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Ectopic Pregnancy:

Radiologic Diagnosis and Intervention

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Objectives

- Ectopic Pregnancy:
 - General Overview
 - Clinical Picture
 - Risk Factors
- Case Presentation
- Ultrasound and Diagnosis
- Medical and Surgical Management



Patient SV

- Patient SV is a 31 year-old woman, G1P0, who presents with right lower abdominal pain and vaginal bleeding.
- Positive home pregnancy test and 5 weeks Estimated Gestational Age (EGA) per last menstrual period.
- Transabdominal and transvaginal ultrasound examinations reveal no gestational sac in the endometrial cavity.



Differential Diagnosis:

Right Lower Quadrant Pain

- Appendicitis
- Ectopic Pregnancy
- Salpingitis
- Nephrolithiasis
- Inflammatory Bowel Disease
- Inguinal hernia



Differential Diagnosis in Women

When patient is a woman presenting with right lower quadrant pain, additional causes should be considered in the differential:

- Ectopic Pregnancy
- Ovarian Torsion
- Salpingitis
- Pelvic Inflammatory Disease
- Spontaneous Abortion
- Ruptured Ovarian Cysts
- Endometriosis
- Leiomyomas



Differential Diagnosis in Women

Classic Triad:
Amenorrhea
Abdominal Pain
Vaginal bleeding

Suspect Ectopic Pregnancy



Ectopic Pregnancy

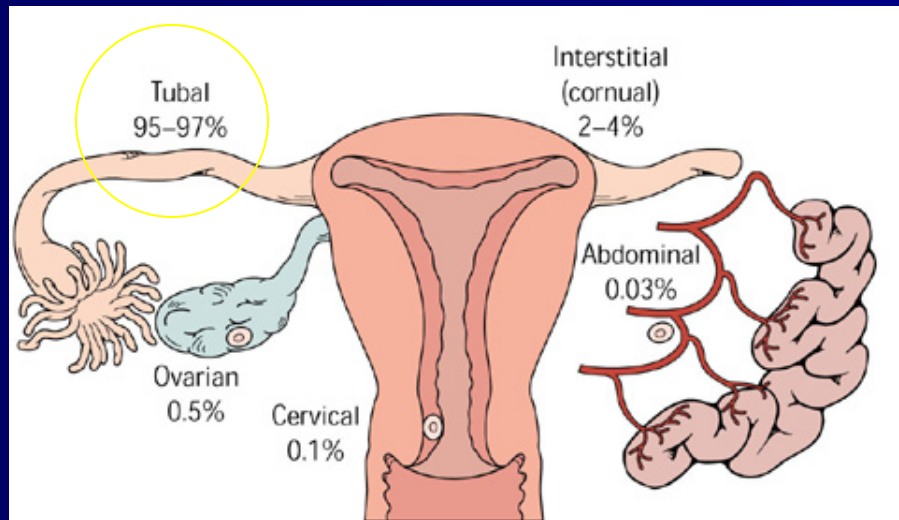
- Implantation of pregnancy outside of the uterine cavity
- 2% of all pregnancies
- #1 cause of maternal death in 1st trimester.



Photograph of ectopic pregnancy in Fallopian tube. White structure inferior to the embryo is the uterus.



Ectopic Sites

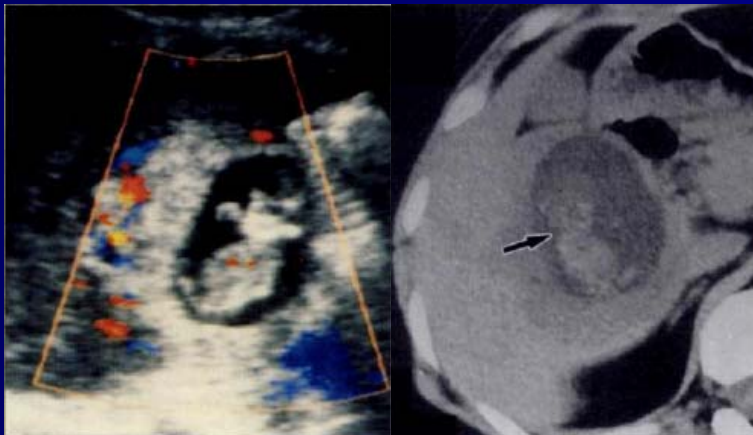


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- Majority of ectopic pregnancies occur in the Fallopian tubes, most commonly the ampulla.
- Isthmic ectopic pregnancies are more likely to rupture.
- Secondary implantation may occur as the result of partial disruption of the initial plantation site in the tube:
 - Tubo-ovarian
 - Tubo-abdominal
 - Broad ligament

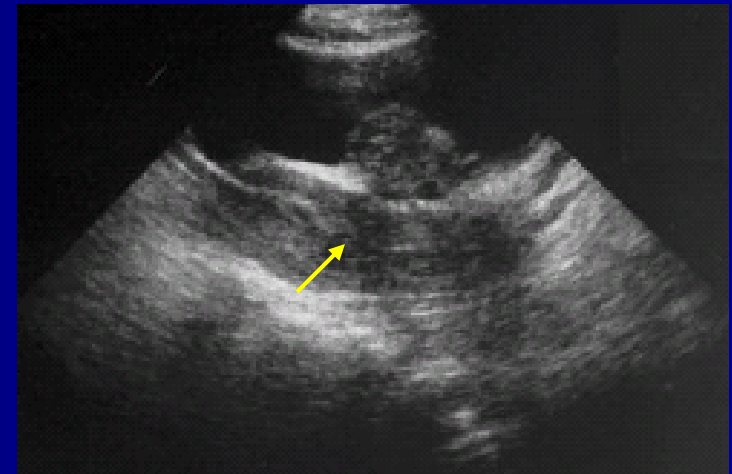


Unusual Sites



Embryo implantation into the liver. Color Doppler shows recruitment of hepatic vessels to support the growing embryo.

Adapted from Delabrousse et al: Intrahepatic pregnancy: sonography and CT findings. *AJR* 173: 1377-78, 1999.



Implantation in the bladder wall following fistula formation of ruptured tubal pregnancy.

Adapted from Truzzi J et al: Rupture of ectopic pregnancy implanted in the bladder. *Journal of International Urology* 13: 1007-08, 2006.



Risk Factors

Any injury that harms the integrity of the Fallopian tube can predispose patient to ectopic pregnancy.

- Previous tubal surgery
 - To restore patency or sterilization
- Pelvic Inflammatory Disease
- Previous ectopic pregnancy
- Adhesions from Previous pelvic surgery
- Intrauterine Device (IUD)
- In utero DES exposure
- In vitro fertilization
- Progestin-only contraceptive pills



Increasing Numbers

- Increase in sexually-transmitted tubal infections.
- Increase in assisted-reproductive practices.
- Earlier detection of ectopic pregnancies that may have otherwise been resorbed without clinical significance.
- Tubal sterilization.
- Contraception with high risk for ectopic.
 - Intrauterine Device



Clinical Presentation

- Vaginal Bleeding or Spotting
- History of Missed Menses
- Abdominal or pelvic pain, unilaterally
- Syncope, Vertigo



Physical Exam

- Abdominal tenderness
 - Abdominal palpation
 - Bimanual exam may also produce cervical motion tenderness
- Tender, adnexal mass
- Bulging posterior fornix
 - secondary to blood in the cul-de-sac

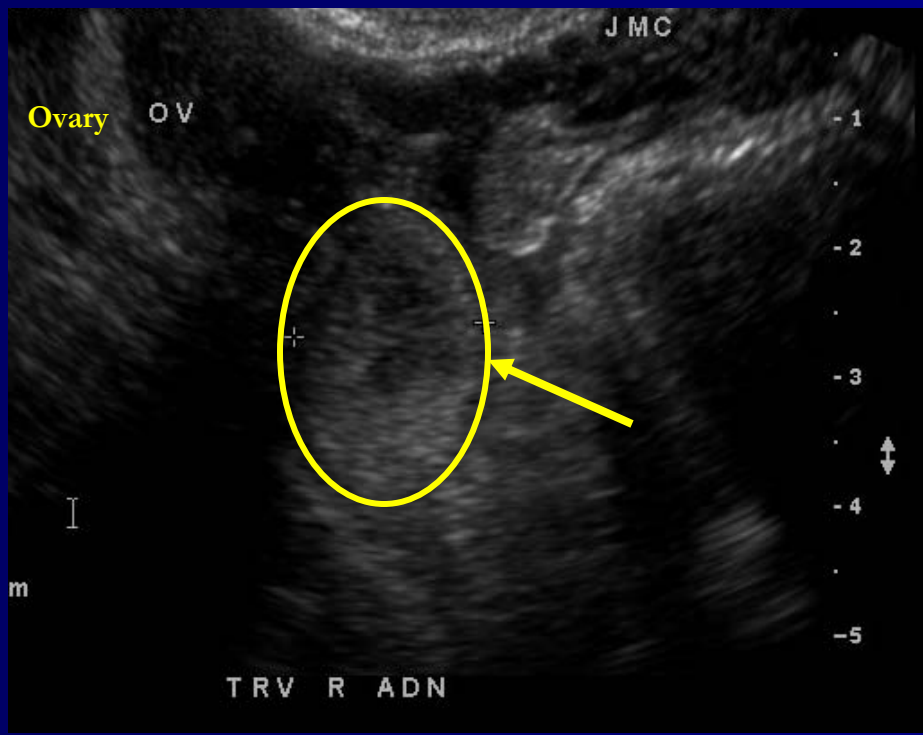


Patient SV's Course

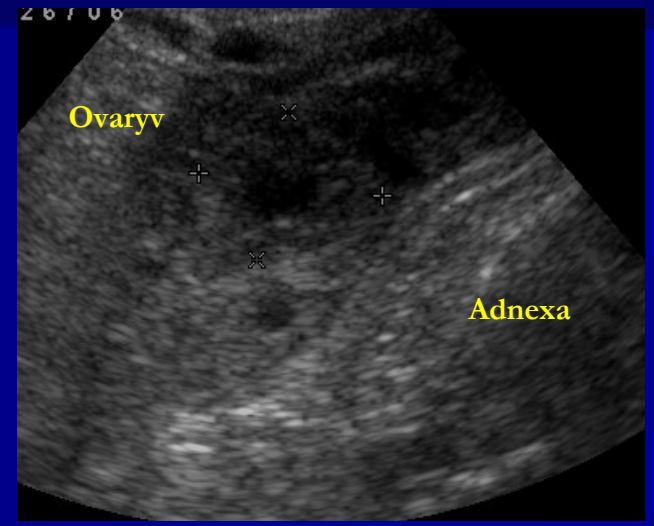
- Because her β -hCG levels were below the discriminatory level, SV was managed conservatively.
- She returned for her two-week follow-up with increased level of β -hCG.
- Repeat ultrasound revealed no intrauterine pregnancy.
- However, echogenic area was found next to the right ovary. No free fluid is present within the cul-de-sac.



Patient SV's Ultrasound Images



Complex mass in Right Adnexa



SV's normal left ovary and adnexa for comparison.



Diagnosis: β -hCG

■ β -hCG levels

- Intrauterine (IU) pregnancy should be observed by β -hCG level of 1500mIu/mL, the discriminatory level.
 - If <1500mIu/mL, patient must return for reevaluation.
 - If >1500mIu/mL and no IU gestational sac present on ultrasound, most likely non-viable IU pregnancy or ectopic.
- β -hCG levels reliably double every 48hrs with normal intrauterine pregnancies.
- If the β -hCG level rises inappropriately, plateaus, or exceeds the discriminatory level without evidence of IU pregnancy by vaginal sonography, a live uterine pregnancy can be excluded.



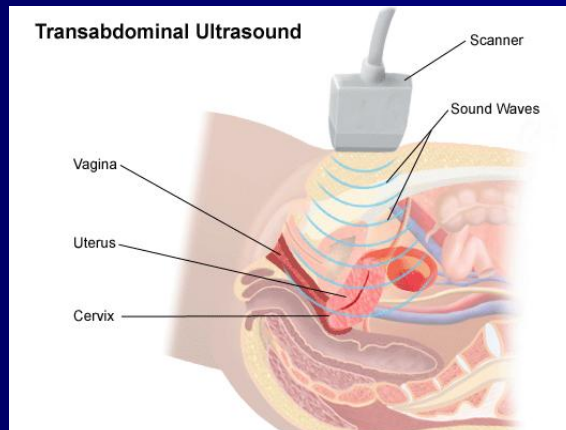
Other Non-Imaging Diagnosis

- Progesterone levels
 - $>25\text{ng/mL}$ excludes ectopic
 - $<5\text{ng/mL}$ suggestive of non-viable intrauterine pregnancy or ectopic
 - However, levels $5\text{-}25\text{ng/mL}$ are not conclusive.
- Endometrial Curettage
 - Endometrial curettage of a pregnant uterus will reveal chorionic villi and products of conception.
 - If no products of conception retrieved, pregnancy is extrauterine.
 - Termination of pregnancy must be desired.



Imaging Diagnosis

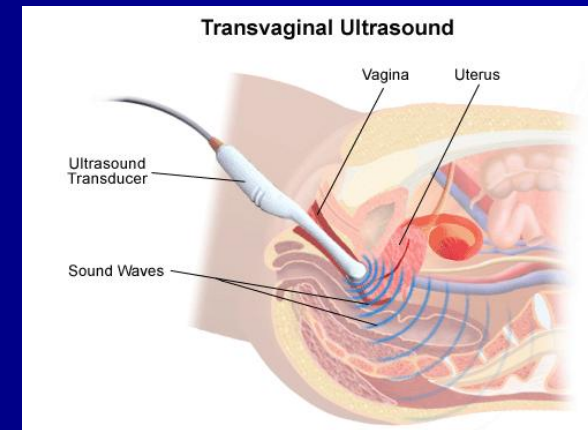
Transabdominal vs. Transvaginal Ultrasound



http://www.ukhealthcare.uky.edu/web/greystone/images/ei_1993.gif

- Allows deeper tissue penetration but less detail
- Requires full bladder
- Imaging of uterine fibroids, cysts, blood clots

**Benefits: No radiation,
inexpensive, bedside exam**



http://www.ukhealthcare.uky.edu/web/greystone/images/ei_1992.gif

- Allows detailed exploration of ovaries, adnexa, and uterus.
- Detection of early pregnancies; ~5wks
- Empty Bladder
- Less bowel gas



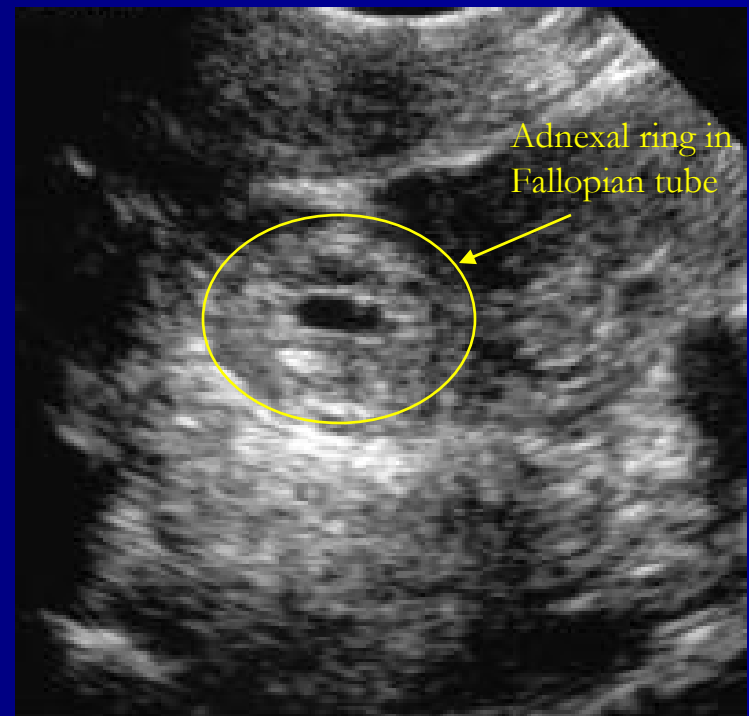
Radiologic Findings

- Absence of IU gestational sac
- Adnexal mass
- Free fluid in pelvis or peritoneum
- Adnexal ring and “ring of fire” on Doppler
- Pseudogestational sac



Adnexal Ring Sign

- Rounded hypoechoic center surrounded by a thick echogenic ring.
- Present in 40-68% of tubal pregnancies.





Ring of Fire

- Represents the vascular flow around the ectopic pregnancy.
- Directly related to the amount of viable trophoblastic tissue.
- Useful in following medically treated ectopic pregnancies.
 - Successful treatment will lower the intensity of the Doppler tracing.



<http://www.gehealthcare.com/inen/rad/us/education/cmcep8.html>

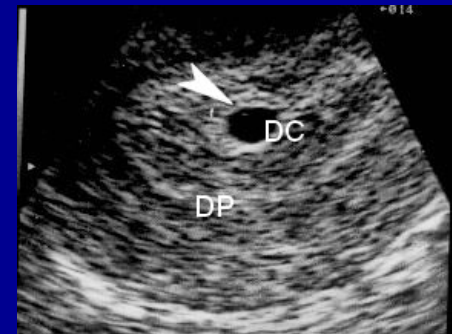


<http://www.emedicine.com/radio/topic231.htm>

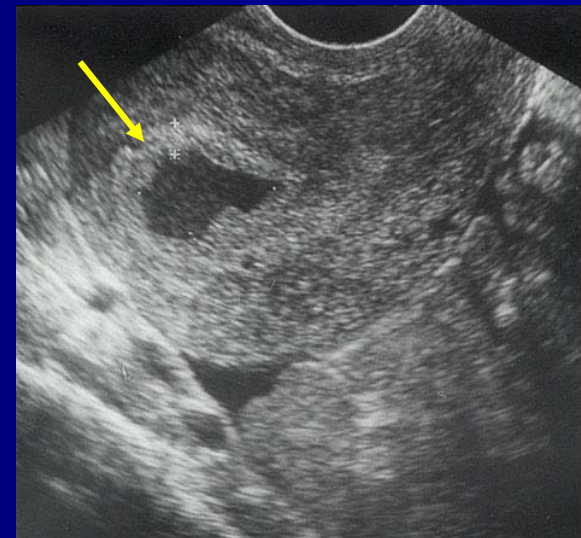


Pseudogestational Sac

- Decidual cast and anechoic fluid collection of blood in the endometrial cavity
- 10-20% of ectopic pregnancies
- Central location, irregular borders, no blood flow, which differentiates it from intrauterine gestation.



Double ring sign
Normal IU Pregnancy





Surgical Diagnosis

- Exploratory Laparoscopy
 - Can convert to surgical treatment
 - Laparotomy should not be delayed in patients who are hemodynamically unstable or there is evidence of abdominal hemorrhage.



Medical Management

- IM Methotrexate
 - Inhibits DNA synthesis of the trophoblast
 - Requires follow-up of β -hCG levels on days 4, 7
 - 67-100% effective
 - Greater success:
 - < 6 weeks
 - the tubal mass is not more than 3.5 cm in diameter
 - non-viable embryo
 - hCG is less than 15,000mIU/mL
- Anti-D Immunoglobulin (RhoGAM)
 - Given to all woman who are Rh- to prevent Rh sensitization



Patient SV Returns

- After 1 course of methotrexate, SV returned 2 days later with severe right lower quadrant pain and was admitted for observation.
- Repeat ultrasound evaluation revealed increase in size of right adnexal mass and free peritoneal fluid.



Signs of Rupture

Sudden Onset Pain + Free Fluid =

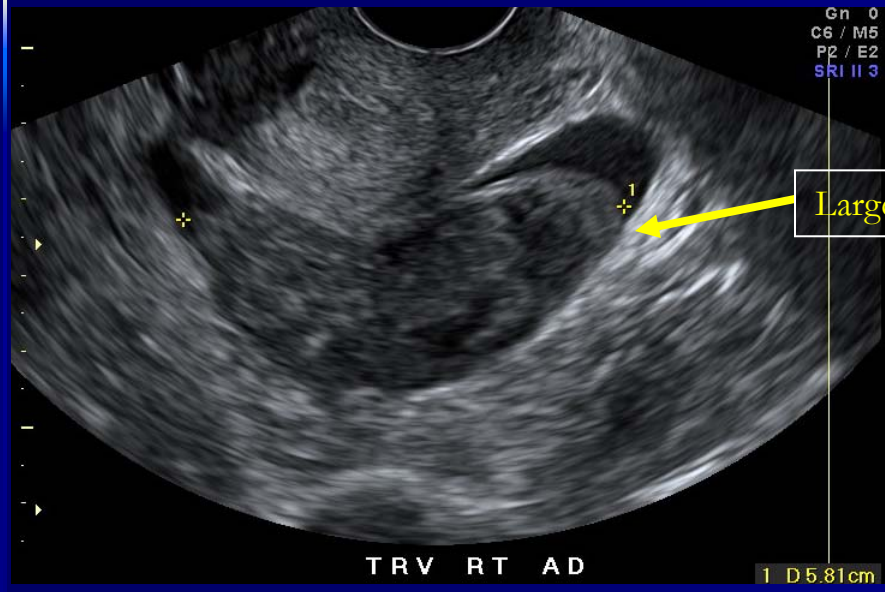
ECTOPIC RUPTURE

until proven otherwise

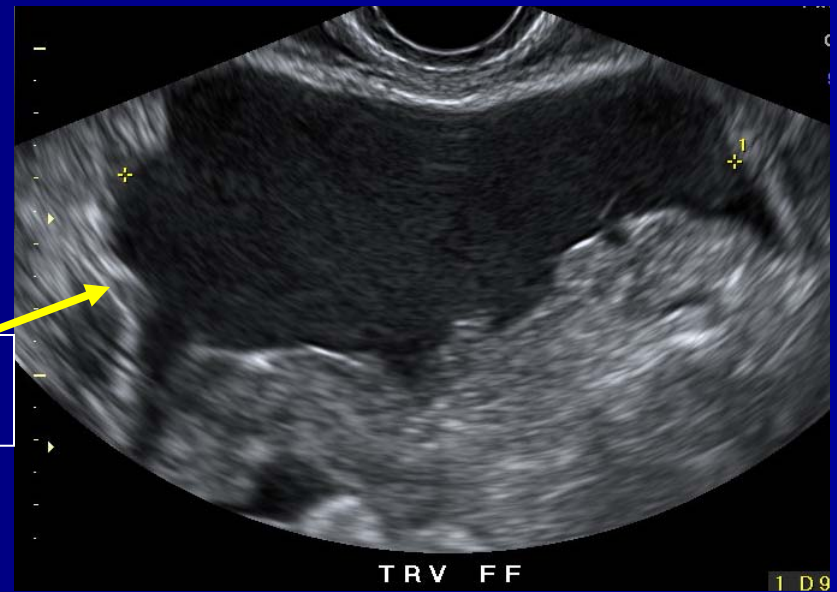
Must be treated as Surgical Emergency!



Patient SV's Follow-up Images



Larger right adnexal mass



New finding of free fluid in the peritoneum.



Ruptured Ectopic Pregnancy

- Signs of Rupture:
 - Increased abdominal pain
 - Hypotension, Shock
 - Shoulder pain
 - Diaphragmatic irritation from intraperitoneal blood causes phrenic nerve irritation which refers to the ipsilateral shoulder.



Why do we care?

- Ruptured ectopic pregnancy can lead to...
 - Secondary implantation into abdominal organs
 - Severe hemorrhage
 - **Death from insanguanation**



Surgical Management

- Surgical Management (Laparoscopic)
 - Salpingostomy
 - Linear incision made in the involved tube without closure
 - Salpingotomy
 - Linear incision made in the involved tube with suture closure
 - Salpingectomy
 - Full tubal resection

**Surgery is always indicated when rupture is suspected.
Laparotomy should NOT be delayed in hemodynamically unstable patients.**



Companion Patient



Intraoperative photograph of a 14-week tubal ectopic pregnancy



Future of Treatment

Ultrasound-Guided Local Injection

■ Method

- Injection of potassium chloride or methotrexate directly into the ectopic pregnancy

■ Benefits

- Lowers systematic chemotherapeutic exposure
- Difficult sites can be treated with risk of surgery

■ Limitations

- Successful with earlier pregnancies, low hCG levels
- No way to predict complications
- Requires experience in invasive ultrasound technique



Summary

- Ectopic pregnancy is most common cause of maternal mortality in 1st trimester.
- Women of childbearing age with vaginal bleeding and abdominal pain... β -hCG.
- Transvaginal ultrasound is gold standard for evaluating ectopic pregnancy.
- Rupture may cause death and should receive immediate surgical attention.



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References (Cont'd)

Web Images:

- Slide 7: http://jaapa.com/issues/j20050301/screen/belly0305_img_6.jpg
- Slide 8: http://www.images.md.ezp1.harvard.edu/users/image_show.asp
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<http://www.gehealthcare.com/inen/rad/us/education/cmeep8.html>
<http://www.emedicine.com/radio/topic231.htm>
- Slide 22: <http://www.gehealthcare.com/inen/rad/us/education/cmeep2.html>
<http://www.obgyn.ufl.edu/ultrasound/4Gyn/1First%20TM/2Gest%20sac.html>
- Slide 31:
http://www.images.md.ezp1.harvard.edu/users/image_show.asp?imgid=AGY0201-07-033A



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