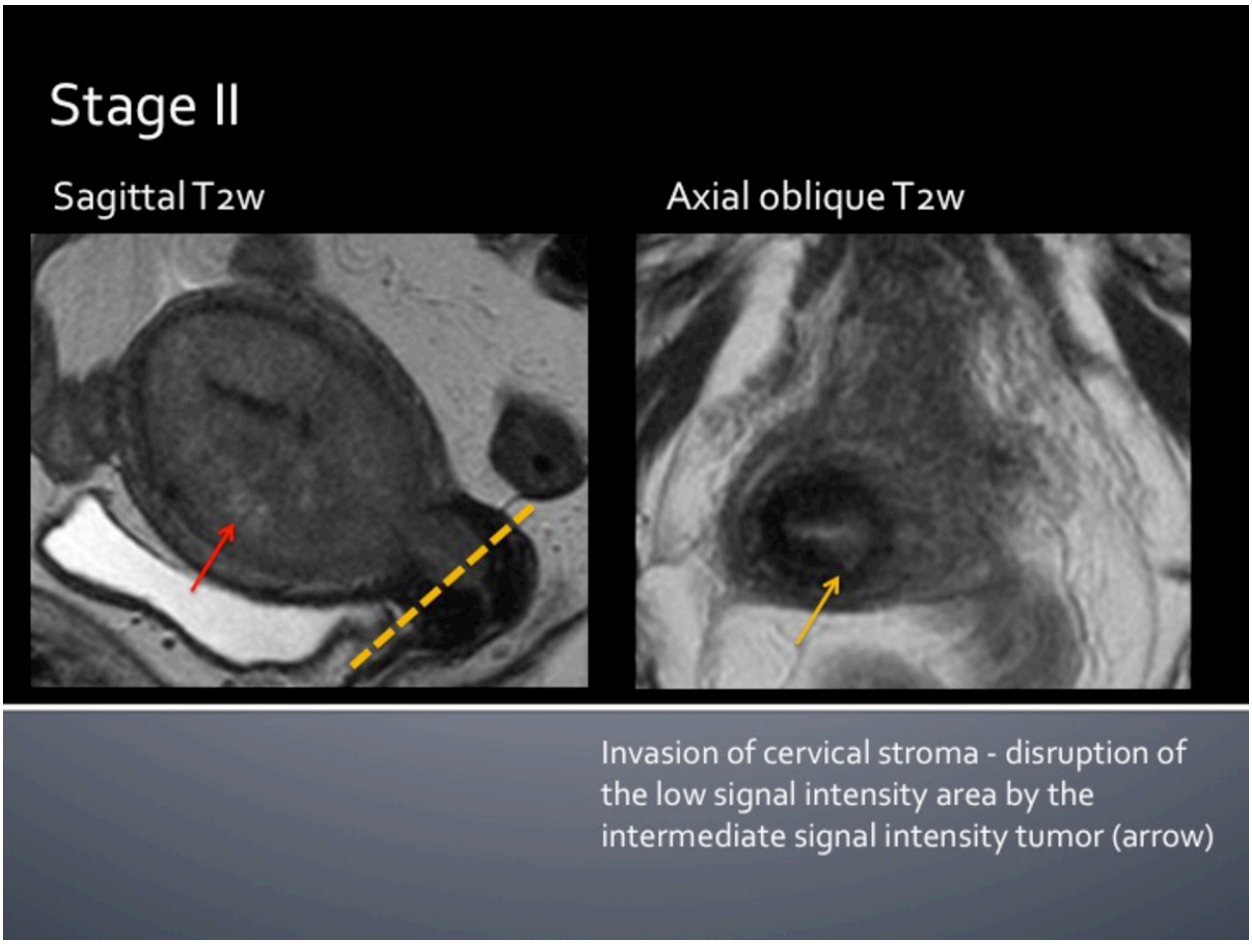

Fig. 8: Stage II - There is intermediate T2w signal intensity tumor filling and expanding the endometrial cavity (red arrow) and it also extends into the cervix (disruption of the low signal intensity area - cervical stroma).

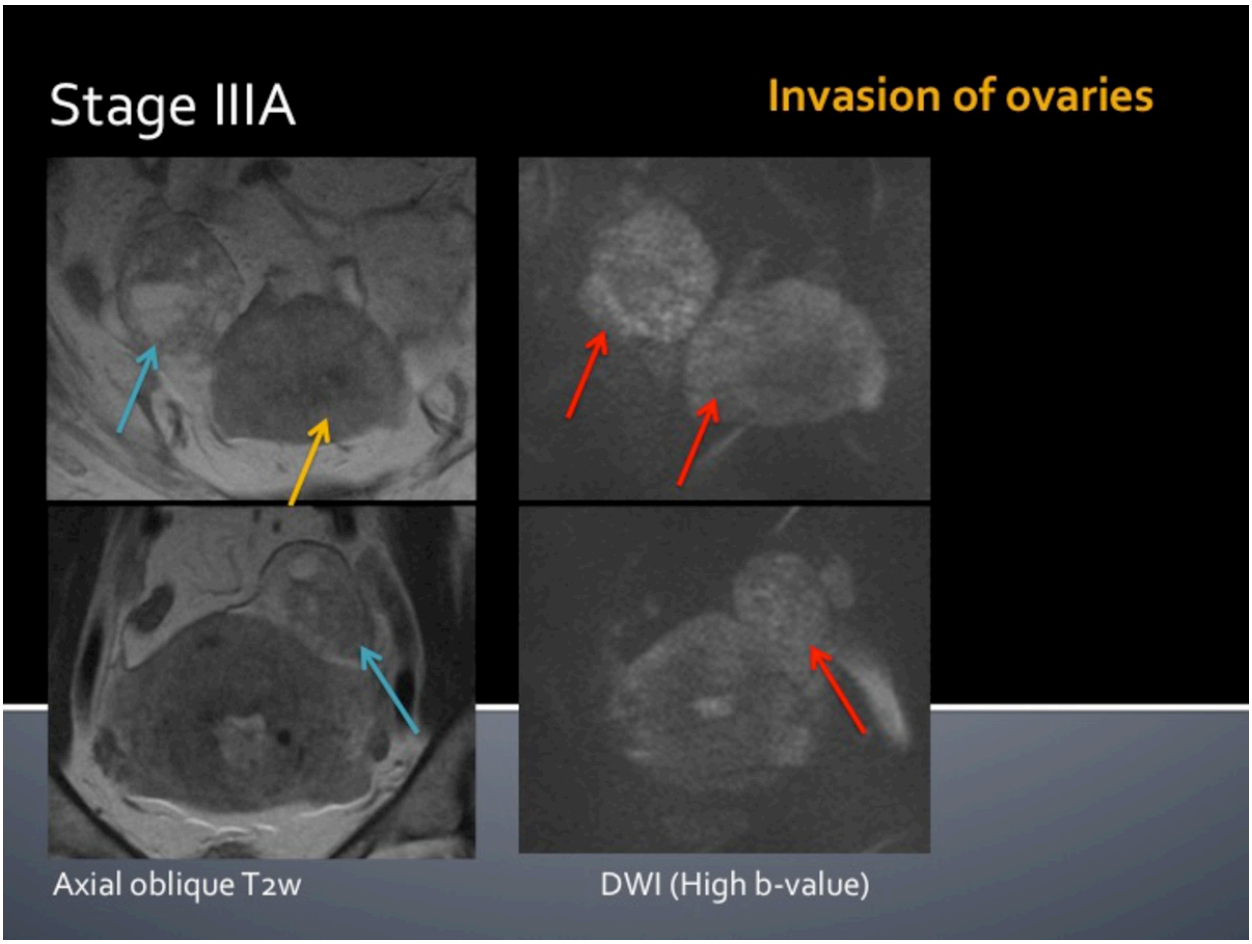

Fig. 9: Stage IIIA - Endometrial tumor with intermediate signal intensity (yellow arrow) and enlarged ovaries, which demonstrate abnormal heterogeneous signal intensity (blue arrows) and restricted diffusion similar to the endometrial tumor (red arrows).

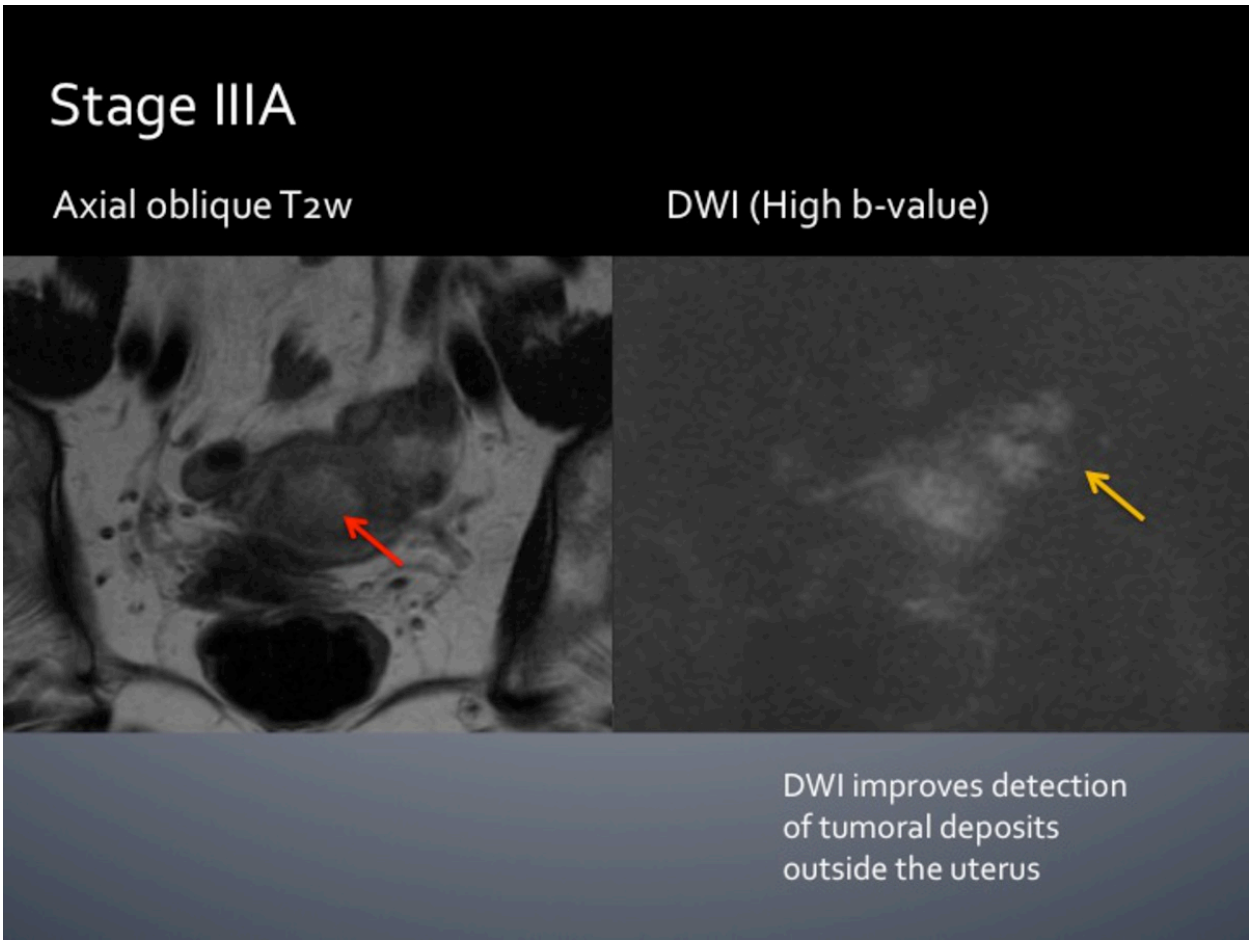

Fig. 10: Stage IIIA -Endometrial tumor presents with intermediate signal intensity (red arrow) on T2w image. On DWI the tumor shows restricted diffusion (high signal intensity on high b-value) as well as tumoral deposits outside the uterus (yellow arrow), improving its detection.

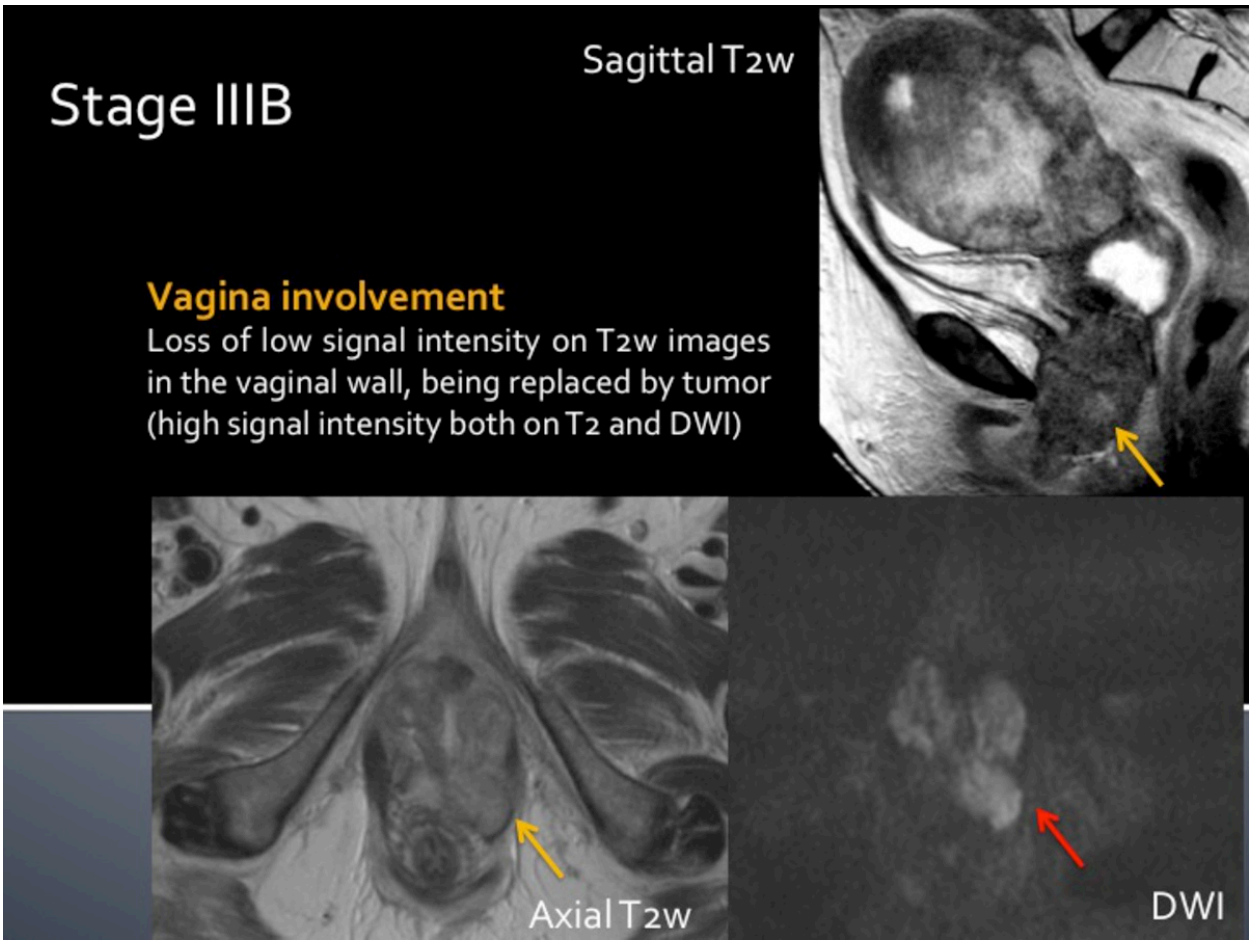

Fig. 11: Stage IIIB - The uterus is replaced with intermediate T2-weighted signal intensity material and there is loss of the normally low signal intensity in the vaginal wall, which is replaced by tumor (yellow arrows). This is also demonstrated with DWI, detecting high signal intensity tumor in the vagina wall (red arrow).

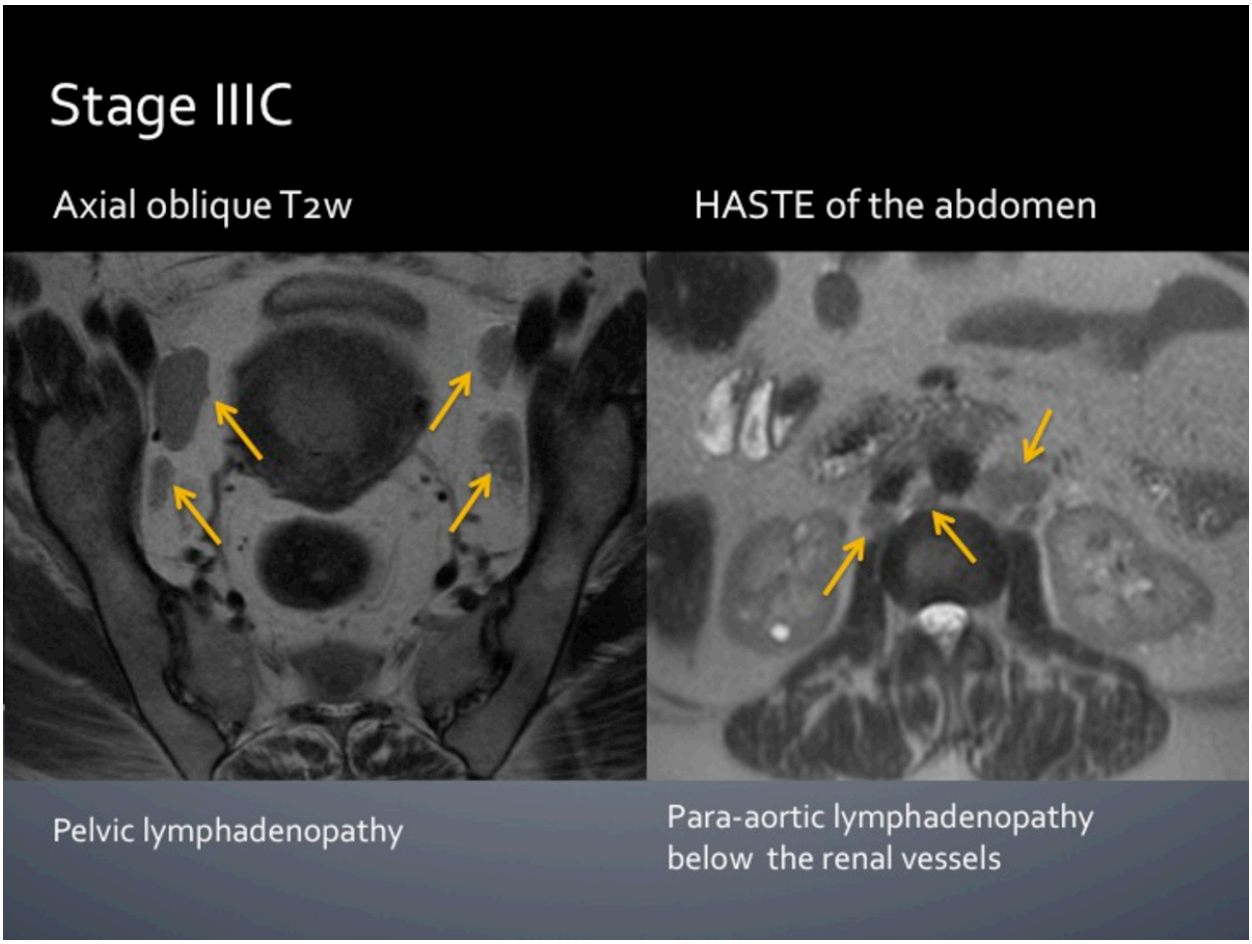

Fig. 12: Stage IIIC - Pelvic and para-aortic lymphadenopathies, in a women with endometrial carcinoma.

Conclusion

MRI is the modality of choice for staging and treatment planning of endometrial carcinoma. Familiarity with key radiologic features from MRI and knowledge of the new FIGO staging system for endometrial carcinoma is important to correctly stage and accurately report, so appropriate treatment options can be considered.

Personal information

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