

PEDIATRIC PELVIS NORMAL ANATOMY

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No financial disclosures

Overview

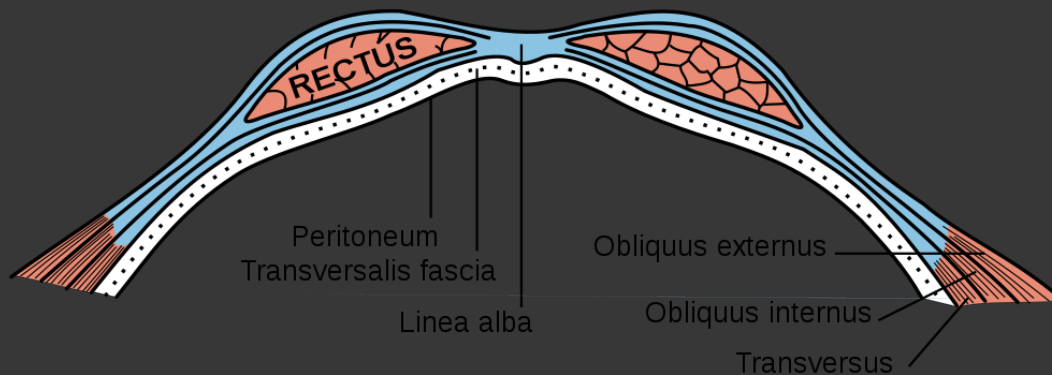
- ⦿ Abdominal wall
- ⦿ Inguinal canal
- ⦿ Bladder
- ⦿ Uterus and ovaries
- ⦿ Seminal vesicles and prostate
- ⦿ Appendix
- ⦿ Bowel
- ⦿ Iliac artery and vein
- ⦿ Free fluid

Obtaining high quality exam

- ⦿ Transducer selection
 - Use highest frequency possible
 - Use linear, curvilinear and sector
 - Transabdominal, endovaginal
 - Doppler
 - Clips
- ⦿ Patient factors
 - Distract
 - Restrain
 - Sedate (very rare)
- ⦿ Appropriate knowledge base

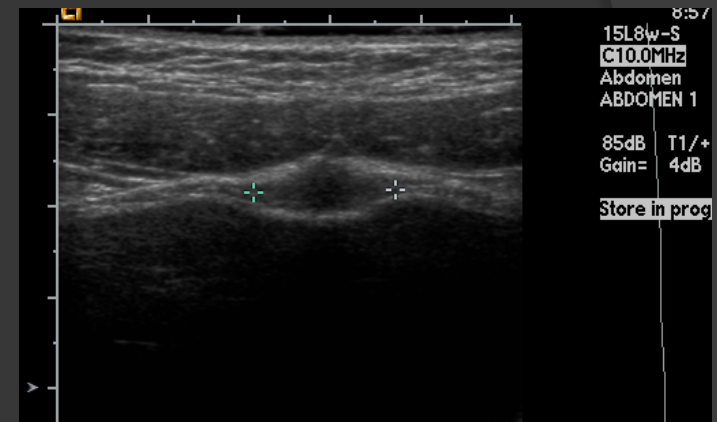
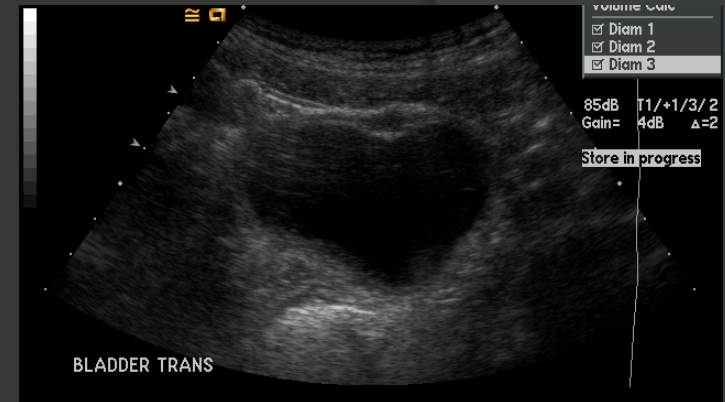
Abdominal wall

- Appearance varies with:
location & level & transducer
- Rectus abdominis
- External oblique
- Internal oblique
- Transversus abdominis

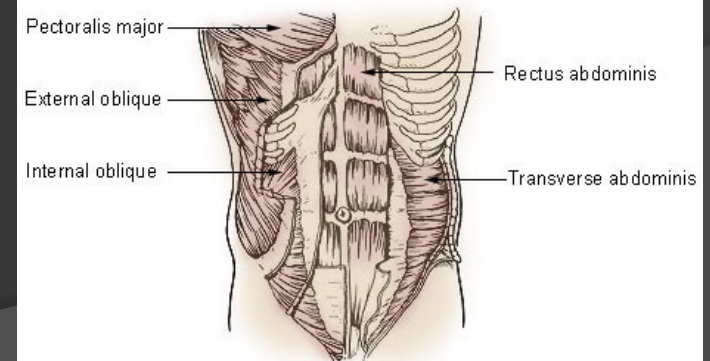


<http://en.wikipedia.org/wiki/File:Gray399.svg>

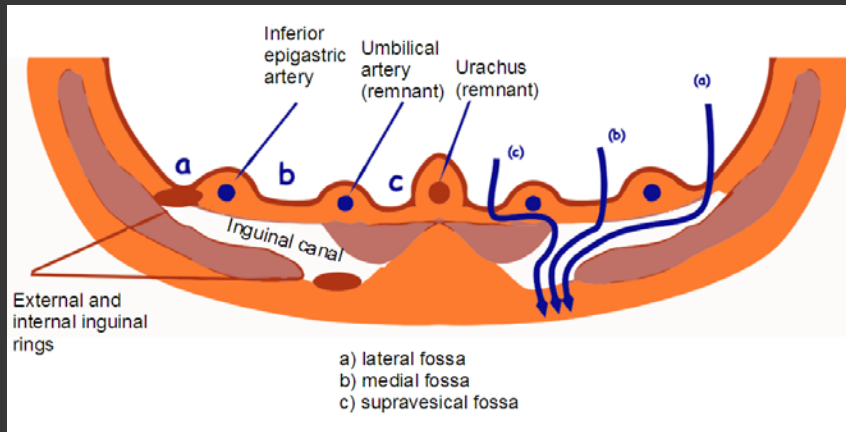
http://upload.wikimedia.org/wikipedia/commons/3/32/Illu_trunk_muscles.jpg



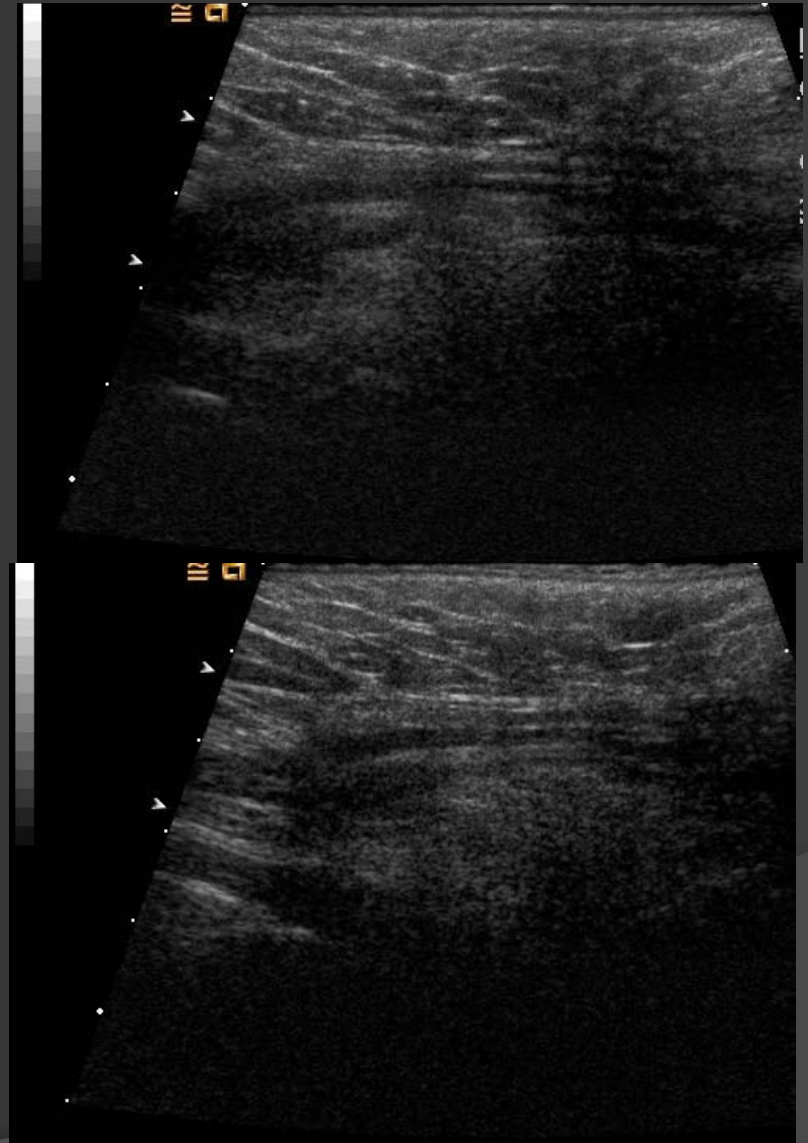
Muscles of the Trunk



Inguinal Canal



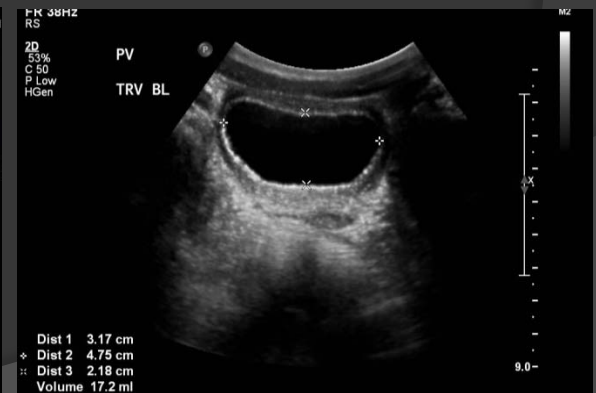
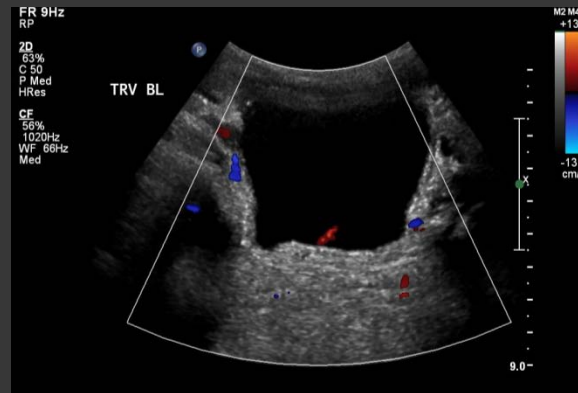
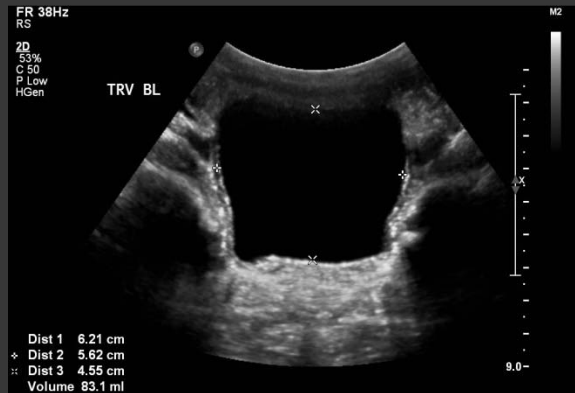
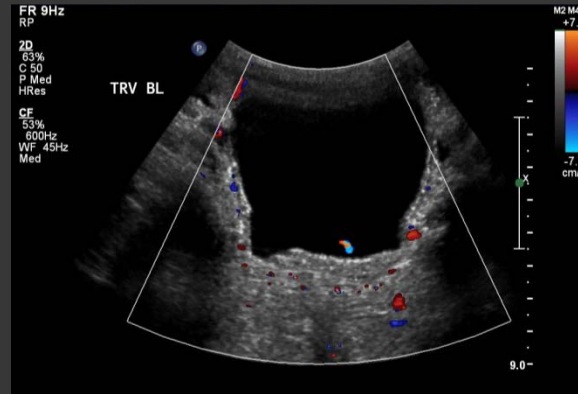
- Boys-spermatic cord
- Girls round ligament
- Indirect hernia
- Hydrocele
- Undescended testes



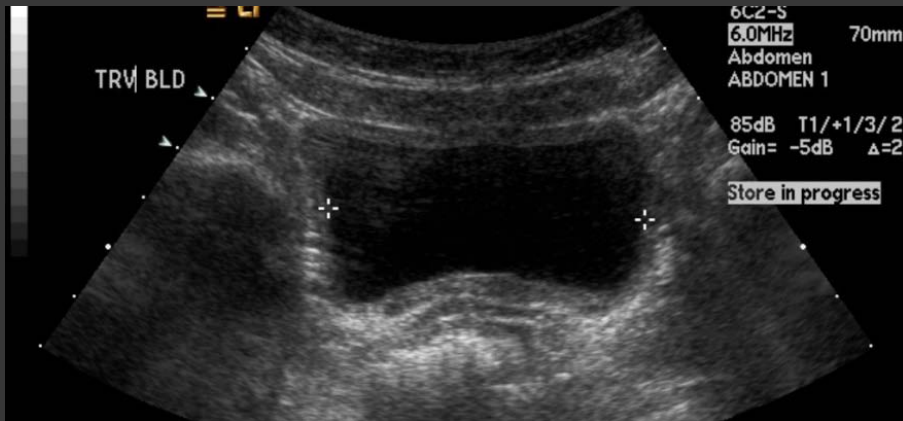
Urinary Bladder

- Newborn bladder capacity of approximately 10 to 30 ml
- Child's bladder capacity predicted as:
 $\text{age in years} + 2 \times 30$
= no. of ml
- Smooth wall
- Wall thickness varies with degree of distention
- Generally less than 3mm

Bladder normal with jets and PV



Urachal remnant

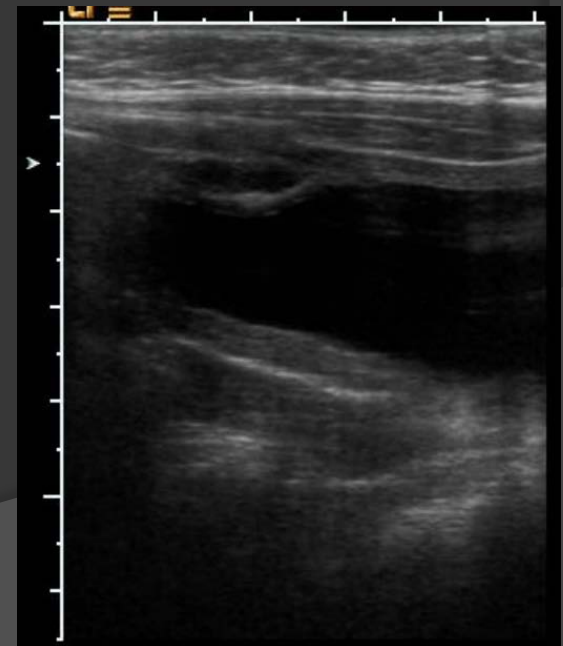
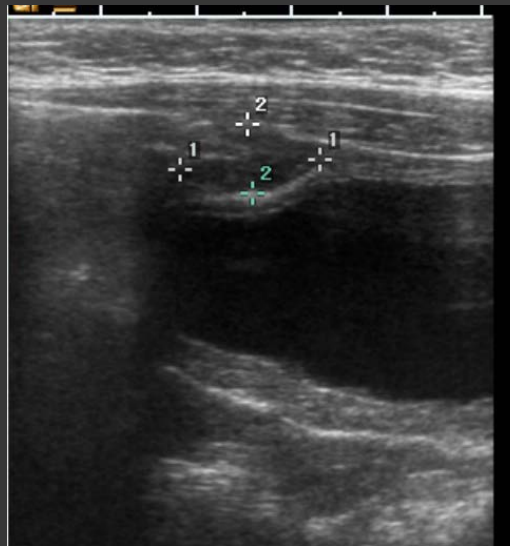
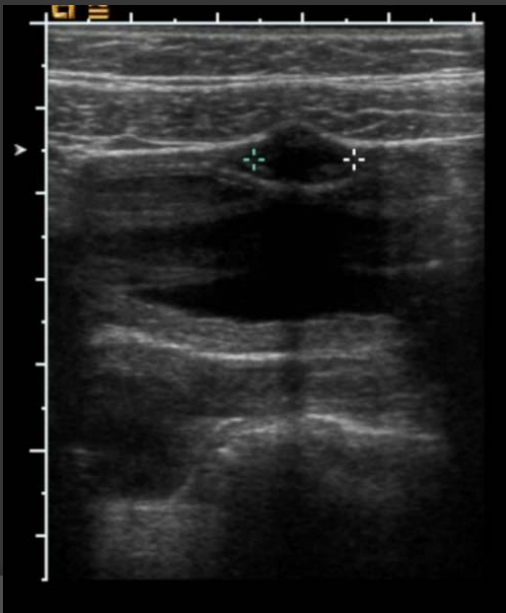


Usually solid

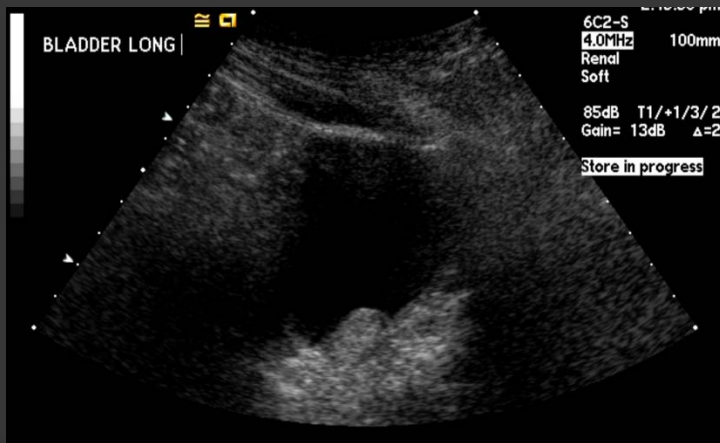
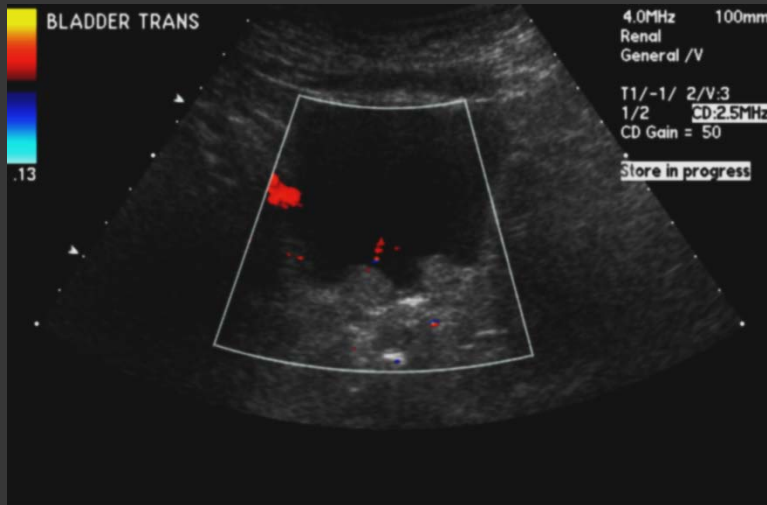
- Seen 99%
- 13 +/- 5 mm
- Ozbek, et. al. Journal of Clinical Ultrasound, 2001. 29(4): p. 218-222.

Can be cystic

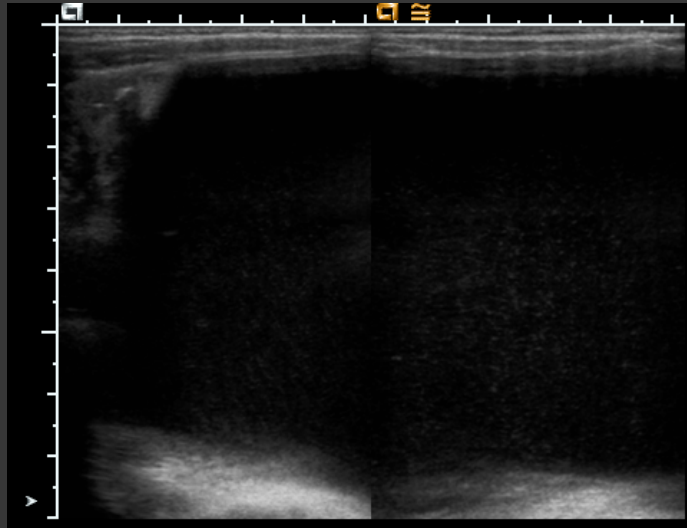
- Metwalli, Z.A., et al., Pediatric Radiology, 2013. 43(8): p. 978-982



Urinary Bladder Deflux



Bladder?

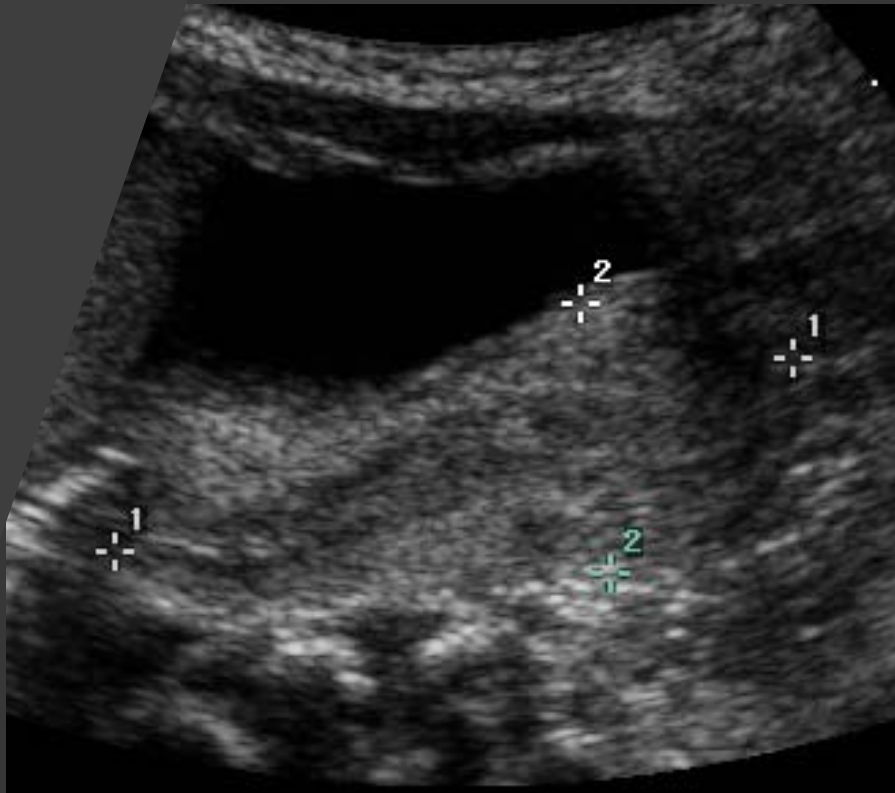




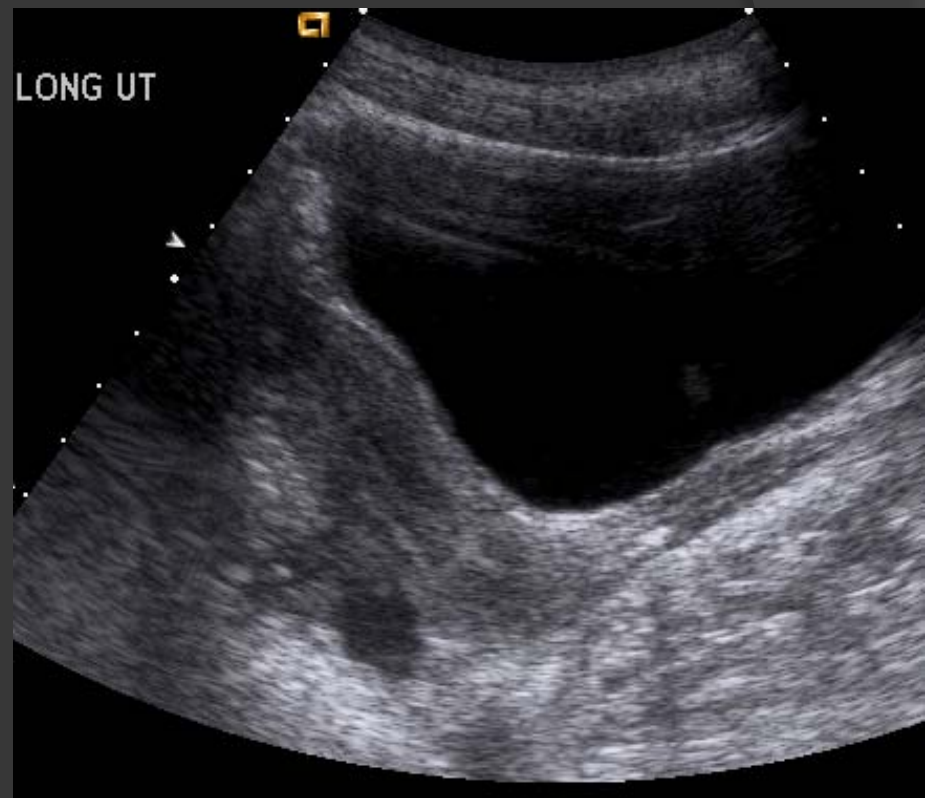
Normal uterine development

- Neonatal uterus: elongated, cervix wider than uterus, endometrial and myometrial layers
- Toddler very small, tubular
- Prepubertal -gradual shift towards puberty
- Pubertal pear shaped, defined endometrial myometrial layers
- Adult/Post pubertal continued growth 6+ years post puberty

Uterine development



Infant

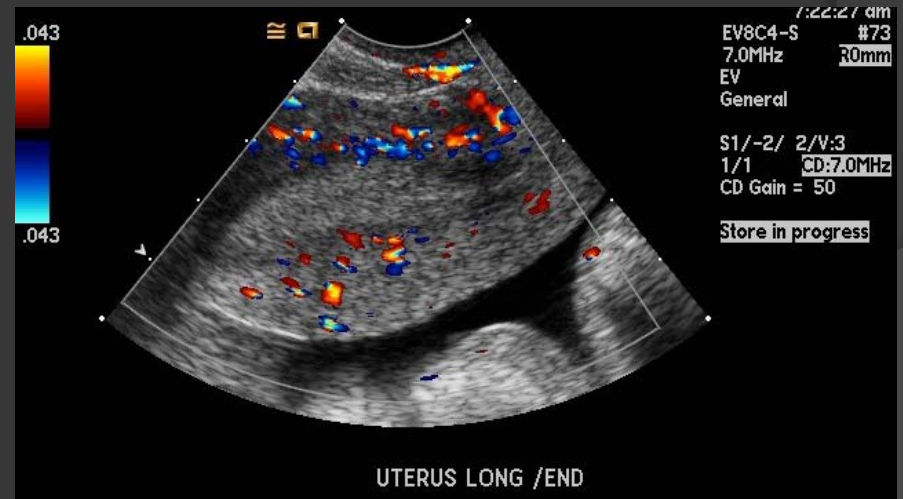
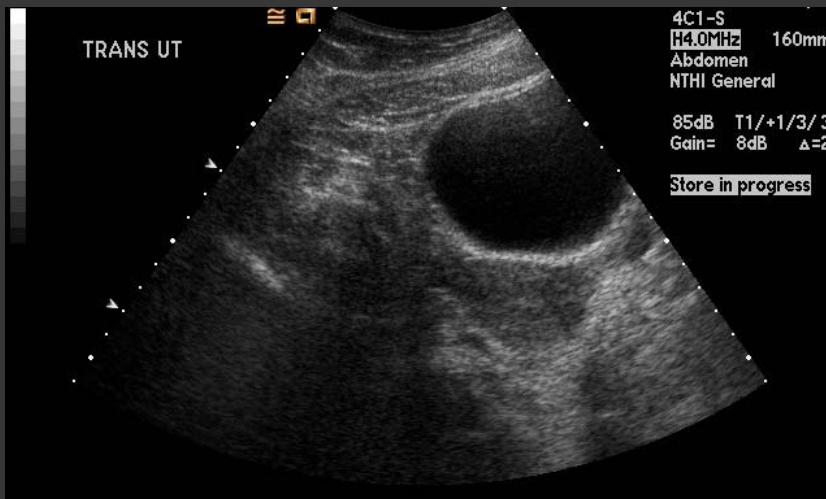
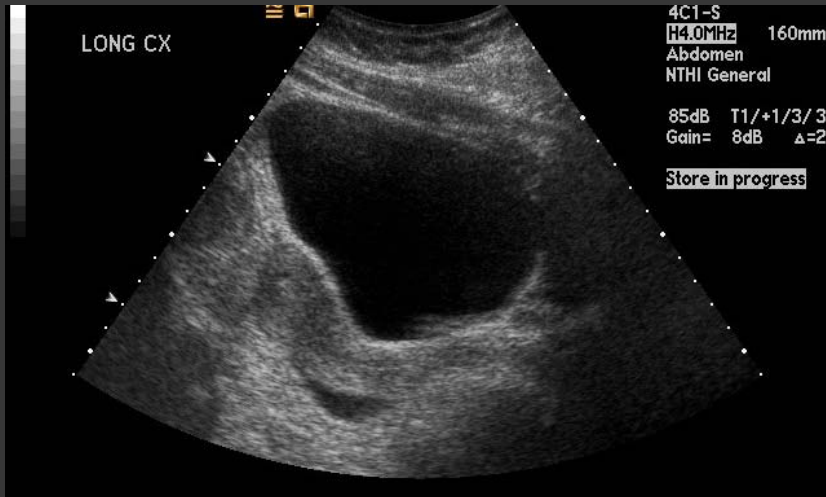


Adolescent

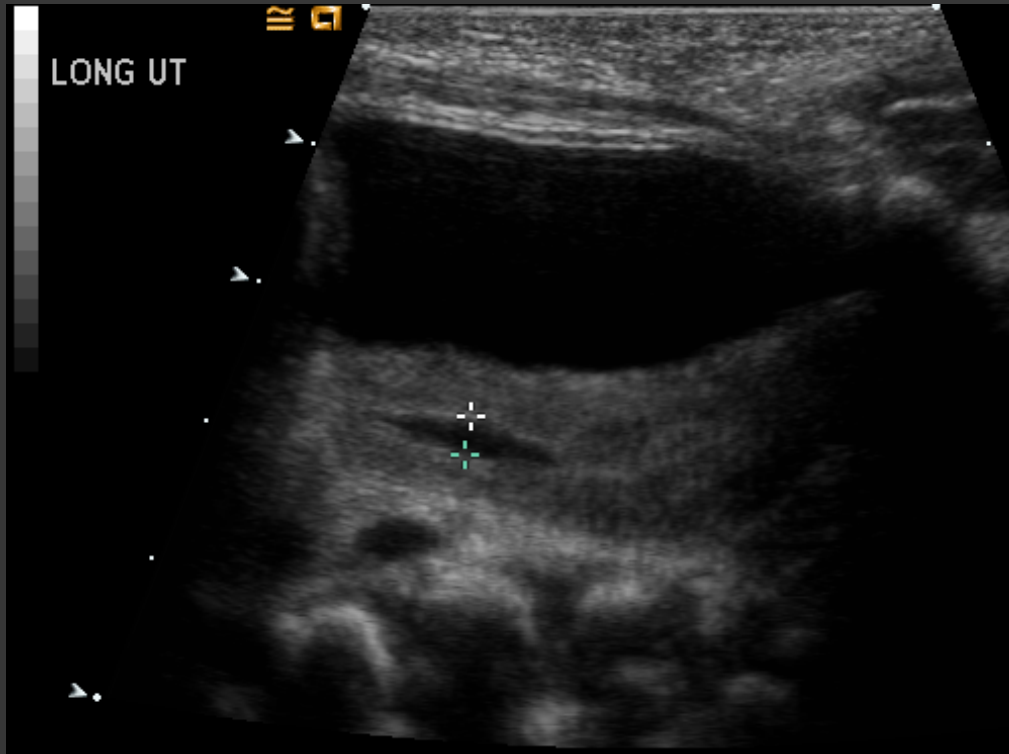
Normal Uterus

- ⦿ Seen >90% in first week of life
 - 3.4 cm long x 1.2 wide
 - cervix 1.4 cm
- ⦿ Regresses 0-7 year old
 - 3 x 0.8 cm uterus, cervix 0.8 cm
- ⦿ Post pubertal
 - 5-8 cm long x 1.6-3 cm AP, 3.5 cm wide

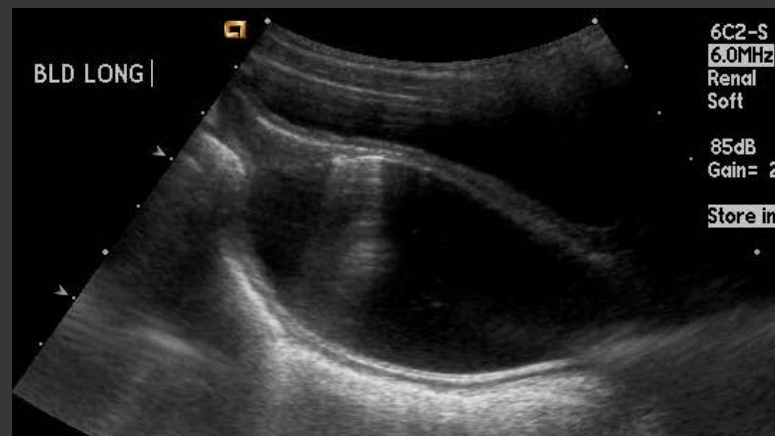
Transabdominal vs endovaginal



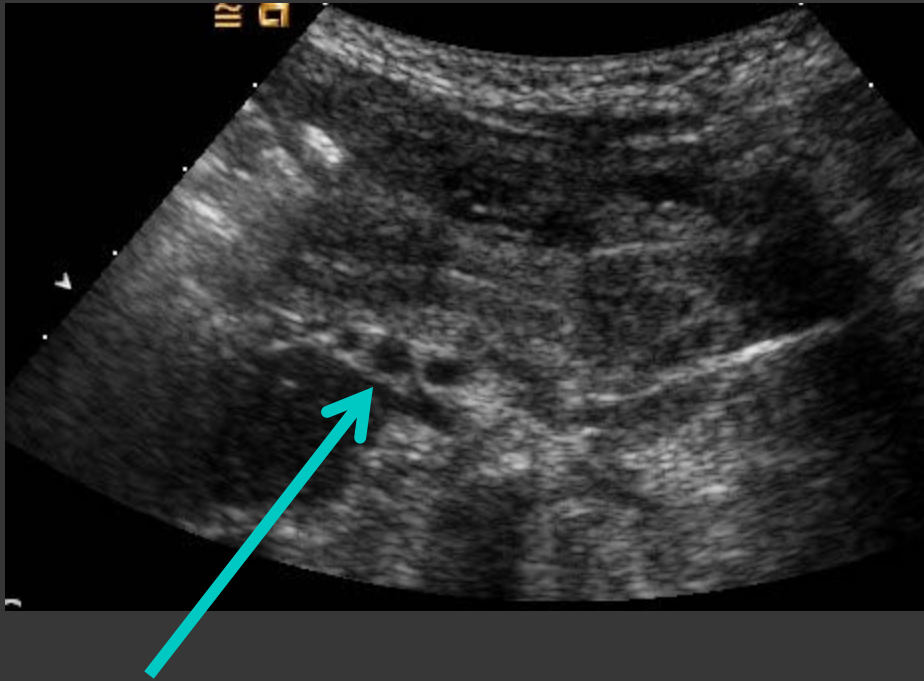
Normal variant: fluid in the endometrial canal



Normal variant transient vaginal fluid

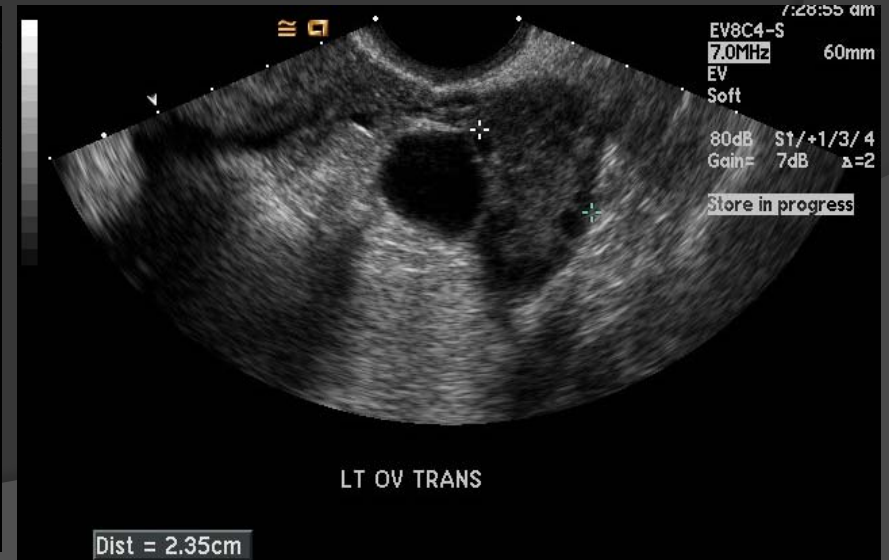
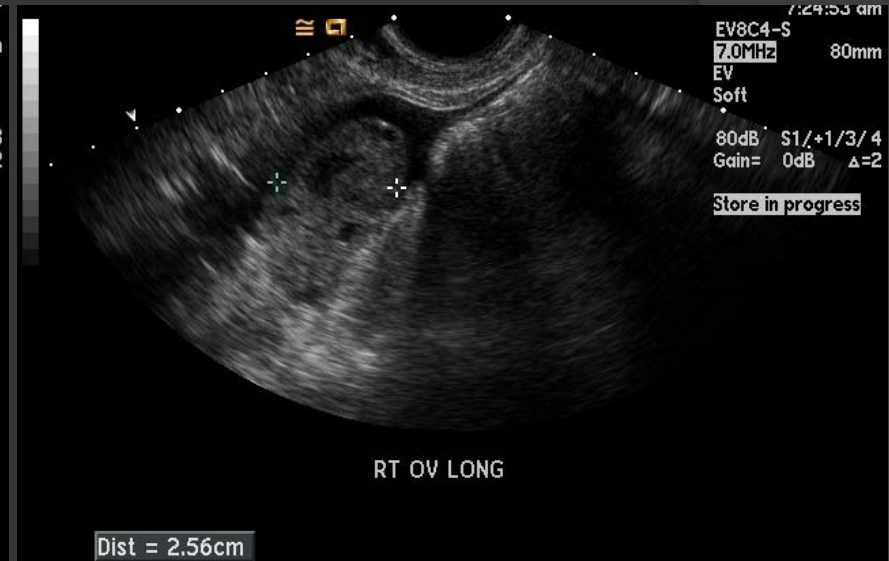
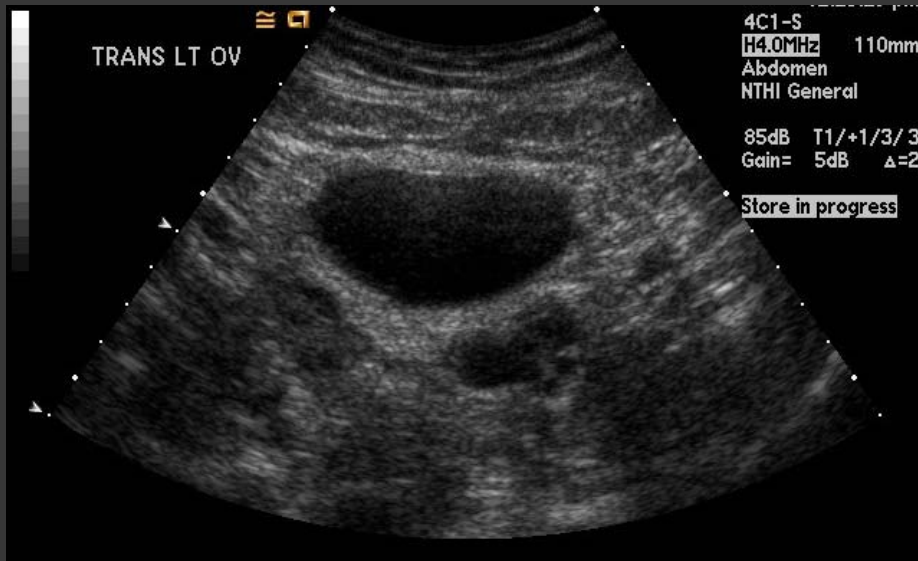


Normal ovaries infant



- Mean volume
 - Infants approximately 1cm^3
 - Toddlers 0.67 cm^3

Post pubertal normal ovaries TA & EV



Uterine and ovarian volume by age

(n = 133)

Age (yr)	No.	Uterine Volume (cm ³)			No.	Ovarian Volume (cm ³)		
		Mean	SD	Median		Mean	SD	Median
1	8	0.91	0.40	0.91	3	0.26	0.12	0.24
2	14	1.30	0.68	1.10	10	0.38	0.11	0.38
3	18	1.26	0.44	1.22	13	0.37	0.11	0.32
4	14	1.48	0.79	1.35	14	0.46	0.14	0.47
5	10	1.81	0.44	1.77	10	0.52	0.22	0.49
6	14	1.84	1.09	2.03	12	0.65	0.23	0.70
7	12	2.27	1.23	2.41	11	0.59	0.25	0.47
8	8	2.07	1.38	1.55	8	0.69	0.30	0.65
9	7	3.43	1.08	2.97	6	0.93	0.23	0.95
10	6	3.50	2.70	2.50	5	1.15	0.18	0.70
11	12	4.63	2.70	3.85	11	1.12	0.43	1.21
12	7	10.92	5.27	9.94	7	1.88	1.56	1.37
13	3	16.15	10.78	14.56	3	2.94	1.30	3.03
Mean		2.87	3.68	1.75	113	0.77	0.73	0.56

Ovarian volume by age

Ovarian Volume and Largest Follicular Diameter According to Age (N = 240)

Age, yr	N	Rt. ovarian V, cm ³	Rt. follicular D, mm	Lt. Ovarian V, cm ³	Lt. follicular D, mm
6	3	4.4 ± 4.0	6.9 ± 2.5	2.5 ± 1.6	6.0 ± 1.8
7	41	2.2 ± 3.2	4.8 ± 1.4	1.8 ± 1.0	4.9 ± 1.6
8	55	2.4 ± 1.8	5.5 ± 2.9	2.4 ± 1.6	5.5 ± 3.3
9	53	2.3 ± 1.7	5.1 ± 1.7	2.2 ± 1.6	4.8 ± 1.3
10	29	4.2 ± 2.6	6.5 ± 2.2	4.4 ± 3.4	6.2 ± 2.6
11	33	3.6 ± 1.9	6.1 ± 2.4	3.9 ± 3.0	5.7 ± 1.8
12	21	5.1 ± 2.4	7.0 ± 2.2	5.7 ± 3.0	7.7 ± 1.7
13	5	5.6 ± 3.1	7.1 ± 3.7	5.7 ± 3.4	5.8 ± 2.7

Data are expressed as mean ± SD.

Abbreviations: N, number of subjects; Rt., right; V, volume; D, diameter; Lt., left.

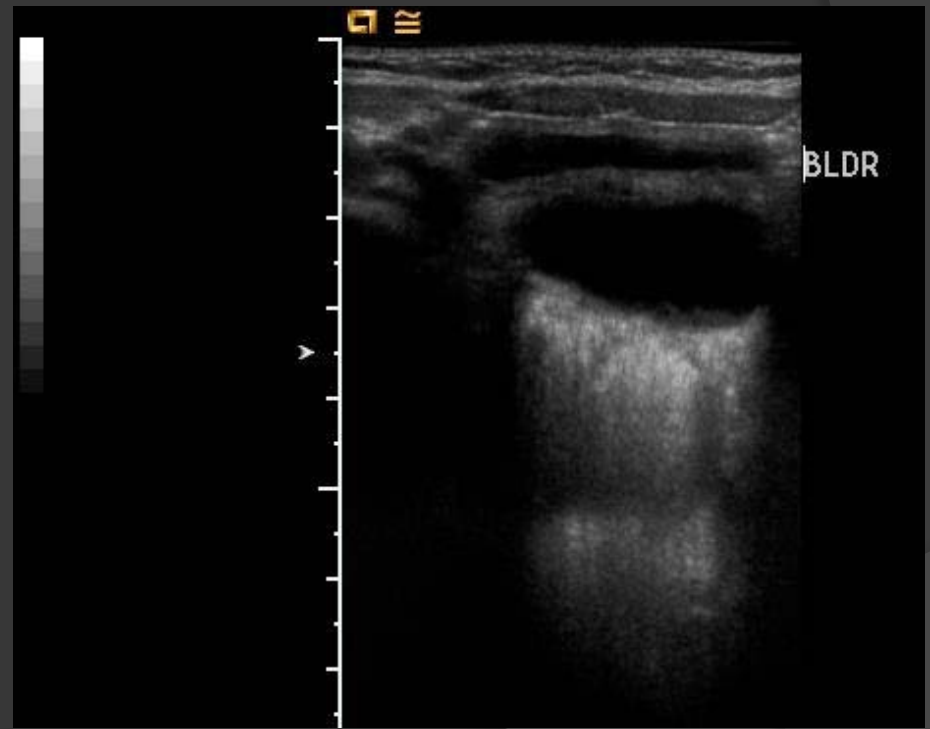
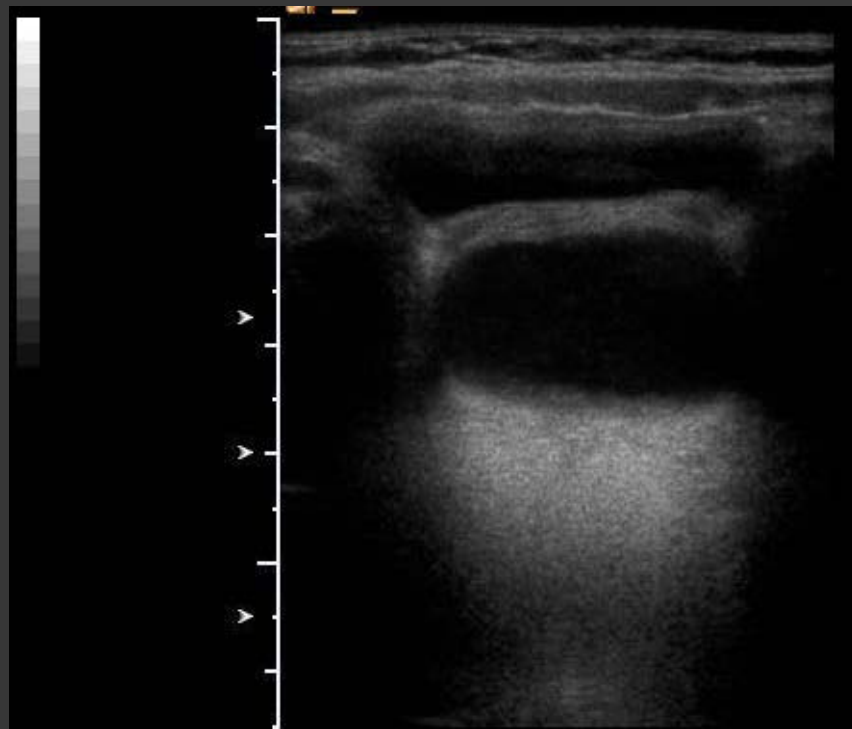
Razzaghy-Azar M, et. al.. J Clin Ultrasound 2011; 39:64-73.

Pediatric Prostate/seminal vesicles



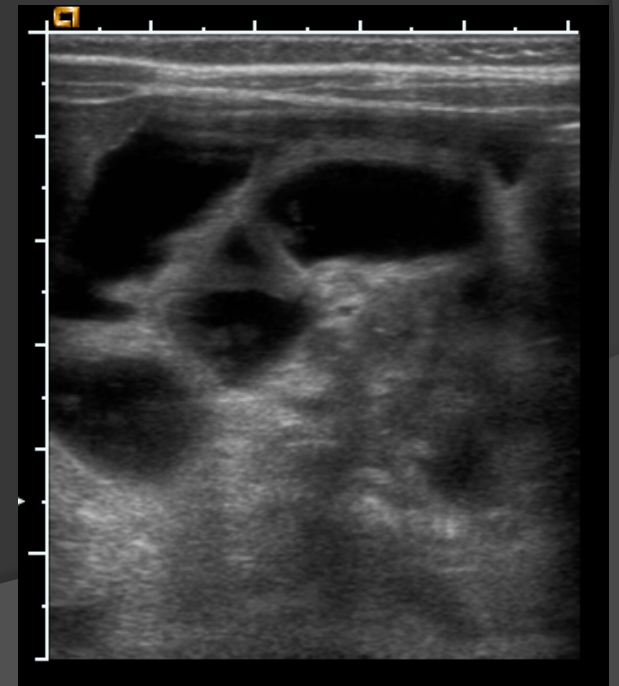
- Visualized in teens
- Can be cause of bladder outlet obstruction
 - RMS
 - Burkett Lymphoma

Prostatic utricle cyst



Bowel

- ⦿ Wall <3mm
- ⦿ Compressible
- ⦿ Contents
 - None
 - Fluid
 - Other
- ⦿ Peristalsis



Normal appendix



Normal Appendix

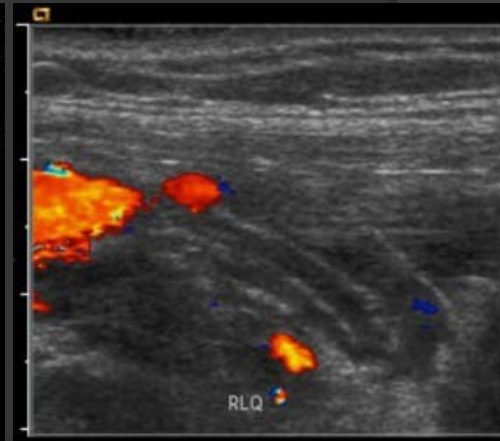
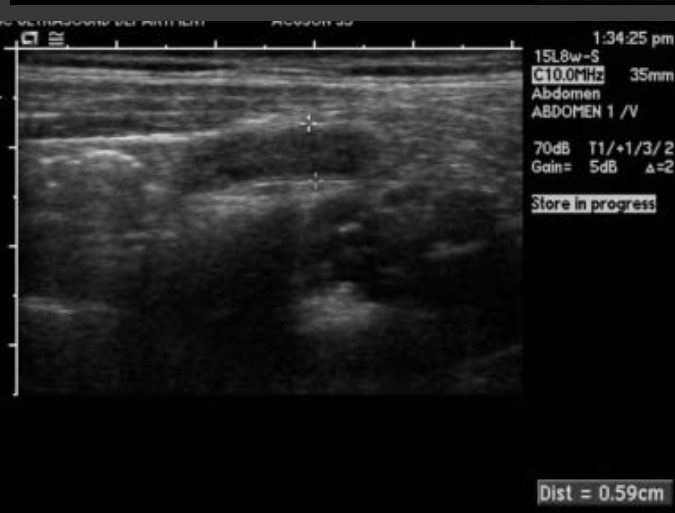
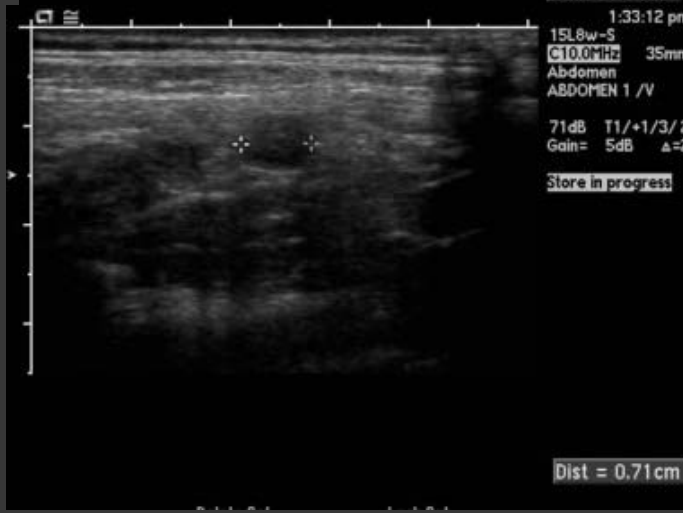


Blind ending tubular structure

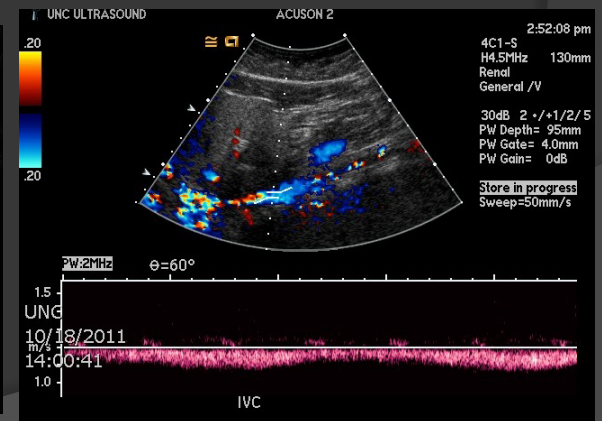
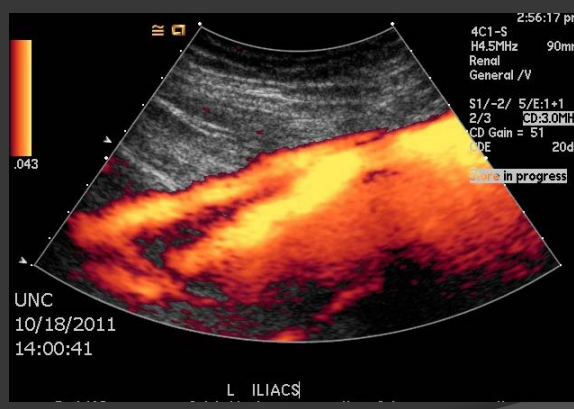
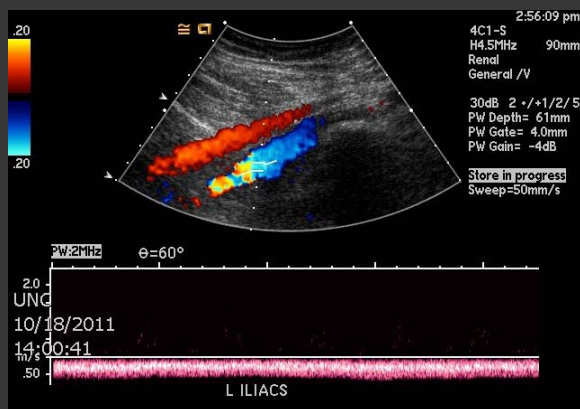
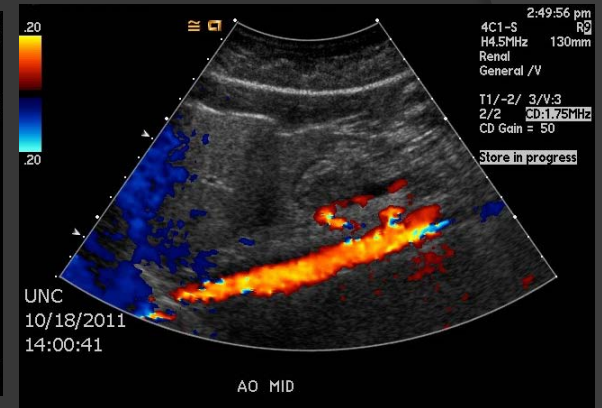
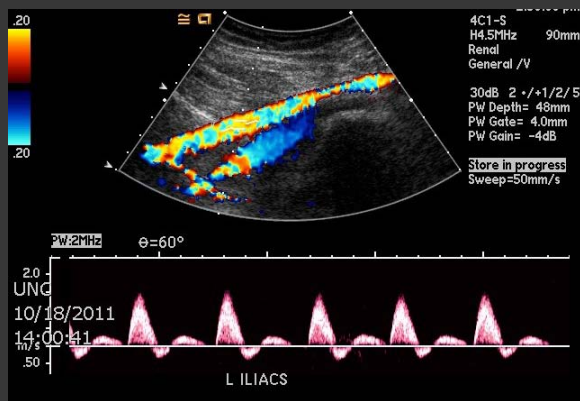
- Two planes

Compressible

- Less than 6 mm in transverse



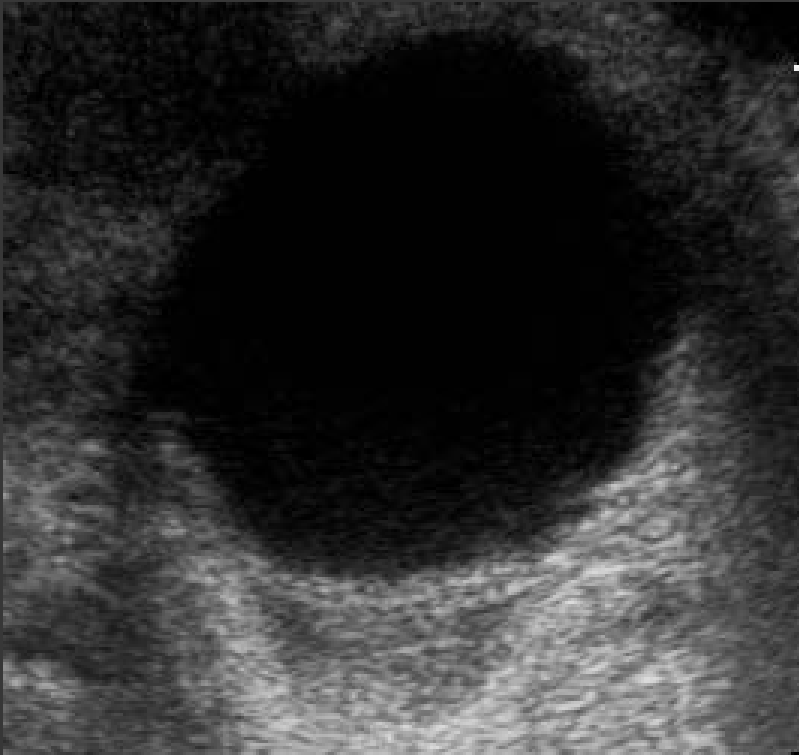
Pelvic vasculature



Free Peritoneal Fluid- Normal?

- ◎ Rathus et al JUM 2003
- ◎ Simanovsky et al Pediatric Radiology 2011
 - 200 asymptomatic children 6mo -15yo
 - Seen 6% all 1 ml or less
- ◎ Matz et al JUM 2013
 - 407 acute non traumatic abdominal pain 0-18yo
 - 33% free fluid
 - US correlates with CT
 - Children with free fluid more likely to have surgical etiology

Complex Free Fluid



Summary

- ⦿ Reviewed normal anatomy of structures in pediatric pelvis
- ⦿ Evaluate related adjacent structures as needed
 - Kidneys
 - Scrotum
 - Inguinal
- ⦿ Use a variety of transducers and techniques

Additional Reading

- ◉ Matz, S., et al., Clinical Outcomes of Pediatric Patients With Acute Abdominal Pain and Incidental Findings of Free Intraperitoneal Fluid on Diagnostic Imaging. *Journal of Ultrasound in Medicine*, 2013. **32**(9): p. 1547-1553.
- ◉ Snyder, E.M., et al., Vesicovaginal Reflux Mimicking Obstructive Hydrocolpos. *Journal of Ultrasound in Medicine*, 2007. **26**(12): p. 1781-1784.
- ◉ Kilicoglu, G., et al., Vesicovaginal reflux: recognition and diagnosis using ultrasound. *Pediatric Radiology*, 2010. **40**(1): p. 114-117.
- ◉ Razzaghy-Azar M, Ghasemi F, Hallaji F, Ghasemi A, Ghasemi M. Sonographic measurement of uterus and ovaries in premenarcheal healthy girls between 6 and 13 years old: correlation with age and pubertal status. *J Clin Ultrasound* 2011; 39:64-73.
- ◉ Herter LD, Golendziner E, Flores JA, Becker E, Jr., Spritzer PM. Ovarian and uterine sonography in healthy girls between 1 and 13 years old: correlation of findings with age and pubertal status. *AJR Am J Roentgenol* 2002; 178:1531-1536.
- ◉ Levine D, Brown DL, Andreotti RF, et al. Management of Asymptomatic Ovarian and Other Adnexal Cysts Imaged at US: Society of Radiologists in Ultrasound Consensus Conference Statement1. *Radiology* 2010; 256:943-954.
- ◉ Coley BD. Topics in Obstetrics and Gynecology Ultrasound Pediatric Gynecologic Ultrasound. *Ultrasound Clinics* 2012; 7:107-121.
- ◉ Ingram S, Hollman AS, Azmy AF. Ultrasound evaluation of the paediatric prostate. *Br J Urol* 1994; 74:601-603
- ◉ States LJ, Bellah RD, Kramer SS. Imaging of the pediatric prostate and related structures. *Semin Roentgenol* 1999; 34:338-349.
- ◉ Mong A, Bellah R. Imaging the Pediatric Prostate. *Radiologic clinics of North America* 2006; 44:749-756.