ULTRASOUND BASICS

Maria Giroux, HBSc, MD

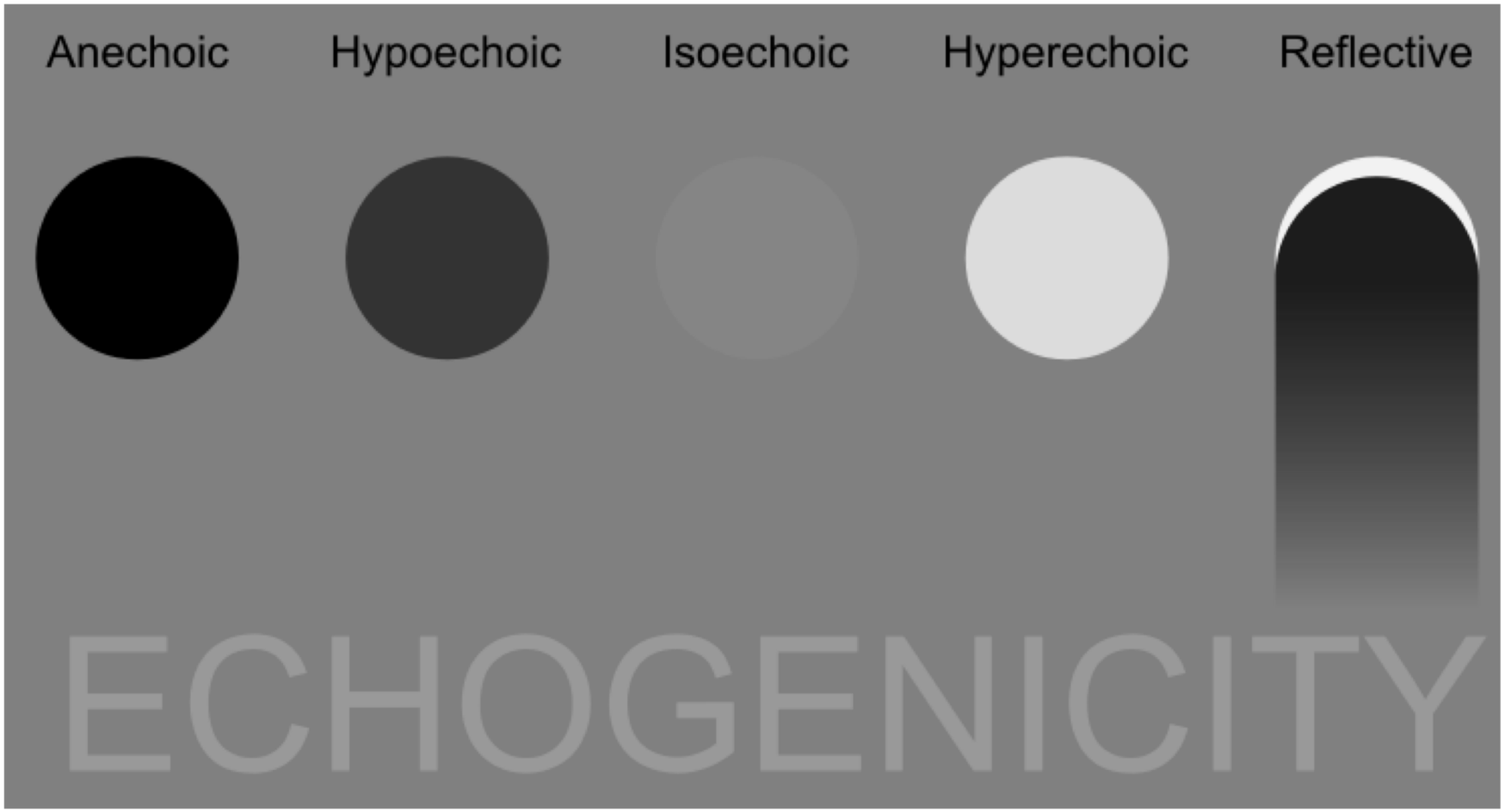
Ultrasound

- Uses high-frequency, low-energy sound waves, does not use ionizing radiation
- Obstetrics ultrasound
    - No evidence of fetal abnormalities or harmful biological effects on the fetus

Coloured Ultrasound Machine [Digital image]. (2018). Retrieved from https://www.indiamart.com/proddetail/coloured-ultrasound-machine-16775298055.html

Echogenicity

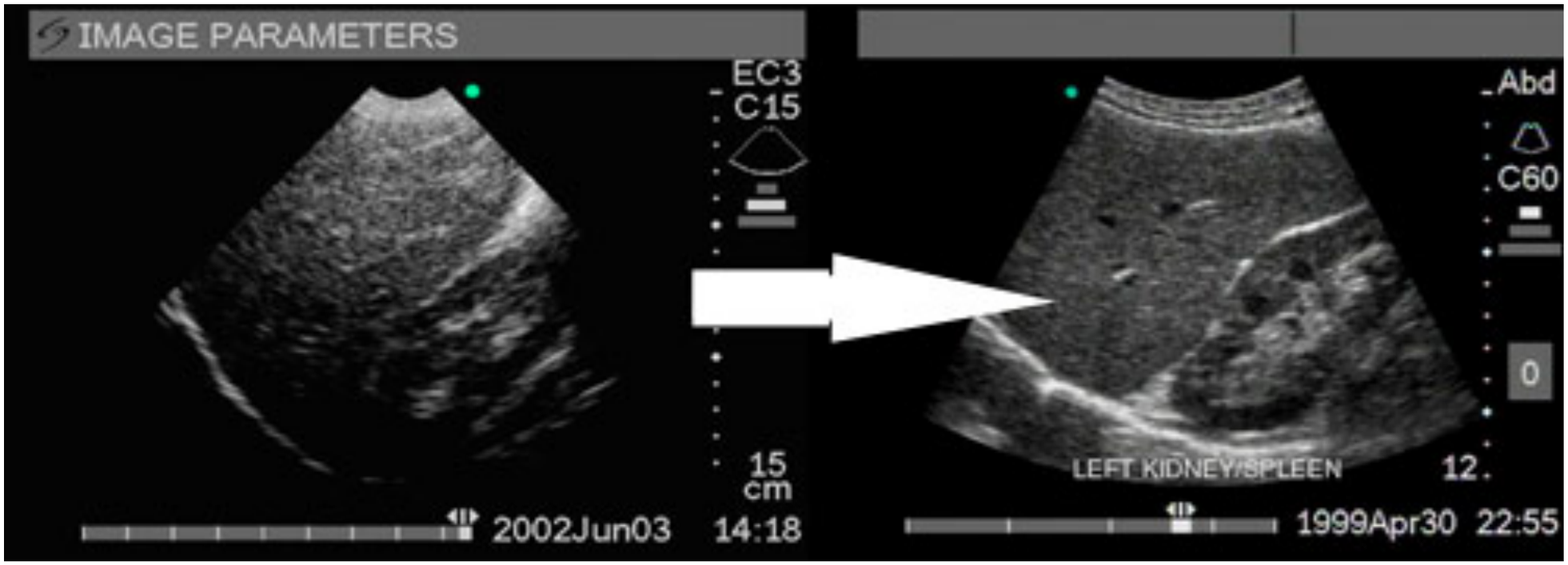
- Ability of tissue to reflect or transmit US waves
- **ANechoic**= black (ex. Bone, blood vessels, fat, lymph nodes)
- **HYPO**echoic= dark= ↓ echogenicity (ex. Cartilage, muscle)
- **HYPER**echoic= bright= ↑echogenicity (ex. fascia)



Dilmen, N. (2011). Ultrasound lesions echogenicity [Digital image]. Retrieved from https://commons.wikimedia.org/wiki/File:Ultrasound_lesions_echogenicity.svg

Adjusting Gain

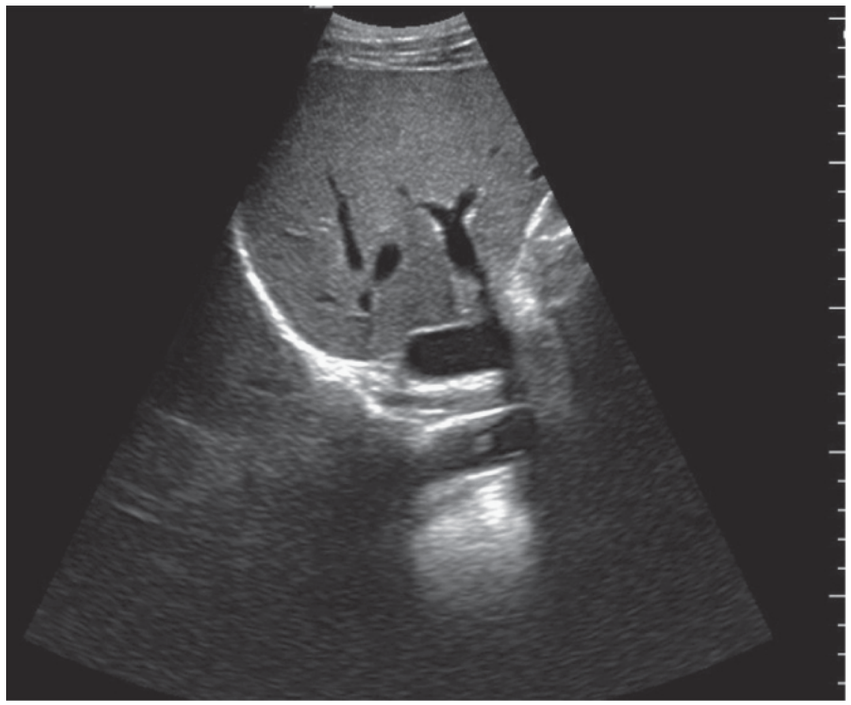
- Changes the brightness of the image



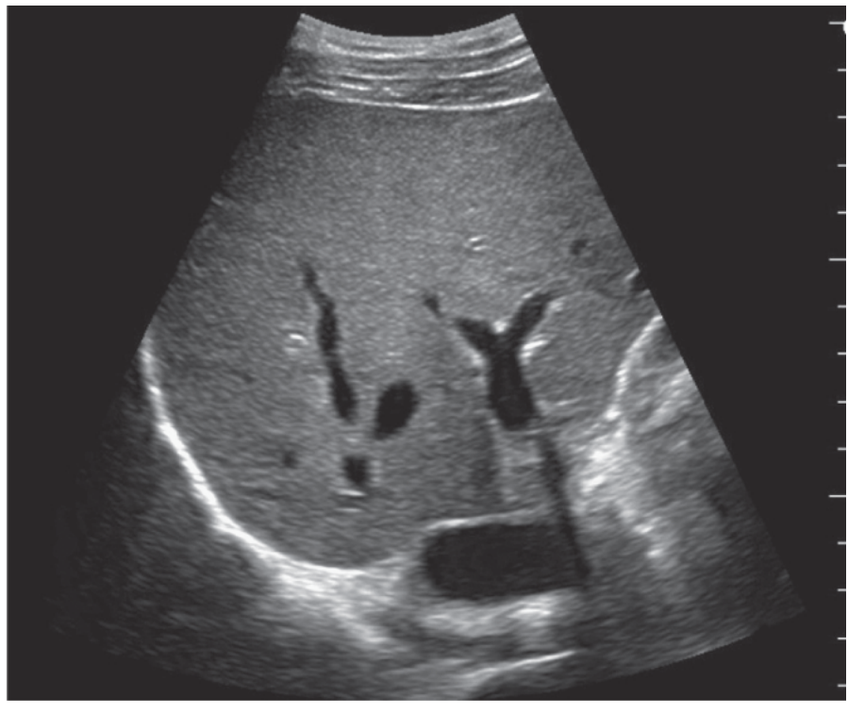
Resolving low gain artifacts [Digital image]. (2004, November 23). Retrieved from http://www.frca.co.uk/article.aspx?articleid=374

Adjusting Depth

- Begin with higher depth to visualize the entire structure, then gradually **decrease depth to focus** on a specific structure



A



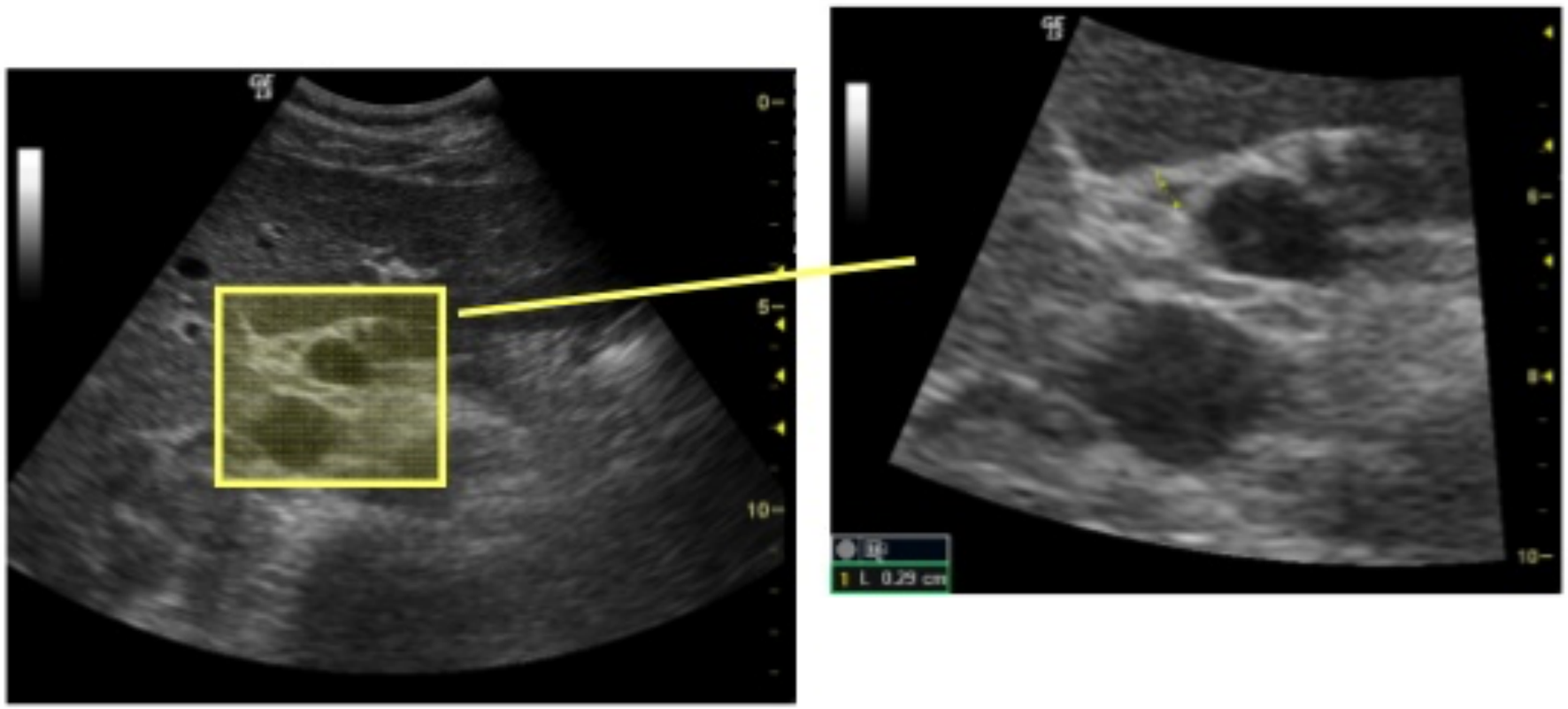
B

Source: Ma OJ, Mateer JR, Reardon RF, Joing SA: *Ma and Mateer's Emergency Ultrasound, Third Edition:* www.accessemergencymedicine.com
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

Fox, C. (2017). [Digital image]. Retrieved from https://accessemergencymedicine.mhmedical.com/content.aspx?bookid=686§ionid=45956939

Zoom

- Used to select and magnify a specific part of the image



[Digital image]. (2009, November 21). Retrieved from https://www.slideshare.net/u.surgery/ultrasound-physics-knobology

Cineloop

- Allows to scroll through several saved images
- Click “freeze” button, then use trackball/touchpad control to go find the optimal image

Figure 30: Click freeze and scroll with the trackball to “cineloop back” to the optimal image for taking a measurement.

Socransky, S., & Wiss, R. (2014, April 25). Figure 30: Click freeze and scroll with the trackball to "cineloop back" to the optimal image for taking a measurement [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Sweeping

- Keep the same point of contact between the skin and the probe
- Tilt the probe

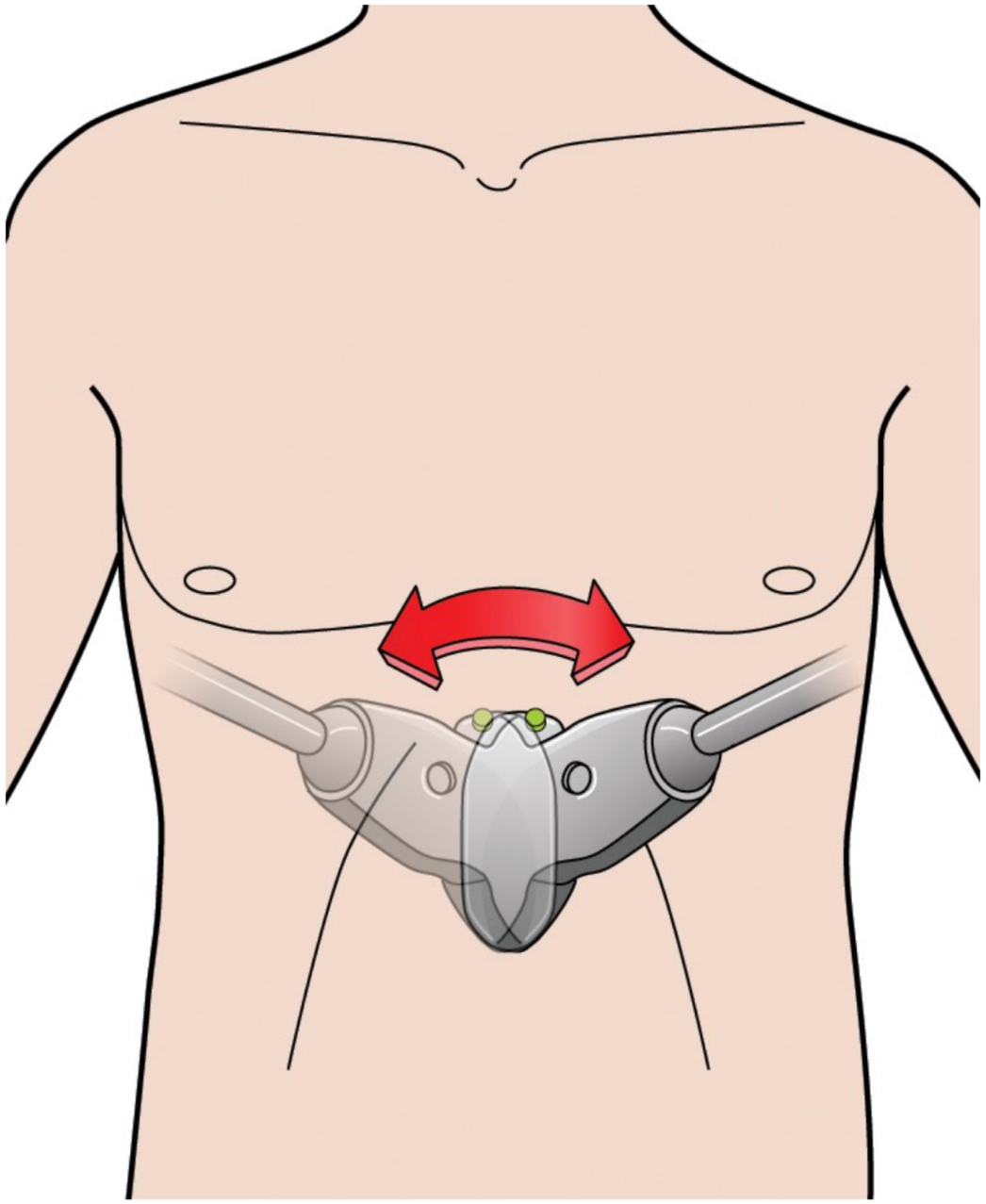


Figure 2: Sweeping the probe

Socransky, S., & Wiss, R. (2014, April 25). Figure 2: Sweeping the probe [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Color Doppler

- Blood vessels
  - **RED**= flowing **TOWARDS** the probe
  - **BLUE**= flowing **AWAY** from probe

FIGURES 26-29

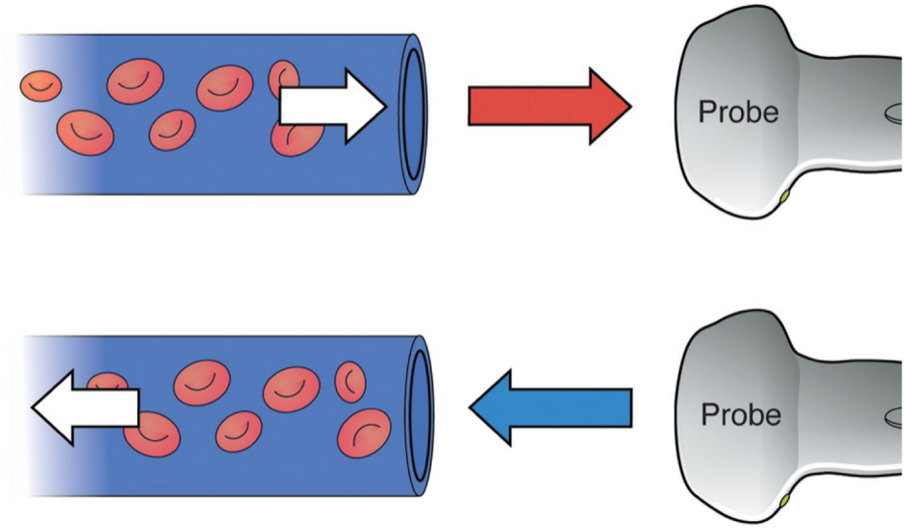
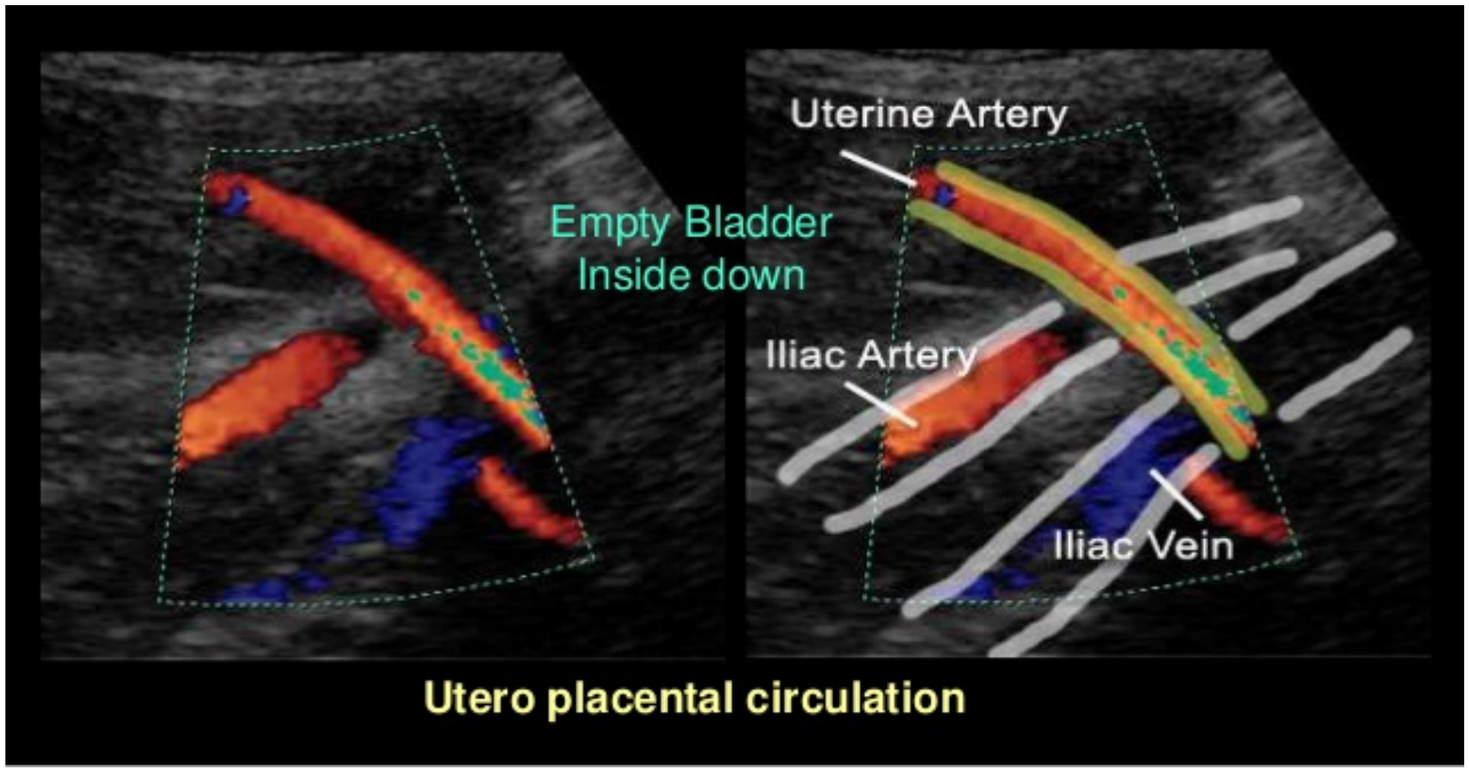


Figure 26: Red indicates motion towards the probe. Blue indicates motion away from the probe.

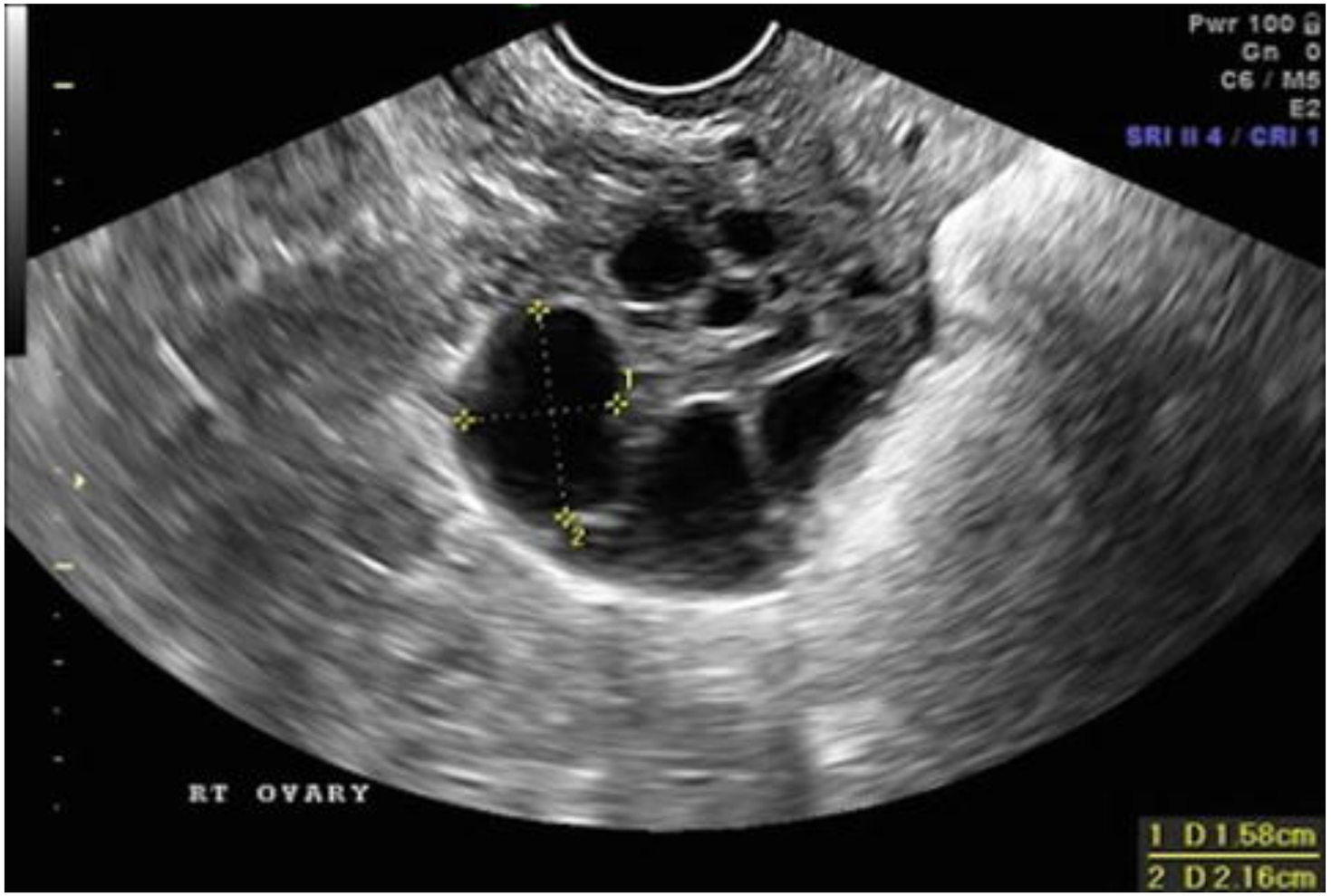
Socransky, S., & Wiss, R. (2014, April 25). Figure 26: Red indicates motion towards the probe. Blue indicates motion away from the probe. [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11



Nicolaides, K., Rizzo, G., Hecker, K., & Ximenes, R. (2002). Site of intonation of uterine artery ("crossing over") [Digital image]. Retrieved from https://sonoworld.com/client/fetus/html/doppler/capitulos-html/chapter_04.htm

Calipers

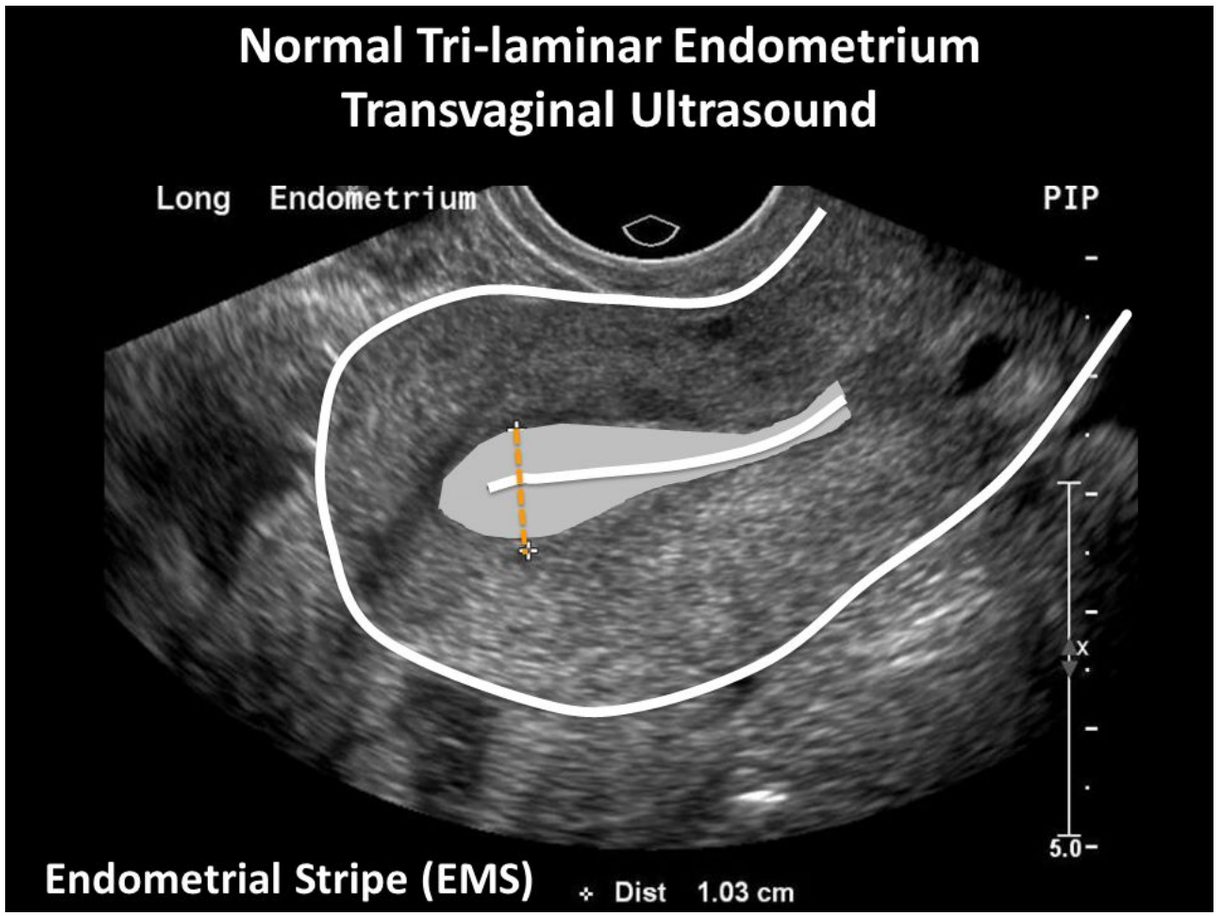
- Used to measure the size of structures
- Freeze the image, then activate the caliper function



Toftager, M., & Cohen, D. (2013, November 12). [Digital image]. Retrieved from https://link.springer.com/chapter/10.1007/978-1-4614-9182-8_19

Endometrial Stripe

- Area of ↑ echogenicity
- Can measure endometrial thickness



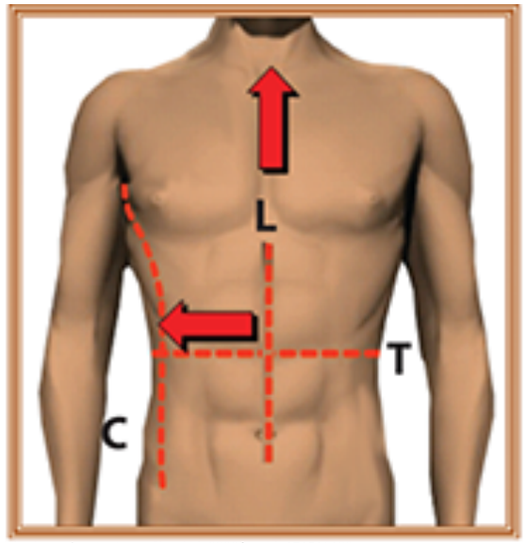
Garcia, A. (2014). [Digital image]. Retrieved from https://slideplayer.com/slide/7422380/

Tuagi, S. (2017, January 13). Is pregnancy possible with normal endometrial lining in follicular study? [Digital image]. Retrieved from https://www.youtube.com/watch?v=AW2anPLf1qY

TRANSABDOMINAL US

Probe Orientation

- All transducers have an indicator that corresponds to the marker on the screen
  - **Transverse (coronal)** plane: aim the indicator towards the patient's **right side**
  - **Sagittal (longitudinal)** plane: aim the indicator towards the patient's **head**



Karmakar, M., Soh, E., Chee, V., & Sheah, K. (2017, December 5). [Digital image]. Retrieved from https://accessanesthesiology.mhmedical.com/content.aspx?bookid=2220§ionid=171516133

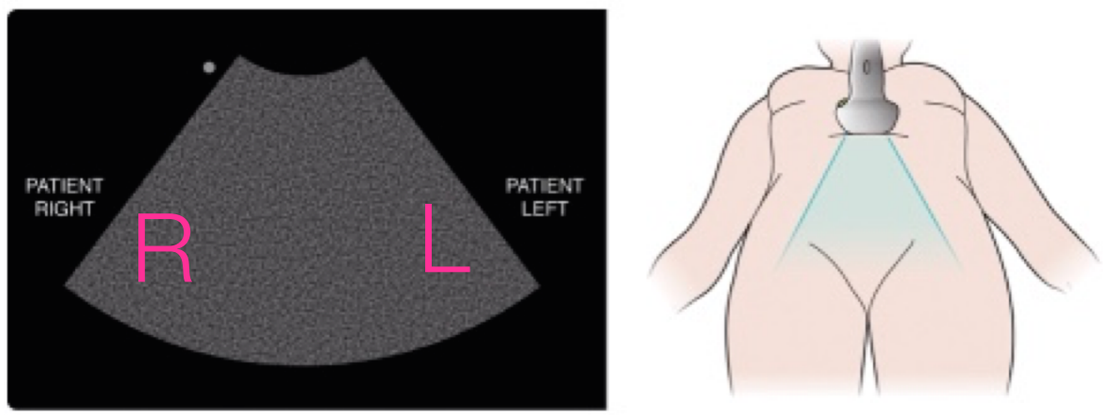


Figure 10: The transverse plane

Socransky, S., & Wiss, R. (2014, April 25). Figure 10: The transverse plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

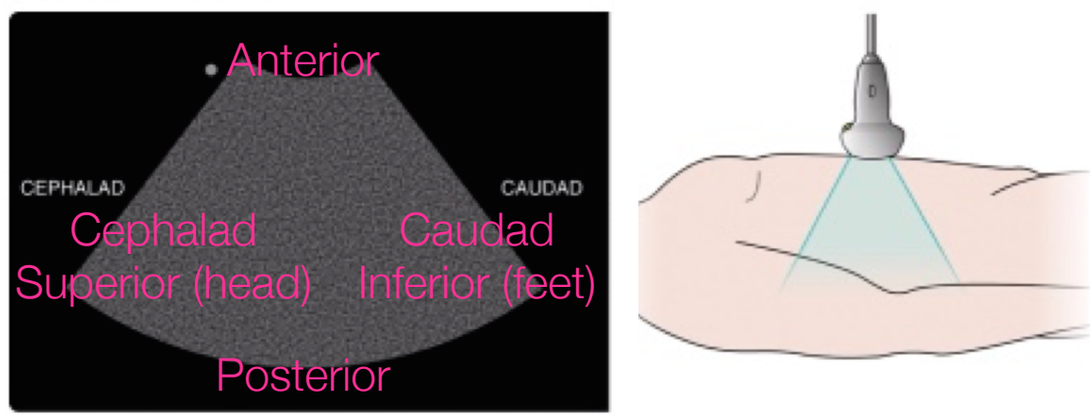


Figure 11: The longitudinal plane

Socransky, S., & Wiss, R. (2014, April 25). Figure 11: The longitudinal plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Transverse Plane

1. Place probe transversely, indicator towards patient's right
2. Identify bladder (top of the screen) and uterus (circular shape), and their juxtaposition→ center them to the middle of the screen
3. Sweep through the uterus

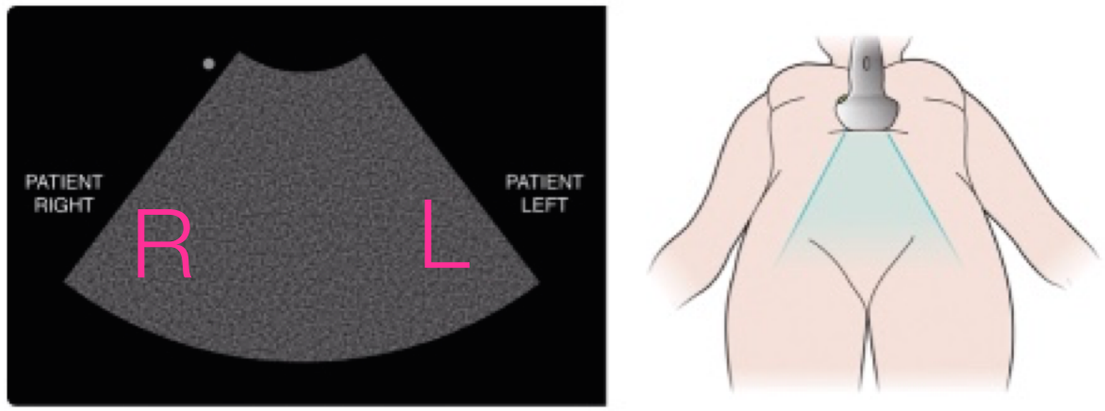


Figure 10: The transverse plane

Socransky, S., & Wiss, R. (2014, April 25). Figure 10: The transverse plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Figure 11: Initial probe placement for the transverse view with the indicator towards patient right

Socransky, S., & Wiss, R. (2014, April 25). Figure 11: initial probe placement for the transverse view with the indicator towards patient right [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Figure 12: Sweep the probe into the pelvis to look for the bladder and the uterus.

Socransky, S., & Wiss, R. (2014, April 25). Figure 12: sweep the probe into the pelvis to look for the bladder and the uterus [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Transverse Plane

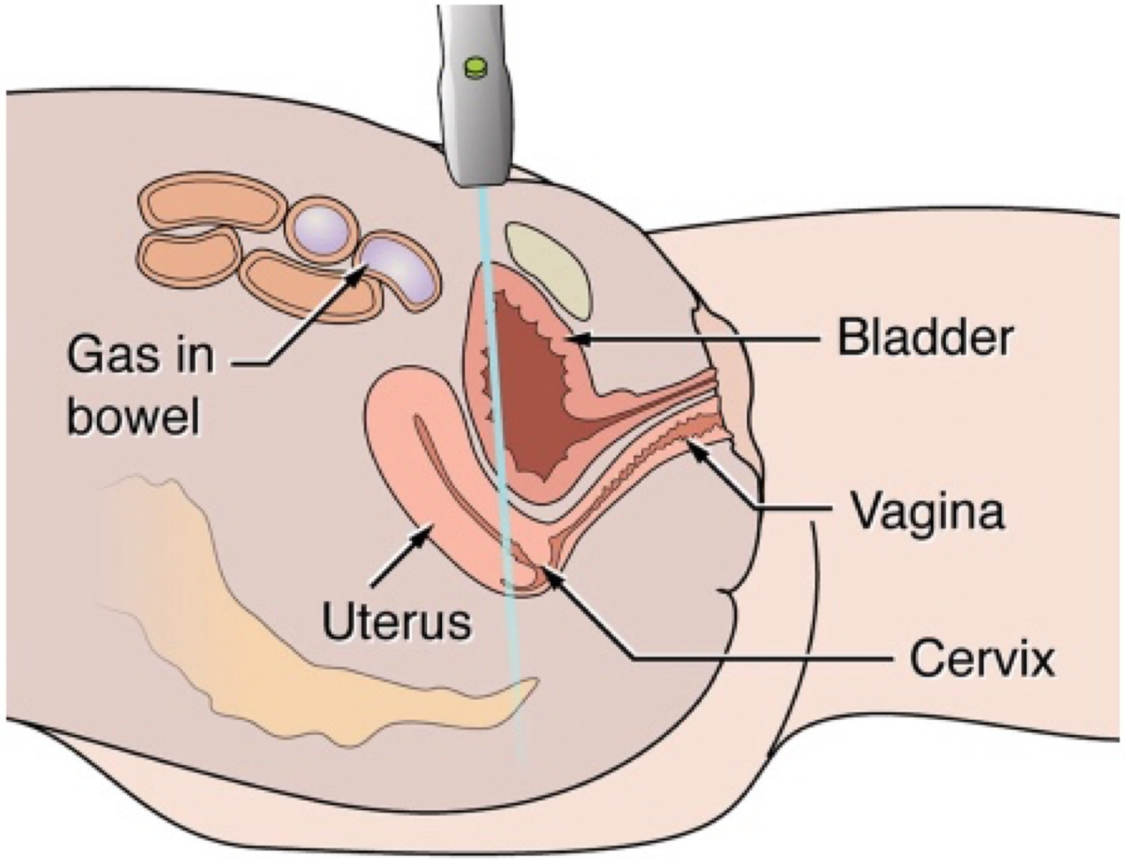


Figure 13: Look for the bladder and the uterus by sweeping the beam into the pelvis.

Socransky, S., & Wiss, R. (2014, April 25). Figure 13: Look for the bladder and the uterus by sweeping the beam into the pelvis [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

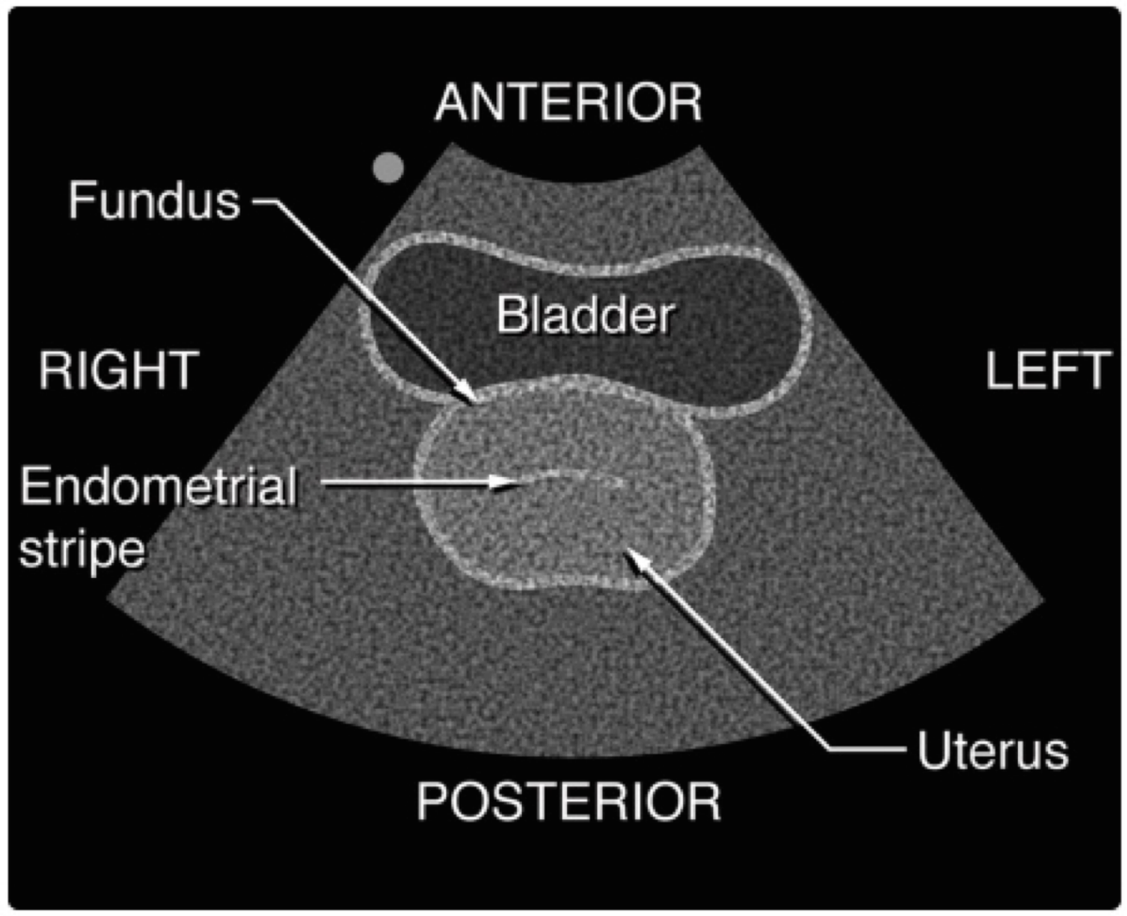


Figure 14: The oval bladder is seen near field to the round uterus.

Socransky, S., & Wiss, R. (2014, April 25). Figure 14: the oval bladder is seen near field to the round uterus [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

- Uterus has a round shape and endometrial stripe appears as a dot or oval
- If the probe is placed too low, the vagina has oval shape and vaginal stripe appears as a line

Transverse Plane

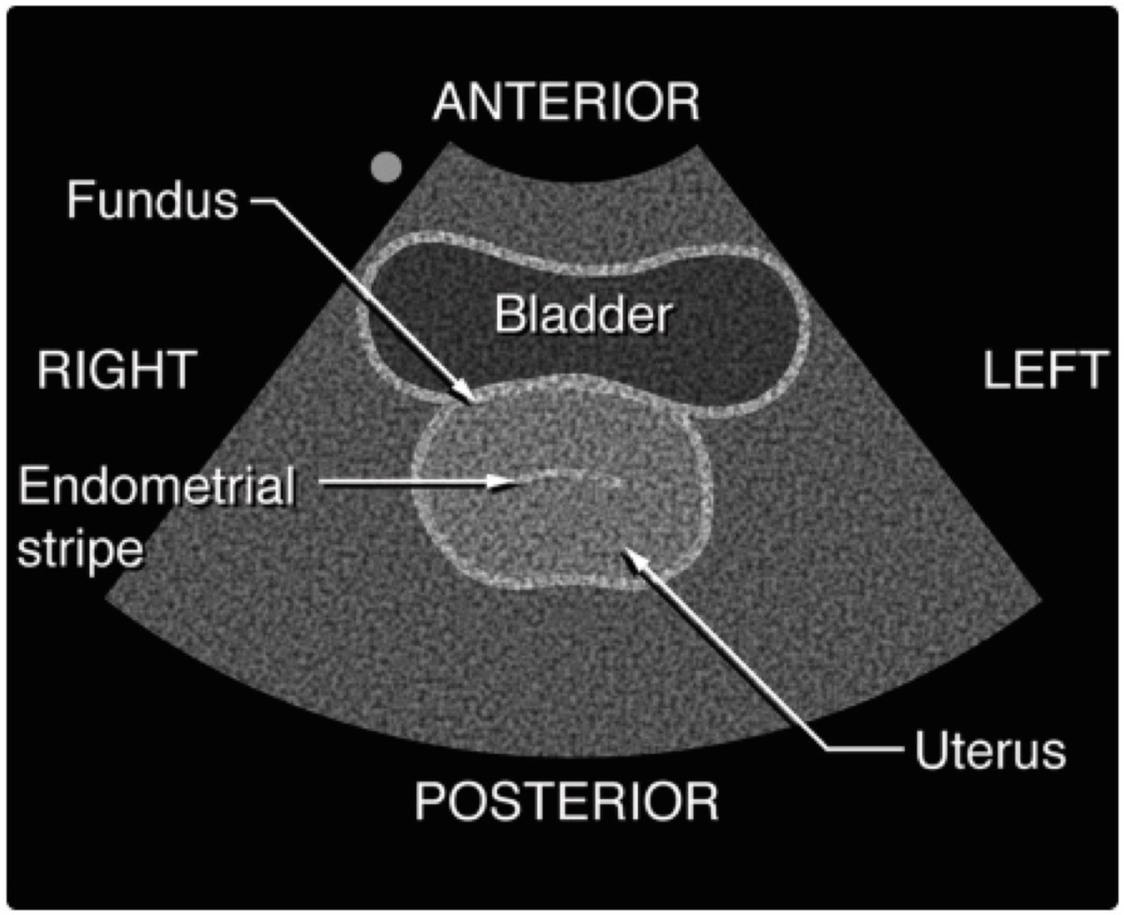
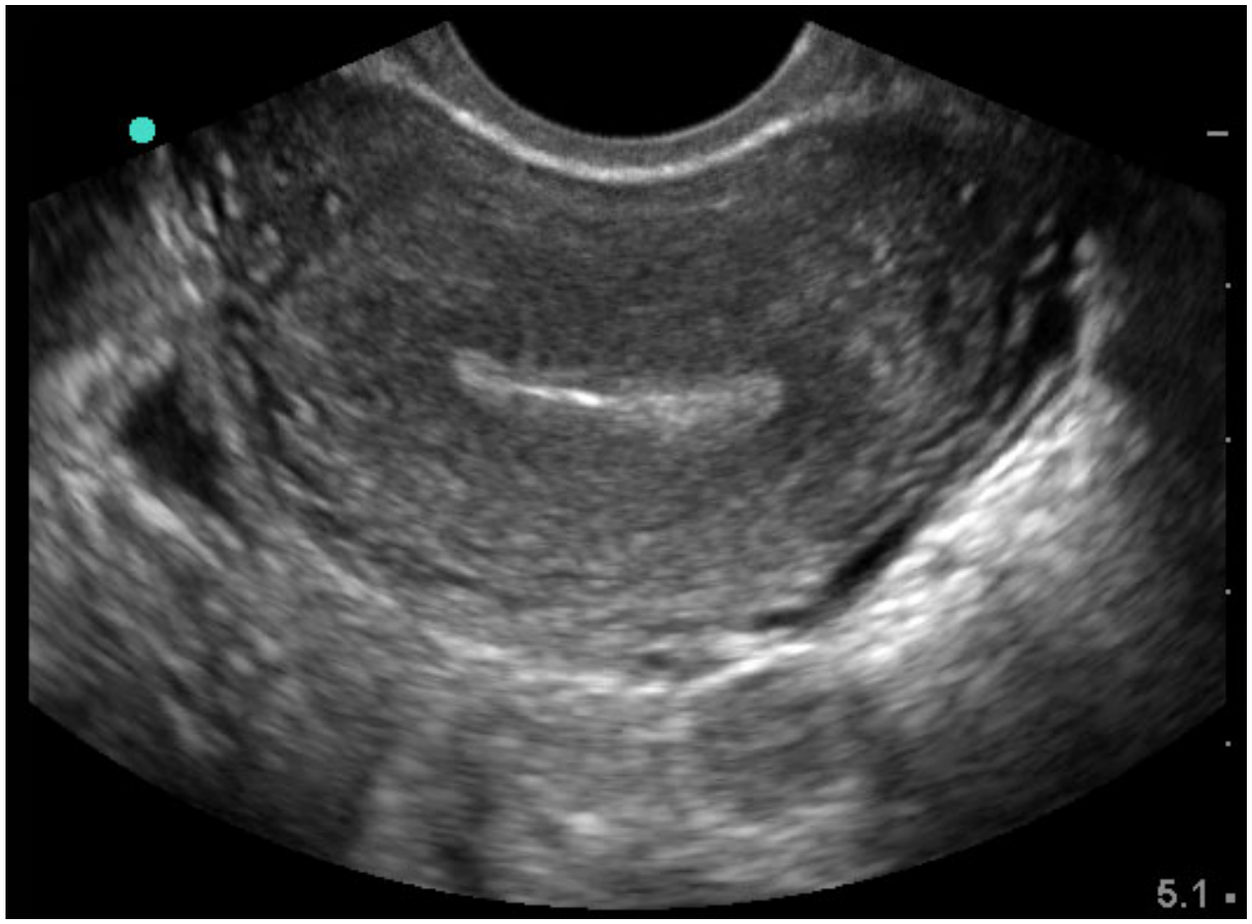


Figure 14: The oval bladder is seen near field to the round uterus.

Socransky, S., & Wiss, R. (2014, April 25). Figure 14: the oval bladder is seen near field to the round uterus [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11



Transverse or coronal view of uterus [Digital image]. (n.d.). Retrieved from https://sinaiem.org/tutorials-2/pelvis/

Sagittal Plane

1. Rotate the probe 90°
   - Place probe at midline longitudinally, superior to the pubic symphysis, indicator towards patient's head
2. Identify bladder, uterus, and their juxtaposition
   → center them to the middle of the screen
3. Sweep through the uterus (30° left to 30° right)

Figure 1: The probe is placed just above the symphysis pubis in the longitudinal plane.

Socransky, S., & Wiss, R. (2014, April 25). Figure 1: The probe is placed just above the symphysis pubis in the longitudinal plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

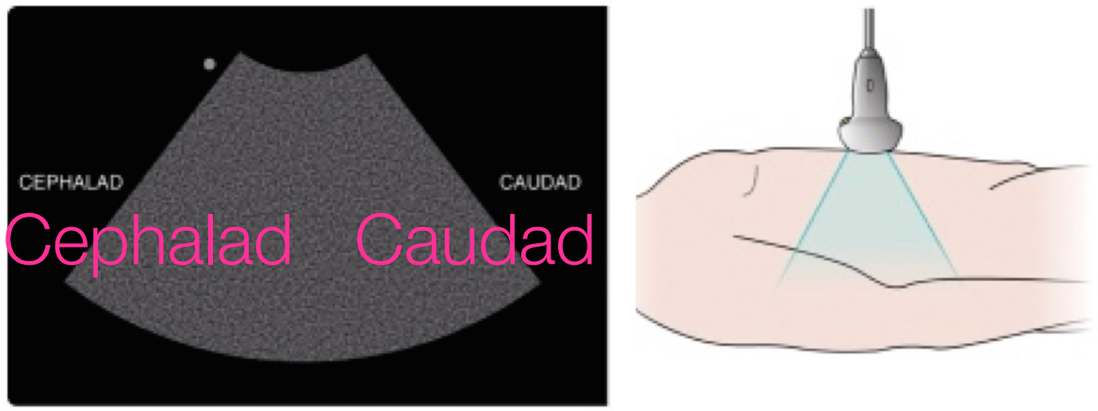


Figure 11: The longitudinal plane

Socransky, S., & Wiss, R. (2014, April 25). Figure 11: The longitudinal plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

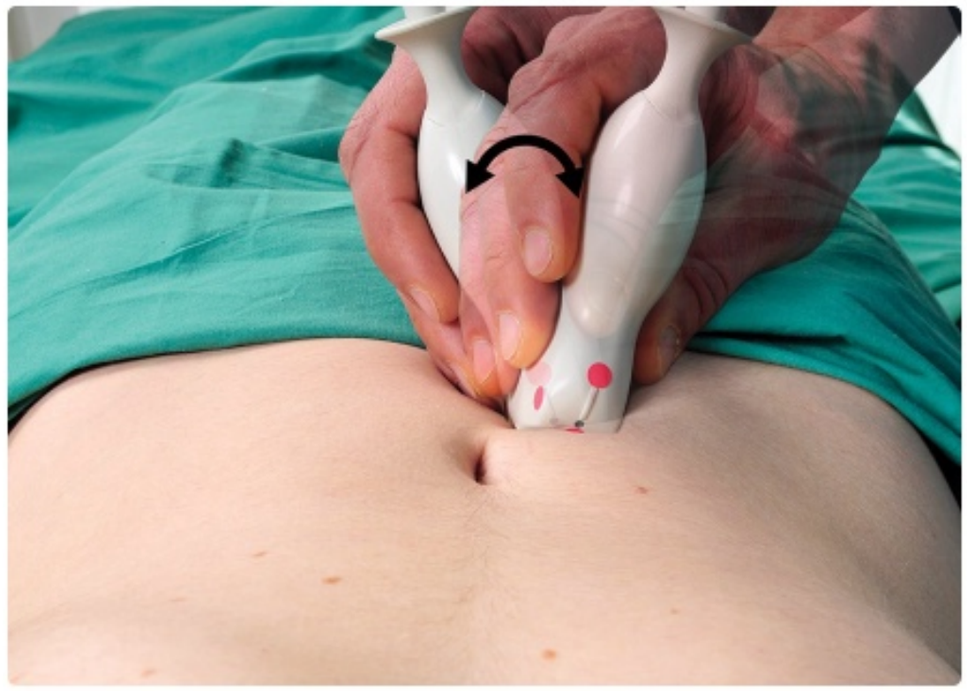


Figure 9: Sweeping through the uterus in the longitudinal plane

Socransky, S., & Wiss, R. (2014, April 25). Figure 9: Sweeping through the uterus in the longitudinal plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Sagittal Plane

Anteverted uterus

- **Juxtaposition** is the point where uterus and bladder come into contact
  - Vagina and cervix are always juxtaposed to the bladder

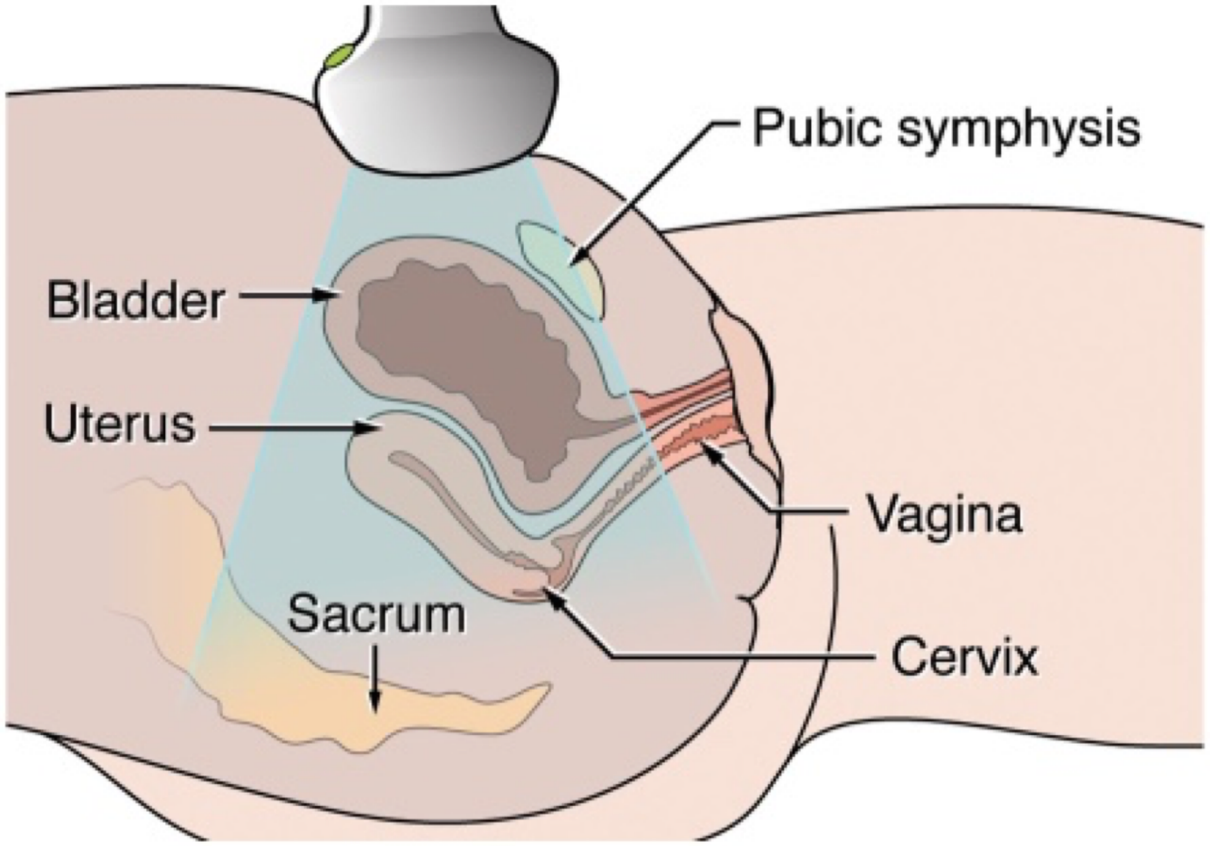


Figure 3: A full bladder will provide a perfect window to the uterus.

Socransky, S., & Wiss, R. (2014, April 25). Figure 3: A full bladder will provide a perfect window to the uterus [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

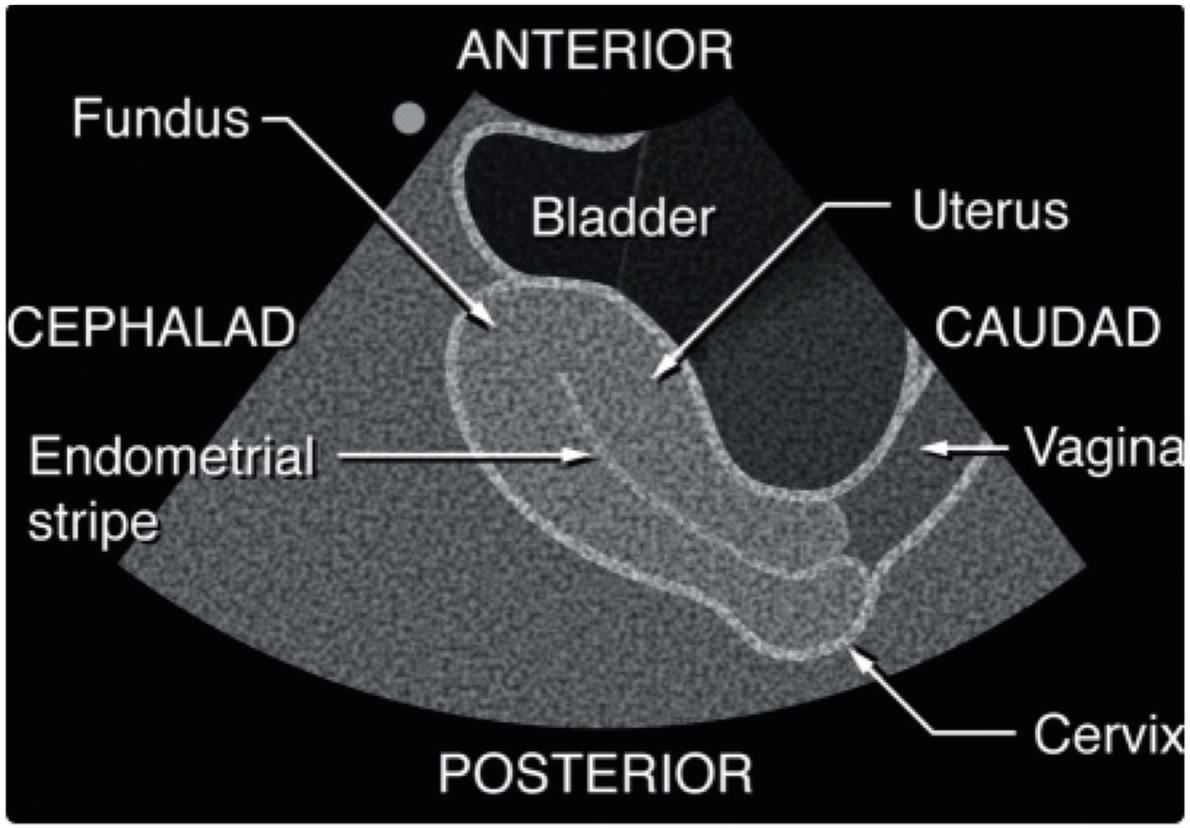


Figure 4: The typical appearance of the pelvic structures in the longitudinal plane

Socransky, S., & Wiss, R. (2014, April 25). Figure 4: The typical appearance of the pelvic structures in the longitudinal plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Sagittal Plane

Anteverted uterus

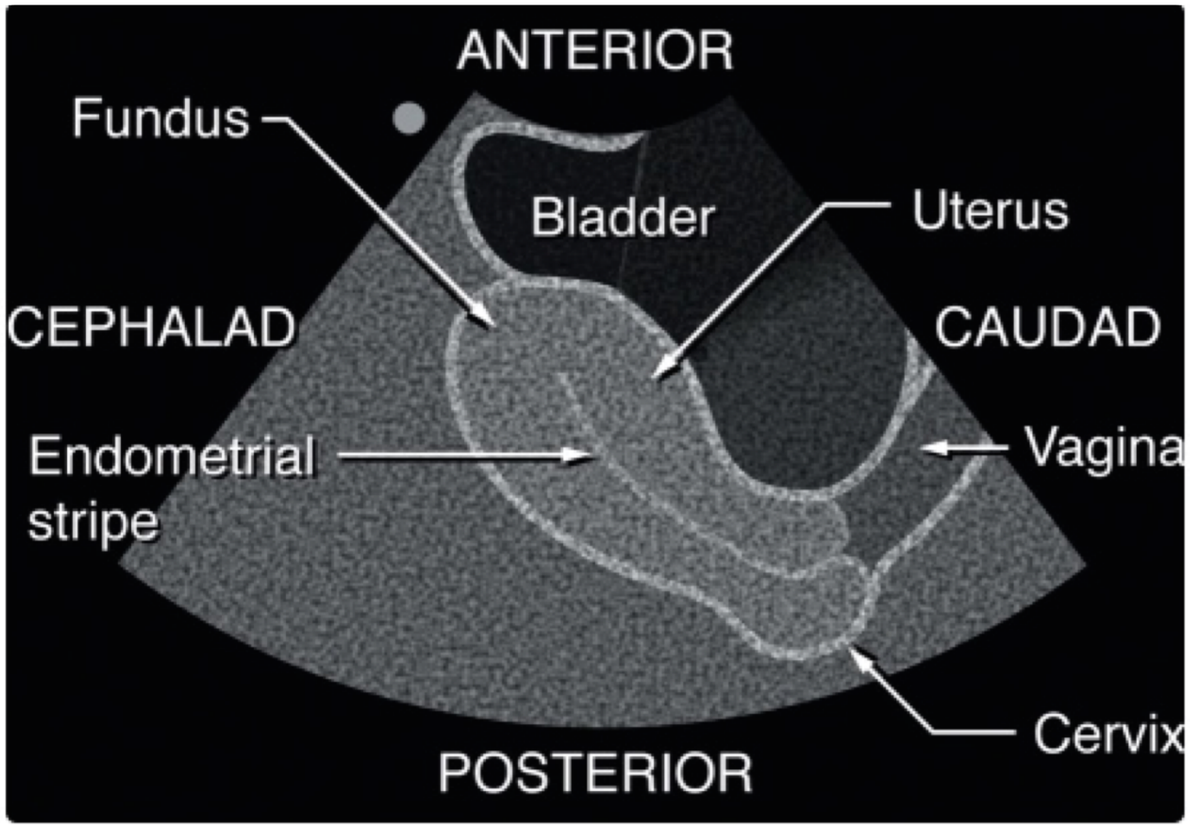
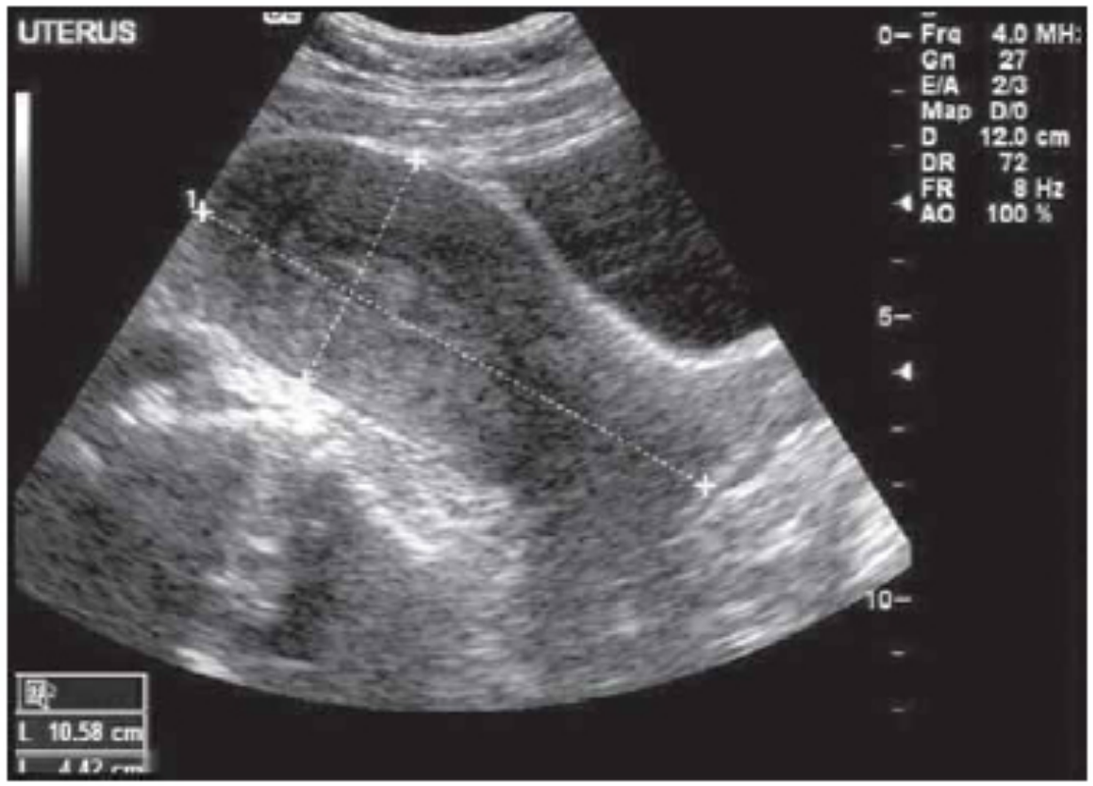


Figure 4: The typical appearance of the pelvic structures in the longitudinal plane

Socransky, S., & Wiss, R. (2014, April 25). Figure 4: The typical appearance of the pelvic structures in the longitudinal plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11



Murphy, B., & Zalud, I. (2007). Anteverted and enlarged postmenopausal uterus [Digital image]. Retrieved from http://www.jaypeejournals.com/eJournals/ShowText.aspx?ID=61&Type=FREE&TYP=TOP&IN=_eJournals/images/JPLOGO.gif&IID=7&isPDF=NO

Sagittal Plane

Retroverted uterus

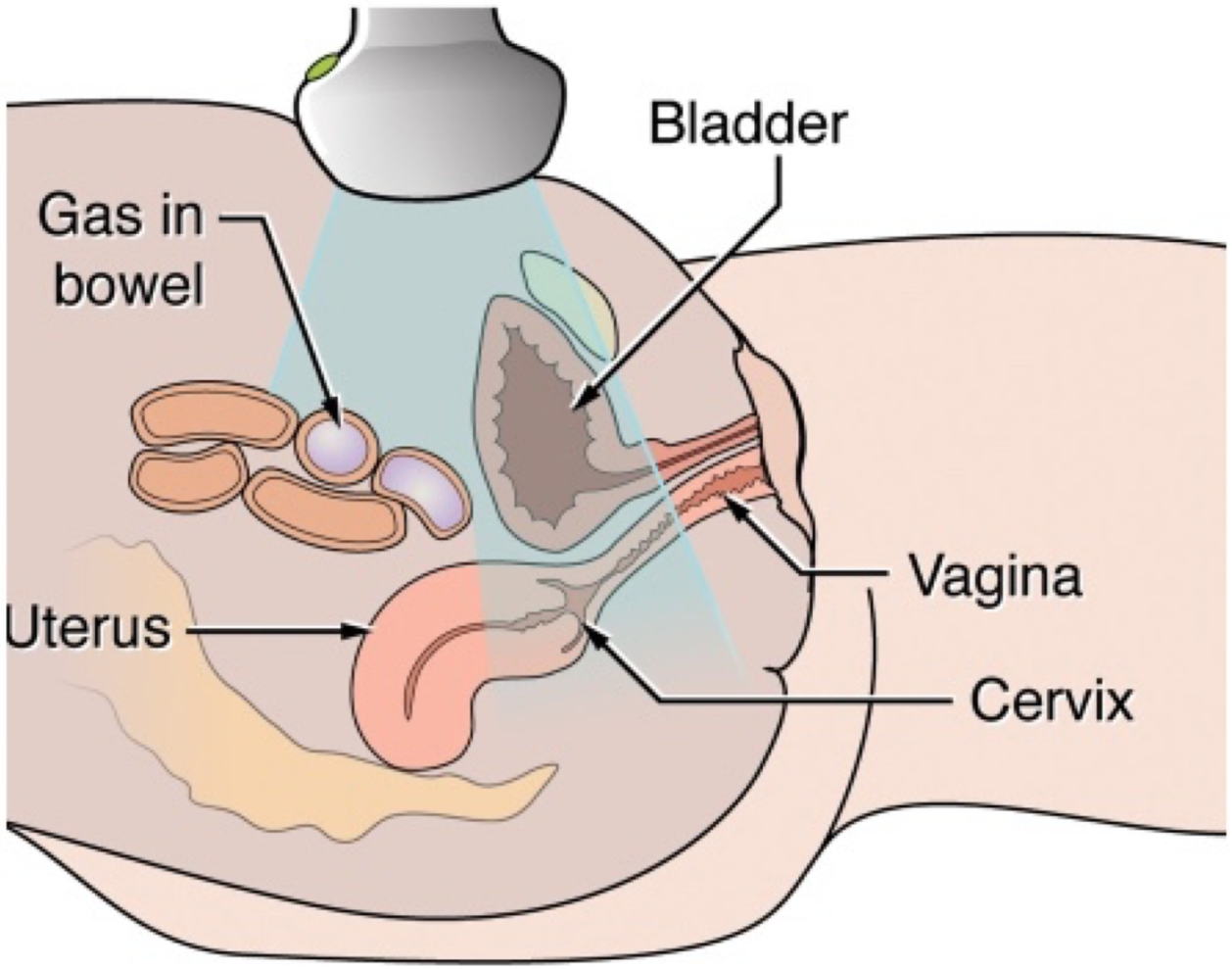
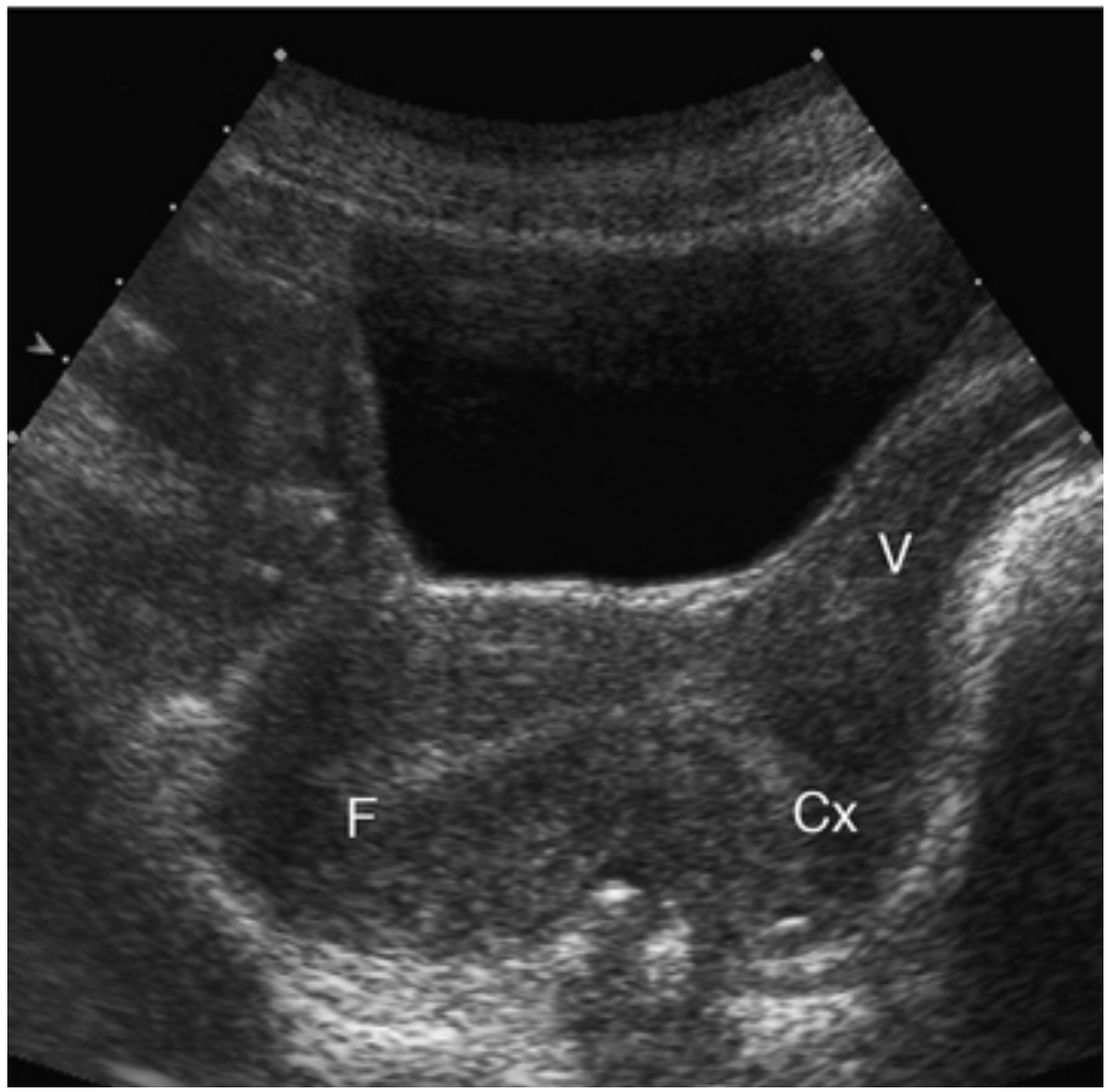


Figure 57: The fundus of the retroverted uterus points towards the patient's back. Your view of the retroverted uterus is more likely to be blocked by gas because the bladder cannot act as a window and bowel is more likely to be located between the probe and the uterus.

Socransky, S., & Wiss, R. (2014, April 25). Figure 57: The fundus of the retroverted uterus points towards the patient's back. Your view of the retroverted uterus is more likely to be blocked by gas because the bladder cannot act as a window and bowel is more likely to be located between the probe and the uterus [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11



Sagittal-transvaginal view of the normal uterus [Digital image]. (2016). Retrieved from https://radiologykey.com/ultrasound-evaluation-of-the-uterus/

TRANSVAGINAL US

Transvaginal US

1. Position the patient (use pelvic pillow)
2. Prepare the probe

Figure 22: A pelvic pillow allows one to drop the handle below the level of the patient's buttocks.

Socransky, S., & Wiss, R. (2014, April 25). Figure 22: A pelvic pillow allows one to drop the handle below the level of the patient's buttocks [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Figure 23: Apply gel to the tip of the probe.

Socransky, S., & Wiss, R. (2014, April 25). Figure 23: Apply gel to the tip of the probe [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Figure 24: The condom is placed on the probe.

Socransky, S., & Wiss, R. (2014, April 25). Figure 24: The condom is placed on the probe [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Figure 25: Gently push any air bubbles to the side.

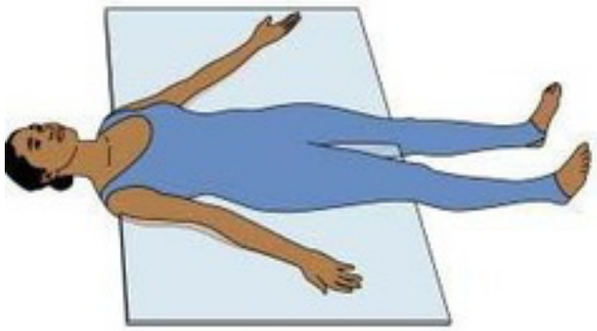
Socransky, S., & Wiss, R. (2014, April 25). Figure 25: Gently push any air bubbles to the side [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Figure 26: Apply sterile water-soluble lubricant to the tip of the condom.

Socransky, S., & Wiss, R. (2014, April 25). Figure 26: Apply sterile water-soluble lubricant to the tip of the condom [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Transverse Plane

1. Insert probe 4-5cm into vagina, indicator towards the patient's right
2. Identify bladder (top of the screen) and uterus (round), and their juxtaposition→ center them to the middle of the screen
3. Sweep through uterus from cervix to fundus (up-down)



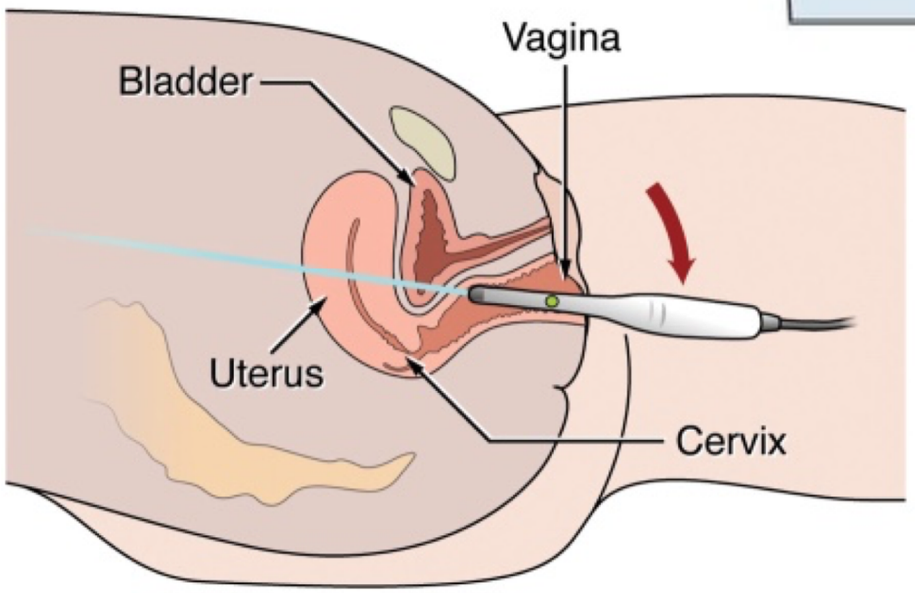


Figure 38: Lowering the handle directs the beam towards the bladder.

Socransky, S., & Wiss, R. (2014, April 25). Figure 38: Lowering the handle directs the beam towards the bladder [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

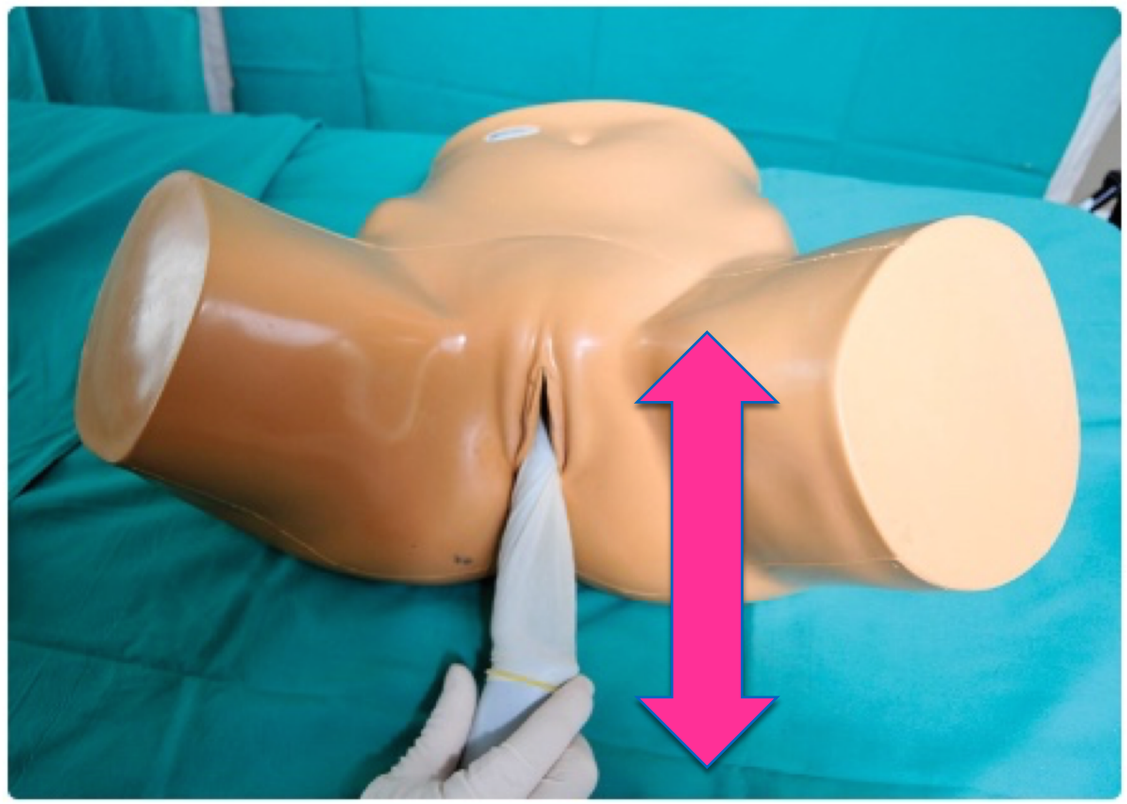


Figure 37: Lower the probe handle to find the bladder in the coronal plane.

Socransky, S., & Wiss, R. (2014, April 25). Figure 37: Lower the probe handle to find the bladder in the coronal plane [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Transverse Plane

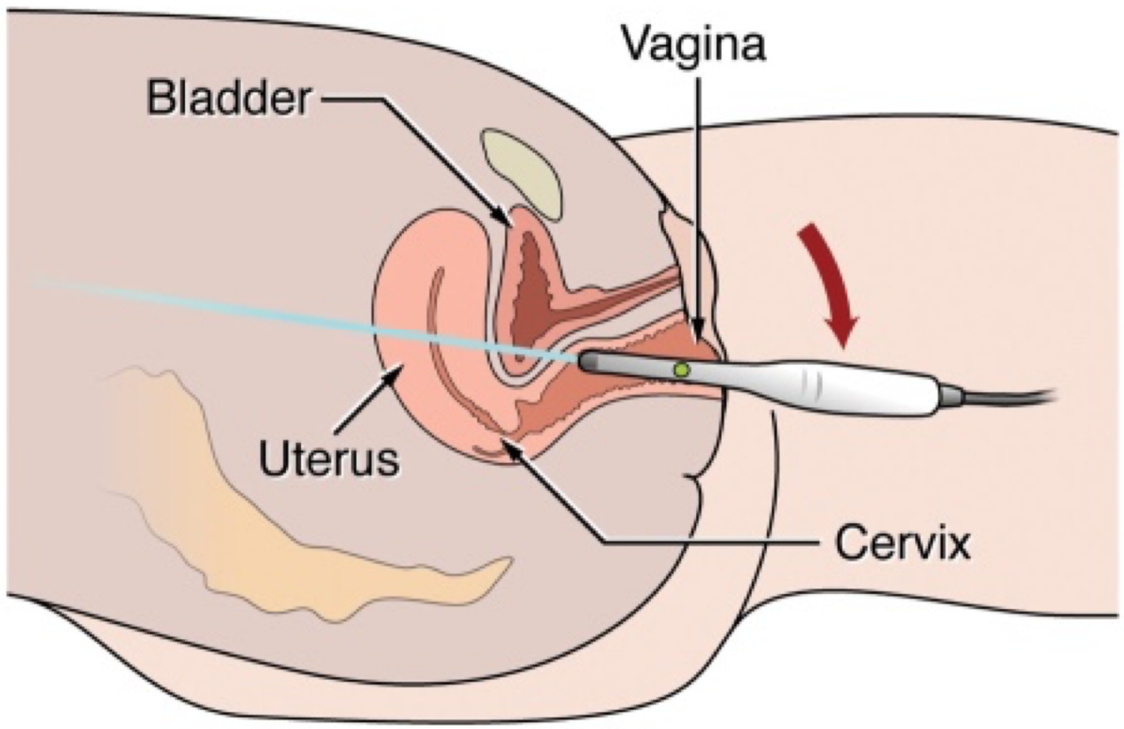


Figure 38: Lowering the handle directs the beam towards the bladder.

Socransky, S., & Wiss, R. (2014, April 25). Figure 38: Lowering the handle directs the beam towards the bladder [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

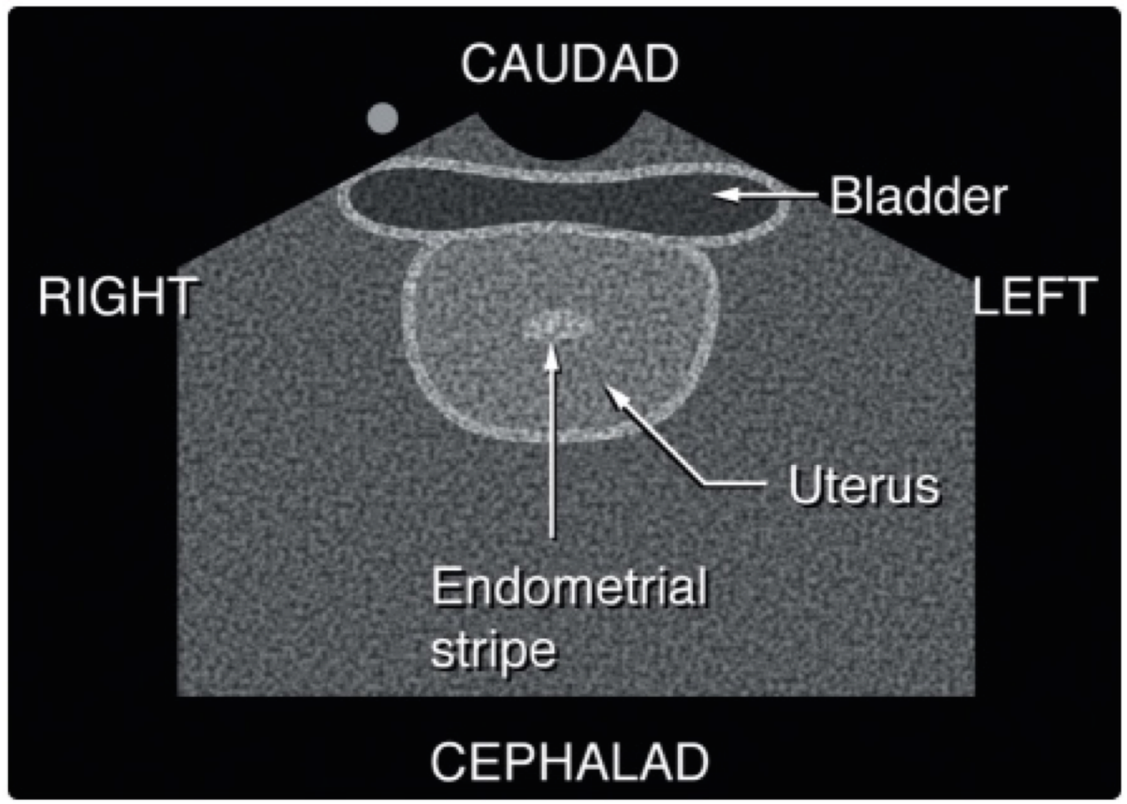


Figure 39: In the coronal plane, the bladder is seen across the top of the screen with the uterus just far field to it.

Socransky, S., & Wiss, R. (2014, April 25). Figure 39: In the coronal plane, the bladder is seen across the top of the screen with the uterus just far field to it [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Transverse Plane

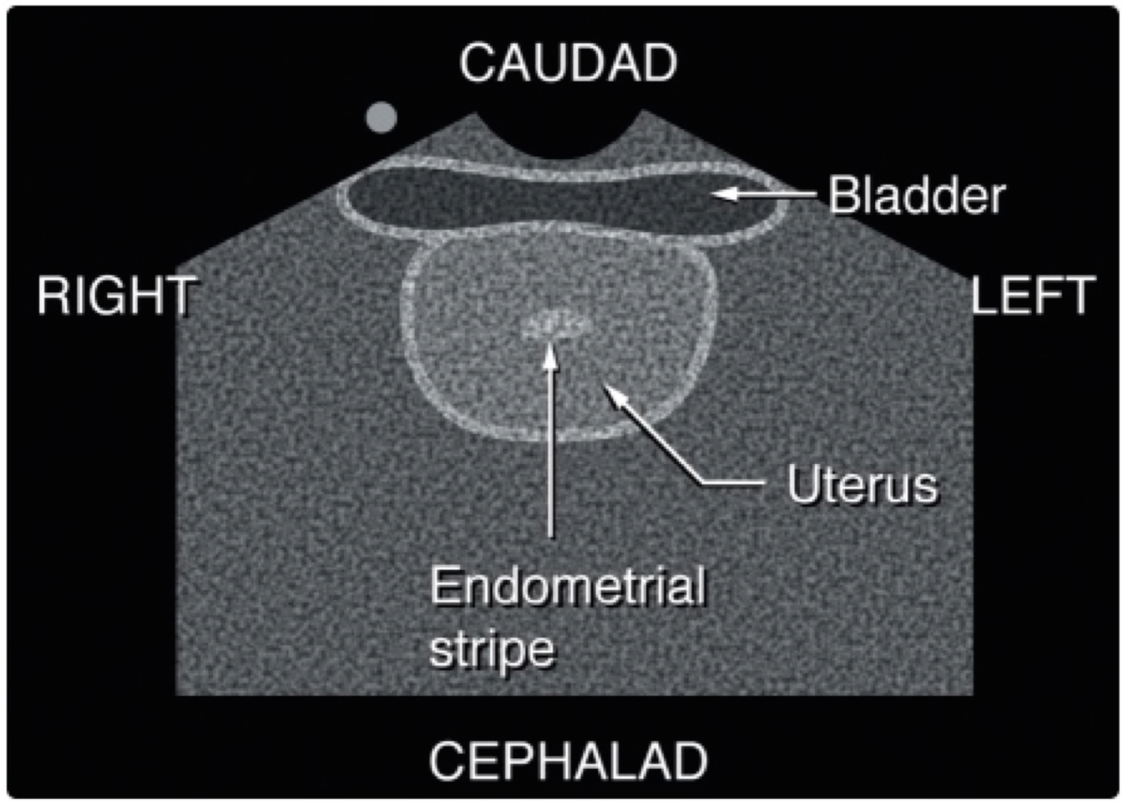
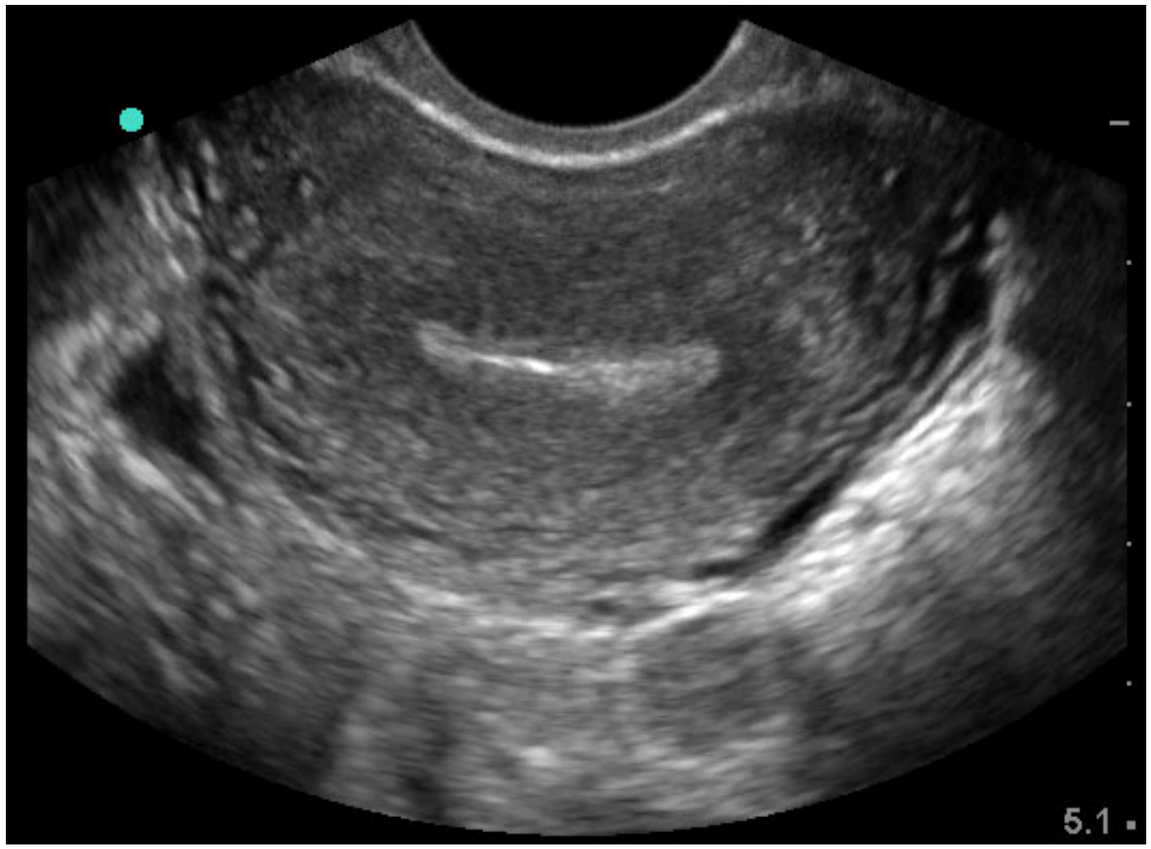


Figure 39: In the coronal plane, the bladder is seen across the top of the screen with the uterus just far field to it.

Socransky, S., & Wiss, R. (2014, April 25). Figure 39: In the coronal plane, the bladder is seen across the top of the screen with the uterus just far field to it [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11



Longitudinal view of uterus [Digital image]. (n.d.). Retrieved from https://sinaiem.org/tutorials-2/pelvis/

Sagittal Plane

1. Rotate the probe 90°
2. Identify bladder and uterus → center them to the middle of the screen
3. Sweep through uterus (side to side)

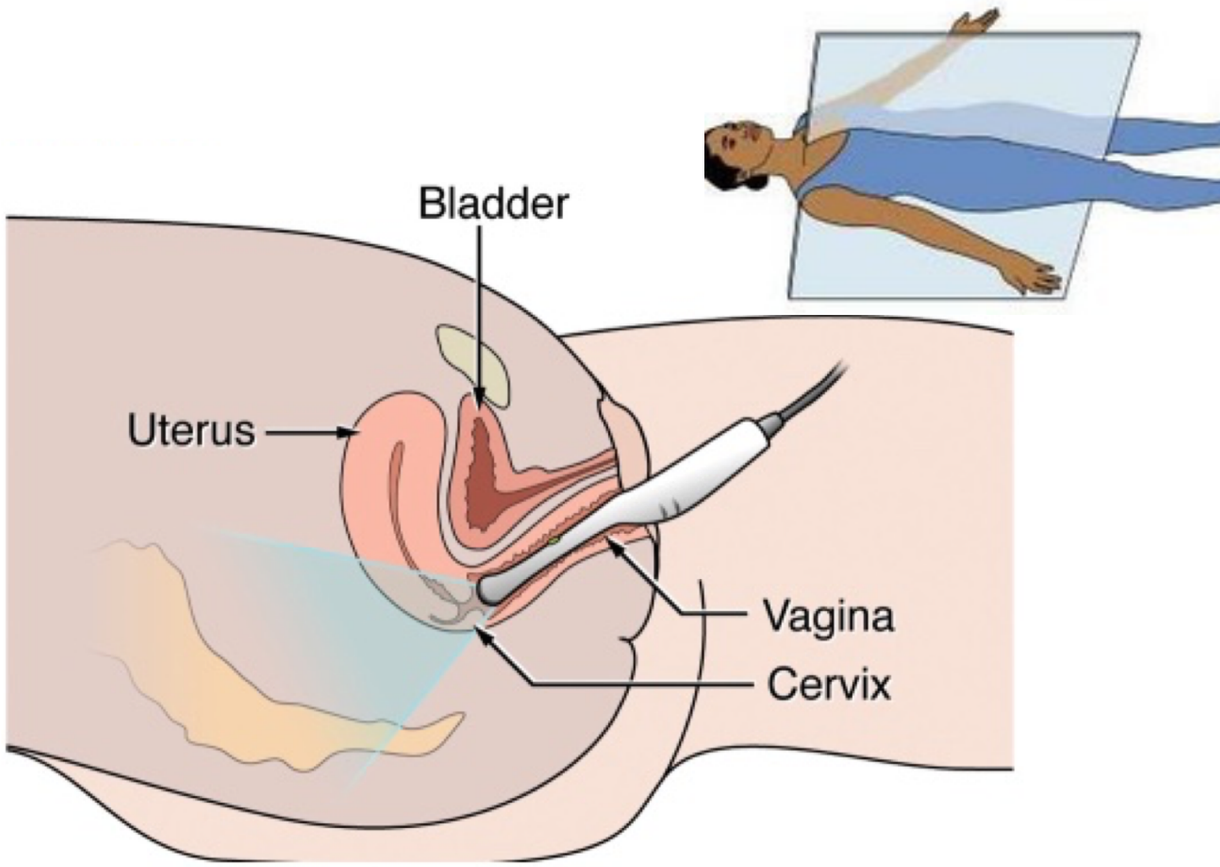


Figure 29: The posterior path of the vagina directs the beam away from the bladder.

Socransky, S., & Wiss, R. (2014, April 25). Figure 29: The posterior path of the vagina directs the beam away from the bladder [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

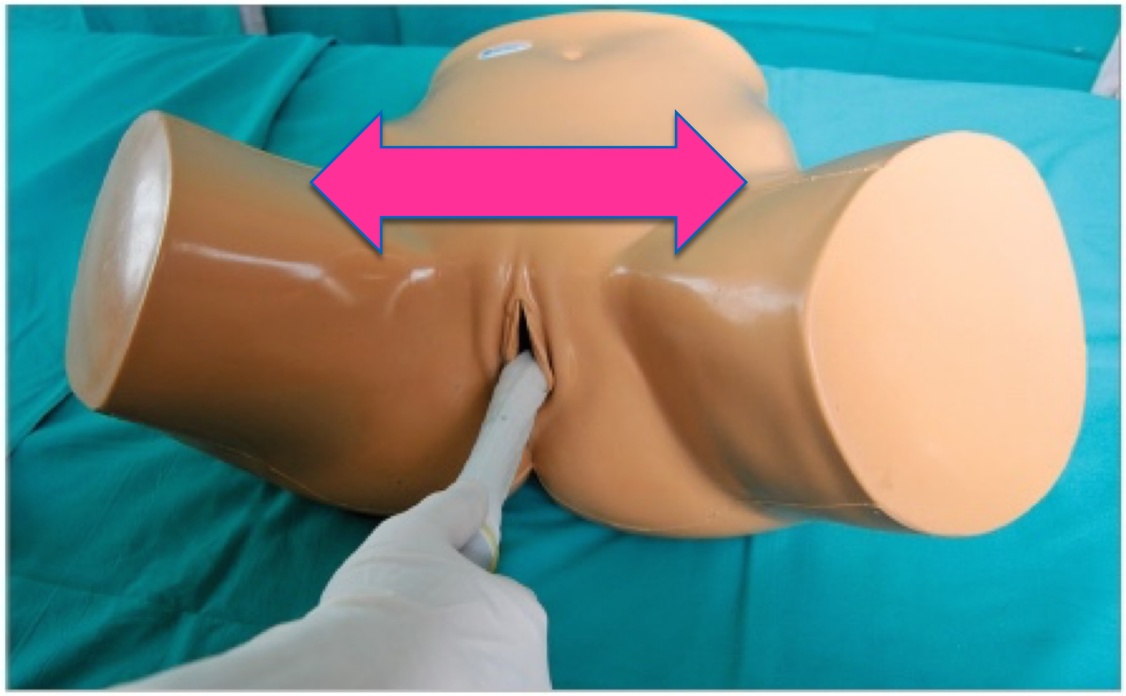


Figure 27: The probe is introduced into the vagina with the indicator (the physician's thumb is on the indicator) directed towards the ceiling.

Socransky, S., & Wiss, R. (2014, April 25). Figure 27: The probe is introduced into the vagina with the indicator directed towards the ceiling [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Sagittal Plane

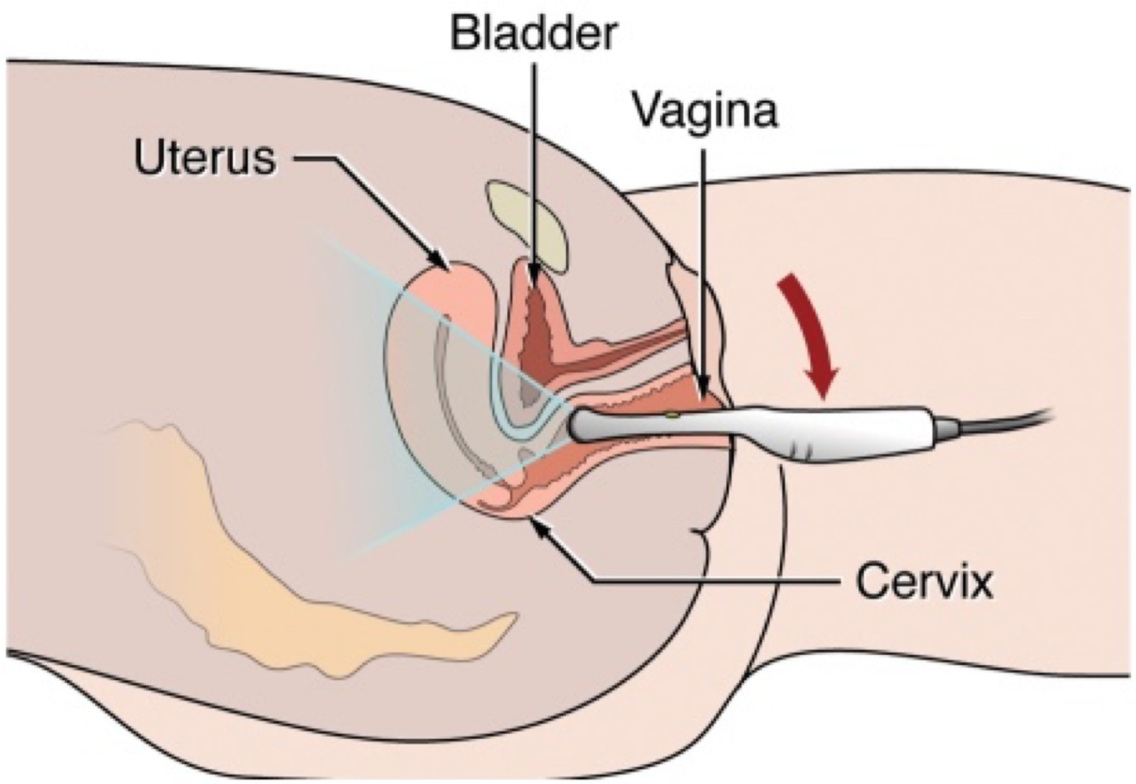


Figure 30: Pushing the handle down directs the beam anteriorly.

Socransky, S., & Wiss, R. (2014, April 25). Figure 30: Pushing the handle down directs the beam anteriorly [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

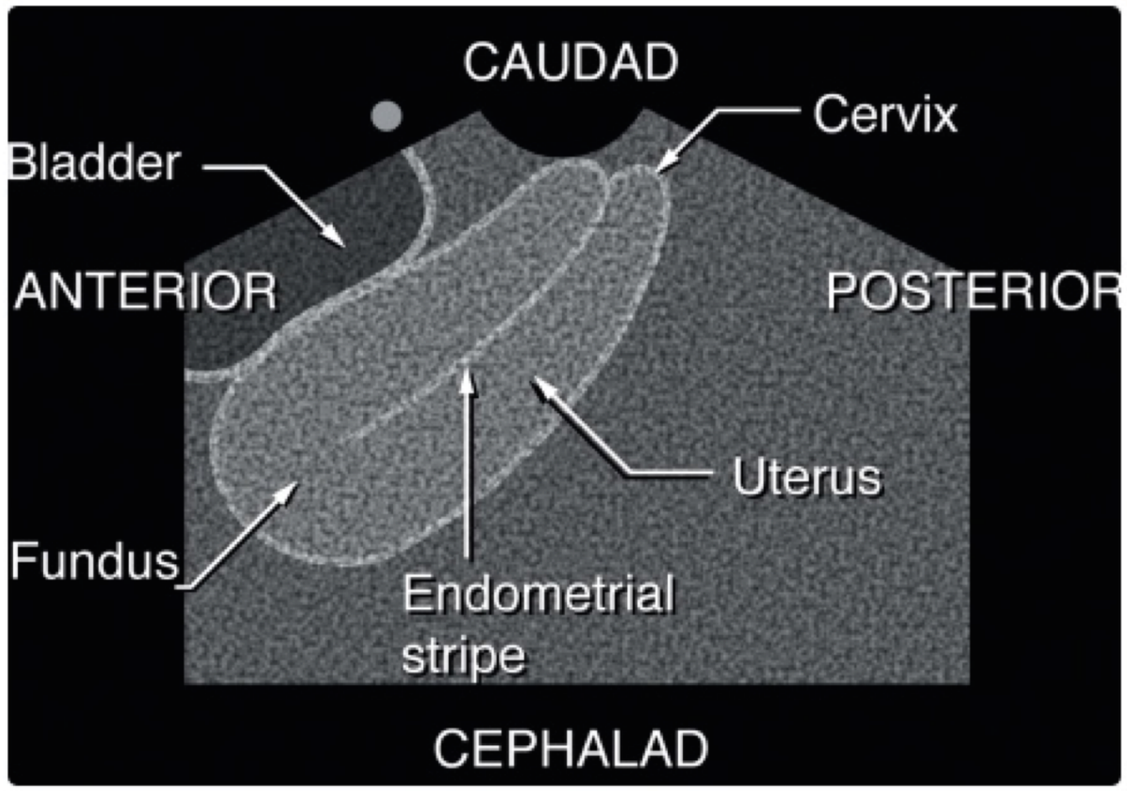


Figure 31: The bladder is seen at the top left of the screen, with the uterus filling the middle of the screen.

Socransky, S., & Wiss, R. (2014, April 25). Figure 31: The bladder is seen at the top left of the screen, with the uterus filling the middle of the screen [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11

Sagittal Plane

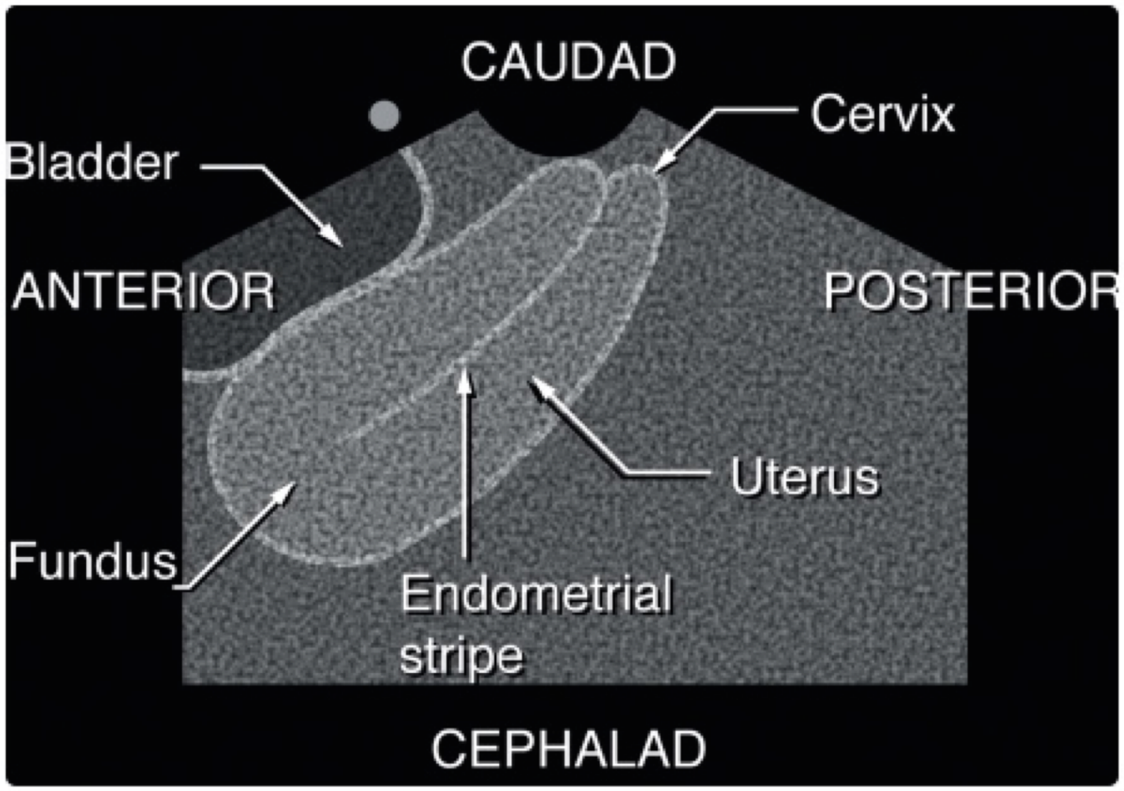
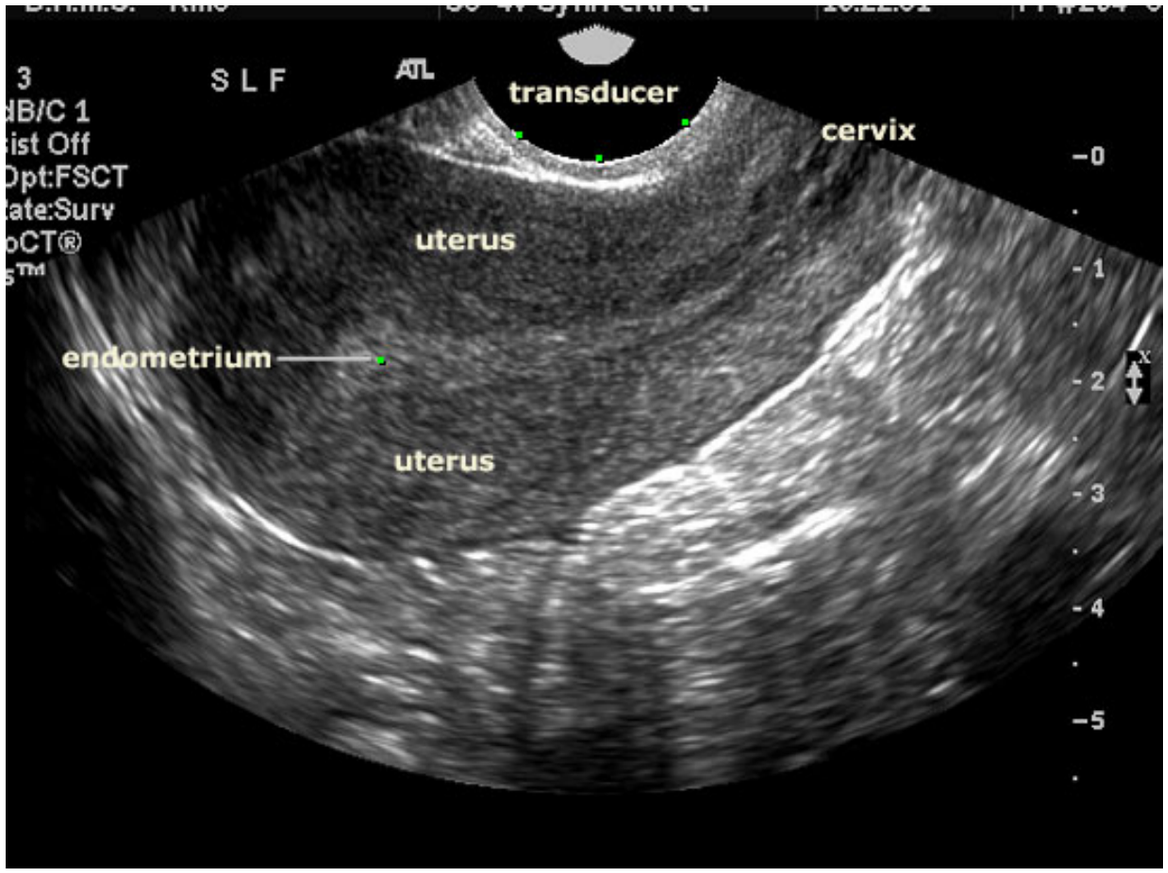


Figure 31: The bladder is seen at the top left of the screen, with the uterus filling the middle of the screen.

Socransky, S., & Wiss, R. (2014, April 25). Figure 31: The bladder is seen at the top left of the screen, with the uterus filling the middle of the screen [Digital image]. Retrieved from https://itunes.apple.com/us/book/essentials-point-care-ultrasound/id841572764?mt=11



[Digital image]. (2014, May 7). Retrieved from https://storytotellya.com/2014/05/07/trans-vaginal-what/comment-page-1/

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