Management of Urolithiasis in the pregnant patient

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Management of Urolithiasis in pregnancy

- Demographics
- Risk factors
- Clinical presentation
- Stone complications
- Diagnostic challenges
- Management options
  - Trial of spontaneous passage
  - Temporary drainage
  - Definitive stone management
Demographics

- Renal colic most common cause of hospitalization for non-OB abdominal pain
- Symptomatic stone 1/200-1,500 pregnancies
- 80-90% 2\textsuperscript{nd}-3\textsuperscript{rd} trimesters
- Prevalence no higher than non-pregnant females, diagnosis and management challenging
- 24-30% have a previous history of stone disease

Risk Factors

- GFR and RPF rise due to increased CO and decreased SVR (Gabert & Miller, 1985)

- ↑ GFR ➔ Increased excretion of calcium, oxalate, uric acid, sodium (Lindheimer, 1981)

- Protective: ↑ excretion of stone inhibitors—citrate, magnesium, GAGs, uromodulin, nephrocalcin
Risk Factors

- ↑ urine pH → Ca++ phosphate stones, most common, up to 75% in pregnant women (Meria et al, 2010)

- ↑ 25-dihydroxycholecalciferol produced by placenta → increased GI absorption, bone mobilization of Ca++

- ↓ PTH → decreased Ca++ reabsorption
Risk factors

• Stasis—ureteral compression, progesterone ➔ longer contact time with lithogenic factors

• Hydronephrosis (up to 90% of pregnant women) due to compression of ureter at pelvic brim, smooth muscle relaxation due to progesterone
Clinical presentation

- Vague complaints—abdominal, back pain may confuse clinical scenario

- Anatomic and physiologic changes of pregnancy can cause flank/abd pain, nausea, LUTS

- Flank/abdominal pain most common—85-100%, usually more severe than with pyelonephritis
Clinical presentation

• Gross hematuria 15-30%, microscopic hematuria 95-100%

• LUTS—lower ureteral stone or UTI

• Other modes: UTI, pre-eclampsia, POL

• Diagnosis difficult due to physiologic hydronephrosis and limited imaging options
Complications of renal colic due to ureteral stone

- Preterm labor
- Premature ROM
- Preterm delivery
- Loss of pregnancy
- UTI
- Hypertension
- Preeclampsia

Laboratory evaluation

- Micro or gross hematuria in > 95%, pyuria 42%, positive urine culture 24%
- Pyuria—may indicate infection
- pH > 7, possible infection stone
- pH < 5, possible uric acid stone
- CBC, BMP

Diagnostic challenges

• Avoid CT due to effects of ionizing radiation, high during 1\textsuperscript{st} trimester

• Mean fetal dose CT abd/pelvis 8mGy; low dose 4mGy (White et al, 2007)

• American College of Obstetricians & Gynecologists recommend doses < 50mGy safe with no increased risk of pregnancy loss or fetal anomalies (ACOG, 1995)
Radiologic diagnosis

- Deterministic—effects more severe with ↑dose
  - Pre-implantation to week 3: embryo most sensitive, most likely to result in fetal death
  - Week 3 to 10: organogenesis, growth malformation
  - Week 8 to 15: fetal mental retardation

Brent RL. The effect of embryonic and fetal exposure to x-ray, microwaves, and ultrasound: Counseling the pregnant and nonpregnant patient about these risks. Semin Oncol 1989; 16: 347-368.
Radiologic diagnosis

- Stochastic—probability, not severity with \(dose\)
  - Heritable genetic effects from radiation difficult to quantify-high rate of spontaneous mutations

- In utero radiation exposure may result in 1.3-2-fold increased risk of childhood cancers (Brent 1989, Stewart 1973, Lilienfeld 1966, Stewart 1970)

- Other studies show no risk with diagnostic radiation (Court Brown 1960, Kato 1971)
Fetal doses

Fetal radiation exposure

- ACOG recommends: “Women should be counseled that the X-ray exposure from a single diagnostic procedure does not result in harmful effects.”

- Specifically, exposure < 50mGy not associated with increase in fetal anomalies or pregnancy loss

Ultrasound


- Physiological HN up to 90%, dx difficult if stone not visible

- Transvaginal US--distal stone, or establish dilation to pelvic brim only = HN of pregnancy

- Doppler, RI—not affected by physiologic HN (Shokeir et al, 2000)
Stone vs physiologic HN

- 300 pts with renal colic during pregnancy

- **Stone = imaging, intervention, passage**
  - Microhematuria 81.3% vs 61.9% p <0.5
  - Previous hx stones 38.9% vs 16.9% p <0.5
  - Labs, other clinical signs/symptoms unhelpful

- Left renal colic more likely indicates stone, 64.9% vs 46.6%, p = .003

Stone vs physiologic HN
Andreiou & MacMahon, 2009

- Ultrasound (223)—dx stone 72/128, 56.2%
  - RI and ureteric jet assessment--71.9%

- IVP-(29)- dx stone 16/18, 88.9%, p <0.05

- Spontaneous resolution, 63% vs 85%, p <.001

- Intervention more common for stone, 29.2% vs 5.9%, p <0.001
IVU

• Anatomic and functional data, site and degree of obstruction

• Small amount contrast passes placenta, no known teratogenic or mutagenic effects

• Iodinated contrast late pregnancy can suppress fetal thyroid function—screen in 1st week of life (Webb et al, ESUR 2005)
IVU

• Lee & Stothers (1992) stone dx 16/17
  • Limited protocol: scout, 30 minute +/- delayed film @ 2h

• Irving & Burgess (2002) stone dx 14/15, conclude safe and accurate
Isotope renography

- Fetal radiation dose 1/10 IVU (Biyani et al, 1999, Spencer et al, 2000)
  - High maternal fluid intake, frequent voiding
- Demonstrates drainage/obstruction
- Lacks anatomic information
MRI


- Use of electromagnetic radio waves, no harmful effects to patient or fetus have been reported

- Avoid gadolinium, especially in first trimester due to limited experience
MRI

- Can detect non-GU pathology—appendicitis, ovarian torsion
- Does not visualize calculi; stones appear as signal voids overlying high signal of urine

MRI

- Presence of standing column of urine below pelvic brim with proximal ureteral dilation suggestive of obstructing distal calculus “double kink sign”

- Other features suggestive of diagnosis (vs PHN):
  - Infrequent site of obstruction (UPJ or UVJ)
  - Abrupt ending of ureter (rather than smooth taper to pelvic brim)
  - Perinephric or periureteral edema

Fig. 1.
Sagittal oblique SSFSE image shows classic pregnancy hydronephrosis with tapering extrinsic compression and no filling defect in 18-year-old woman hematuria and pain on left side at 22 weeks of pregnancy.
Fig. 3.

Thick slab SSFSE image shows double kink sign with constriction at pelvic brim from gravid uterus and at vesicoureteral junction in 29-year-old woman with left loin pain and gross hematuria at 14 weeks of pregnancy. Stone was shown on high-resolution T2-weighted image and confirmed on oblique coronal image.
MRU

- T2-weighted half-fourier single shot turbo-spin echo (HASTE) MRU; 8/9 distinguished stone vs PHN; 1 limited by pt motion
- Rapid acquisition, no contrast
- Limited by cost, availability, metallic implants, difficult for claustrophobics

Mullins JK, Semins MJ. Half fourier single shot turbo spin echo magnetic resonance urography for the evaluation of suspected renal colic in pregnancy. Urology 2012; 79: 1252-1255
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CT

- Retrospective review 2007, 20 patients underwent LDCT for refractory flank pain

- 19/20 US showed PHP, 1 negative, CT detected 13 stones
  - 4 treated conservatively
  - 2 stent placement
  - 5 URS
  - 2 treated postpartum (SWL)

- Average radiation exposure 705.75mrds (210-1372)
- Judicious use of CT to avoid frequent ER visits, narcotic requirements, unnecessary/misguided treatment

CT

- Brent & Mettler 2004: “for every 10,000 infants born each year, each has a lifelong fatal cancer risk of approximately 18%”; approximately 1 extra case of cancer in this population of 10,000 would appear if all 10,000 received 0.01 Gy (1 rad)

Imaging

- Multi-institutional retrospective study, 51 patients

- Negative ureteroscopy 14%

- Negative URS 23% with US alone, 20% US + MRU, 4.2% US + low dose CT

- PPV for CT, MRU, US 95.8%, 80%, 77%

- Use US first, if equivocal, MRU HASTE or low dose CT prior to surgery

Management

- Multidisciplinary approach
  - Urologist
  - Obstetrician
  - Radiologist
  - If needed, neonatologist
- Expectant management
  - Spontaneous passage rates 70-80%
  - May be overestimated due to error in diagnosis or reluctance to operate
  - Appropriate unless contraindication
Trial of passage

- Pain control
  - Narcotics
  - Avoid NSAIDS due to teratogenic effects
- Hydration
- Antiemetics
- A-blockers
  - Silodosin, Tamsulosin, Uroxatral, CCB-class B
  - Inform of off-label use
- Follow labs, US, close follow up
“Expectant therapy for the expectant mother” ~Horowitz & Schmidt

- No randomized trials
- Majority pass spontaneously, helped in part by dilated upper tract during pregnancy
- Most series report 64-84% spontaneous passage rate with conservative therapy (Lewis 2003, Stothers 1992, Parulkar, 1998)
- Close communication between urologist, OB/gyn
- Hydration, antibiotics if needed, anti-emetics, straining of urine
- Approximately 1/3 will have multiple admissions with this management, though not indication for surgery
Trial of passage

- 1998 Retrospective review, 72 pregnancies, 70 patients
- 40/65 US showed stone, 2 identified by subsequent IVP, 3 ruled out by IVP
- 20 no stones identified
- Conservative treatment, 64.3% stone passage
- Intervention in 19—15 stent, URS 4, no complications
- 2 fetal losses—1 pyelonephritis, 1 premature ROM

Trial of passage

- Stone dx in pregnancy, 1997-2009—accuracy of dx and rate of passage
- Stone-imaging 63/117 events, 22 passage, 1 in OR, 4 on postpartum imaging
- 90/117 (77%) confirmed stones
- 43 (48%) passed spontaneously
- Almost ¼ diagnosed inaccurately; inappropriate dx may mislead spontaneous passage rate

Intervention

- Evidence of infection
- Intractable pain, nausea, vomiting
- Solitary kidney
- Bilateral ureteral obstruction
- Worsening obstruction or decline in renal function
- Obstetric complications—preterm labor, preeclampsia
Treatment options

- Historically temporary drainage (NT or stent) until definitive stone management
- Recent literature URS is safe in pregnancy
Intervention

- Temporary drainage—previous mainstay of treatment
- NT or stent depending on surgeon/patient preference
- Frequent changes due to encrustation
- Discomfort, LUTS
- Prolongs course, definitive management after delivery
Temporary drainage

• Minimal anesthesia

• Ultrasound guidance

• Rapid decompression

• Preferred when treatment contraindicated: Infection, large stone burden, obstetric complications, inadequate resources
Percutaneous NT placement

- Sepsis; avoids excessive ureteral manipulation
- Local anesthesia, US guidance, success >90% (Khoo et al 2004, Stable 1982)
- Min inv, immediate decompression, access for future PCNL, min LUTS, easy exchanges
- Disadvantages: tube discomfort, bleeding, bacterial colonization, tube blockage/dislodgement, external appliance
- Change Q 6-8 weeks
Stent

• Rapid, effective, local anesthetic, US guidance
• May need limited fluoro
• LUTS, decreased QOL—not studied in pregnancy (Mokhmalji et al, 2001)
• Potential for ureteral trauma, hematuria, ascending UTI
• Rapid stent encrustation—hypercalciuria, hyperuricosuria
• Replace Q 6-8 weeks
Intervention

• Shock wave lithotripsy and PCNL contraindicated

• PCNL-long operative times, prone, invasive, associated complications, fluoro use

• URS now possible due to endourologic and obstetric advances
SWL

- Contraindicated due to unknown effects of SW on fetus (Streem 1997)

- SWL-miscarriage, congenital malformation, IUGR, placental displacement (Chaussy 1989, Smith 1992)

- Reports of SWL in unrecognized pregnancy—uncomplicated pregnancy, delivery, healthy baby (Asgari 1999, Deliveliotis 2001)
PCNL

• May proceed to PCNL after delivery
• Not advised during pregnancy
• General anesthesia, prone position, prolonged operative times, fluoro use make this unsafe during pregnancy
• Case reports
  • Shah et al, 2004: 5\textsuperscript{th} week presentation, declined NT changes, underwent PCNL 14\textsuperscript{th} week, healthy term baby
  • Tóth et al 2005: 11 weeks, PCNL under US
  • Kavoussi et al 1992: 29 weeks and 32 weeks, no post-op complications
  • Denstedt et al 1992: 24 wks--premature delivery POD 2
Ureteroscopy

• Now procedure of choice (provided endourologic expertise/equipment)
• Decreased hospital stay compared to stent placement
• Stone free rates 70-100%
• General or spinal anesthesia
• US guidance, limited fluoroscopy
• Holmium: YAG likely safest with penetration <0.5mm

Ureteroscopy in pregnancy

• 2009 Systematic review/Meta-analysis of URS in pregnancy

• 14 reports/108 patients—9 complications
  • 2 Clavien 1: post op pain managed with analgesia
  • 6 Clavien 2: 5 UTI, 1 PUC managed with tocolytic
  • 1 Clavien 3: ureteral perforation managed with stent

• No significant difference in ureteral injury (0.9% v 3.8%) or UTI (4.6% v 3.8%) compared to contemporary meta-analysis (AUA/EAU 2007 Guideline for the Management of Ureteral Calculi)

Ureteroscopy in pregnancy

• 2012 retrospective review, 5 tertiary centers—obstetric complications

• 45 patients—2 obstetric complications (4.3%)
  • 1 preterm labor—conservative management
  • 1 preterm labor—delivery
  • No fetal loss

• URS urologically safe, 4% obstetric complications

Ureteroscopy in pregnancy

- 2014 literature review 1990-2013, 17 reports/378 pts
- GU complications 39 (10%)
  - 14 UTI, 3 fever, 2 sepsis
  - 2 hematuria, 14 dysuria
  - 4 stent pain

- Obstetric complications 5 (1.3%)
  - 2 PUC—managed conservatively
  - 2 preterm labor—NSVD
  - 1 preterm delivery
  - No maternal or fetal deaths

Conclusions

• Pregnancy changes kidney stone risk factors
• Diagnostic and therapeutic algorithms required in this population
• Ultrasound remains first-line imaging modality
• May attempt trial of spontaneous passage
• Intervention for maternal or fetal distress
• Ureteroscopy for stone removal a safe option
• Multi-disciplinary approach should be undertaken
How to Counsel

- Trial of passage
- Stone complications
- Surgical complications
- Radiation exposure
  - Diagnosis
  - During treatment
Thank you!
Anesthetic concerns

- Teratogenic effects and anesthetic risks higher in 1\textsuperscript{st} trimester—generally wait until 2\textsuperscript{nd} trimester
Anesthetic concerns

• Examination of anesthesia and surgery risks must take into consideration background incidence of poor outcomes of pregnancy in young women:
  • Denmark study 1978-1992, rates of miscarriage, ectopic, still birth in women under 20 10.6%, 1.6% and 0.4%
  • 3 studies looking at congenital abnormalities: 3.5%, 2.8%, 3.7%
  • 2 or more anesthetic exposures under 4 years increases risk of diagnosis of learning disability
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