Adenomyosis
Routine US and SIS with Multimodality Correlative Imaging

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Epidemiology
• Historically based upon hysterectomy
  – estimates of overall incidence vary from 5-70%
  • 20-30% US hysterectomy specimens
  – Racial, ethnic, parity and age variations may be related to hysterectomy rates
  – Uterus may be morcellated during laparoscopic resection
  – Likelihood of histologic diagnosis related to number of tissue samples taken

Epidemiology- “Risk Factors”
• Age
• Multiparity
• Uterine surgery
• Smoking
• Ectopic Pregnancy
• Depression, anti-depressant meds
• Tamoxifen

Symptoms
• Menorrhagia, chronic pelvic pain, dysmenorrhea
• Previously thought that adenomyosis was “incidental” to other, more obvious pelvic disease
• Commonly co-exists with leiomyomas
  – Data suggests that women with both diseases have more symptoms than women only with leiomyomas

Theory of Pathophysiology
• Repeated peristalsis ➔ strain and tissue injury ➔ micro trauma ➔ increase in localized estrogen production ➔ hyperperistalsis
• Results in myometrial dehiscences and desquamated endometrium
• Eventually junctional zone is infiltrated by dislocated basal endometrium
• Fundo-cornual raphe most susceptible

I have no disclosures
Categorization of Findings of Adenomyosis

I. Stromal/Muscular Hyperplasia
II. Ectopic Endometrial Glands
III. Vascularity

Ultrasound Findings in older literature

- Enlarged uterus without discreet myomas
- Asymmetric thickening anterior versus posterior myometrium
- Heterogeneous areas in myometrium without contour abnormality of mass effect
- Abnormal echotexture of myometrium

Other findings better appreciated with more modern US technology

- Subendometrial echogenic nodules
- Subendometrial echogenic striations perpendicular to endometrium
- Blurred endometrial myometrial junction
- Myometrial cysts: 1 – 5mm
- Hypoechoic areas in myometrium associated with thin edge shadows
- Echogenic nodules, striations, asymmetric myometrial thickening had specificity 92% (7-5 MHz transducer technology)
- US allows correlation with location of patient’s pain
- Diagnosis more difficult in presence of fibroids

Technical Scanning Pearls

1. High frequency transvaginal imaging best for heterogeneity and shadowing
2. Penetration mode helps to appreciate stromal/muscular hyperplasia
3. Margins of endometrium may be better delineated with lower frequency transabdominal transducer
4. Subtle echogenic striations best appreciated with cine clips from high frequency transvaginal imaging
5. Location of adenomyosis may be better appreciated with coronal reformats
Stromal/Muscular Hyperplasia

- Globular/rounded enlargement of the uterus
- Symmetric or asymmetric myometrial thickening
- Thickened junctional zone > 12mm
- Additional US findings
  - Heterogeneous/hypoechoic myometrium
  - “venetian blind” shadows from whorls of muscle fibers
  - Indistinct endometrial-myometrial interface
  - Classic findings typically seen on US and MR
  - Can also appreciate these findings on CT

Stromal hyperplasia manifests as symmetric or asymmetric myometrial thickening and heterogeneity with “pencil thin” shadows

Pearl 1:
- High frequency TV imaging best for heterogeneity and shadowing

Pearl 2:
- Penetration mode helps to appreciate stromal/muscular hyperplasia

TA versus TV for adenomyosis

TA

Routine TV

TV

With penetration mode

TV

TA

Endometrial border blurs on side with adenomyosis

Pearl 3:
- Margins of endometrium may be better delineated with lower frequency transabdominal transducer

Post menopausal adenomyosis

Pearl 5:
- Location of adenomyosis may be better appreciated with coronal reformats
**Ectopic Endometrial Glands**

- Myometrial/junctional zone cysts – US, MR, CT
- Thin hyperechoic/hyperintense linear striations extending from endometrium into junctional zone - US, MR
- Echogenic nodules - US
- Sonohysterogram: fluid and air filled cracks
- Hysterosalpingogram: “lollipop diverticula”

**Vascularity**

- Generalized increase in density of uterine vessels
- Tortuous uterine arteries
- Penetrating vessels on color and power Doppler
- Enhancement on MR, CT

**Vascularity: Differentiating focal adenomyosis from fibroid**

- Focal adenomyosis:
  - No well defined mass
  - Generalized increased flow throughout the abnormal appearing myometrium
- Fibroid:
  - Well defined mass with peripheral vascularity
  - Relative lack of internal flow

**Adenomyosis versus fibroids**

- Poorly marginated
- Minimal mass effect
- Ovoid or irregular
- No calcifications
- Pencil thin shadows
- Infiltrative appearance
- Penetrating vessels
- Contiguous with endometrium
- Well marginated
- Mass effect when large
- Round, smooth
- Various calcifications
- Edge shadows
- Whorled appearance
- Circumferential flow
- Variable location
Adenomyosis interpreted as submucosal myoma on TA imaging

Other Issues

- Unusual appearances of adenomyosis
  - Adenomyoma - mass-like localized form, more difficult to distinguish from a myoma
  - Adenomatous polyp associated with tamoxifen-endometrial polyp with smooth muscle
  - Adenomyotic cyst - endometrioma like intramymetrial hemorrhagic cystic mass

- Progression of adenomyosis
- Adenomyosis and endometriosis
- Post menopausal adenomyosis

Focal adenomyosis US and MR

Focal adenomyosis compressing uterine fundus

Endometriosis and Adenomyosis

- Likely share underlying pathophysiology
- Endometriosis
  - Prolonged estrogen in early menstrual life during irregular cycles
- Adenomyosis
  - Common in women with endometriosis
  - Quite common in pre-menopausal women with longer span of “trauma-repair cycle”
**Adenomyosis and Endometriosis**

Implant of deep endometriosis
N.B. Separate from junctional zone

**Adenomyosis and Tamoxifen**

- Tamoxifen citrate: anti-estrogen effect on breast, estrogenic effect on endometrium and myometrium
- Increase in adenomyosis or adenomyosis-like changes
  - Likely a “flare up” of dormant adenomyosis
- May not be able to measure endometrium accurately with adenomyosis causing FP thickening, use SIS or MR to differentiate

**Tamoxifen induced endometrial hyperplasia and adenomyosis**

Uterus from LS spine MR

**Post Menopausal Adenomyosis**

- Well documented in pathology and imaging studies
- More common in peri-menopausal period
- Often described in “resting state” after menopause
- May be revitalized with tamoxifen

**Adenomyosis on Hysterosalpingography**

- May be imaged when nests of endometrial glands within myometrium retain connection to endometrial cavity
- Appears as small “lollipop” diverticula
- Honeycomb appearance of contrast in myometrium
- With focal adenomyosis a mass-like filling defect may be appreciated with small diverticula
- Low sensitivity for adenomyosis

Simpson et al. Radiographics 2006;26:419-431
Junctional zone “cysts” with endometrial connection = lollipop diverticuli

Adenomyosis on Sonohysterography
- Fluid and/or air intravasates into myometrium filling “cracks” that prior to saline injection appear as echogenic striations
- Increased distention enlarges cracks allowing better visualization
- Likely represent dilated endometrial glands communicating with endometrial cavity

Adenomyosis on MR
- Stromal anatomy best on sagittal T2
- MR findings
  - Abnormal widening of junctional zone ≥ 12mm
  - Junctional zone ≤ 8mm excludes adenomyosis
  - Bulky, ill-defined low signal areas on T2
  - Poor definition endometrial myometrial interface
  - Bright foci of endometrial glands within smooth muscle
  - Linear striations extend from endometrium
- SEN 88 – 93 %, SPEC 66 – 91%

Adenomyosis on CT
- Improved detection with contrast
- Thickened inner myometrium
- Uterine enlargement
- Myometrial cysts
- However, myometrial enhancement is variable on CT depending upon hormonal status, making diagnosis difficult in subtle cases

Adenomyosis: CT, MR, US

Notes:
- Reeves et al. US Obstet Gyn 2010;36:115-119
- Verma et al. AJR. 2009; 192: 1112-1116.
Treatment of Adenomyosis

• Medications: NSAIDs, OCPs, progestins, danazol, gonadotropin releasing agonists
• Limited success of minimally invasive surgical techniques (ablations, electrocoagulation)
• Newer techniques show promise, strongest data available for UAE, but no randomized or controlled trials
  – High intensity focused US (HIFU) with MR or US guidance
  – US guided percutaneous microwave ablation

Uterine Artery Embolization

• No double blind trials
• 2011 review of 15 studies
  – 2-159 patients per study
  – Improvement of symptoms reported by 76% patients
  • Short term relief in 83%-93%
  • Long term relief 80% pure adenomyosis, 82% with leiomyomas
  – Median follow up 27 months
  – Issues with this data: lack of uniform original diagnosis, variable methodologies, no standard for outcomes, relief of symptoms may be related to treatment of concomitant fibroids, no objective symptomatic assessment

Adenomyosis initial studies

Adenomyosis: Pre and Post UAE

UAE in patients with pure or dominant adenomyosis results in decrease size of uterus, regions of devascularization

Unusual issues related to adenomyosis

• Decidualization during pregnancy (analogous to decidualized endometrioma)
• Adenocarcinoma arising from adenomyosis (malignant ectopic glands with normal endometrium)
• Difficulty staging endometrial carcinoma in presence of adenomyosis

New US Approaches

• 2D 3D reforms: allow better measurement of lateral and fundal adenomyosis and better appreciation of early invasion of junctional zone
• Elastography: fibroids and adenomyosis may have different elastoraphic patterns

Taran et al. Geburtshilfe Frauenheilkd. 2013 Sep; 73(9): 924-931
Kitamura Y, et al. AJR 2006;186:855-64