Introduction

- Vaginal bleeding and pain are common symptoms early in pregnancy. They can occur in as many as 25-30% of normal, viable pregnancies.
- However, these symptoms are also common in early pregnancy failure and ectopic pregnancies.
- A significant number of patients with pain and spotting are facing the dilemma: is this a normal pregnancy.

Ectopic Pregnancy

- In the USA
  - Ectopic pregnancies account for 2% of all pregnancies
  - In 2011-2013 ruptured Eps were the reason for 2.7% of all pregnancy-related deaths and was the leading cause of hemorrhage-related mortality.
  - Prevalence of EP among ED visits with first trimester bleeding or abdominal pain or both has been reported as high as 18%.

Ectopic Pregnancy

- The fallopian tube is the most common site accounting for > 90%
- Heterotopic pregnancies are rare
  - After natural conception - Rate 1:4,000 to 1:30,000
  - After IVF as high as 1:100
- Risk factors for EP include
  - Damaged fallopian tubes
  - Prior ectopic EP
  - Risk after 1 EP is 10%; after ≥2 is 25%
- Approximate 50% have none
The “old” ‘Classical Triad’ of Ectopic Pregnancy

- Pain
- Vaginal bleeding
- Amenorrhea

± Syncope, shoulder pain and shock
Surgical evaluation

Currently, history and physical exam alone rarely leads to diagnosis; since most EP are diagnosed earlier in their course
- 1/3 women with EP have no clinical signs
- 10% have no symptoms

Ultrasound Diagnosis of Ectopic Pregnancy

- Studies from the 1980’s showed
  - Sensitivity: TAS of 77-80% and for TVS of 88-90%
  - Recent studies have shown higher detection rates for TVS as expertise and equipment has improved.
  - Not all EP will be diagnosed using TVS, and not in one visit.
  - A prospective study of 120 tubal EP found 73.9% were detected by TVS on the 1st scan; the rest were classified as PUL. Most EPs were visualized on subsequent scans making the overall sensitivity of TVS 98.3%

Ectopic Pregnancy

- The hCG value above which a normal IUP should be visible by US or “Discriminatory level” is ≥3500 mIU/ml*
- Progesterone
  - <5ng/ml = abnormal pregnancy
  - 5-20ng/ml = equivocal
  - >20 ng/ml = normal pregnancy
- By US the presence of GS in the uterus essentially r/o an EP
  - Heterotopic pregnancies are rare

Sonographic Finding in Ectopic Pregnancy

- There is no specific endometrial appearance or thickness that reliably denotes an EP.
  - ~20% have intracavitary fluid collection
  - Hypoechoic area in the endometrial cavity more likely to be an early IUP*

Sonographic Finding in Tubal Ectopic Pregnancy

- Eps are most commonly found in the adnexa within an imaginary triangle formed between the uterus, lateral pelvic wall and the ovary; Easily seen by TVS

Sonographic Finding in Tubal Ectopic Pregnancy

- However, a TA scan may be needed to find the EP in patients with fibroids or other conditions that may elevate the f.tubes
Sonographic Finding in Tubal Ectopic Pregnancy

- Mass in the adnexa aka ‘Bagel’ or ‘Blob’ sign
- Seen in ~80% of EP
- The presence of a mass that is separate from the ovary should raise the suspicion of an EP with a reported PPV of 80%*.

*Barnhart KT et al. Obstet Gynecol 2011;117:590

Bagel or Blob sign

Positive sliding organ sign. EP and ovary move separately

Sonographic Finding in Tubal Ectopic Pregnancy

‘Blob Sign’

- Is defined as an inhomogeneous mass in the adnexa
- In fact is the gestational sac, blood and blood clots within the fallopian tube.

Sonographic Finding in Tubal Ectopic Pregnancy

‘Live’ Tubal Ectopic Pregnancy

- An EP with positive cardiac activity is seen in about 1/3

Definite Tubal Ectopic Pregnancy

- Definite EP with GS, YS and embryo is seen in about 15% cases.

Corpus Luteum an Useful Marker

- 70-80% EPs occur in the same side (ipsilateral) as the corpus luteum

Asymptomatic hCG 24 mIU/ml
Corpus Luteum ‘Ring-of-Fire’ an Useful Marker

- Color Doppler the “Ring-of-Fire” sign can help differentiate between an EP and a CL
- Warning: Both the corpus luteum and the ectopic pregnancy may have peripheral blood flow.
- The difference: the CL with its circular flow is INTRAOVARIAN

Corpus Luteum an Useful Marker

- 20-30% the EP are in the contralateral ovary to the corpus luteum

Hematosalpinx in tubal ectopic Pregnancy

- Cross section of the ovary and EP

Differential Diagnosis of Ectopic Pregnancy

- Corpus luteum
- Ovarian or paratubal/paraovarian cysts
- Bowel

Free Fluid in the Cul-de-Sac

- A small amount of free pelvic fluid in the cul-de-sac (Pouch of Douglas) can commonly be seen in both EP and normal IUP.
  - Echogenic fluid has been reported in 28-56% of women with EP*
  - This does not confirm tubal rupture, as blood may leak from the fimbriated end*

Free Fluid and Rupture Ectopic Pregnancy

- If pelvic fluid reaches the uterine fundus or is present in the utero-vesical pouch the amount is significant.
- If fluid is seen in the Morrison’s pouch, there is serious intraperitoneal bleeding.
- Focused Assessment by Sonography for Trauma (FAST) scan**

*Henschen et al., 1990; Nyberg et al., 1991
**Scalea et al., 1999
Treatment of Tubal Ectopic

Medical & Surgical

• Medical management may be offered to hemodynamically stable patients, who have an unruptured mass, and who do not have absolute contraindications to MTX administration.
  • Failure rate of 14.3% if hCG > 5000 compared to 3.7% when hCG < 5000
  • Other predictors of failure: advanced GA, elevated hCG and rapidly increasing hCG

• Medical management may be offered to hemodynamically stable patients, who have an unruptured mass, and who do not have absolute contraindications to MTX administration.
  • Failure rate of 14.3% if hCG > 5000 compared to 3.7% when hCG < 5000
  • Other predictors of failure: advanced GA, elevated hCG and rapidly increasing hCG

Methotrexate Treatment Protocols

• Single, two-dose or fixed multiple dose

Trials have shown similar rates of successful resolution for the single and two-dose protocols and comparable risk of adverse effects.

ACOG Practice Bulletin #193 2018

Methotrexate Treatment Protocols

• Single, two-dose or fixed multiple dose

Trials have shown similar rates of successful resolution for the single and two-dose protocols and comparable risk of adverse effects.

ACOG Practice Bulletin #193 2018

Treatment of Tubal Ectopic

Surgical management is required for unstable patients with ruptured ectopic or hemoperitoneum

• Laparoscopic resection tubal EP

Hematosalpinx

Right Fallopian tube dilated with blood and clots due to EP

ACOG Practice Bulletin #193 2018

Cornual Pregnancies

The term “cornual pregnancy” is imprecise because it has been applied to 5 different types of pregnancies. Two of these are ectopic pregnancies, which by definition are pregnancies implanted outside the endometrial cavity, and 3 of these are intrauterine pregnancies......

...is a descriptive term depicting a bump or mass effect on the external surface of the uterus in the cornual region... An eccentrically placed gestational sac causing this mass-effect has been termed a “cornual pregnancy.”

The Term “Cornual Pregnancy” Should Be Abandoned Baltarowich OH J Ultrasound Med 2017; 36:1081–1087

ACOG Practice Bulletin #193 2018

Cornual Pregnancies

Interstitial Pregnancy

ACOG Practice Bulletin #193 2018
All have been called Cornual Pregnancies

**Interstitial Pregnancy**
- Interstitial pregnancies account for approximately 2-3% of all ectopic pregnancies
- Implantation is *not within* the endometrial cavity; but in the fallopian tube in the interstitial segment
- Resulting in a bulge in the external contour of the uterus
- May result in significant morbidity & mortality if it ruptures
- Risk factors: previous EP, previous salpingectomy, uterine anomalies, ovulation induction ± IVF, and PID.

**Chorionic Sac Separate from Endometrial Cavity**
- Empty uterine cavity
- Chorionic sac >1 cm from lateral edge of the uterine cavity (endometrium)
- Thin (< 5mm) myometrial layer surrounding the chorionic sac
  - Combined Sens 40%; Spec 90%

**Interstitial Line Points to the Pregnancy**
- Interstitial line
  - Echogenic line extending from endometrium to pregnancy
  - Sens 80%; Spec 98%

**‘Bulging Sign’ in Interstitial Pregnancy**
- The developing pregnancy in the interstitial segment results in bulging of the outer contour of the uterine cavity
Interstitial Pregnancy s/p Lt Tubal Resection for EP

Ipsilateral tubal resection represents the highest risk factor for interstitial pregnancy

Summary of the Findings for IP in 3D

Treatment of Interstitial Pregnancy
• Surgical management
  • Most commonly cornual resection using laparotomy or laparoscopy

Treatment of Interstitial Pregnancy
• Conservative (or watchful waiting)
  • Stable patient with low or falling hCG who want to preserve fertility; but carries a risk of rupture
• Non-surgical management
  • Multiple treatments although the optimal remains undetermined.
    • Local injection of KCL or MTX
    • Systemic MTX single or two-dose; Success rates between 66 and 100 %*
    • Other uterine artery embolization, etc...
  • Recent paper reported 70% success rate ; although, 16.5% (5 cases) had uterine rupture**
  • GS diameter > 20mm was seen in all cases of failed non-surgical treatment.

Differential Diagnosis of Interstitial Pregnancy is the Angular Pregnancy
• Angular pregnancies have unknown prevalence
• Located in the endometrial cavity in the superior lateral aspect, just medial to the uterotubal junction.
• Have been classified as ectopic, nearly ectopic, or intrauterine.
• Associated with poor OBS outcome*
• Recent study positive outcome**
  • 80% live-birth; 20% early pregnancy loss

Sonographic Findings in Angular Pregnancy
• Implantation in the lateral angle of the uterine cavity.
• Eccentric implantation; best seen in a transverse section of the uterus
• No intervening myometrium between the endometrial cavity and the gestational sac
• Adequate myometrial mantle surrounding the gestational sac.

*Panelli DJ et al. Fertil Res Pract 2015;115
### Sonographic Findings in Angular Pregnancy
- 3D coronal valuable in differentiating angular from interstitial.
- Endometrium surrounds the pregnancy

### 3D Multiplanar Findings in Angular Pregnancy
- Sagittal plane: empty uterus
- Transverse plane: eccentric implantation
- Coronal plane: superior lateral implantation

### Natural Progression of “Angular” Pregnancies
No treatment necessary as the pregnancy will ‘move into the uterus’ with advancing gestation

### Cervical Pregnancies
- Cervical pregnancy accounts for < 1% of all ectopic pregnancies. They implant in the cervical mucosa below the level of the internal os.
- On digital examination, the cervix may be boggy and enlarged.
- Classically presents with spontaneous and painless vaginal bleeding.
- Risk factors: prior IUD usage, D&C as well as infertility treatment

### Sonographic Finding of a Cervical Pregnancy
- On transabdominal sonography the cervix appears large with a ‘ballooned’ cervical canal
- Uterus has an ‘hourglass’ appearance
- Pregnancy centrally located within the cervix with +FHR

### Sonographic Finding of a Cervical Pregnancy
- Uterine cavity is empty; ‘beware’ of co-existent IUP
- Gestational sac centrally located within the endocervical canal below the level of the internal os; with the placenta implanted in the anterior or posterior cervical lip
Sonographic Finding of a Cervical Pregnancy

- Empty uterine cavity
- 6.5 weeks embryonic pole with +FHR

Differential Diagnosis of Cervical Pregnancies

- It may be difficult to differentiate a cervical pregnancy from a spontaneous abortion in progress.
- In an abortion in progress the GS is irregular and no FHR is seen. ‘Sliding sign’ or movement of the sac may be apparent. Color Doppler will NOT show a normal trophoblastic blood flow pattern.

Cervical Pregnancy: Differential Diagnosis is CSP

- No prior history of CD
  - GS centrally located
  - Cervical Pregnancy
  - Cesarean scar Pregnancy
- Prior history of CD
  - GS anteriorly located

Sonographic Finding of a Cervical Pregnancy

- The 3D coronal planes is not very helpful in differentiating it from CSP since their differences are very subtle.
- The differences are: cervical pregnancy is centrally located in the cervix; below the level of the internal os and above the external os.
- Uterine cavity is empty or not may have co-existent IUP.

Treatment of Cervical Pregnancy

- Surgical management
  - The most effective treatment has not been clearly elucidated.
  - Surgical management may affect future fertility
  - D&C, if performed, may result in catastrophic bleeding
    - Therefore should be avoided in these patients
  - Hysterectomy is reserved for unstable patients presenting with severe hemorrhage.

- Conservative (or watchful waiting)
  - Patients wishing to retain fertility; with no fetal cardiac activity and low hCG

- Medical
  - Local injection with MTX or KCL
    - Systemic MTX - single or multi-dose
      - Reported success rates for MTX between 60 and 90%*
      - Lower success rates in pregnancies of advanced GA with CRL > 10 mm and + FHR, and hCG levels > 10,000 mIU/ml *
  - Local pressure by inflatable balloons
    - Single balloon (Foley) or a double balloon (cervical ripening Cook catheter) ± MTX

**Cesarean Scar Pregnancy (CSP)**

- Cesarean scar pregnancy likely accounts for ~1% of all ectopic pregnancies*. However, the exact prevalence has not been clearly elucidated.
- The pregnancy implants in or on the scar from a prior cesarean delivery.
- If a D&C is performed may result in catastrophic bleeding.
- Is a predisposing risk factor for placenta accreta spectrum (PAS).
- Risk factors: prior cesarean section.

*Not truly an ectopic since it can result in a live-birth.

**Sonographic Diagnosis of CSP**

- In inexperienced hands can be challenging.
- Misdiagnosing a low intrauterine pregnancy for a CSP, or a true CSP for a normal IUP can have serious consequences.
- First look at the cervix.
- Secondly, look at the uterine cavity- find the pregnancy.

**Sonographic Finding of a Cesarean Scar Pregnancy**

- GS and embryo in prior CS scar.
- Thin myometrial layer between the bladder and gestational sac.
- Triangular shaped gestational sac filling the 'niche' of the prior CS delivery.
- Gestational sac close to the bladder and anterior uterine wall.

**Sonographic Diagnosis of CSP**

- Scanning tip:
  - Small amount of urine in the bladder allows good imaging of the bladder, myometrial placenta interphase.

**Sonographic Finding of a Cesarean Scar Pregnancy**

- The 3D coronal plane is not very helpful in differentiating it from CxP since their differences are very subtle.
- The differences are: CSP is located lower uterine segment or upper cervix.
- Uterine cavity is empty or may have co-existent IUP.
Sonographic Finding of a Cesarean Scar Pregnancy

- The 3D coronal plane cesarean scar pregnancy vs cervical pregnancy.

- Uterus with IUP
- Empty uterine cavity
- Internal os
- External Os

Treatment of Cesarean Scar Pregnancy

- Major Surgical
  - Laparotomy (hysterectomy or local excision).
  - Excision by laparoscopy, hysteroscopy or by transvaginal approach.
  - US guided dilatation of the cervix followed by sharp or blunt curettage.
  - US guided suction aspiration without dilatation of the cervix.

- Minimally Invasive Treatment
  - Local injection of MTX or KCl with or without local vasopressin.
  - Systemic Medication:
    - Single or multidose IM or IV of methotrexate (MTX)
    - Uterine artery embolization (UAE).
    - Combination of the above treatments.
    - Local pressure by inflatable balloons
      - Single balloon (Foley) or a double balloon (cervical ripening Cook catheter)

Treatment Options for Cesarean Scar Pregnancy

- Local pressure by inflatable balloons
  - Double, cervical ripening balloon catheter

- Advantages:
  - Simultaneously terminates pregnancy and prevents bleeding
  - Simple treatment; Minimize patient discomfort
  - High success rate, low complication rate
  - Rare complication: EMV/AVM usually treated by UAE

Catheter Insertion and Inflation Sequence

- First anchor balloon in the uterus
- Secondly, pressure balloon opposite CSP

Local Pressure by Inflatable Balloons

- Timor-Tritsch et al. AJOG 2016
- Catheter insertion and inflation sequence
- Inserting the catheter
- Inflating upper anchor balloon
- Inflating lower pressure balloon
- Adjusting balloon volumes
- There are 4 video clips!!!!!
Abdominal Pregnancies

- Abdominal pregnancies are rare accounting for approximately 1% of ectopic pregnancies.
- Classified as:
  - Primary, occur when fertilization of the ovum takes place within the abdominal cavity.
  - Secondary, theorized to result from extrusion of a pregnancy from a fallopian tube with 2nd implantation anywhere in the abdomen.
- Associated with significant maternal morbidity and mortality (8X that of tubal).

Sonographic Findings in Abdominal Pregnancies

- Empty uterus
- No evidence of a tubal, cervical or ovarian ectopic pregnancy
- Intraperitoneal gestational sac, with cardiac activity.
- Most common implantation sites are anterior and posterior cul-de-sac and on the serosa of the uterus and adnexa.
- ±Hemoperitoneum

Differential Diagnosis of Abdominal Pregnancies

- Differentiating between an abdominal and tubal EP or a pregnancy in a horn of a septate or bicornuate uterus is difficult.
- In a tubal EP the GS is well defined and typically is located lateral to the uterus.
- In a pregnancy in a septate or bicornuate uterus the GS is surrounded by thick myometrium. 3D coronal reveals pregnancy within the uterus.
- The GS sac is seen intraabdominally
- No surrounding myometrium
- Placenta attached to uterine serosa or other organs.
Ovarian Pregnancies

- Rare; account for approximately 0.5-3% of all ectopic pregnancies
- 75% will terminate in the 1st trimester
- Often misdiagnosed as a hemorrhagic corpus luteum
- Often present as a ruptured EP
- Risk factors: PID, IUD use, endometriosis, and assisted reproductive technologies

Spielberg’s Criteria for Pathologic Dx Ovarian Pregnancy

- Fallopian tube on the affect side is normal
- GS has to be in the ovary
- GS and ovary connects to the ovarian ligament
- Placenta tissue mixed with ovarian cortex

Sonographic Diagnosis of Ovarian Pregnancy

- Empty uterus
- Symptoms similar to tubal EP with rising hCG, pain and bleeding
- Echogenic ring with an internal anechoic area on the ovarian surface
- Ovarian cortex, including corpus luteum or follicles seen around the structure

Differential Diagnosis of Ovarian Pregnancy

- Ovarian ectopic pregnancies must be differentiated from tubal ectopic pregnancy, hemorrhagic corpus luteum, or ovarian cyst
- Tubal ectopic will be seen separately from the ovary: ‘bagel or blob’ sign
- The CL will demonstrate the typical ‘Ring of Fire’ blood flow pattern; irregular margin and internal low-level fluid
- Ovarian cyst typically have a thin wall and clear fluid

Conclusions:

- The majority of ectopic pregnancies are tubal ectopic pregnancies.
- The finding of an empty uterus is an important clue to the diagnosis of ectopic pregnancies.
- 3D coronal plane of the uterus is indispensable in correctly diagnosing an interstitial pregnancy
- Cervical pregnancies occur in a uterus without a prior CD while all CSP have a history of a prior CD
- Abdominal and ovarian pregnancies are rare