

# Complex fetal genitourinary anomalies-how can MRI help?

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# Goals & Objectives

- To review prenatal imaging approach to assess GU anomalies
- To discuss the differential diagnosis in the setting of megacystis and absent bladders
  - (most frequent scenarios for potential underlying complex GU malformations)

# **PRENATAL IMAGING APPROACH**

# Background

- Fetal urine production starts at 8-10 weeks' gestation
- The fetal bladder will first be seen at around 10-12 weeks (diameter: no more than 6-8 mm)
- Even in the presence of severe GU anomalies, usually amniotic fluid volume is normal in the 1<sup>st</sup> Trimester

# Background

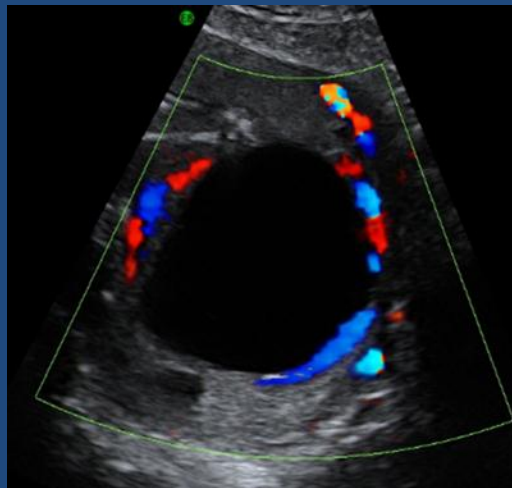
- Congenital GU abnormalities are common (14-40% of prenatal US abnormalities detected): broad spectrum from mild to severe
- Severe GU abnormalities will most likely present amniotic fluid volume changes, megacystis or other major associated malformations including abdominal wall and spinal defects.
  - In other cases, the findings are more subtle (high index of suspicion +improved knowledge of potential associations + Fetal MRI will help)

# US Imaging Targets/check list

- Accurate assessment of amniotic fluid volume

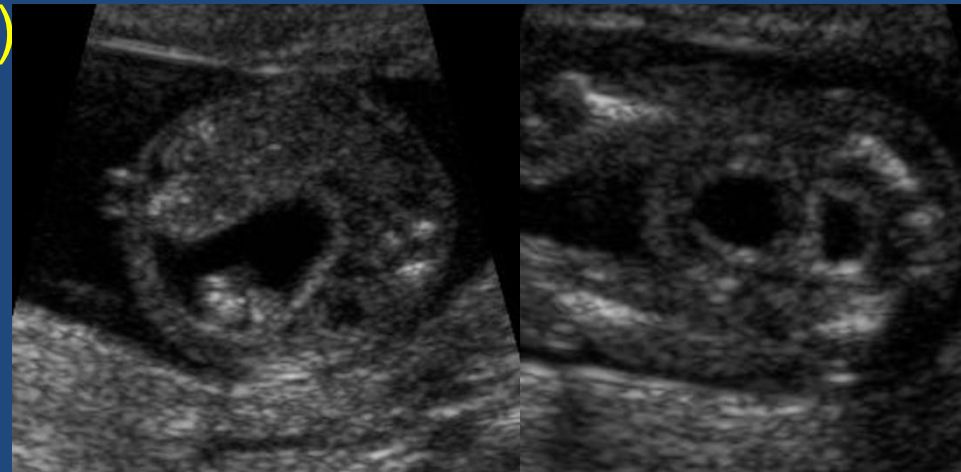
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(anorectal malformation)





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- External genitalia: Gender/ ambiguous/ incompletely formed

# US Limitations

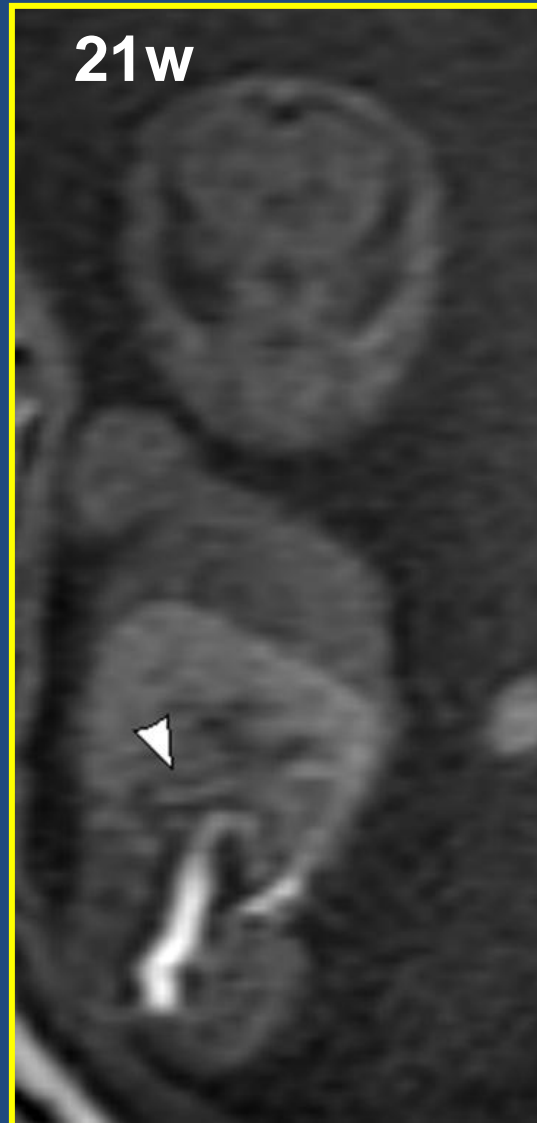
- In the setting of oligohydramnios, US imaging can be challenging
- Cystic renal dysplasia can be difficult to detect in early stages
- Ectopic vs. absent kidney (Color Doppler can help)
- Anorectal malformations

# Fetal MRI Imaging Targets

- Kidneys
- Bladder/posterior urethra (bladder cycles, potential dilatation of Posterior Urethra)/ infraumbilical abdominal wall
- External genitalia
- Spine
- Calculation of lung volumes (3<sup>rd</sup> trimester)
- Bowel: Anorectal region/colon

# Fetal MRI: Assessment of the colon

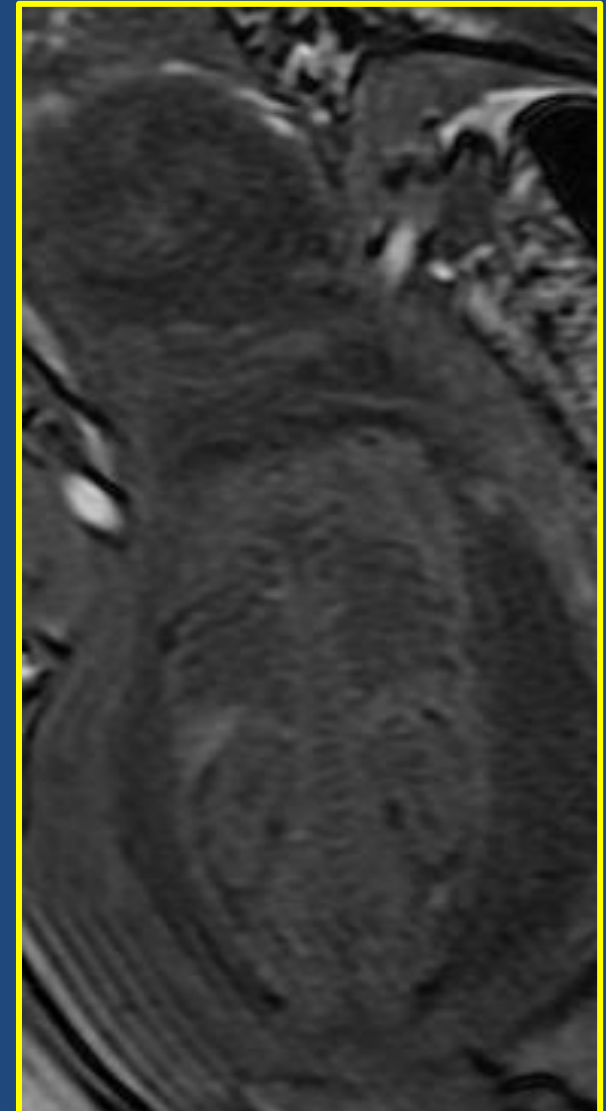
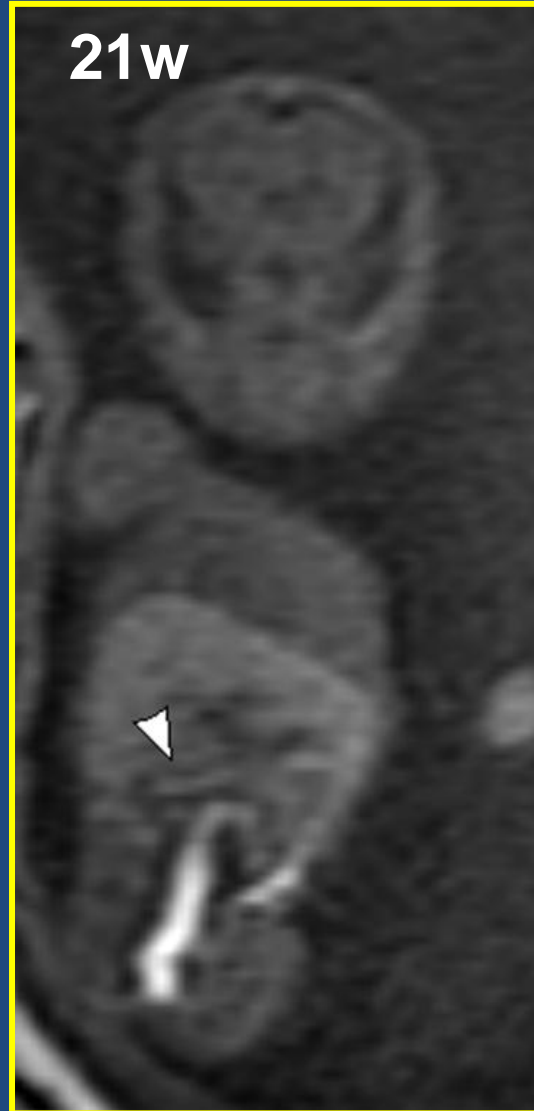
- After 20w we expect to see meconium filled rectum.



# Fetal MRI: Assessment of the colon

28w

21w



- Around the 27w the whole colon is filled with meconium
- Assessment for microcolon (Megacystis microcolon intestinal hypoperistalsis syndrome)

# Fetal MRI: Assessment of the colon

- The rectum is close to the bladder and its cul-de-sac at least 10mm below the bladder base

(Saguintaah M. et al.  
(2002) Ped Radiol)



# Fetal MRI: Assessment of the colon

(Calvo-Garcia M.A.  
et al Ped Radiol  
2011)

- **Long channel cloacas** have:

- Dilated rectum

- High cul-de-sac

(Calvo-Garcia M.A.  
et al Ped Radiol  
2011)



**NORMAL RECTUM**



**CLOACA**



# Fetal MRI: Assessment of the colon

- **Cloaca**
- and **imperforate anus with RU fistula:**
  - Can present rectal dilatation with fluid content and enteroliths



NORMAL RECTUM



CLOACA

# Fetal MRI: Assessment of the colon

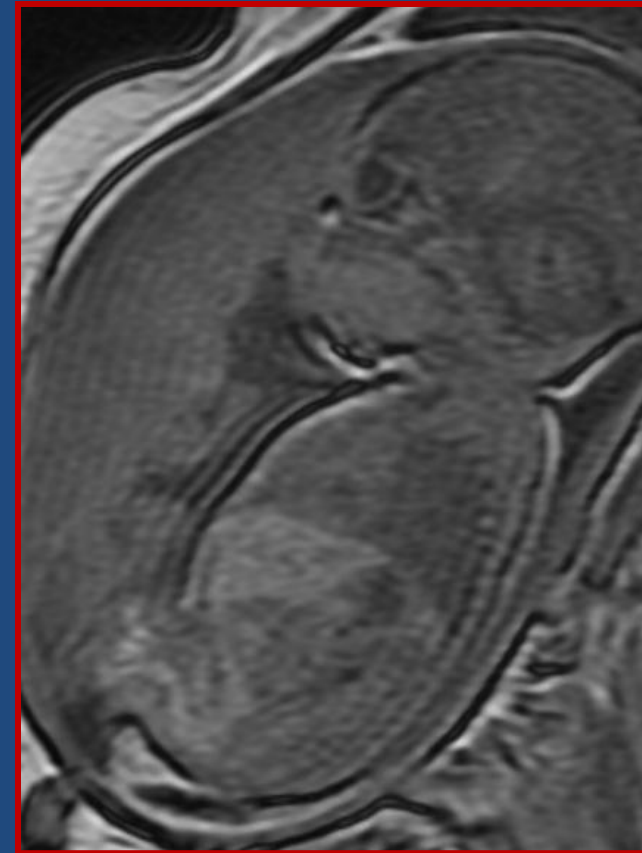
- **Cloacal exstrophy:**

- Absent meconium in the rectum/colon

(Calvo-Garcia M.A. et al, Ped Radiol e-pub 2012, DOI 10.1007/s00247-012-2571-3)



**NORMAL RECTUM**



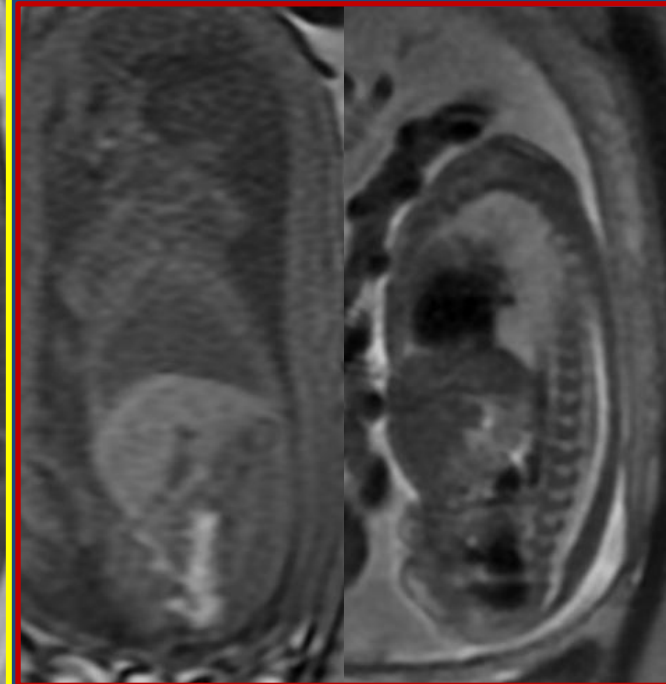
**CLOACAL EXSTROPY**

# Fetal MRI: Assessment of the colon

- **Bladder exstrophy:**
  - Normal meconium in the rectum/colon



**NORMAL RECTUM**



**BLADDER  
EXSTROPHY**

# DIFFERENTIAL DIAGNOSIS

# Etiology of Megacystis

- **Bladder obstruction:** Overtime oligohydramnios
- **Non-obstructive bladders:** not true or persistent mechanical obstruction. Amniotic fluid usually normal, and in some cases, increased.

# Etiology of Megacystis

- **Bladder obstruction:** (overtime oligohydramnios)
  - ***Males:***
    - Posterior urethral valves
    - Urethral atresia (early presentation)
    - Complex anorectal malformations
  - ***Females:***
    - Urethral atresia
    - Cloacal malformations
  - ***No gender specific:***
    - Extrinsic or intrinsic pathology leading to obstruction:  
SCT with BOO/ Everted ureterocele

# Etiology of Megacystis

- **Non-obstructive bladders** (Amniotic Fluid usually normal, sometimes increased)
  - ***Prune Belly Syndrome (PBS)***, more frequent in males
  - ***Megacystis Microcolon Intestinal Hypoperistalsis Syndrome (MMIHS)***, more frequent in females. Common development of poly after 30 weeks (presumably owing to GI malformation associated)
  - ***Megacystis-megaureter association*** (No gender specific-severe vesicoureteral reflux)

# Etiology of Non-visualization of the Fetal Bladder

- **Lack of fetal urine production/obstruction**
  - oligo/anhydramnios (maybe a small bladder present)
- **Inability of the bladder to store urine** (no visible bladder)
  - normal amniotic fluid



# Etiology of Non-visualization of the Fetal Bladder

- **Lack of fetal urine production/obstruction**  
oligo/anhydramnios (maybe a small bladder present)
- Pre-renal failure (IUGR): we should see kidneys
- Renal (bilateral renal agenesis, Bilateral MCDK, Bilateral renal dysplasia)
  - **In that situation you might encounter anorectal malformations as end-stage bladder outlet obstruction!!!!**

# Etiology of Non-visualization of the Fetal Bladder

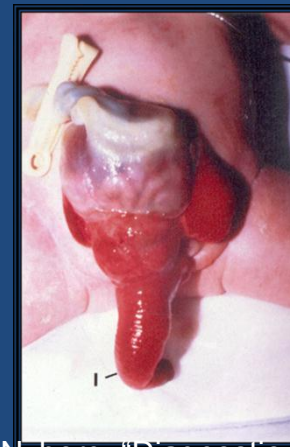
- **Inability of the bladder to store urine** (no visible bladder): normal amniotic fluid
  - **Infraumbilical wall defect**
    - Bladder exstrophy: usually normal rectum and spine
    - Cloacal exstrophy (OEIS): “elephant trunk-like” image sometimes (but not always!)

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Calvo-Garcia MA et al.  
Pediatr Radiol  
DOI 10.1007/s00247-012-2571-3.



Nyberg "Diagnostic Imaging of Fetal Anomalies page 536"

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  - **No wall defect is seen but low-set umbilicus** (+ males with short, broad penis):
    - Epispadias (In both males/females the bladder neck is often inadequate: urinary dribbling)
  - **If no malformations seen:**
    - Bilateral single ectopic ureters

# Key Points

- **Megacystis**

- Enlarged bladder versus other cystic lesions
  - Relationship with umbilical arteries
- Assess bladder and adjacent bowel content
- Always check colon/rectum (fetal MRI)
- AFV: Oligohydramnios/polyhydramnios

- **Absent bladder**

- AFV: normal versus decreased
- Wall defect /low ACl/ prolapsed terminal ileum
- +/- meconium in colon/rectum

# Selected References

- Yiee J, Wilcox D. Abnormalities of the fetal bladder. *Seminars in Fetal et Neonatal Medicine* (2008) 13, 164-170
- Hubert K C, et al. Current diagnosis and management of fetal genitourinary abnormalities. *Urol Clin N Am* 34 (2007) 89-101
- McHugo J, Whittle M. Enlarged fetal bladders: aetiology, management and outcome. *Prenatal Diagnosis* (2001); 21: 958-963
- Wilcox D.T., Chitty S. Non-visualization of the fetal bladder: aetiology and management. *Prenat Diagno* 2001; 21:977-983
- Calvo-Garcia M A et al. Fetal MRI clues to diagnose cloacal malformations. *Ped Radiol* (2011); 41:1117-1128
- Phillips TM. Spectrum of cloacal exstrophy. *Seminars in Pediatric Surgery* (2011) 20,113-118
- Calvo-Garcia M A et al. Fetal MRI of cloacal exstrophy. *Ped Radiol e-pub.*(2012) DOI 10.1007/s00247-012-2571-3

Thank you!