Imaging of the Female Pelvis:
Evaluation of a Submucosal Rectal Mass

Lauren Goldstein, HMS III
Gillian Lieberman, MD
Our Patient: History of Present Illness

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- 51 yo F with history of breast cancer undergoes screening colonoscopy
- Submucosal lesion noted above rectum at junction of rectosigmoid
- Lesion biopsied & tattooed
  - Biopsy results were benign/nondiagnostic
Submucosal Lesion at Endoscopy

Companion Patient #1:
Representative image from sigmoidoscopy of patient with same lesion as our patient.

Our Patient: Pertinent History

- **Past medical history**
  - stage I breast cancer s/p left lumpectomy 1997, lymph node dissection (0/13 positive), and radiation therapy
  - HTN, hypercholesterolemia, morbid obesity, GERD

- **Gynecologic history**
  - Cesarean section 1991, other history unavailable

- **Smoker**

- **Family history**
  - no family history of colorectal carcinoma or IBD
  - family history of gynecologic malignancy (not specified)
Our Patient: Review of Systems

- No bright red blood per rectum, no melena
- No changes in stool caliber
- No nausea, vomiting, diarrhea
- No abdominal pain
- Irregular vaginal bleeding
- No fever, chills, sweats, weight loss
Submucosal Rectal Mass

- Mass or mass-like lesion that protrudes into lumen of GI tract
  - may be soft tissue, fluid, or air
- Is covered with normal overlying GI mucosa
- May be
  - intramural: originating from within GI tract wall
  - extramural: caused by external compression from nearby structures
Layers of the Rectal Wall

Differential Diagnosis: Intramural Mass

- Lipoma
- Carcinoid
- Lymphoma
- GI stromal tumors
  - leiomyoma & leiomyosarcoma
- Metastatic neoplasms
- Colitis cystic profunda
  - benign dilated mucus-filled submucosal glands
- Pneumatosis cystoides intestinalis
  - air in bowel wall
- Lymphoid polyps
- Enteric endometriosis or endometrioma
Differential Diagnosis: Extramural Mass

- **Cervical mass**
  - cervical carcinoma
  - nabothian cyst
- **Uterine mass**
  - leiomyoma
- **Ovarian mass**
  - malignant: ovarian carcinoma
  - benign: functional follicular cysts, single cysts, cystadenoma, dermoid (mature teratoma), endometriomas, polycystic ovaries
- **Cul-de-sac mass**
  - endometriosis or endometrioma
  - metastatic deposit
  - lymphadenopathy
Anatomy of the Female Pelvis – Sagittal View

Most dependent area of pelvis:
- fluid accumulation
- metastasis seeding

Anatomy of the Female Pelvis – Axial View

Menu of Imaging Tests for the Evaluation of the Female Pelvis

- Endorectal ultrasound
- Transvaginal ultrasound
- MRI
  - Endorectal MRI
- CT
Endorectal Ultrasound

- Used widely in staging of rectal carcinoma to
  - assess depth of tumor penetration
  - detect presence of local and regional nodal metastases
  - detect vascular invasion
- For rectal submucosal lesions, useful to
  - determine whether mass is intramural or extramural
  - determine wall layer from which lesion originates
  - define echotexture of lesion
- Advantages:
  - radiation-free, readily available, inexpensive, generally well-tolerated
- Limitations:
  - requires technical expertise and experience
  - may require anesthesia
  - may not be able to pass probe if lesion stenosing or obstructing
Endorectal Ultrasound Layers

# Differentiating Pelvic Masses with EUS

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Endosonographic layer</th>
<th>Endosonographic features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinoid</td>
<td>2nd, 3rd or 4th</td>
<td>Hypoechoic, sharp margins</td>
</tr>
<tr>
<td></td>
<td>(often originate in mucosa)</td>
<td></td>
</tr>
<tr>
<td>GIST</td>
<td>Usually 4th</td>
<td>Hypoechoic, heterogenous, sharp margins</td>
</tr>
<tr>
<td>Pneumotosis cystoides intestinalis</td>
<td>2nd and 3rd</td>
<td>Impenetrable to ultrasound. Multiple hyperechoic interfaces just below mucosal layer</td>
</tr>
<tr>
<td>Lipoma</td>
<td>3rd</td>
<td>Hyperechoic</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>2nd, 3rd or 4th</td>
<td>Hypoechoic inhomogeneous mass</td>
</tr>
<tr>
<td>Endometriosis</td>
<td>4th but can involve all layers as endometriosis invades through colonic wall</td>
<td>Usually hypoechoic, may have cystic component</td>
</tr>
<tr>
<td>Extrinsic organ</td>
<td>Extracolonic</td>
<td>Appearance of extrinsic organ (vessel, uterus, ovary, etc.)</td>
</tr>
</tbody>
</table>

Submucosal Rectal Masses on EUS

Companion Patient #2: Carcinoid

Companion Patient #3: GIST (leiomyosarcoma)

Companion Patient #4: Pneumatosis coli

Companion Patient #5: Lipoma

Companion Patient #6: Endometriosis


Source: http://www.ddc.musc.edu/ddc_pro/pro_development/atlas/EUS/cancer1.htm
Transvaginal Ultrasound

- Used widely in gynecologic examination of location, size, consistency of lesions of
  - uterus
  - adnexa
- For rectal submucosal lesions, useful to
  - determine whether mass is intramural or extramural
  - define echotexture of lesion
  - provide better visualization of rectovaginal space infiltration and lymph node enlargement than endorectal ultrasound
  - enhance staging accuracy of rectal neoplasms
  - Doppler allows assessment of lesion vascularity
- Advantages:
  - radiation-free, readily available, inexpensive, generally well-tolerated
- Limitations:
  - difficult to evaluate the depth of rectal wall involvement
  - unable to determine exact distance of rectal lesions from the anal margin
  - limited field of view renders examination of large or high pelvic masses difficult
  - requires technical expertise and experience
TVUS Layers

R = rectum
MM = mucosa and submucosa
MP = muscularis propria
PVF = posterior vaginal fornix
C = cervix

Selected Pelvic Lesions on TVUS

Companion Patient #7:

Rectal leiomyosarcoma

Companion Patient #8:

Posterior pelvic endometriosis

MRI

- Multiplanar imaging & superior soft tissue contrast resolution allows:
  - determination of origin of pelvic mass
  - differentiation between intramural and extramural lesions
  - characterization of pelvic mass
  - staging of gynecologic malignancies, especially nodal involvement

- Advantages: radiation-free

- Limitations: expensive, contraindicated in some patients, not as widely available
T2 MRI of Normal Female Pelvis

**Sagittal view**
- e = endometrium
- white arrows = junctional zone
- black arrows = myometrium

**Axial view**
- short arrows = uterine fundus
- long arrows = ovaries

**Incidental finding** = bladder fold

# Differentiating Pelvic Masses with MRI

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Radiographic features</th>
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</thead>
<tbody>
<tr>
<td>Rectal tumors</td>
<td>Intermediate signal on T1 and T2</td>
</tr>
<tr>
<td>Uterine leiomyoma</td>
<td>Circumscribed, decreased T1 and T2 signal&lt;br&gt;Cellular: intermediate T2 signal, early enhancement&lt;br&gt;Degenerating: heterogeneous → high T2 signal intensity necrosis</td>
</tr>
<tr>
<td>Cervical carcinoma</td>
<td>Isointense to normal cervix on T1; hyperintense to normal low signal intensity cervix on T2&lt;br&gt;With T2 or gad-enhanced T1, can assess extension to vaginal wall (sagittal), to parametrial tissues (axial), and through muscularis propria of rectum (axial)</td>
</tr>
<tr>
<td>Lymphadenopathy</td>
<td>Lymph nodes appear dark against much brighter background pelvic fat on T1</td>
</tr>
<tr>
<td>Ovarian masses</td>
<td><strong>Benign</strong>: follicular cysts (high signal on T2), hemorrhagic cysts (high signal on T1), endometriomas (loss of signal on T2), dermoids (loss of signal on fat-suppressed T1 &amp; on T2), teratomas (fat-fluid level, mural nodules, low signal bony elements), PCOS (multiple bilateral cysts), benign tumors (cystic with fine septations &amp; no solid components)&lt;br&gt;<strong>Malignant</strong>: cystadenocarcinoma (predominately cystic mass with nodular enhancing wall and thick enhancing septa)</td>
</tr>
<tr>
<td>Endometriosis</td>
<td>Unilocular or multilocular; predominately high signal on T1, low or mixed signal on T2, often with intermediate signal shading on T2 due to shortening of blood products</td>
</tr>
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Lesions on MRI

Companion Patient #9:
Uterine leiomyoma on T2 sagittal (a) and axial (b)

Companion Patient #10:
Endometriosis on axial T1 (a) and T2 (b)

Companion Patient #11:
Cervical cancer on T2 sagittal (a) and axial (b)

Endorectal MRI

- Usually combines endorectal coil for local imaging with standard MRI for imaging distant organ involvement
- Allows assessment of:
  - location of rectal tumor
  - depth of invasion
  - presence of nodal metastases >5mm
  - presence of distant metastases
- Advantages:
  - radiation-free, generally well-tolerated
- Limitations:
  - limited field of view renders examination of large or high pelvic masses difficult
  - requires technical expertise and experience
  - may require anesthesia
  - may not be able to pass probe if lesion stenosing or obstructing
Multiplanar imaging allows
- determination of origin of pelvic mass
- differentiation between intramural and extramural lesions
- characterization of pelvic mass
- staging of gynecologic malignancies, especially nodal involvement

Advantages: widely available, quicker, higher spatial resolution than MR

Limitations: radiation exposure, expensive
CT of Normal Female Pelvis – Axial View

Source: Female Pelvis CT  http://www.dartmouth.edu/~anatomy/pelvis/labimages/femalepelvisct1.html
Intramural Masses on Axial CT

Companion Patient #12: Lymphoid polyps in colon
Companion Patient #13: Lipoma in colon: fat attenuation
Companion Patient #14: GIST in rectum
Companion Patient #15: Pneumatosis cystoides coli: air-filled cysts with localized subserosal air

Pelvic Masses on Axial CT

Companion Patient #16:
Parametrial cervical cancer

Companion Patient #17:
Teratoma: fatty mass with calcification

How were the available imaging modalities employed in the evaluation of our patient?
Our Patient: OSH Evaluation & Management

- Records of imaging history at OSH unavailable
- Flexible sigmoidoscopy at OSH on initial presentation
  - appeared that lesion had increased in size
  - mass appeared to emanate from posterior wall of cervix
  - biopsy results = benign/nondiagnostic
- Exploratory laparotomy at OSH on initial presentation
  - goal: resect posterior cul-de-sac mass to obtain tissue diagnosis
  - mass could not be identified intra-operatively
  - intra-operative gynecology consult: exam under anesthesia showed mass on cervix, probably projecting into rectal lumen
  - repeat flex sigmoidoscopy with tattoo of lesion
  - due to concern that growing mass might cause rectal obstruction, completed Hartman’s procedure w/end sigmoid colostomy
- Patient referred to DFCI/BWH for further evaluation and management
**Our Patient: MRI one month after initial presentation**

**Sagittal View – T1**

- Mass arising from posterior aspect of the cervix, hypointense on T1
- Second anterior cervical lesion, bright on T1 (does not enhance on T2)

Source: PACS, BWH
Our Patient: MRI one month after initial presentation

Axial View – T2

- mass in the posterior cul-de-sac
- 2.8 cm diameter
- rim hypointense on T2
- centrally hyperintense on T2

spiculation & invasion of right parametrial tissue

Source: PACS, BWH
Our Patient: MRI one month after initial presentation

Axial View – T1

thickening of right uterosacral ligament

Source: PACS, BWH
Our Patient: MRI one month after initial presentation

Axial View – T1 Post-Gadolinium

mass enhances with IV gadolinium

Source: PACS, BWH
Our Patient: Summary of MRI Findings

- Posterior cervical mass, gadolinium-enhancing and with central T2 hyperintensity and rim hypointensity, concerning for
  - primary cervical neoplasm
  - local or metastatic cancer recurrence
  - degenerating leiomyoma

- Several enlarged lymph nodes on both sides, largest 1.4 cm in right common iliac lymph node chain, concerning for
  - metastatic colon cancer deposit
  - post-surgical inflammation

- Anterior cervical mass, non-enhancing, concerning for
  - metastatic deposit
  - nabothian cyst

- Extensive infiltration of mesenteric fat in anterior pelvis

- Normal ovaries

- Normal liver
Our Patient: TVUS ten days later

Sagittal View

Heterogenous irregular mass in posterior cul-de-sac, 3.5 x 3.3 x 2.6 cm

Source: PACS, BWH
Our Patient: TVUS ten days later
Coronal View

Heterogenous irregular mass in posterior cul-de-sac, 3.5 x 3.3 x 2.6 cm

Source: PACS, BWH
Our Patient: Further Evaluation & Management

- **Gynecologic consult on first presentation**
  - TVUS-guided biopsy
    - benign, with some fibrotic connective tissue elements, potentially suggestive of leiomyoma
  - Pap smears and cervical biopsies negative

- **Follow-up radiology consult**
  - lesion likely benign, potentially degenerating leiomyoma

- **Exploratory laparotomy two months later**
  - goals
    - biopsy mass to obtain tissue diagnosis to rule out malignancy
    - reverse colostomy
  - identified nodular mass between the cervix and the rectum, particularly along the right uterosacral ligament, stony hard on palpation
  - biopsy results consistent with endometriosis
Conclusions

- All imaging modalities assist in determining whether rectal submucosal lesion is intramural or extramural
- **Endorectal US & endorectal MRI**
  - best modalities for evaluating rectal intramural lesions
- **Transvaginal US**
  - best modality for evaluating extramural lesions involving uterus & adnexa
  - good modality for visualization of rectovaginal space infiltration and lymph node enlargement
- **MRI & CT**
  - best modalities for determination of origin of pelvic mass & staging of gynecologic malignancies, especially nodal involvement
  - MRI better for lesion characterization due to superior soft tissue differentiation
  - MRI better due to lack of ionizing radiation
References

Books and Journal Articles

References

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