Revised FIGO Staging for Endometrial Carcinoma - A Pictorial Review

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Learning objectives

The staging of endometrial carcinoma is surgical, however imaging plays a paramount role in evaluating and defining local extent of these tumours as well as in subsequent management and follow up. Several controversies existed with the previous International Federation of Gynecology and Obstetrics (FIGO) staging system, which have now been addressed in the revised system introduced in 2009. MRI has an important role in local staging and imaging influences subsequent surgical management.

In this poster we will present the 2009 FIGO staging for endometrial carcinoma with the rationale behind the recent changes. We will also review the optimised magnetic resonance imaging (MRI) protocol for endometrial carcinoma staging, as proposed by the European Society of Urogenital Radiology (ESUR) in 2009.

Each stage of endometrial carcinoma will be described in detail and illustrated by MRI examples.

Background

Endometrial cancer is the fourth most common cancer in women. In the United Kingdom, 7,536 cases were diagnosed in 2007 and there were 1,741 deaths in 2008. Between 1971 and 2005 there was a fall in mortality by 27% in the UK. The 10 year survival rate of endometrial carcinoma is 75% (1).

The majority of endometrial cancer occurs in postmenopausal women, but up to 25% of cases may be premenopausal (2).

The lifetime risk of developing endometrial carcinoma is 1.7-2%, and the incidence is rising with an increase in life expectancy and in risk factors (Table 1), such as obesity (3).

Risk Factors associated with endometrial carcinoma

Obesity

Late menopause (>52 years old)
Nulliparity

Diabetes mellitus

Tamoxifen therapy and oral contraceptive pill

Prolonged unopposed oestrogen exposure

Hypertension

Family history of endometrial or breast cancer

Personal history of ovarian or breast cancer

**Table 1:** Risk factors associated with endometrial carcinoma

The majority of women with endometrial carcinoma present with inter-menstrual or post-menopausal bleeding, with 75-80% presenting with stage I disease.

There are several different histological subtypes of endometrial carcinoma. The most common is endometrial adenocarcinoma (90%). Less common subtypes include adenocarcinoma with squamous differentiation, adenosquamous carcinoma, papillary serous carcinoma and clear cell carcinoma. The last 2 histological subtypes are considered the most aggressive and, along with grade III endometrial adenocarcinoma, are associated with a worse prognosis. (See Table 2 for prognostic indicators).

**Factors Affecting Prognosis**

Patient age

Histologic grade of tumour

Deep myometrial invasion

Cervical invasion

Extra-uterine spread
Lymph node involvement

Table 2: Prognostic indicators in endometrial carcinoma\(^{4,5}\)

A typical clinical presentation occurs with symptoms of abnormal bleeding per vaginum and referral from a primary care physician to a dedicated hospital clinic. Assessment often consists of history, examination, ultrasound examination to assess for endometrial thickness and cytological assessment by pipelle endometrial sampling. If this sampling is inadequate, particularly in patients with an abnormally thickened endometrium on ultrasound, direct tissue biopsy via hysteroscopy is often then employed.

Accurate staging of endometrial cancer is vital. Both effective treatment and prognosis relates directly to tumour stage at presentation. As with all gynaecological malignancies the International Federation of Gynecology and Obstetrics (FIGO) staging system is used. This is very similar to TNM classification staging system widely used for other solid organ malignancies.

Gynaecological staging systems have been present from the 1920s and FIGO itself was derived from pre-war League of Nations staging criteria. Originally FIGO staging was based on anatomical extent of disease assessed on clinical examination but with time has become both surgically and pathologically based. Modern pre-operative staging relies on magnetic resonance imaging (MRI) to triage presenting patients into differing treatment arms. MRI provides the most accurate radiological modality for assessing tumour invasion, particularly in the vast majority of cases where tumour remains confined to the uterine corpus.

The FIGO staging was revised in 2009 for the first time in a decade (Table 3 & 4).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Surgico-Pathologic Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>Tumour limited to the endometrium</td>
</tr>
<tr>
<td>IB</td>
<td>Invasion to less than half of the myometrium</td>
</tr>
<tr>
<td>IC</td>
<td>Invasion equal to or more than half the myometrium</td>
</tr>
</tbody>
</table>
IIA Endocervical glandular involvement only
IIB Cervical stromal invasion
IIIA Tumour invades the serosa of the corpus uteri and/or adnexae and/or positive peritoneal cytological findings
IIIB Vaginal metastases
IIIC Metastases to pelvic and/or paraaortic lymph nodes
IVA Tumour invasion of bladder and/or bowel mucosa
IVB Distant metastases, including intra-abdominal metastasis and/or inguinal lymph nodes

Table 3: The previous 1998 FIGO Staging for Endometrial Cancer

<table>
<thead>
<tr>
<th>Stage</th>
<th>Surgico-Pathologic Findings</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Tumour confined to uterine body</td>
</tr>
<tr>
<td>IA</td>
<td>No or less than one-half myometrial invasion</td>
</tr>
<tr>
<td>IB</td>
<td>Invasion equal to or more than one half of the myometrium</td>
</tr>
<tr>
<td>II</td>
<td>Tumour invades cervical stroma, but does not extend beyond the uterus</td>
</tr>
<tr>
<td>III</td>
<td>Local and / or regional spread of the tumour</td>
</tr>
<tr>
<td>IIIA</td>
<td>Tumour invades the serosa of the corpus uteri and / or adnexae</td>
</tr>
</tbody>
</table>
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

IV  Tumour invades bladder and /or bowel mucosa, and / or distant metastases

IVA  Tumour invasion of bladder and/or bowel mucosa

IVB  Distant metastases, including intra-abdominal

Metastases and / or inguinal lymph nodes

Table 4: The revised 2009 FIGO Staging for Endometrial Cancer

2009 FIGO Staging Modifications

The 4 main modifications to the 1998 FIGO staging criteria are as follows:

1. Myometrial Invasion

In the 1998 FIGO staging criteria, stage IA referred to disease within the endometrium, but with preservation of the junctional zone and no myometrial involvement. Stage IB referred to disease that invaded the myometrium by less than 50%. On review, it was found that there was minimal survival difference between the two groups, therefore in the 2009 FIGO staging criteria these groups have been combined.

Stage IA now describes disease involving the endometrium and / or less than 50% of myometrial thickness. Stage IB now describes invasion of the tumour into the outer half of the myometrium (previously classified as IC disease)\(^5,6\).
2. Cervical Involvement

In the 2009 FIGO staging criteria, stage II is no longer divided into stage IIA and IIB. Involvement of the endocervical glands is now considered stage I and involvement of the cervical stroma is regarded as stage II.

3. Nodal Disease

Para-aortic node involvement is considered to have a poor prognosis; therefore, the staging of pelvic and para-aortic node involvement has now been separated into: Stage IIIC1 positive pelvic nodes and stage IIIC2 positive para-aortic nodes with or without positive pelvic nodes.

4. Peritoneal Cytology

Peritoneal cytology is no longer included in the FIGO staging criteria, however it must still be reported\(^5\).

Full FIGO staging necessitates a total hysterectomy, bilateral salpingo-oophorectomy, acquisition of peritoneal fluid or washings, a thorough exploration of the abdominal cavity and pelvic and para-aortic nodal areas and full pelvic lymphadenectomy \(^7\).

Although the rate of lymph node involvement in endometrial carcinoma is low (5-8%), lymphadenectomy is still part of the FIGO staging. However, the complication rate of lymphadenectomy is between 17-19%, which can be even higher in high-risk surgical candidates \(^8, 9\). Therefore, most centres will reserve pelvic lymphadenectomy for those patients in which there is a high pre-operative risk for nodal invasion (Table 5) based on histology or imaging.

Factors Affecting the Likelihood of Lymph Node Invasion

Tumour grade

Depth of myometrial invasion
Degree of cervical invasion

**Table 5: Factors affecting the likelihood of lymph node invasion**

By defining the depth of myometrial invasion and the presence of cervical involvement, pre-operative MRI allows for accurate treatment planning i.e. selection of women who would benefit from lymph node resection and those who would need adjuvant therapy (11).

**Imaging findings OR Procedure details**

**Imaging Techniques**

Magnetic resonance imaging (MRI) is the most reliable imaging technique to define the depth of myometrial invasion and the degree of cervical involvement pre-operatively.

Transvaginal ultrasound (TVUS) is used for initial assessment of the endometrium in patients who present with abnormal uterine bleeding, however MRI has been found to be more accurate than TVUS in assessment of myometrial invasion (12).

CT can be used to differentiate stage I and II (disease limited to the uterus) from stage III and IV (extra-uterine spread of disease) in endometrial carcinoma. However several studies have demonstrated the accuracy for the detection of deep myometrial invasion and cervical involvement to be far inferior than that of MRI (13,14).

MRI staging acts as an important triage to place patients in correct treatment arms. These may be surgical and non-surgical, may involve radiotherapy, and may involve treatment at a specialist gynaecological oncology institution (12).

Staging tries to reduce variation in treatment across centres. As the initial provisional staging is radiological, based on MR imaging, attempts have been made to standardise MR techniques. The following are the current ESUR guidelines for MRI cancer staging protocols published in 2009 (13).
ESUR protocol

- Fasting 3-6 hours.
- Antiperistaltic agent, e.g. buscopan, to reduce artefact from bowel movement (unless contra-indicated).
- Empty bladder prior to examination to reduce artefact.
- High resolution T2 weighted imaging of the pelvis in sagittal, axial oblique (perpendicular) and coronal oblique (parallel) to the uterine cavity (Figure 1). If there is suspected cervical involvement, axial oblique imaging perpendicular to the long axis of the endocervical channel is recommended.

**Fig.**: Figure 1: Image planes for high-resolution T2-weighted imaging of the uterus. Initial high resolution T2-weighted sagittal images of the pelvis are obtained. Axial oblique images are obtained by scanning perpendicular (dotted blue lines) to the long axis of the endometrial cavity (solid red line). These sequences can then be used for accurate assessment of myometrial invasion by tumour. If there is suspected cervical
invasion, further imaging is recommended on a plane perpendicular to the long axis of the endocervical canal.

**References:** R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

- For assessment of para-aortic lymph node enlargement, metastases and complications e.g. hydronephrosis, extended FOV imaging is required.
- For the diagnosis of deep myometrial invasion as well as for use in atrophic uteri, associated adenomyosis and fibroids, and for suspected Stage IV endometrial carcinoma, contrast-enhanced imaging is suggested for higher accuracy. 2D or 3D techniques may also be performed with optimal tumour contrast timing to be between 90 and 150s\(^{10}\).

**Normal uterine anatomy on MRI**

![Normal Zonal Anatomy](image)

**Fig.** Figure 2: Normal zonal anatomy in a pre-menopausal female. High resolution sagittal T2-weighted image. The endometrium demonstrates high signal intensity.
The junctional zone or inner myometrium is demonstrated by a band of low signal intensity. The intermediate signal outer layer represents the remainder of the myometrium. Zonal anatomy in post-menopausal women is less clear.

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

**Tumour Appearance**

On T2-weighted imaging, endometrial carcinoma is of lower signal intensity than the endometrium.

On T1-weighted post-contrast imaging the tumours are of lower signal intensity than the enhancing myometrial tissue. On dynamic imaging, the tumour is seen to enhance slower than the adjacent myometrium.

Non-contrast T1-weighted imaging is of no benefit in the evaluation of endometrial carcinoma since the endometrium, myometrium and carcinoma all demonstrate similar intermediate signal intensities, therefore differentiation is not possible (9,14).

**Stage I: Tumour confined to the uterine body**

The survival differences between stage IA and IB in the previous FIGO staging system were minimal so these two substages have now been combined as stage IA. The previous Stage IC is now classified as stage IB.

On T1-weighted post-contrast imaging the tumour demonstrates poor enhancement and can be identified within the avidly enhancing myometrium. T2-weighted sagital and axial oblique imaging can be used to determine the degree of myometrial invasion.

**Stage IA: No or less than one-half of myometrial invasion** (Figures 3 & 4).
Fig.: Fig 3: Stage IA Endometrial carcinoma. Sagittal T2-weighted (a) and axial oblique T2-weighted (b) images in a post-menopausal female. On the T2-weighted images the endometrial cavity is distended with intermedaite signal intensity tumour (red arrows). The tumour has invaded the anterior myometrium by less than 50% (yellow arrows).

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM
Fig.: Figure 4: Stage IA Endometrial Carcinoma. Axial Diffusion Weighted Imaging (DW-MRI). Imaging has been obtained from the same patient used in Figure 3. 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 (red arrows). On the corresponding Apparent Diffusion Coefficient (ADC) map the lesion is of low signal intensity (yellow arrow) in keeping with tumour. This was histologically confirmed to represent grade 2 endometrial adenocarcinoma.

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

Stage IB: Invasion equal to or more than one half of the myometrium (Figures 5 & 6).
Stage IB Endometrial Carcinoma

(a) Sag T2-W

(b) Cor Obi T2-W

**Fig.**: Figure 5: Stage IB Endometrial Carcinoma. Sagittal (a) and coronal oblique (b) T2-weighted images in a post-menopausal female. Intermediate signal intensity tumour is seen distending the endometrial cavity with loss of the normal low signal intensity junctional zone. The tumour is seen to extend through greater than 50% of the myometrium (red arrows), but does not breach the uterine serosa.

**References**: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM
Fig.: Figure 6: Endometrial Carcinoma. Sagittal T2-weighted (a) and sagittal T1-weighted fat suppressed post-gadolinium (b) images in a post menopausal female. On the T2-weighted image, the endometrium is distended with intermediate signal intensity of tumour (red arrow). There is suspicion of deep myometrial involvement, however the post-contrast images demonstrate that there is actually less than 50% myometrial invasion (yellow arrows) making this Stage IA endometrial carcinoma. Confirmed histopathologically following hysterectomy.

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

Limitations and Pitfalls in the Assessment of Myometrial Invasion (16)

There are several factors that can limit accurate assessment of myometrial invasion, these include:

1. Benign uterine disease
Leiomyomas (Figure 7) and adenomyosis (Figure 8) can mimic deep endometrial invasion and therefore be responsible for overstaging of myometrial invasion.

**Fig.**: Figure 7: Axial oblique T2-weighted image in a post-menopausal female. A large left-sided uterine fibroid (F) demonstrates low signal intensity on T2-weighted imaging and can be seen to distort the normal zonal anatomy of the uterus. It is difficult to assess the degree of myometrial invasion by the intermediate signal intensity of the tumour (T).

**References**: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM
Fig.: Figure 8: Stage 1A Endometrial carcinoma. Sagittal (a) T2-weighted and T1-weighted (b) fat suppressed post- gadolinium images in a post menopausal female. There is intermediate signal intensity tumour seen distending the endometrial cavity (red arrows). The juntional zone is widened with evidence of adenomyosis (yellow arrows) making evaluation of myometrial invasion difficult. This tumour was Stage IA on histopathology.

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

2. Polypoid tumours

Polypoid tumours within the uterine cavity may result in myometrial thinning, which may result in understaging of endometrial carcinoma (Figure 9).
Fig.: Figure 9: Stage IA Endometrial carcinoma. Sagittal (a) and coronal-oblique (b) T2-weighted images in a post-menopausal female. There is a large intermediate signal intensity tumour (T) expanding the endometrial cavity. The tumour disrupts the normal low signal intensity of the junctional zone at the uterine fundus (red arrow) but does not involve greater than 50% of the myometrum indicating Stage IA disease. Myometrial thinning makes assessment of depth of invasion difficult.

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

3. Tumours of the uterine cornu

These are difficult to assess since the myometrium in this region is thin, and this may adversely affect staging of endometrial carcinoma within this area.

4. Atrophy of the juntional zone
This may result in understaging of endometrial carcinoma.

Dynamic contrast enhanced magnetic resonance imaging (DCE-MRI; Figures 6, 8, 10, 11) and diffusion weighted MRI (DW-MRI; Figure 6) can be included in imaging protocols for staging patients with endometrial carcinoma. These techniques enable more accurate assessment of the depth of myometrial invasion especially in the presence of the pitfalls mentioned above. It has been shown that the combination of DCE-MRI and T2W imaging offers the highest efficacy for staging patients with endometrial carcinoma. In one study the depth of myometrial invasion was correctly determined in 78% of cases on T2 weighted-imaging, increasing to 92% with the addition of DCE-MRI (15).

**Stage II: Tumour invades cervical stroma, but does not extend beyond the uterus**

On T2-weighted imaging the tumour is of intermediate signal against a background of low signal intensity normal cervical stroma (Figure 10).

Post-contrast T1-weighted imaging is also used to improve accuracy and can help to differentiate true cervical invasion from endometrial polyps within the endocervical channel (17).
Fig.: Figure 10: Stage II Endometrial Carcinoma. Sagittal T2-weighted (a) and sagittal T1-weighted post gadolinium (b) in a post-menopausal female. There is intermediate T2-W signal intensity tumour filling and expanding the endometrial cavity (red arrows). In addition the tumour is seen to extend into the anterior lip of the cervix (yellow arrow). Note: tumour is seen to enhance less than the avidly enhancing myometrium.

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

Stage III: Local and/or regional spread of the tumour

Stage IIIA: Tumour invades the serosa of the corpus uteri and/or adnexae (Figure 11).
**Fig.**: Figure 11. Stage IIIA Endometrial carcinoma. Coronal oblique T2-weighted (a) and axial post-contrast T1-weighted fat saturated images through the pelvis in a postmenopausal female. The endometrial cavity is expanded by intermediate T2-W signal intensity material which shows enhancement following gadolinium administration (red arrows). In addition there is an enhancing metastatic nodule seen on the right ovary (yellow arrows) and a peritoneal deposit seen posterior to the urinary bladder (blue arrow).

**References:** R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

On T2-weighted images tumour may be seen extending to or beyond the outer margin of the uterus. On contrast-enhanced imaging there is loss of the normal enhancing rim of myometrium.

In the 1998 FIGO staging for endometrial carcinoma, peritoneal cytology was included in Stage IIIA disease. Although cytology is not included in the 2009 staging criteria, it must still be reported as an additional feature.
Stage IIIB: Vaginal and/or parametrial involvement

On T2-weighted imaging there is focal loss of the normal low signal intensity of the vaginal wall indicating involvement (Figure 12).

Fig.: Figure 12. Stage IIIB Endometrial Carcinoma. Sagittal T2-weighted image in a post-menopausal female. The entire uterus is replaced with intermediate T2-weighted signal intensity material which is seen to extend inferiorly to involve the anterior vaginal wall (red arrow). The posterior vaginal wall returns normal low T2-weighted signal intensity (yellow arrow).

References: Dr S Liyanage, Department of Radiology, Southend University Hospital

Stage IIIC: Metastases to pelvic and / or para-aortic lymph nodes
Stage IIIC1: Positive pelvic nodes (Figure 13)

Fig.: Figure 13: Stage IIIC1 Endometrial Carcinoma. Sagittal (a) and coronal-oblique (b) T2-weighted images in a post-menopausal female. There is intermediate signal intensity tumour extending from the endometrial cavity and replacing the myometrium. The serosal surface has been breached (red arrows). There is a left sided common iliac lymph node (yellow arrow), which has similar signal intensity to tumour - suggestive of lymph node involvement.

References: R. Patel; Radiology, The Royal Free Hospital, London, UNITED KINGDOM

Stage IIIC2: Positive para-aortic lymph nodes with or without positive pelvic lymph nodes

Enlarged lymph nodes are low signal within high signal fat on T1-weighted images and intermediate signal intensity on T2-weighted images. Confusion between vessels and lymph nodes can be avoided since vessels contain flow voids (18).
Assessment of nodal involvement on standard MRI sequences mainly employs size based criteria (e.g. >10mm in short axis diameter) as in computed tomography. However, this does not always correlate with histological findings due to the high frequency of micrometastatic spread. Therefore these standard sequences are not optimal for detecting Stage IIIC disease and can only really be used for guidance of possible lymph node involvement (19), with a reported sensitivity of only 50% and specificity of 95% in one study (20). Other techniques include using Ultrasmall particles of iron oxide (USPIO, lymph node specific MRI contrast agent). These have recently been shown to increase the sensitivity to lymph node metastases from 29% to 93% but the future availability of these agents is now in question (21). $^{18}$F-FDG PET/CT has also shown to be of some use for detecting nodal metastases and may have an important role in the future.

Stage IV: Tumour invades bladder and/or bowel mucosa, and/or distant metastases

On T2-weighted imaging, the bladder or rectum wall are of low signal intensity, interruption of this signal is indicative of tumour invasion. For true FIGO stage IV classification, tumour should be visible within the bladder or rectal lumen at cystoscopy or colonoscopy respectively. MRI is able to suggest earlier invasion before tumour invades through the entire wall of these adjacent organs.

Stage IVA: Tumour invasion of bladder and / or bowel mucosa (Figure 14).
Fig.: Figure 14. Stage IVA Endometrial Carcinoma. Sagittal (a) and coronal oblique (b) T2-weighted images through the pelvis of a post-menopausal female. Intermediate signal intensity tumour is seen to replace the normal uterine tissue with serosal breach. In addition tumour extends to involve the sigmoid colon (red arrows) and the pelvic side wall (yellow arrow). Upper abdominal imaging also revealed hydronephrosis.

References: Dr S Liyanage, Department of Radiology, Southend University Hospital

Stage IVB: Distant metastases, including intra-abdominal metastases and / or inguinal lymph nodes.

Delayed dynamic contrast-enhanced imaging is best for peritoneal deposit detection, however the accuracy of detection reduces if deposits are less than 10mm. 

Images for this section:
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Conclusion

The FIGO staging system for endometrial carcinoma has changed significantly in the 2009 modification, with simplification of myometrial invasion, cervical involvement, peritoneal cytology and nodal disease.

Imaging is not considered to be part of formal FIGO staging for endometrial carcinoma, but it has a vital role in the triage of patients with cytologically or histologically diagnosed endometrial malignancy, both in terms of surgical selection and those likely to require adjuvant therapy.

Further research is required in DW-MRI for assessment of myometrial invasion and the use of USPIOs and $^{18}$F-FDG PET/CT in more accurate assessment of lymph node involvement.

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References


