Ultrasound of the Fallopian Tube

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Outline
- Introduction
  - Embryology
  - Normal Tubes on Ultrasound
- Pelvic Inflammatory Disease
- Hematosalpinx
  - Endometriosis
  - Ectopic Pregnancy
- Tumors
- Torsion
- Infertility
- Look-a-likes

Embryology
- 5-6 weeks paired paramesonephric ducts form
- Cranial portions ➜ fallopian tubes
  - Caudal portion fuses, forms uterus
  - Cranial end is funnel shaped and open to peritoneum
- Congenital Anomalies
  - Hydatid of Morgagni = Paratubal cyst
    - Part of paramesonephric duct that does not contribute to uterine tube may remain as a vesicular appendage
  - Other congenital anomalies: ectopic tube, tube in inguinal hernia (along with ovary)

Normal Fallopian Tubes
- Extend from ovary to uterus within broad ligament, serve to transport ovum
- 10-12 cm in length, 1-4 mm in diameter
- Open to peritoneal cavity
- Fimbria at open end suspended over ovary and capture released ovum

Normal Fallopian Tube
- 4 anatomic segments
  - Interstitial- within myometrial cornua
  - Isthmic- narrowest portion of tube
  - Ampullary- closer to ovary, wider segment, ½ tube
  - Funnel shaped infundibulum
- Composition of wall
  - Mucosa- with fingerlike projections (plicae)
  - Epithelium- ciliated and non-ciliated columnar cells
  - Ciliated epithelium and plicae propel ovum towards uterine cavity, fluid is propelled out of tube into peritoneal cavity
Normal fallopian tube

Normal Tube with paratubal cyst

Newborn with inguinal hernia containing ovary and tube

PID: Background

- Polymicrobial: Gonorrhoeae cause epithelial damage to tubes allowing super infection with opportunistic organisms
- Initial endometritis, leads to tubal inflammation, adhesions, obstruction, spread to peritoneum and ovary
- In 50% symptoms insufficient for diagnosis

Ultrasound

- Frequently used, no large trials of sensitivity and specificity
- Insensitive for mild abnormalities and non-specific for some findings
- TV imaging most useful; supplement with TA for large abnormalities and extent of fluid
- Useful to exclude other diagnoses
- Sonographic demonstration of abnormal tube is hallmark of PID

Abnormal Fallopian Tube

- Waist sign = diametrically opposed indentations in wall
- Incomplete septum = linear, echogenic protrusion arising from one wall but not reaching the opposite wall
- Thick wall (≥ 5mm) and cogwheel sign are best markers for acute disease
- Thin wall (< 5mm) and beads on string indicates chronic disease
- Other findings: tubular, “solid” structure, fluid/debris level, gas
- Cine clips, 3D inverted imaging
Discriminators of Hydrosalpinx

- Single best feature
  - Incomplete waist sign
- Best combined features
  - Tubular structure with incomplete waist sign
  - Tubular structure with short projections, "beads on a string"

Patel. AJR. 2006; 186:1033-1038

Normal tube
"Cogwheel sign"

"Waist Sign"
"Beads-on-string sign"

Inflammatory changes around enlarged ovary and thickened fallopian tube: salpingitis

Acute Salpingitis

CT with pre-vesicle inflammation and thickened hyperemic tubes

Mildly dilated tube
Examples of “Cogwheel Sign”

Do Not Mistake folds for Mural Nodules!

Cogwheel Sign on CT and histology

Progression of Disease

- Salpingitis: swollen, congested tube
- Pyosalpinx: distal tube occludes, lumen fills with pus
- Tubo-Ovarian Complex: tube becomes adherent to ovary, but ovary still distinct
- Tubo-ovarian Abscess
- Other: peritonitis, rupture, Fitz-Hugh-Curtis, ileus, hydronephrosis

Pyosalpinx

Bilateral pyosalpinx

Thick walls, hyperemia

Tubo-ovarian complex
Bilateral tubo-ovarian abscesses

Bilateral tubo-ovarian abscesses with gas

Recurrent PID

Imaging findings may be out of proportion to clinical presentation

2006 R ovary and hydrosalpinx

2007 recurrent sx, R pyosalpinx

Corresponding CT: very dilated tube, minimal inflammation

Chronic abnormalities secondary to PID

Sonography of PID after treatment

- Complex fluid and inflammation can resolve in a few days
- Pyosalpinx can change to hydrosalpinx and possibly resolve over few weeks to months
- Initially normal sonogram may develop hydrosalpinx over time
- If pyosalpinx does not resolve or develops into a hydrosalpinx, probably signifies an incompletely treated infection

Hydrosalpinx

Waist, Incomplete septum sign, beads on string
Hydrosalpinx

- Secretions accumulate in tube with distal obstruction
- Most common after PID, but can be due to tubal ligation, ovulation induction, tumors and occasionally after hysterectomy when tubes are left in place
- Identification of separate ovary crucial to distinguish from cystic ovarian mass

Postmenopausal woman

Hydrosalpinx post hysterectomy

History of PID with significant, chronic pain

Dilated tube In cross section

Peritoneal Inclusion Cyst with hydrosalpinx

Peritoneal Inclusion Cyst with normal tubes

Peritoneal Inclusion Cyst

- trapped by peritoneal adhesions
- Causes: prior surgery, trauma, pelvic inflammatory disease, endometriosis
- Need to demonstrate ovary within the cysts or within the wall of the cyst
- Differential diagnosis: hydrosalpinx, para-ovarian cysts
- Treatment: oral contraceptives, lysis of adhesions

Hematosalpinx

- Endometriosis
- Uterine anomalies
- Tubal ectopic pregnancy
Endometriosis: Left hematosalpinx and right endometrioma

Hematosalpinx 2° Endometriosis

Endometriosis

- Endometrial implants involve tubes in <10% with endometriosis
- Intra-luminal implants with repeated hemorrhage may result in hematosalpinx
- Implants on serosal surface of tube not visible by imaging

Jenkins et al. Obstet Gynecol 1986;67:335-338
Woodward et al. Radiographics 2001;21:193-216

Early pregnancy
Palpable left adnexal mass

Hematosalpinx

Atretic Left Horn
Unicornuate right uterus, atretic left horn
Left tube develops into hematosalpinx during pregnancy

Ectopic pregnancies within hematosalpinx

Left pelvic pain in 46 year old
Initial study
Interpreted as PID with tubo-ovarian complex

6 months later patient returns with recurrent pain
Dilated tube and complex fluid
Interpreted as possible rupture of tubo-ovarian complex

CT ordered because of persistent symptoms in face of adequate treatment for PID
Primary fallopian tube carcinoma
Omental 'cake'
Shape and size of tube changes frequently over time as accumulated fluid discharges into peritoneum

More pain 1 month later
Tubal abnormality larger
More complex fluid
Primary Fallopian Tube Carcinoma
Clinical
• copious fluid leading to tubal distention and hydrosalpinx
• Pain occurs as tube dilates and abates with discharge into vagina/peritoneum
  – Latzko triad: intermittent vaginal discharge, colicky pain, adnexal mass
• Appearance and symptoms overlap with PID, rarely diagnosed preoperatively
• CA-125 antigen often positive with PFTC

Primary Fallopian Tube Carcinoma
Pathophysiology
• EOC (epithelial ovarian carcinoma)- no underlying cell of origin, no precursor lesions
• Recent theory: vast majority of serous EOC actually arises from fimbrial end of FT which implants in ovary
  – ovariotomy rather than in situ EOC
  – salpingo-oophorectomy in high risk women rather than in situ EOC
  – Recommend also removing uterus with entire FT
• Further studies found > 70% non-hereditary EOC and peritoneal serous carcinomas have tubal mucosal involvement

PFTC with thick, "solid" tubes

Acute right pelvic pain, US to evaluate for ovarian torsion

Normal ovary

Above and separate from right ovary

Fallopian Tube Torsion
Acute right pelvic pain

Enlarged, avascular right ovary

**Fallopian Tube Torsion**

- Isolated FT torsion extremely rare, usually premenopausal, occasionally post-menopausal
- Predisposing factors
  - Intrinsic to tube: tortuosity, dilatation, tubal ligation, tumor
  - Extrinsic: paratubal mass, adhesions, uterine enlargement
- Presentation: sudden lower quadrant pain, nausea and vomiting, peritoneal signs, discrete adnexal mass
- Complications include tubal and secondary ovarian necrosis, superinfection, peritonitis
- More common on the right

**Vijayaraghavan**. *JUM* 2009;28:657-662

**HyCoSy**

- 3D US inversion rendering to more easily appreciate hydrosalpinx
- HyCoSy: hysterosalpingo-contrast sonography using saline agitated with air as contrast to evaluate tubal patency
- Sonohysterography using US contrast agents and 3D reformatting
- Contraceptive devices

**Newer Techniques:** issues of tubal patency

- Complications include tubal and secondary ovarian necrosis, superfection, peritonitis
- More common on the right
- Imaging findings: normal uterus and ovary with ipsilateral dilated fallopian tube often displaced out of pelvis. Doppler may not be intrinsically helpful, however visualization of twisted vascular pedicle (whirlpool sign) may help in diagnosis
- Ovarian torsion with tubal torsion much more common

**Gross et al.**. *AJR* 2005;185:1590-1592


**Strandell** et al. *US Obset Gynecol* 1999;14:200-204

**HyCoSy**
30 year old G0P0 with infertility, menorrhagia and R hydrosalpinx

Hydrosalpinx develops during SIS

Look-a-Likes (Alternative Diagnoses)

Free Fluid

Pelvic Varices

From B. Benacerraf, MD
Professor of Radiology, Harvard University Brigham and Women’s Hospital

3D inversion reformat of hydrosalpinx
Pelvic varices 2° portal HTN

IMV to systemic pelvic varices

Acute Appendicitis

Right pelvic pain, rule out PID

Dilated fallopian tube?
Appendix with appendicolith?

Acute right hydroureteronephrosis with calculus at UVJ

Abnormal terminal ileum

Crohn’s Disease

Right pelvic pain, US to rule out PID
Normal uterus and ovaries

Normal ROV and tube
Summary

• Become familiar with appearance of normal fallopian tubes so that you can appreciate subtle abnormalities
• Remember signs of tubal origin of an adnexal “mass”
  – Waist, incomplete septum, cogwheel
• Distinguish between acute and chronic disease
• Distinguish tubal disease secondary to PID from other causes, including endometriosis, ectopic pregnancy and malignancy
• Beware of “look-a-likes”

The End
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