لا يَنَامُ اللَّهُ
از باد خزان و نخوت ِ قهرآمیز
وز آمدن بهار بعد از پاییز
درسی ز تلاتم حوادث برگیر
هربارکه آمدی بیفتی، برخیز
(اسد کلانتری "ساعی")
Findings of Pelvic Endometriosis at Transvaginal US, MRI & Laparoscopy

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OB & Gynecologist
Endometriosis is a chronic gynecologic disorder that is characterized by the growth of endometrial tissue outside the uterine cavity.

It may occur as invasive peritoneal fibrotic nodules and adhesions or as ovarian cysts with hemorrhagic content.
What is DIE:

Deeply Infiltrating Endometriosis

• Invasive tissue that infiltrates adjacent structures at a depth of more than 5 mm from the peritoneal surface.

• DIE is associated with fibrosis and muscular hyperplasia.
Epidemiology of Endometriosis

• 10 % of women of reproductive age.
• 20 % – 50% of women with infertility.
• 90 % of women with chronic pelvic pain.
Pathogenesis of Endometriosis

1. Implantation of endometrial glands and stroma on the peritoneum from retrograde menstruation
2. Hematogenous and lymphatic dissemination
3. Celomic metaplasia
4. Stem cell migration from bone marrow
5. Epigenetic factors
6. Polygenic-multifactorial inheritance
Clinical Manifestations

• Secondary dysmenorrhea
• Deep dyspareunia
• Sacral backache with menses
• Perimenstrual diarrhea
• Cramping and dyschezia
• Dysuria
• Hematuria

Note: Endometriosis-related pain may not correlate with the disease stage but may be associated with the lesion infiltration depth.
Diagnosis

1. Physical examination: (Inadequate)

2. Imaging:
   - Transvaginal ultrasonography
   - Transrectal ultrasonography
   - Magnetic resonance imaging (MRI)

3. Histologic confirmation of surgically resected lesions (laparotomy and laparoscopy)
Best methods for diagnosis of DIE

- Transvaginal US
- MRI

Note: DIE lesions are not easily accessible with laparoscopy.
TVS-based Soft Markers of Endometriosis

**TVS – Based Soft Markers**

1. Ovarian Fixation to uterus
2. Ovarian Fixation to Iliac vessels
3. Ovaries not on the same level
4. Left ovary is higher
5. Right ovary is higher
6. Non Visualization of left Ovary
7. Tender Ultrasound
8. Inability to rectify Uterus
9. Free Fluid In DP (Douglas Pouch)
10. Peritoneal Cyst
11. Obliterated DP
Both ovaries seen in normal position.
Both ovaries at different levels when compared to the endometrium line.

Figure 3  Arrows show both ovaries at different levels when compared to the endometrium line.
Left ovary is higher than the level of the endometrium
Obliterated pouch of Douglas

Figure 10  Obliterated pouch of Douglas and peritoneal cyst seen.
Obliterated pouch of Douglas

Figure 11  Obliterated pouch of Douglas (shown by arrows).
A bout Transvaginal US:

- It is the first-line imaging examination.
- Transvaginal US should be done first when the presence of endometriosis is suspected.
- This method is as accurate as transrectal US for diagnosing intestinal lesions and identifying the bowel layers affected.
- Transvaginal US has better results than MRI for the assessment of deeply infiltrating endometrial implants in other locations, especially small (<1.5-cm-diameter) lesions of the uterosacral ligament and bladder.
About MRI:

- Is an excellent method for identifying:
  - Old hemorrhagic content that characterizes endometriomas.
  - Mapping multiple deeply infiltrating endometrial implants.

Because MRI has:
- Large field of view
- Multiplanar capabilities
- Outstanding contrast resolution

**Extensive pelvic adhesions** & **ureteral involvement** are two important indications for MRI.
A new mapping system, called the Endometriosis Surgical Ultrasonographic System (ESUS), was developed to assess the extent of endometriosis by describing accurately the locations of the lesions in the pelvis and by measuring the size and depth of the lesions at the various pelvic sites.
This mapping system is based on the anatomical site where DIE could be found and was elaborated by surgeons and a sonographer together to define exactly each site and to obtain information useful for choosing between surgical or medical treatment.
<table>
<thead>
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<th>LOCATION</th>
<th>LESION</th>
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<td>RECTO-VAGINAL SEPTUM and VAGINA</td>
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<table>
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<tr>
<th>DOUGLAS (D)</th>
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| NODULE | Yes | site: | | |
|---------|-----|------|---|
| Distance from right ureter: | | | |
| Distance from left ureter: | | | |

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<tr>
<td>ADHESIONS (left ovary)</td>
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| OTHER SITES | |
|-------------| |
• The mapping sheet was filled out first by the sonographer, based on TVS findings, and then, after laparoscopy, by the surgeon.
• The ESUS was filled by marking the location of pelvic endometriosis divided into four compartments (adnexal, anterior, posterolateral, and Douglas)
• Adding a graphic scheme site by site, and for each lesion the corresponding box option of “yes-no” with relative diameter and depth of infiltration was added.
Procedure and Patient Preparation Before Transvaginal US

- The transvaginal US examination is performed by using a US machine with a 5 – 9-MHz frequency transducer.

- It should be done after bowel preparation.(to eliminate fecal content and gas in the rectosigmoid colon).

- The duration of the US examination is 25–35 minutes.
Bowel Preparation Before Transvaginal US

1. Mild laxative administered in two oral doses (at 8:00 am and 2:00 pm) the day before the scheduled transvaginal US examination.
2. The patient should have a low-residue diet for 24 hours before the examination.
3. An enema (120 mL of sodium diphosphate) should be administered approximately 1 hour before the examination.
# Imaging algorithm

<table>
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<th>Evaluation of the:</th>
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<tr>
<td>• Uterus</td>
<td>• The bladder wall</td>
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<td>• Ovaries</td>
<td>• Anterior uterine serosa</td>
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<td>• Pelvic peritoneum covering the bladder</td>
<td>• Uterine insertion of the round ligaments</td>
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<td>• Uterus Douglas pouch</td>
<td>• Rectovaginal septum</td>
</tr>
<tr>
<td>• Retrocervical region</td>
<td>• Posterior vaginal fornix</td>
</tr>
<tr>
<td>• Rectosigmoid colon</td>
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</table>
Structures that should be evaluated transabdominally after Transvaginal US

- The descending colon
- Appendix
- Ileocecal transition

Note: These structures may be inaccessible transvaginally.
Characteristics of a normal intestinal wall depicted from the outer to the inner layer at transvaginal US include:

- A thin hyperechoic line that represents the serosa
- Two hypoechoic strips separated by a thin hyperechoic line, which represent the muscularis propria
- A hyperechoic line that represents the submucosa
- A hypoechoic line representing the muscularis mucosa
- A hyperechoic linear interface between the bowel lumen and the mucosa.
Other important points to be considered:

• The portion of the circumference that is affected.

• The distance from the inferior margin of the lesion to the anal verge. It can be estimated by measuring the distance between the peritoneal reflection, which is 7–9 cm from the anal verge, and the bowel lesion.
Bladder and intestinal involvement

In patients with bladder and intestinal lesions:

• A volumetric acquisition may be performed
• A three-dimensional (3D) US image reconstructed to allow better evaluation of the lesion shape and provide the surgeon a spatially more comprehensive coronal view.

Note: For better distention of the posterior fornix and better identification of nodules and thickening of the posterior vaginal wall → Use 60 mL of US gel into the upper third of the vagina.
Diagnosis of Pelvic Adhesions

Pelvic adhesions can be evaluated by:

Gently moving the transducer **back and forth against the cervix** during abdominal palpation to assess whether the uterus, ovaries, and bowel loops slide freely over each other.
Locations of multiple endometriotic lesions

Figure 1. Drawings of the female pelvic anatomy in the axial (a) and sagittal (b) planes show the locations of multiple endometriotic lesions. The round black lesion in the right ovary in a represents an endometrioma. The lesions with irregular margins are indicative of deeply infiltrating endometriosis.
Limitations of Transvaginal US

• The main limitation: Restricted field of view. (It is difficult to visualize lesions located outside the pelvis).

• Lesion visualization impaires with:
  - Large ovarian cysts
  - Subserosal leiomyomas
  - Acute retroflexion of the uterus
  - Severe pelvic adhesions
  - Distortions of the pelvic anatomy
Procedure and Patient Preparation Before Pelvic MRI Technique

- Pelvic MRI is performed by using a 1.5-T MR imaging system with an eight-channel cardiac coil.
- Patient should take a low-residue dietary regimen on the day before and the day of the MR imaging examination.
• Just before MR imaging:
  - 10 mg butylescopolamine is injected IV → Reduce bowel peristalsis
  - 60 mL of gel is infused into the vagina → Distend the fornix
• The average duration of the MRI is 25 minutes + 20 minutes for image interpretation = about 45 minutes.
  (10 minutes more than transvaginal US)
Bowel Preparation Before Pelvic MRI

- The patient must fast for at least 4 hours.
- Refrain from voiding for 1 hour before the examination → Correct the angle of uterine anteversion and displace the small bowel cephalad.
- Bowel cleansing is routinely performed by the patient with two doses of an oral laxative (5 mg bisacodyl per dose), one at 8:00 am and the other at 2:00 pm the day before imaging.
Rectal distention (with gel/ saline) do not perform because:

- Rectal distention may cause patient discomfort
- It increases bowel peristalsis → may cause blurring of bowel segments on MR images.
- The nondistended colon above the rectum may become spastic, creating an offset between the two segments that might obscure multifocal lesions or lesions in the upper part of the colon.
- Bowel wall retraction, a valuable sign of the presence of an endometriotic lesion, is likely to disappear when the rectum is distended.
Limitations of Pelvic MR Imaging

some conditions can reduce the quality of MRI and its sensitivity:

1. Bowel peristalsis:
   Peristalsis blurs the bowel contours and adjacent organs and may simulate bowel thickening or mask small lesions.

2. Fecal residues and gas may impede visualization of deeply infiltrating endometriotic lesions. (Even after bowel preparation)
3. Inability to introduce gel into the vagina of a patient may contribute to the failure to detect small lesions on the posterior vaginal wall.

4. Large endometriotic ovarian cysts, subserosal leiomyomas (especially those located in the retrocervical region), and acute retroflexion of the uterus are other common conditions that may impair visualization of endometriosis at MR imaging.
دلا! جوانی خودرا، که داده ای سباد
برای موسم سری، زخان نیکونی؟

(اسکالندری "ساعی")
Bladder Endometriosis

- Endometriosis of the urinary tract occurs in approximately 20% of cases.
- Bladder is the organ most frequently involved.
- Most cases are asymptomatic.
- Women with bladder involvement may experience these symptoms during menses:
  - Dysuria
  - Urgency
  - Hematuria
In US:

- Bladder endometriosis is defined by:
  ① full-thickness infiltration of the bladder detrusor
  ② appears as a mural mass projecting into the bladder lumen
- The bladder mucosa is usually intact.
- Small nodules of the vesicouterine fold are not considered indicative of bladder endometriosis.
- The internal appearance of the lesions varies, depending on the presence and size of cystic areas within them.
• At transvaginal US → presence of a minimal amount of urine in the bladder is sufficient for a dynamic assessment of the posterior vesical wall.

• At MRI → minimal filling of the bladder may impair the visualization of small lesions in the bladder.

Note: most accurate imaging technique for diagnosing bladder endometriosis is transvaginal US, which allows the determination of lesion size and depth of extension into the detrusor.
Bladder endometriosis
Bladder endometriosis
Color Doppler of Bladder endometriosis

FIGURE 7. Transvaginal sagittal color Doppler sonogram shows an endometriotic implant (arrows) involving the inferior bladder wall.
Endometriosis of the Uterine Serosa and Round Ligaments

- Deeply infiltrating endometriotic lesions that involve the anterior uterine serosa and round ligament insertion sites have an infiltrative pattern with indistinct margins.
- At transvaginal US: These lesions appear hypoechoic in comparison with the myometrium and usually contain multiple bright foci or small cystic areas.
Clues to the correct diagnosis of deeply infiltrating endometriotic lesions are:

1. Their indistinct margins in contrast with the circumscribed and well-defined margins of subserosal leiomyomas
2. The presence of small cystic areas or bright punctate foci in endometriotic lesions.
Endometriosis of the anterior pelvic compartment
Extensive endometriosis in the anterior pelvic compartment
Retrocervical endometriosis

• The retrocervical region is commonly affected by deeply infiltrating endometriosis.
• Involvement of this region usually causes severe and painful symptoms.
• Association with vaginal and intestinal lesions is frequent.
• In more extensive disease, adhesions among pelvic structures may result in a frozen pelvis.
• In most patients in physical examination we can palpate:
  ① Thickened uterosacral ligament
  ② Nodules in the posterior cul-de-sac
• Lesions of the uterosacral ligament may be unilateral or bilateral.
• At transvaginal US, these lesions appear hypoechoic.
Retrocervical endometriosis
Bilateral retrocervical deeply infiltrating endometriosis
Retrocervical endometriosis
Endometriosis of the Rectovaginal Space (Rectovaginal septum)

- The rectovaginal space is the region situated between the posterior vaginal wall and the anterior rectal wall below the peritoneal reflection.
- The inferior two-thirds of this space, is rarely affected by deeply infiltrating endometriosis.
- Rectovaginal lesions are frequently extensions from retrocervical or posterior vaginal lesions.
• At vaginal examination:
  ① firm nodules that can be palpated.

  ② The purplish nodular infiltrations are easily seen through the speculum, usually in the posterior vaginal wall.
At transvaginal US:

• Endometriosis of the Rectovaginal Space have a hypoechoic appearance.

• A small amount of fluid in the posterior cul-de-sac facilitates the identification of the peritoneal reflection.
Extensive endometriosis of the posterior pelvic compartment
Extensive endometriosis of the posterior pelvic compartment
Rectovaginal deeply infiltrating endometriosis
Rectovaginal deeply infiltrating endometriosis
Endometriotic nodule in the posterior cul-de-sac

FIGURE 3. Transvaginal sagittal sonogram shows an endometriotic nodule (arrows) in the posterior cul-de-sac. Note the connection between the lesion and the posterior margin of the uterus and anterior bowel wall.
Endometriosis of the Rectosigmoid Colon

• Occurs in 12%–37% of patients.

• Commonly associated with: Severe, deeply infiltrating endometriosis in multiple pelvic locations (uterosacral ligament, ovaries, vagina, bladder, and pelvic sidewall).

• The classic symptoms are:
  - Cyclic pain during defecation
  - Bloating
  - Bowel cramping that are relieved by passing air or feces
  - Cyclic rectal bleeding during menses is observed rarely
• Mild symptoms may be present during both the premenstrual and periovulatory periods.

• Because the symptoms are nonspecific, the condition is often misdiagnosed as irritable bowel syndrome.

• Depending on the lesion size, degree of infiltration, and affected bowel circumference, surgeons may opt to perform alternative procedures such as shaving or discoid or segmental resection.
• The typical imaging appearance of intestinal endometriotic lesions is:

  a solid, homogeneous nodule + irregular contours attached to the intestinal wall

• Nodules demonstrate marked hypoechogenicity at transvaginal US after bowel preparation.
Intestinal endometriosis
Intestinal endometriosis
Intestinal endometriosis
Intestinal endometriosis
Bowel Endometriosis

**FIGURE 2.** Transvaginal sagittal sonogram shows a large hypoechoic nodular lesion (arrows) seen on the rectosigmoid colon representing bowel endometriosis.
Deeply infiltrative endometriosis lesion of the bowel

Figure 1: Deeply infiltrative endometriosis lesion of the bowel on ultrasound.
Vaginal Endometriosis

- Vaginal endometriosis may be an incidental finding in asymptomatic patients.
- It is more often associated with:
  - Dysmenorrhea
  - Postcoital spotting
- The condition is almost always associated with endometriosis in other pelvic locations (especially retrocervical and rectal lesions).
• It may appear as **nodular or polypoid masses** involving the posterior vaginal fornix.

• The accurate diagnosis of vaginal endometriosis is **especially important** because:
  ① A specific surgical procedure is required for treatment.
  ② The condition is associated with a risk for rectovaginal fistulation
At Imaging:

• The imaging appearance varies from:
  ① Thickening of the superior one-third of the posterior vaginal wall without a defined nodule.
  ② Large polypoid masses that protrude into the posterior vaginal fornix.

• Insertion of vaginal gel before transvaginal US or MR imaging is useful for visualizing the posterior fornix and the interface between the posterior cervical lip and vaginal wall.

• Vaginal endometriotic nodules are hypoechoic on transvaginal US images.
Vaginal endometriosis
Vaginal endometriosis
Ureteral Endometriosis

- Ureteral endometriosis is uncommon but serious because of the lack of specific symptoms and the high risk for loss of renal function.
- Preoperative diagnosis is unlikely unless associated ureteral obstruction or hydronephrosis occurs.
- It is estimated that 47% of patients with ureteral endometriosis require nephrectomy at the time of diagnosis.
Clinical manifestations are usually **nonspecific**, but **dysmenorrhea** and **dyspareunia** may predominate.

The possibility of ureteral involvement must be considered in the presence of large paracervical lesions (≥ 2 cm in diameter).
At Imaging:

• Renal US may depict hydronephrosis, but unless the ureters are dilated, it is difficult to visualize the ureteral pathways at transabdominal and transvaginal US.

• Ingestion of approximately 300 mL of water just before transvaginal US allows identification of the ureter and its peristaltic movement from the segment below the iliac vessels to the ureterovesical junction.

• Color or power Doppler US may demonstrate a jet indicative of unobstructed ureteral flow.

• best imaging modality for ureteral evaluation is pelvic MRI.
Paracervical endometriosis with ureteral stenosis
Paracervical endometriosis with ureteral stenosis
Ovarian Endometriosis

- The ovaries are the most common sites of endometriosis (20%–40% of cases).
- Ovarian endometriosis may manifest either as:
  1. Superficial fibrotic implants associated with fibrous adhesions.
  2. Chronic retention cysts with cyclic bleeding (endometriommas).
- Endometriosis confined to the ovarian surface is underdiagnosed at imaging because of the microscopic size of the lesions.
Endometriomas are:

1. Thick-walled cysts
2. With a dark, dense content that represents degenerated blood products
3. The cysts may be solitary or multiple
4. They are bilateral in 50% of cases
5. Endometriomas may include peripheral nodules (blood clots) or fluid-fluid levels due to recent hemorrhages
• A multilocular-appearing endometrioma may consist of multiple contiguous cysts.

• Endometriomas are a marker of severity of deeply infiltrating endometriosis.

• The risks for multifocal disease and intestinal involvement in patients with an endometrioma are two- to threefold the risks among patients with endometriosis but without an endometrioma.
At Imaging:

• Transvaginal US is highly sensitive (84%–100%) and specific (90%–100%) in the diagnosis of endometriomas.

• Most endometriomas have:
  1. Homogeneous, diffuse internal hypoechogenicity
  2. Thin or thick septa
  3. Fluid-fluid levels
  4. Echogenic peripheral nodules
  5. Bright foci within the cysts
On color Doppler US images:

1. The cysts appear hypovascular
2. Without internal flow

- Transvaginal US is also useful for preoperative evaluations of adhesions.
- MRI is widely accepted as the best imaging modality for diagnosing endometriomas.
- The high specificity of the MRI (98%) is attributed to the ability to detect aged hemorrhagic content.
The differential diagnosis of endometrioma includes:

- Hemorrhagic corpus luteum cysts: (are usually unilocal, have a “reticulated” pattern on transvaginal US images

- Dermoid cysts
Endometriomas
Large endometrioma
Color Doppler of Endometrioma

FIGURE 1. Transvaginal sagittal color Doppler sonogram of an ovarian endometrioma. The homogenous echopattern of the cyst contents produces the characteristic ground glass appearance.
Follicular physiological cyst
Paraovarian cyst
Serous cystadenoma
(A) Unilocular serous cystadenoma
(B) Multilocular cystadenoma
Mucinous cystadenomas
(A) Unilocular  (B) Multilocular
Dermoid Cysts
پاساس