



ISUOG Basic Training

Transducers, Image Production,
Knobology and Scanning Planes

Learning objectives

At the end of the lecture you will be able to explain:

- How to set up the ultrasound machine
- Which knobs are important to ensure optimal imaging
- The correct orientation of ultrasound images

Key questions

1. Which controls should be used to maximise the quality of the image?
2. What is the correct image orientation when scanning with a transabdominal (TA) probe?
3. What is the correct image orientation when scanning with a transvaginal (TV) probe?

Transducer types



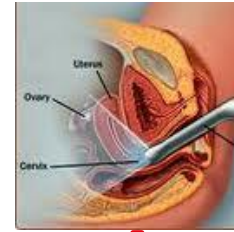
TA



Linear



Curvilinear



TV



Annular / Intracavitary

Hygiene for TV imaging



A sheath or cover must **always** be used when performing TV examinations. Prior to every examination ask the patient if they have a latex allergy and ensure latex free covers are available.

Clean the transducer post scan



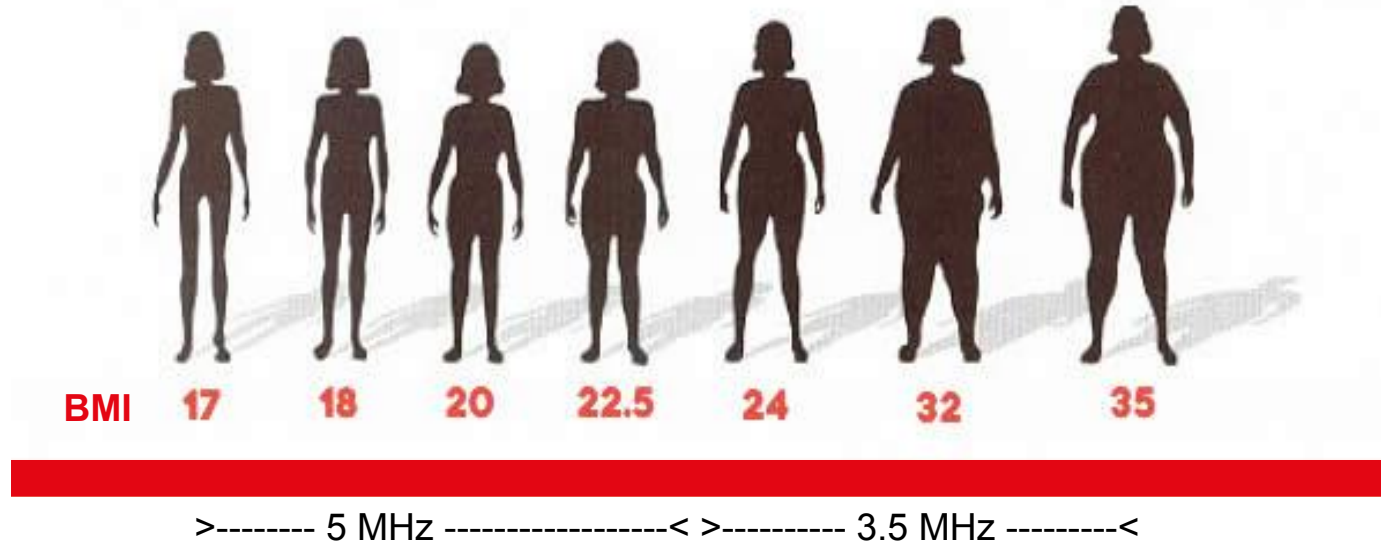
Efficient disinfection will significantly reduce the risk of cross-contamination for the ultrasound patient.

Transducers do not need to be visibly soiled to be contaminated with bacterial spores or viral capsids

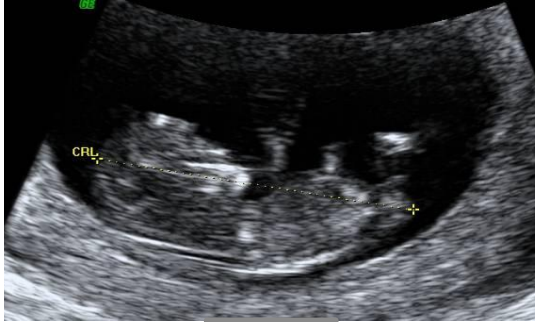
Comparison of TA & TV imaging

Probe	Transabdominal (TA)	Transvaginal (TV)
Frequency	3.5 – 5 MHz	5 - 9.5 MHz
Resolution	Inferior	Superior
Field of view	Larger	Smaller
Structures > 4cm from the probe face	Within field of view	Beyond field of view
<ul style="list-style-type: none">Imaging challenges	<ul style="list-style-type: none">Full bladder in some casesHigh body mass index (BMI) - distance from probe face to area of interestBowel gas	<ul style="list-style-type: none">Field of viewHigh BMI (to lesser extent)Bowel gas (to lesser extent)

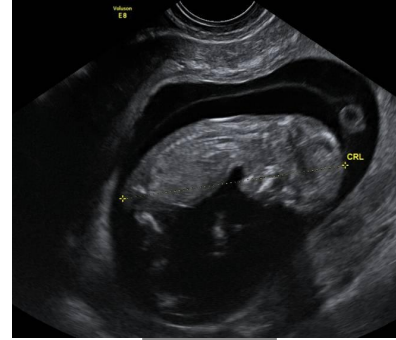
Transducer selection



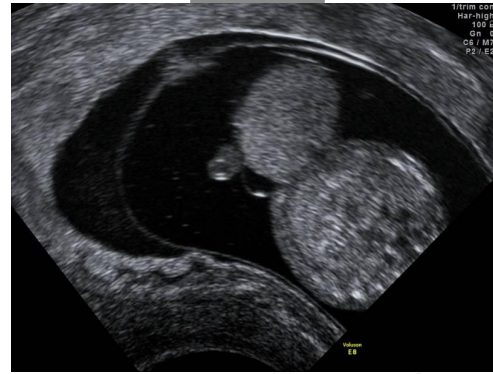
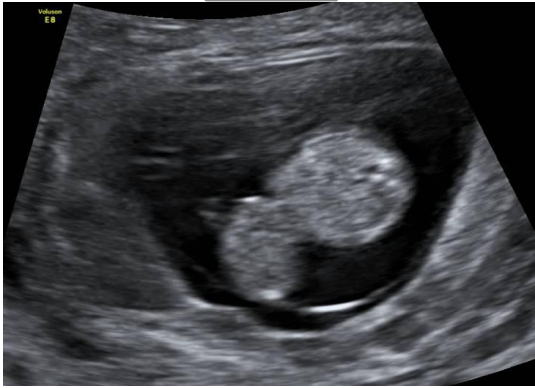
Comparison of TA & TV imaging



TA



TV

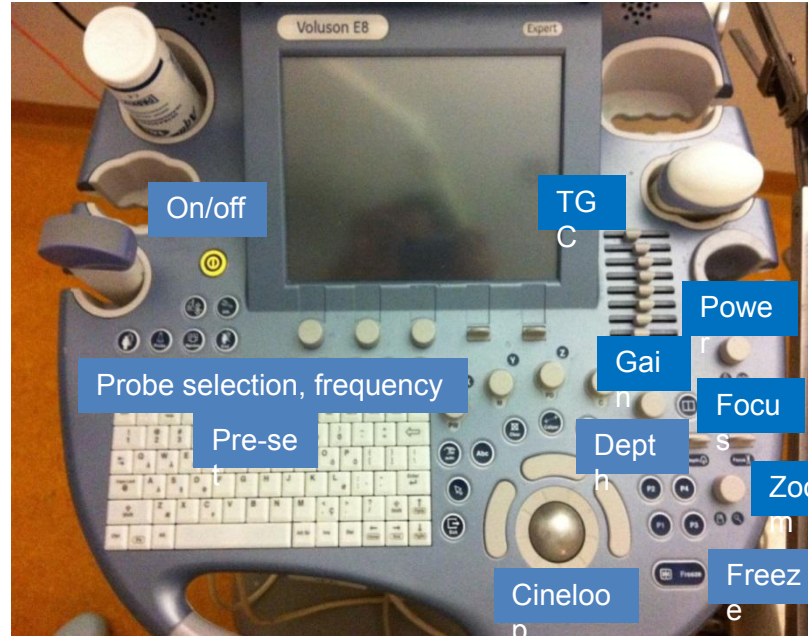


Transducer selection

Examination	Route	Frequency
1st trimester 5-8 w	TV	5 - 9.5 MHz
1st trimester 8-13 w	TA	5 MHz (equivalent multi-frequency)
2nd trimester	TA	5 MHz (equivalent multi-frequency) <i>If available, also consider 3D probe (heavier than 2D)</i>
3rd trimester	TA	3.5 MHz (equivalent multi-frequency) <i>If available, also consider 3D probe (heavier than 2D)</i>
Accurate assessment of: <ul style="list-style-type: none">• Low placenta• Cervical length	TV	5 - 9.5 MHz

Image optimisation / knobology

- Adapt image according to scan plane & object of interest
- Multiple options
 - Probe selection
 - Frequency
 - Preset
 - Power
 - Depth
 - Gain
 - Time Gain Compensation (TGC)
 - Focus
 - Zoom (read/write)
 - Freeze
 - Cineloop



Power

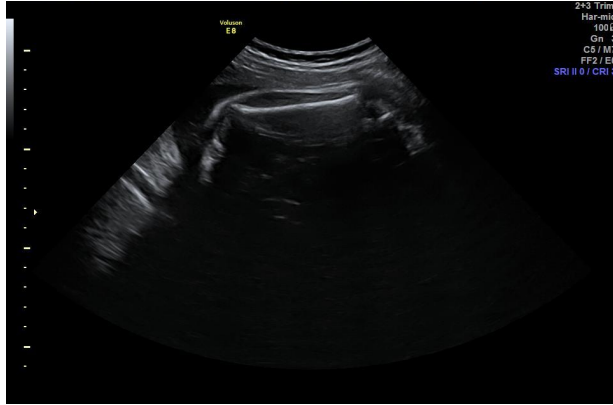


- = Energy transmitted into patient
- Default should NOT be set at 100% (maximum output)
- Recommend 75% as default, then use gain control to optimise image

Power



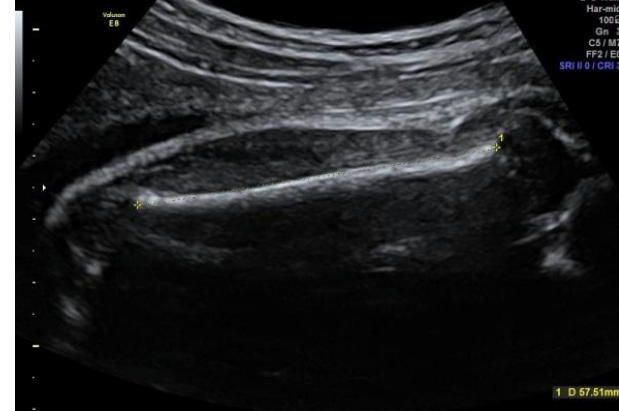
Depth & zoom



X



X



✓

Depth & zoom

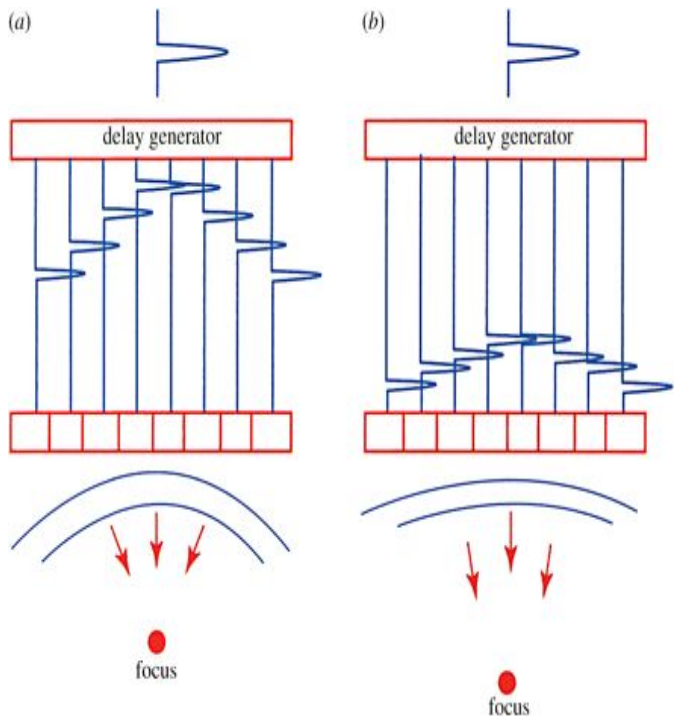
Read zoom



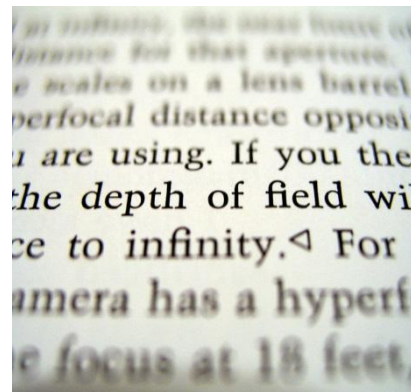
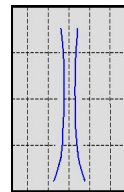
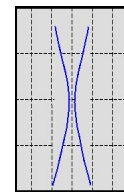
Write zoom



Focus



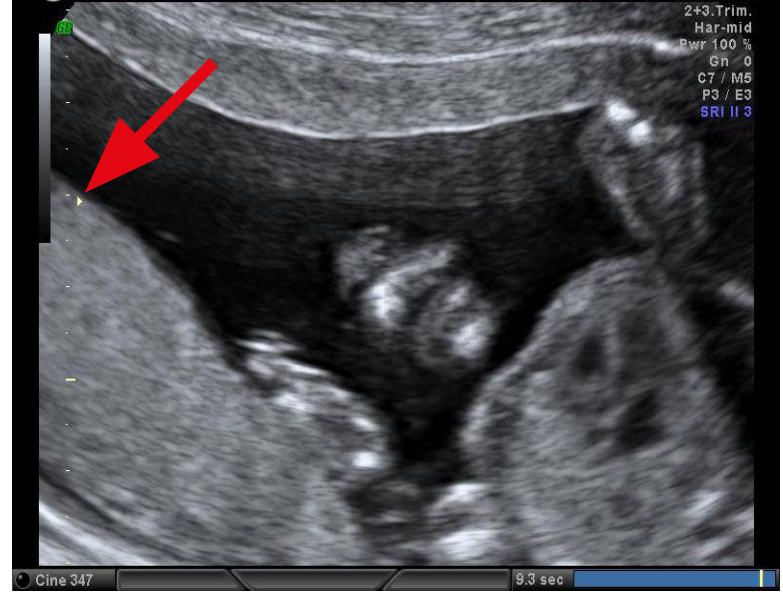
- Compare to a lens
- Extremely important in US guided needling
- Often forgotten!



Focus



X



✓

2D gain



X



✓



- Gain amplifies returning frequencies
- Fluid is black when correct gain settings are applied

Sector width

- Sector width related to field of view required
- A narrow sector (right) improves resolution, but reduces field of view

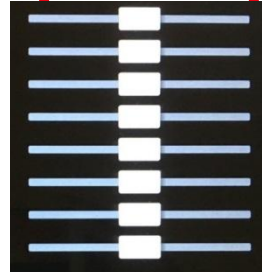


Time gain compensation

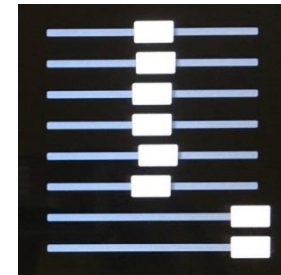
(TGC)



Insufficient near gain

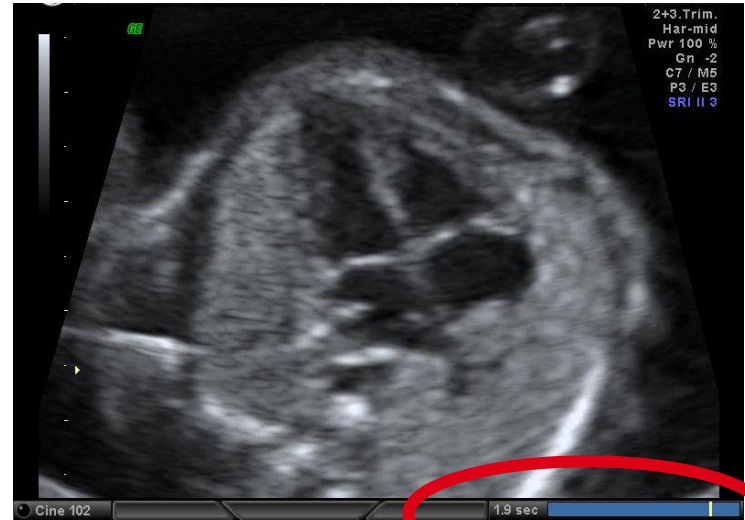
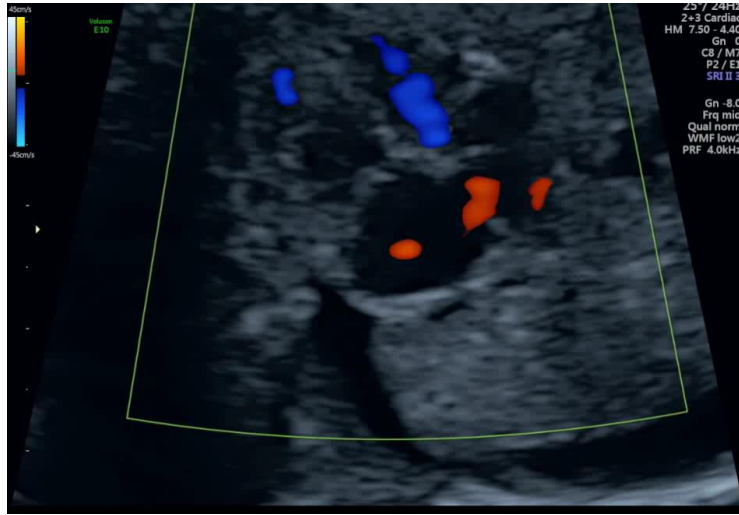


Uniform gain



Excessive far gain

Cineloop



- Useful for retrieving optimal image of rapidly moving structure(s)
- Should not be used to 'hunt' for acceptable image

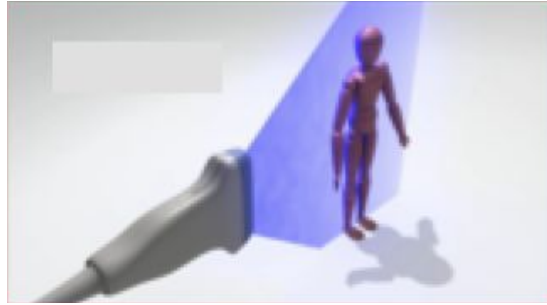
Room set up – TV & TA

Typically the scan is performed with:

- The woman lying to the right of and facing the operator
- The operator holding the probe in the right hand & operating the machine controls with the left hand



Ultrasound planes



Coronal



Sagittal



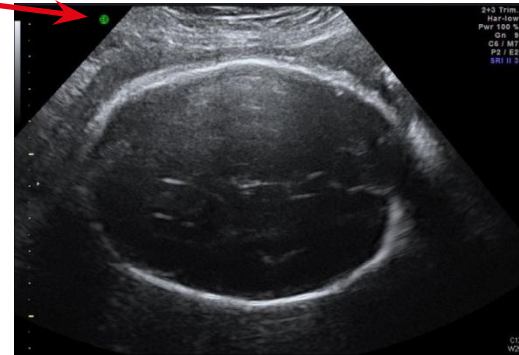
Transverse

Probe orientation

- Every probe has one or more marks which you can feel and see
- The mark on the probe always relates to one side on the monitor
- Check the position of the probe and of the image on the monitor



May also be called an orientation notch

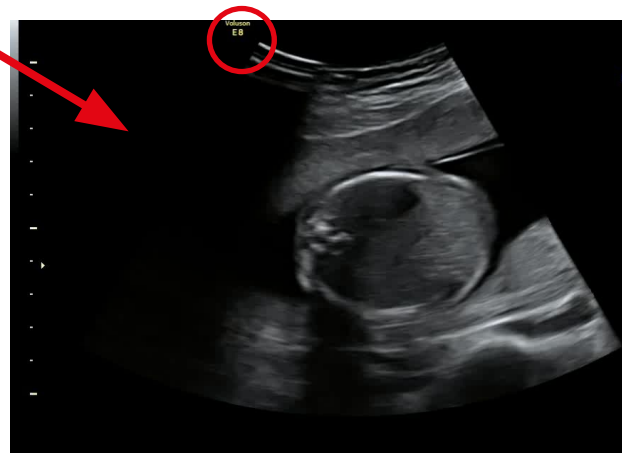


Correct probe orientation - transverse

Rule:

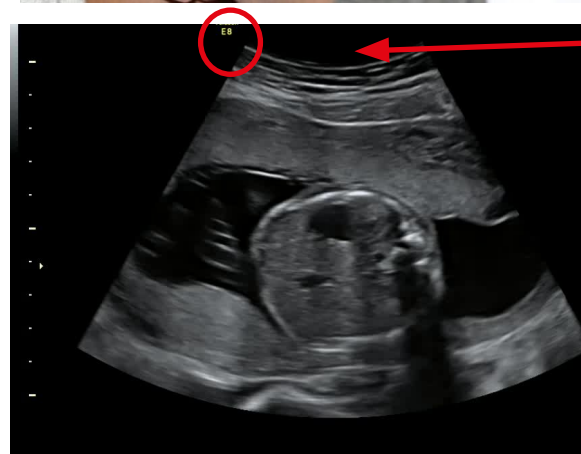
When you look at the woman and at your monitor:

- The **Right** side of the woman is displayed on the **Left** on the monitor
- Use pressure of your finger to check the correct position
- Fetus with its back to the right of the woman
- **NEVER** rotate the probe $> 100^{\circ}$ but go back to where you started



Incorrect probe orientation - transverse

- The probe has been rotated, incorrectly, through 180° (the mark is now towards the woman's left)
- The fetus therefore seems to be lying with its back to the left side of the woman



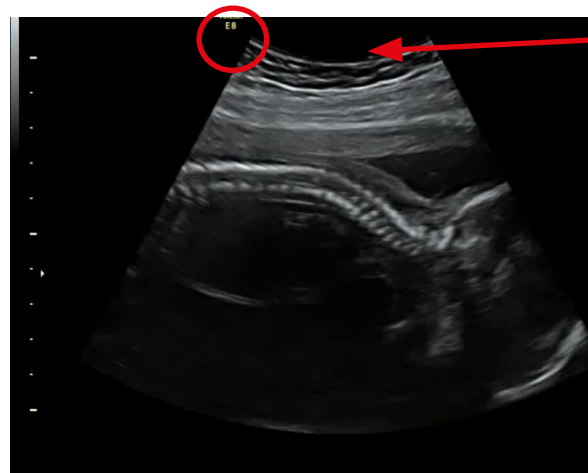
Pressure
from finger

Correct probe orientation - longitudinal

Rule:

When you look at the woman and at your monitor:

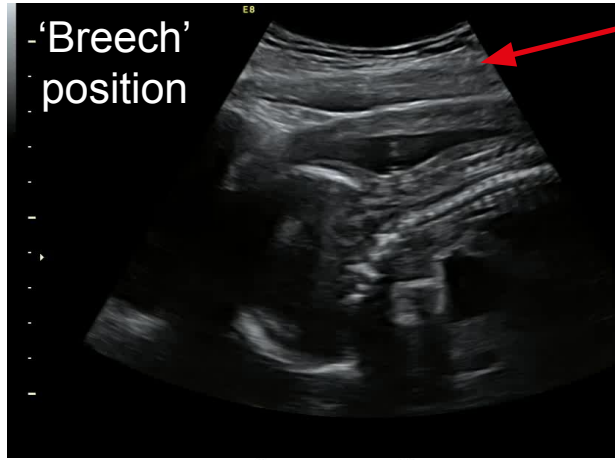
- The **CEPHALAD** /fundus of the woman is displayed on the **Left** on the monitor
- **NEVER** rotate the probe $>100^{\circ}$, but go back to where you started



Pressure
from
finger

Incorrect image orientation - longitudinal

- The probe has been rotated, incorrectly, through 180° (the mark is towards the maternal bladder)
- The fetus is now diagnosed, **incorrectly**, as in a breech position



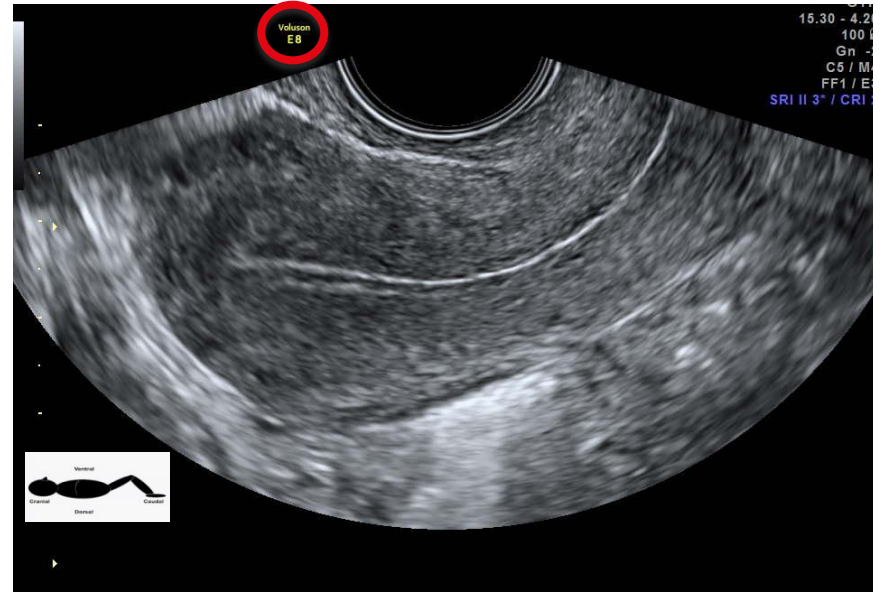
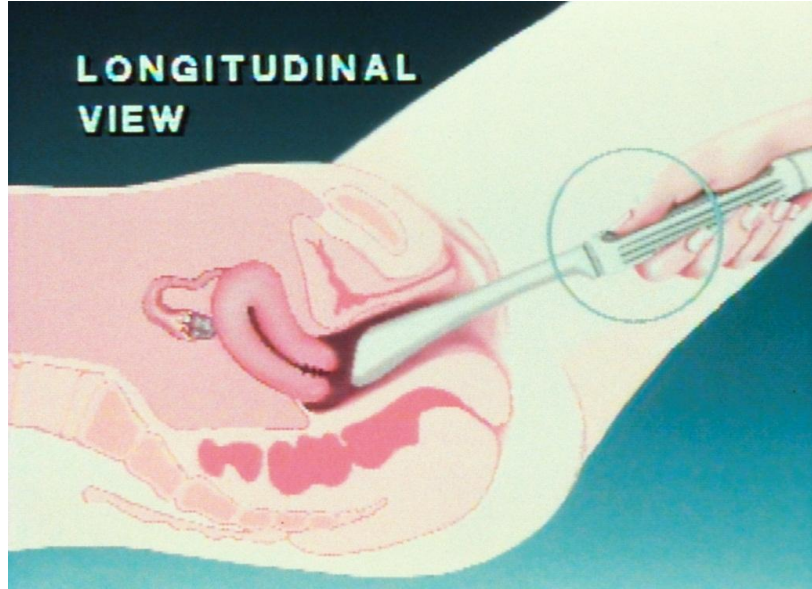
Pressure from finger

Transvaginal probe orientation

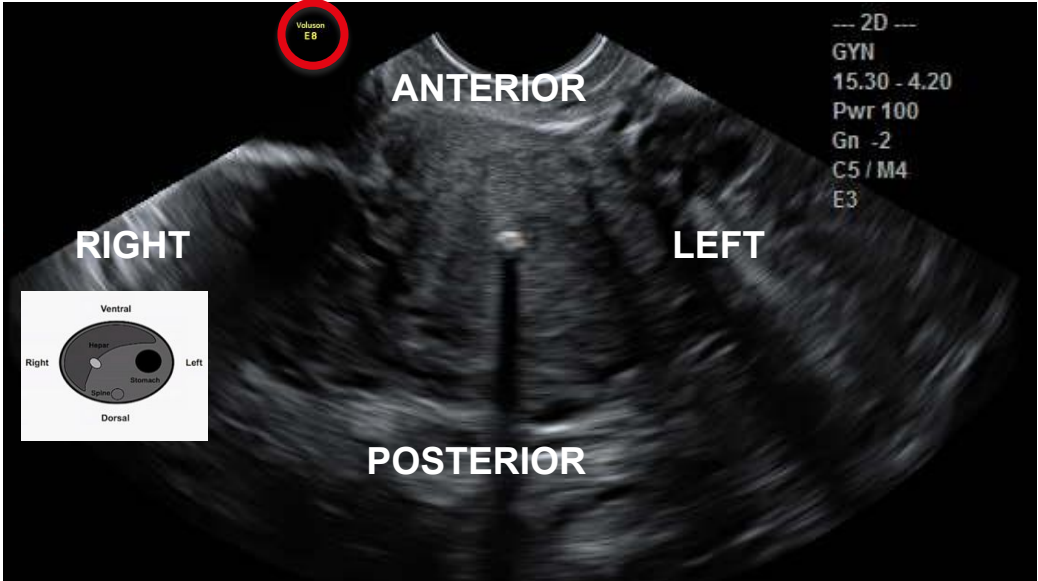


(rotate probe anticlockwise)

TV probe orientation sagittal



TV probe orientation transverse / coronal



Transducer movements

- Rotating: Changes the transduce plane from sagittal to transverse
- Sliding: Along wide and narrow axis of transducer
- Dipping (Heel/Toe): Along narrow axis of transducer
- Angling (Fanning): Along wide axis of transducer

Rotating : Changes transducer planes

- Transverse to Sagittal

.....rotate Clockwise



- Sagittal to Transverse

.....rotate Counter Clockwise



The notch should always be towards the patients right side (transverse) or towards the head (sagittal)

Rotation is also used to elongate a structure such as to image the full length of the femur

Slide in sagittal plane – along narrow axis

SLIDE in the sagittal plane

- Centers anatomy on screen
- Towards or away from notch
- Slide along the narrow axis



Towards notch Away from notch



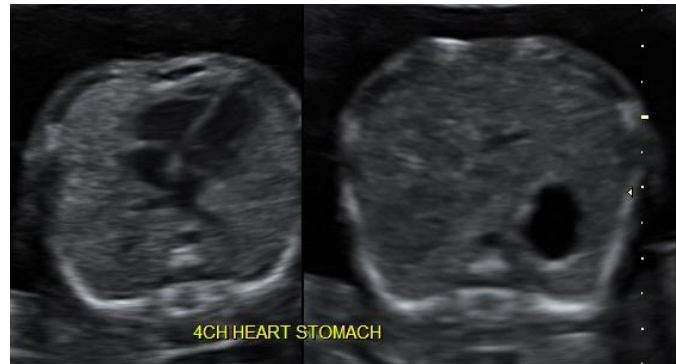
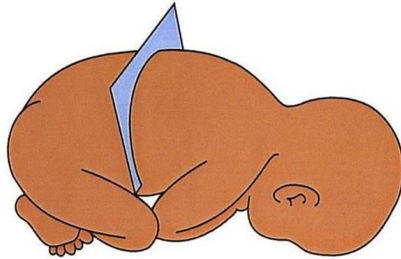
Sagittal view: Sliding AWAY from notch - inferiorly



Sliding in the sagittal plane helps center the anatomy of interest on the screen

Slide in transverse plane – along wide axis

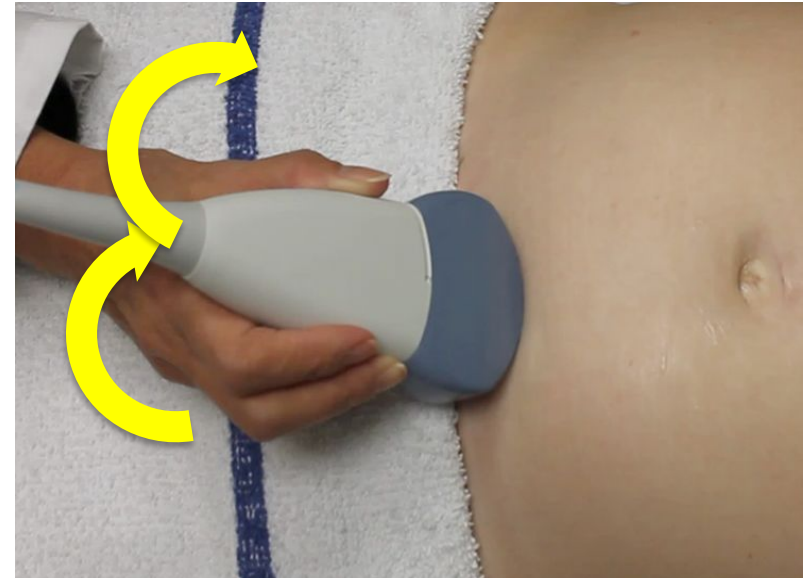
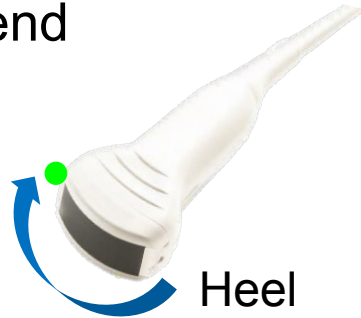
- Used for survey scan of the pregnancy / fetus
- Helps determine fetal lie and locate anatomy
 - e.g. sliding from fetal heart to fetal stomach



Transducer movements:

Dipping (heel / toe)

- **Dipping (heel / toe)** towards or away from notch along narrow axis of transducer
- Helps center anatomy on screen
- Toe is at the notch end,
- heel is the non-notch end



Transducer movement: Angle / Fan

- Keeping probe in one spot :
Can angle from side to side
along wide axis of transducer
- This is used to center anatomy



Key points

1. Select correct probe
2. Adapt the machine settings throughout the examination to obtain & maintain optimal views
3. Probe orientation and image orientation should be consistent
4. Rotate probe anti-clockwise when changing from longitudinal plane to transverse/coronal plane for - TA and TV



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