NZ COLLEGE OF SEXUAL & REPRODUCTIVE HEALTH

MODULE 4

Point of care ultrasound in first trimester abortion (POCUS)

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CONTENTS

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1. INTRODUCTION

Ultrasound is one of several diagnostic tools available to clinicians for evaluating a pregnancy and the contents of the uterus. There are two levels for ultrasound diagnosis:

- The first, point of care ultrasound (POCUS) is a limited scan using an abdominal handheld ultrasound scanner, undertaken by health practitioners, using an abdominal scan to answer a simple clinical question, such as gestational age
- The second is a formal comprehensive scan using transvaginal or abdominal probes, undertaken by a trained sonographer, to provide a comprehensive review of the anatomy

This training module describes the theoretical knowledge required to provide point of care ultrasound for people seeking abortion.

Provision of point of care ultrasound (POCUS) by an abortion provider was supported by the 2018 New Zealand Standards in Abortion Care. Whilst this recommendation is not continued in the 2021 New Zealand Aotearoa Abortion Guideline, the potential benefits referred to in the standards document remain unchanged.

> The 2018 New Zealand Standards in Abortion Care, recommendation 8.4.3 states: "If an ultrasound is required, it should be available within the abortion service rather than by a community provider. The reasons for this are:
>
> (a) There are often delays in getting a scan in the community
> (b) Many community providers charge a co-payment
> (c) There is inconvenience and cost associated with attending a scan appointment
> (d) Community providers are sometimes insensitive to a woman's situation"

Point of care ultrasound is not the equivalent of a formal diagnostic scan. Where a diagnostic scan reviews the available anatomy/function and reports on the findings, point of care ultrasound is performed by a health professional with the aim of answering simple clinical questions. As such pathologies outside of the clinical question may be missed with a point of care scan, and this tool is only valuable in answering the clinical question posed.

This module is aimed at providing the theory elements for using a simple, handheld device for the following:

1. Identifying the uterus
2. Identifying what is in the uterus, such as blood, foetus, sac, retained products of conception
3. Differentiating between proven intrauterine pregnancy (IUP) and pregnancy of unknown location
4. Gestation measurements in the context of establishing upper limit for early medical abortion (EMA)
5. Identifying that the uterus has been evacuated following vacuum aspiration

After completion of these theory elements, it will be necessary to undertake a practical assessment for accreditation.

In the case of first trimester scanning for abortion providers, the following clinical questions are relevant:

- Is there an intrauterine pregnancy?
- What is the gestational age of the intrauterine pregnancy?
- Is the uterus empty?
- Is there a twin pregnancy?
- Are there retained products of conception?

Other tools available to clinicians in making their assessment are:

- Medical history, date of last menstrual period (LMP) and ectopic risk assessment
- Urine βhCG pregnancy tests, which are available at differing levels of sensitivity
- Serum βhCG analysis (a single value or movement in values)
- Physical examination
- A detailed ultrasound scan by a sonographer

These other tools are considered in more detail in Module 1 – Consultation.

2. OVERVIEW

Introduction

The World Health Organization (WHO) outlines that ultrasound is not necessary to provide abortion care, but it is a simple diagnostic tool that can provide useful information. Ultrasound, not urine βhCG or blood tests, is the fastest way to determine a viable pregnancy.

1. **Ultrasound can be used to diagnose the location of the pregnancy and ectopic pregnancies**
   An ectopic pregnancy occurs when the fertilised egg implants somewhere other than the uterus. In an ectopic pregnancy, the egg most often implants in the fallopian tube (a tubal pregnancy), but it can also implant inside the ovary, in the abdominal cavity or on the cervix. Continuing the pregnancy could destroy an ovary or a fallopian tube and cause life-threatening blood loss for the mother.

   If a patient were to have an ectopic pregnancy and follow through with an abortion procedure, the treatment would not have any effect on it and the pregnancy would continue to grow and cause serious risks.

   See the relevant research into this in the Further reading and resources section.

   As a consequence of this research and associated guidelines, it is evident that handheld ultrasound has an excellent prediction confirming viable IUP from gestational week 7, **but an ectopic risk assessment should be completed and gestation estimated through LMP and physical examination**, rather than relying on these simple handheld ultrasound tools to provide this diagnosis.

2. **Ultrasounds can determine gestational age.**
   It is very important to know the gestation of a pregnancy before an abortion is performed and an indication of gestation can be achieved using this simple diagnostic tool.

3. **Ultrasounds help the client to be fully informed.**
   The client should be fully informed before making any decision. Having an ultrasound will help them to make a fully informed choice.

3. TIKANGA IN ABORTION CARE

Tikanga Māori: Living by Māori values (Mead, 2016) states that:

> *"Generally speaking, tikanga are Māori customary practices or behaviours. The concept is derived from the Māori word 'tika' which means 'right' or 'correct' so, in Māori terms, to act in accordance with tikanga is to behave in a way that is culturally principled and appropriate. According to Mead (2016) "it is difficult to imagine any social situation where tikanga Māori has no place. Ceremonies relating to life itself – birth, marriage, sickness and death – are firmly embedded in tikanga Māori". Furthermore, "tikanga comes out of the accumulated knowledge of generations of Māori and is part of the intellectual property of Māori."*

Physical and practical approaches to upholding Tikanga within abortion care include:

1. The physical transition from waiting areas to areas where consultation/abortion occur. Separating Noa (ordinariness) from Tapu (sacredness)
2. The right to Karakia (prayer) should be offered
3. The ability to offer whānau support throughout the process, whilst maintaining confidentiality. Always ask the patient as to their wish/need for whānau involvement.
4. Be respectful of Taonga (valuables worn with spiritual significance)
5. The ability to wash after the procedure
6. Support of Kai Atawhai (return of pregnancy tissue to cultural land) and facilitation of this if the patient is unable

The Abortion Legislation Act 2020, in combination with the principles of Te Tiriti o Waitangi, provides whānau, hapū and iwi with the opportunity to revitalise their older knowledges and practices for abortion. The intention is for Māori, in the context of abortion, to enact their rangatiratanga or self-determining rights over tikanga and mana motuhake or autonomy over their bodies and their reproductive health and wellbeing. For this reason, health practitioners should be very careful not to impose their understanding of tikanga or mātauranga Māori on Māori through the abortion process. Nor should they assume that all Māori are familiar with terms such as tikanga, mātauranga and Te Tiriti o Waitangi. Unfamiliarity with such terms can be experienced by Māori as a diminishment of their mana as expressed by Te Tiriti o Waitangi; an outcome that is antithetical to Te Tiriti, the Abortion Clinical Guideline and Ngā Paerewa.

As a health practitioner providing abortion care please refer to "The New Zealand Aotearoa Abortion Clinical Guideline 2021". This document provides the framework for abortion providers and health practitioners providing abortion services to Māori while upholding the principles of Te Tiriti o Waitangi and was developed with the support of *Ngā Paerewa Health and Disability Services Standard*

For further information, see "Māori women and abortion: A Kaupapa Māori literature review".

4. THEORY OF ULTRASOUND

What is ultrasound?

Ultrasound is a medical imaging technique that uses high frequency sound waves and their echoes. The technique is similar to the echolocation used by bats, whales and dolphins, as well as SONAR used by submarines. In ultrasound, the following events happen:

- The ultrasound machine transmits high-frequency (1 to 15 megahertz) sound pulses into the body using a probe
- The sound waves travel into your body and hit a boundary between tissues, e.g. between fluid and soft tissue, soft tissue and bone
- Some of the sound waves get reflected back to the probe, while some travel on further until they reach another boundary and get reflected
- The reflected waves are picked up by the probe and relayed to the machine
- The machine calculates the distance from the probe to the tissue or organ (boundaries) using the speed of sound in tissue (1,540 m/s) and the time of each echo's return (usually on the order of millionths of a second)
- The machine displays the distances and intensities of the echoes on the screen, forming a two-dimensional image
- In a typical ultrasound, millions of pulses and echoes are sent and received each second. The probe can be moved along the surface of the body and angled to obtain various views.

Ultrasound can produce different types of image on a screen

The ultrasound that you will be using for this module presents a two-dimensional image, or "slice," of a three-dimensional object (fetus, organ). In addition some point of care ultrasound machines offer a doppler mode. Doppler measures movement (usually of fluids) representing the movement as colours on the two-dimensional image. For early pregnancy ultrasound for the abortion provider, it can give extra information about the fetal heart and blood flow in potential retained products of conception.

5. EQUIPMENT

There is a wide range of ultrasound equipment available, from high tech machines with multiple probes costing six figure sums to handheld devices with limited functionality. For the clinical questions this module is designed to answer, cheaper handheld devices with a single abdominal (low frequency, curvilinear) probe are sufficient.

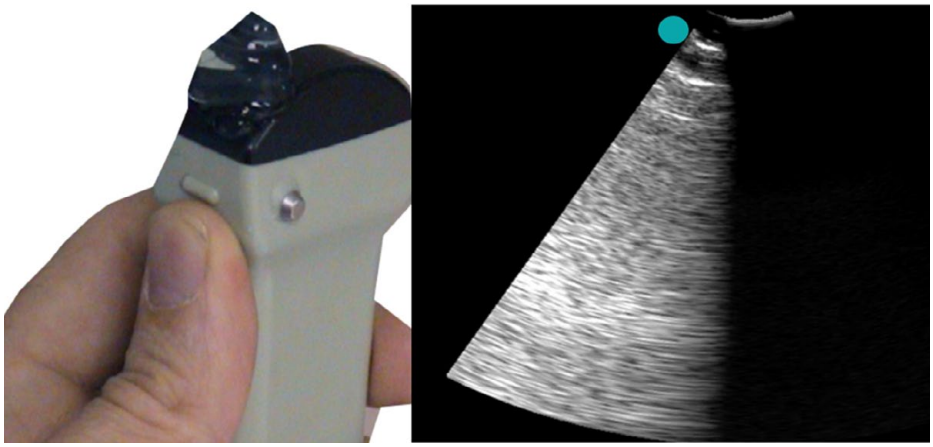
There are multiple devices on the market. Functionality and quality can vary between them. In purchasing a handheld scanner, you should consider the following:

- Does it have its own screen, or does it need to be partnered with a mobile device?
- Is it a suitable size and is it portable?
- Is the user interface design intuitive? (e.g. ease of depth and gain adjustment)
- Is there an image archiving capability? (if required)
- Can it easily be cleaned?
- What is its resolution? Devices with higher resolution give a clearer image
- Does it have an obstetric setting? Without this you will not be able to easily calculate gestational age.
- Is it wired or cordless? Although cordless may be less cumbersome, there is often a trade off with image quality and price.
- What is the battery life/charging time? Can the device be used while charging?
- What is the warranty? And is the service New Zealand based?
- Are there any hidden costs? Some scanners have a yearly subscription in addition to the cost of the machine.

Adjusting Ultrasound Machine Settings:

Machine adjustment can improve image quality and diagnostic accuracy. There are four important settings to find on your ultrasound machine:

- **Examination type:** examination pre-sets optimise the imaging settings for the kinds of structures you are interesting in viewing. Select an obstetric examination type if it is available, abdominal is your next best option.
- **Depth:** set the depth such that your object of interest is centred on the screen to optimise image quality.
- **Gain:** adjusts the overall screen brightness of the ultrasound image. In general, the gain should be set at a level where urine in the bladder appears black and there is adequate contrast between structures.
- **Probe Indicator Marker (Figure 1):** every ultrasound probe has an indicator marker, a mark on the probe the corresponds to a orienting marker on the screen. Apply gel to the transducer or touch one edge of the probe. Look at the ultrasound screen to see match orientation on the screen.



Images provided by Dr Sierra Beck.

Figure 1. Location of an ultrasound probe orientation marker and an example image demonstrating its location on the ultrasound screen image.

6. PROCEDURES

Some useful background information is available here: www.youtube.com/watch?v=S8AWts0oTnw

Abdominal scan versus transvaginal scan

Transvaginal scans can provide a higher level of clarity and can be used at earlier gestations. However, for the purposes of this training, only abdominal scanning will be considered as this is less invasive and easier to perform and requires less advanced ultrasound machines.

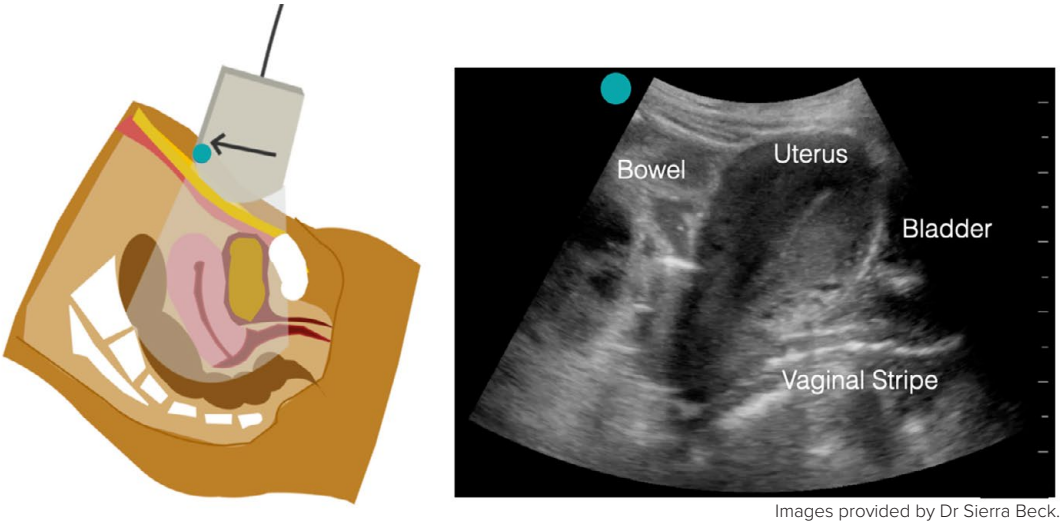
The quality of trans-abdominal scanning depends on many factors, including body habitus, fullness of the bladder and the uterus position. These are not major factors when transvaginal scanning.

Typically, in order to see a gestational sac using an abdominal probe, βhCG levels would need to be at least 3,500 MIU/L, compared to level of only 2,000 MIU/L for a transvaginal probe. In clinical terms, this means that transvaginal scanning will identify a sac 2 to 3 days before abdominal scanning. All other features of pregnancy will be seen equally earlier in transvaginal scanning.

The ultrasound examination

Click here to access a video explaining the basic uterine ultrasound technique

1. First introduce yourself to the patient and explain the ultrasound procedure and obtain their verbal consent. The patient should then be asked to lie in a supine position with legs flat (on an examination bed or couch). Then expose the abdominal area (taking care to cover any exposed areas that are not needed for the examination). Tuck paper towel tissue into pant line to ensure gel does not get over the patient's clothes. Check with the patient if they would like to see the images or not. Then explain that the gel may feel cold and that the probe will apply pressure. Ask them to tell you if they are uncomfortable at any time.
2. Apply gel to the skin over the area for examination – this gel eliminates air between the probe and the skin to help pass the sound waves into the client's body. It ensures clearer images and easier gliding of the probe over the patient's skin for user ease.
3. Place the probe on the mid-line of the suprapubic abdomen area, just above the pubic bone, with the probe marker facing the patient's head. Pointing or rocking the transducer into the pelvis towards the patient's feet may be needed to bring the uterus into view (Figure 2). Adjust the depth and gain to improve image clarity. Then slide the transducer to the patients left or right so that you look through the entire three-dimensional uterus in this plane. Gentle pressure can help to compress bowel gas that may obscure your view

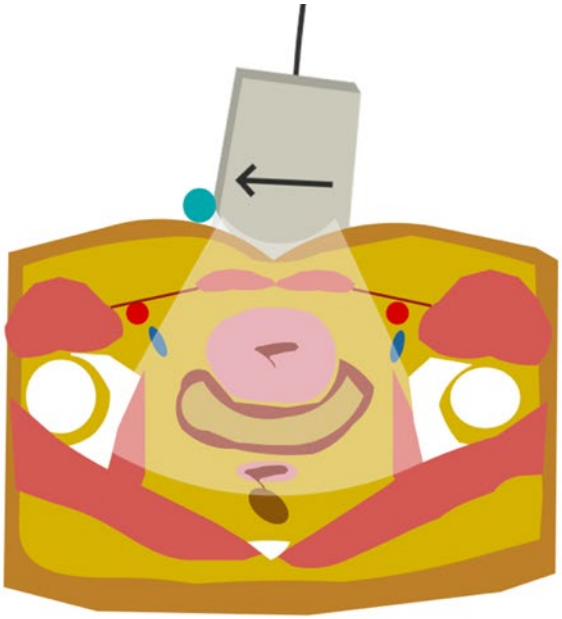


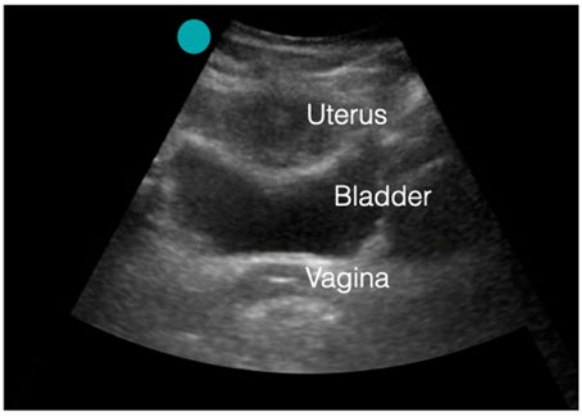
Images provided by Dr Sierra Beck.

Figure 2. Longitudinal orientation of the ultrasound transducer.

4 Repeat the above step with the probe in the transverse position (Figure 3) – rotate the probe 90 degrees counter-clockwise with the probe indicator facing towards the patients right. Using the bladder as your landmark, slowly fan through pointing the probe up towards the head and then towards the feet to identify the bladder and uterus and locate the pregnancy. Follow the same steps as you did in longitudinal position if you are having trouble locating the pregnancy. Freeze/screenshot in the same way.

5. Once you have identified a gestational sac within the uterus – assess whether you see a yolk sac and a fetal pole (Figure 4). A yolk sac must be sighted within the gestational sac to confirm an intra uterine pregnancy (IUP). Freeze/screenshot the image once you have identified the gestational sac with yolk sac and fetal pole if sighted.
6. If a fetal pole is seen, measure the crown rump length (CRL) (see later). If only a gestational sac is seen with or without a yolk sac, measure the gestational sac. N.B. CRL measurements are more accurate than gestational sac measurements. An IUP is not confirmed until a yolk sac or fetal pole is seen within a gestational sac.
7. After the images have been acquired and measurements taken, the data is stored on your device. You may transfer the saved image to your patient management software or get a hard copy of the images for notes.
8. Give the patient a towelette to clean up/wipe off the gel. They will then dress and can discuss the results.

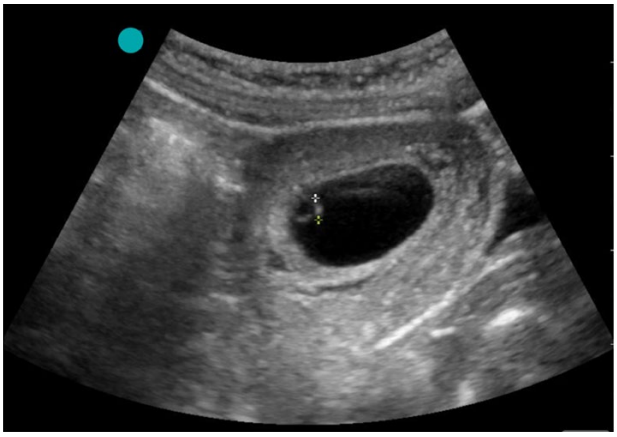




Images provided by Dr Sierra Beck.

Figure 3. Transverse Orientation of the ultrasound transducer anteverted uterus wraps around the top of the bladder.

Figure 4. Representative Longitudinal Image of a 6 week IUP with a yolk sac and fetel pole seen within a gestation sac. Calipers are also depicted, measuring crown rump length (see later)."



Images provided by Dr Sierra Beck.

Points to consider during USS procedure

- **Full bladder** – A full bladder is the best tool to help you to find the uterus, thus – the pregnancy. A full bladder pushes the uterus up towards where you will put the transducer displacing the bowel and providing a sonolucent window into the uterus. **If a patient has a full bladder with a retroverted uterus, it can sometimes be more difficult to get clear images of the uterus – they may need to empty their bladder slightly if it is too full**. For further information, see the "Acoustic windows" section below.
- **Depth** – Checking the depth of the ultrasound. Most machines will let you adjust the depth to which the scan will penetrate. Generally speaking, you should have the depth set deep enough to see all of the uterus, but not so deep as to scan way past it as you will lose resolution. Not every patient is the same so depth will need to be adjusted for body size and position of the uterus (ante-verted vs retroverted). Trans Abdominal scans may be pre-set to 10–12cm, you may need to increase your depth to 15cm to get started, then you can adjust as required.
- **Having enough gel** – Gel should be used to ensure clearer images and easier gliding over the skin
- **Bearings** – Using the patient's pubic bone as a point of reference (Figure 5). This will appear as a shadow cast at the most caudal part of the scan (the part nearest the foot end of the patient). Fan through (staying in one position pointing the transducer left and right) with the pubic bone shadow showing. If you cannot view all of the uterus, you can then tilt the probe higher in the pelvis.
- **Fluid on ultrasound appears black in colour** – This includes the gestational sac. An IUP cannot be confirmed until a yolk sac and/or fetal pole are sighted within the gestation sac (the black fluid like structure). A yolk sac is usually sighted first within a gestation sac in early pregnancy.

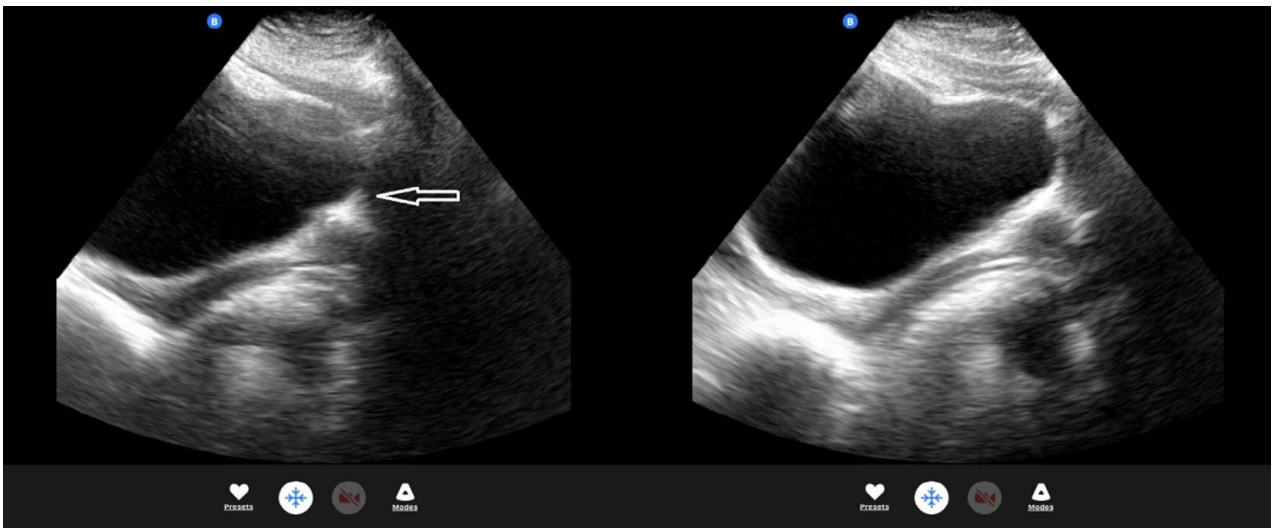


Figure 5. Longitudinal image showing pubic bone shadow on pelvic ultrasound.

Acoustic windows

Air in the bowel scatters soundwaves and limits your ability to see deeper structures. This can be improved with gentle pressure or by imaging the uterus through the bladder. The urine in the bladder allows ultrasound waves to pass through unimpeded (hence it is black on the image). This means more sound waves reach (and returns from) the uterus. If the bladder is not full enough, the size of the "window" through which the uterus can be seen is restricted. If the bladder cannot be filled to perfection, another option is to move the probe to make the most of the Acoustic window.

7. INTERPRETATION OF ULTRASOUND IMAGES

Click here to access a video explaining how to interpret ultrasound images.

Grey scale

An ultrasound image is made from reflected sound waves. Fluids reflect very little sound and so appear black, tissues reflect more sound and appear a lighter grey. Boundaries between tissues of different density can appear lighter still. It is these variations in grey which create the picture which represents the tissues scanned.

Artifacts

An artifact is any part of the ultrasound image that does not truly represent the structure it is viewing. Similar to audible sound waves, the environment though which ultrasound is transmitted can alter it causing echos, blocking sound or making it appear to be coming from a different source.

Artifacts typically occur when sound waves pass through different densities of tissues or hit the edge of a tissue type.

See figure 6 below for an example of how there is shadowing behind the gallbladder on ultrasound. This occurs as sound waves are reflected back at the interface with the gallbladder and the quality of image behind this is degraded and shadowing artefact is produced.

It is important to recognise the possibility that the image seen could contain artifacts and therefore not truly represent the actual structure being scanned. By scanning through the structure in two different planes artifacts seen in one plane will be eliminated in the other – allowing clearer understanding of the imaging of the anatomy.

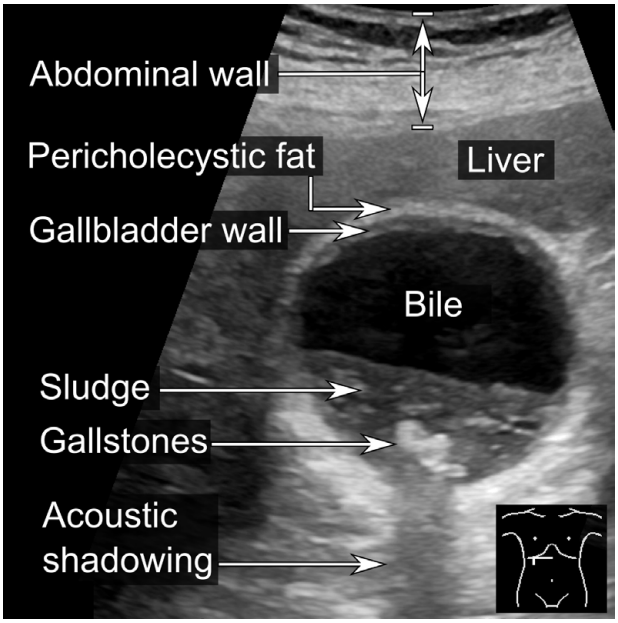


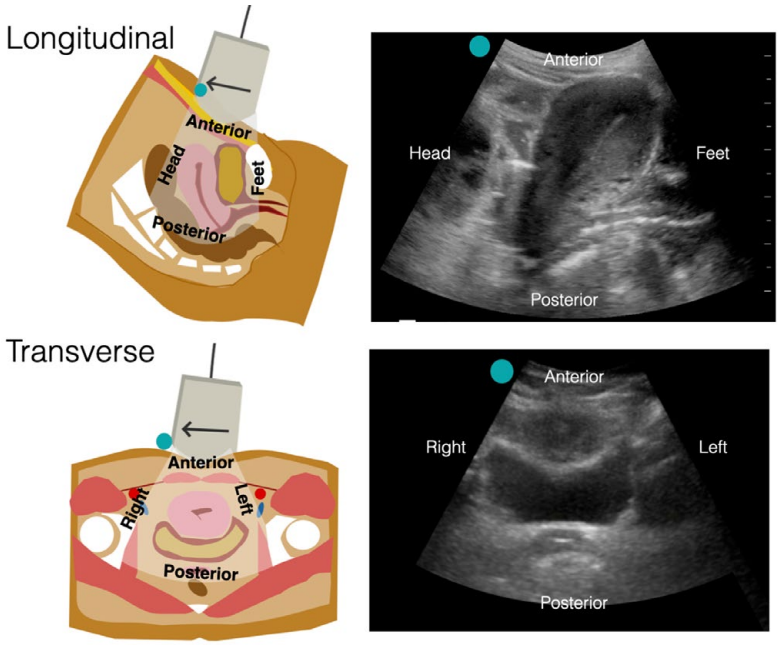
Figure 6. Ultrasound image of the gallbladder demonstrating different densities and shadowing

Interpreting 2D images from a 3D uterus

One of the most difficult skills for someone new to ultrasound is learning how the 2-dimensional image on the screen relates to the 3-dimensional body part being scanned.

A simple way to visualise the ultrasound is by comparing the probe to a flashlight, where the beam coming out of it is in a single plane. The image on the screen is a representation of this “beam” as if viewed from the side. The very top of the image is the place where the transducer contacts the body and the image widens out as the beam passes into the body. The image ends at the deepest point that the beam has been set to penetrate.

By tilting the probe from left to right and right back to left when scanning in the longitudinal plane (and from cranial to caudal in the transverse plane), you build up a group of 2-dimensional slices through the 3-dimensional structure (Figure 7). By doing this in real time you can develop a mental picture of the 3-dimensional image.



Images provided by Dr Sierra Beck.

Figure 7. Visualising three-dimensional anotomical structures using the two-dimensional ultrasound image

The images in Figure 8 show a cardboard tube as a 3-dimensional structure and how that structure would appear in a longitudinal and transverse 2-dimensional cut. The 2-dimensional images are quite different but combining them allows the ultrasonographer to create a mental image of the 3-dimensional structure. Once you have viewed the entire structure across both planes, you are in the position to freeze the single 2-dimensional image that is most appropriate. In the case of our scanning, this will either be the image that shows a structure or the one which shows the structure at its largest point for measuring purposes.

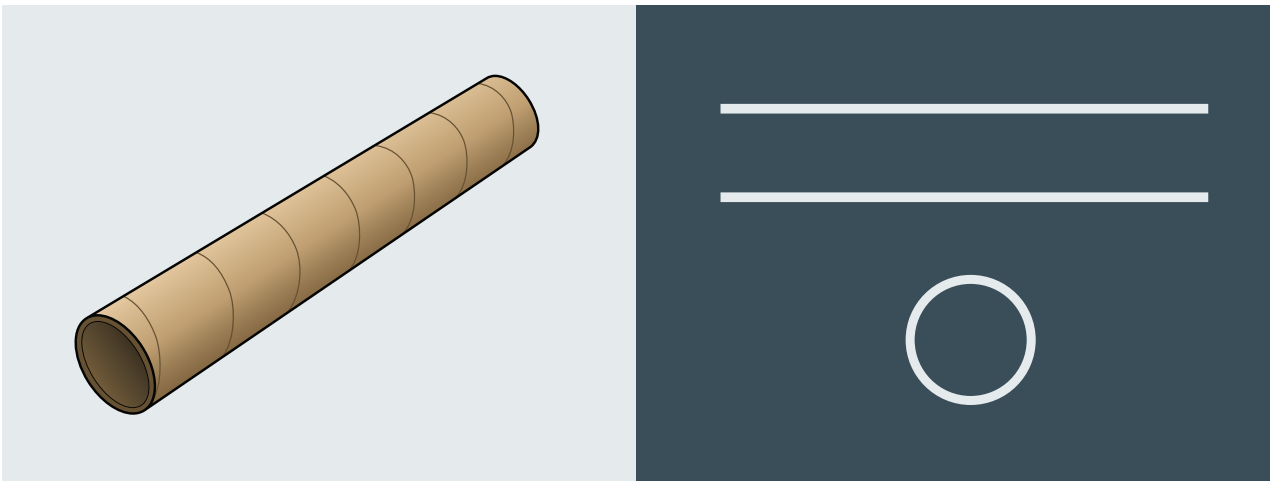


Figure 8. Example of how a 3-dimensional structure (left) appears in both a longitudinal or transverse 2-dimensional cut (right).

Is something inside the uterus or outside?

The importance of identifying the uterus and scanning all the way through the uterus (from side to side and top to bottom) before taking measurements cannot be stressed enough.

It is essential to make sure that, when viewing a gestational sac, that the sac is located entirely within the uterus surrounded by a thick rim of uterine muscle. The muscular wall (myometrium) of the uterus is seen in 360 degrees around the sac and continues to remain so as the scan passes through and out of the sac. Failure to do this could risk missing an interstitial ectopic pregnancy (Figure 9) – where only part of the sac is within the uterus, and part extends to the isthmus of the fallopian tube. In this situation the muscular structure of the womb will become very thin on the lateral extent of the scan.

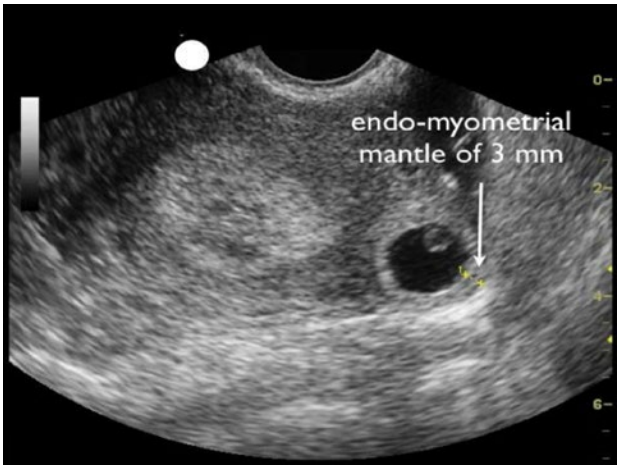


Figure 9. Ultrasound image showing an interstitial (cornual) ectopic pregnancy.

Similarly, novices to pelvic ultrasound sometimes make the mistake of thinking that an ovarian cyst (Figure 10) is a gestation sac by failing to confirm the presence of the muscular wall of the uterus around the fluid filled structure.

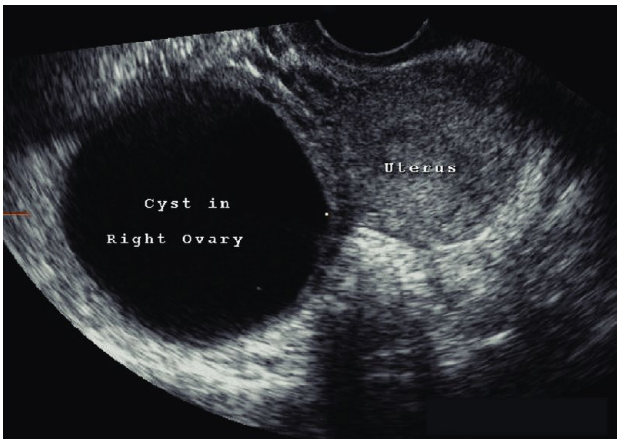


Figure 10. A simple ovarian cyst on the right side of the uterus.

Scanning early pregnancy

Before interpreting ultrasound images in early pregnancy, it is important to be clear about the structures that can be seen on early gestation scans.

The gestational sac is the fluid filled cavity that surrounds the embryo. In very early pregnancy it is formed by the chorionic cavity; as pregnancy progresses, the amniotic cavity expands to replace it. The gestational sac is the very first sign of pregnancy seen by ultrasound. The sac suggests an IUP but does not confirm it.

Figure 11 demonstrates an implanted embryo (approximately 14 days post conception) and the processes necessary for maintaining early pregnancy. As the embryo progresses, the large yolk sac develops and by around 5 to 6 weeks gestation is larger than the embryo. This is the second sign visible in early pregnancy on ultrasound, seen before the embryo, and is what confirms an IUP.

At approximately 6 weeks, the embryo (fetal pole) will be large enough to see on ultrasound. Around this time, both the embryo and yolk sac will be visible and as the pregnancy develops further the embryo becomes larger and the yolk sac smaller (Figure 12).

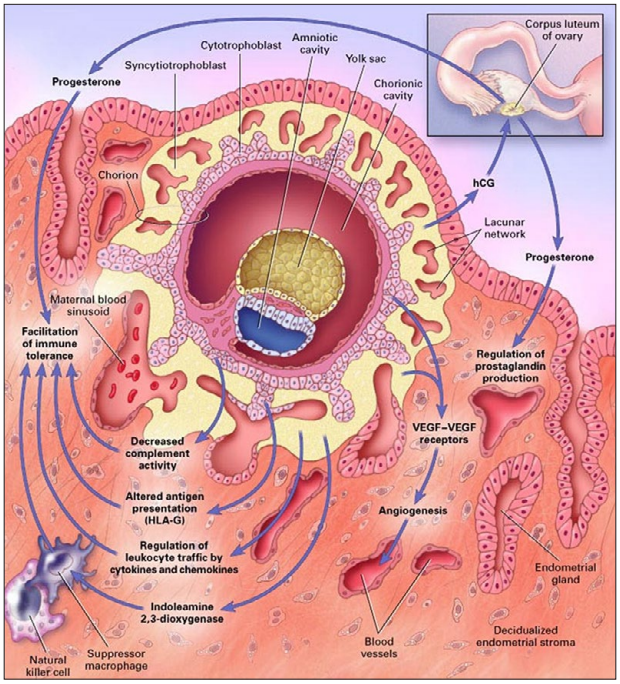


Figure 11. Implanted embryo approximately 14 days post conception.

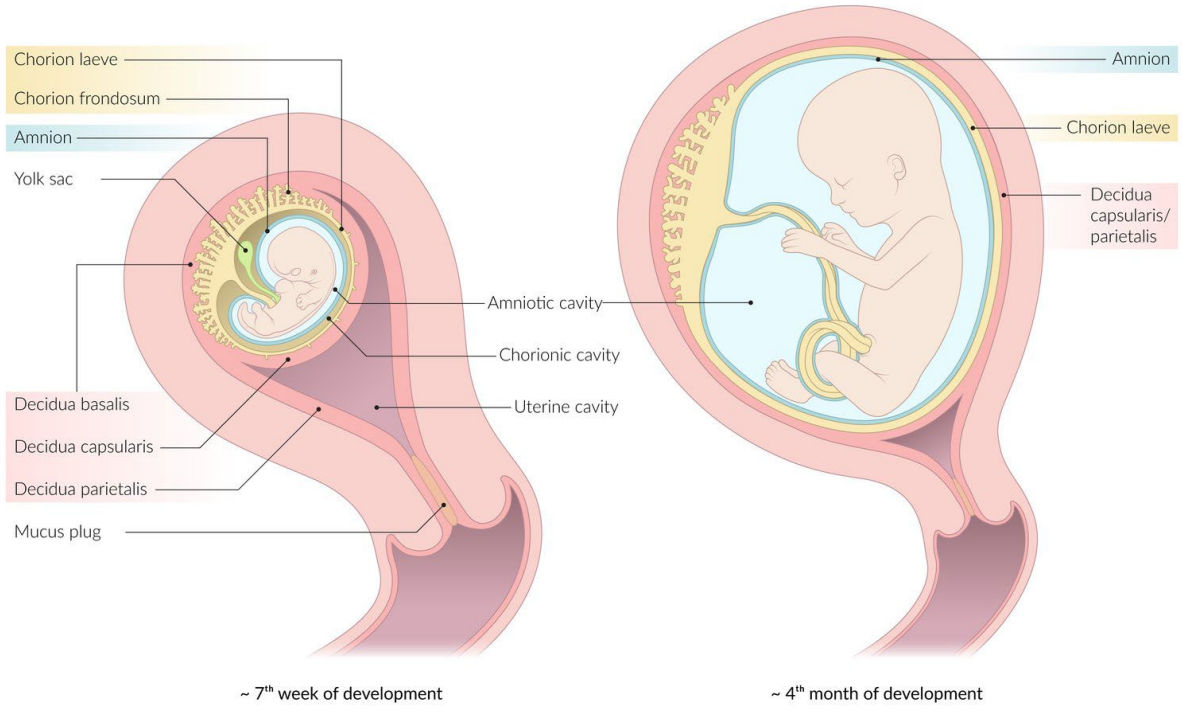


Figure 12. Diagram showing a foetus at 7 weeks gestation and second trimester gestation.

Distinguishing the gestation sac on ultrasound

The gestation sac is the very first sign of pregnancy on an ultrasound and appears as a fluid filled sac inside of the uterus (for an example ultrasound image of a gestational sac, see Figure 1A at www.contemporaryobgyn.net/view/an-imaging-approach-to-early-pregnancy-failure).

Whilst very suggestive of an early IUP, it is not conclusive proof. Similar images could be obtained with the presence of fluid inside of the uterus. One such cause is a pseudo sac, which involves fluid in the uterus associated with a tubal ectopic pregnancy

To see an example of a pseudosac on ultrasound check out www.patientcareonline.com/view/pseudosac-ectopic-pregnancy

It is outside of scope for this point of care course to look at differentiating between a gestation sac and a pseudo sac. What is important is to be clear that the discovery of a fluid filled sac in the uterus in early pregnancy suggests early IUP but **DOES NOT** rule out ectopic pregnancy.

Measuring the gestation sac to estimate gestational age

As pregnancy advances, the gestation sac increases in size. The size of the sac can be used to calculate the gestational age of the pregnancy within an accuracy of 3 days prior to the ability to visualise the embryo.

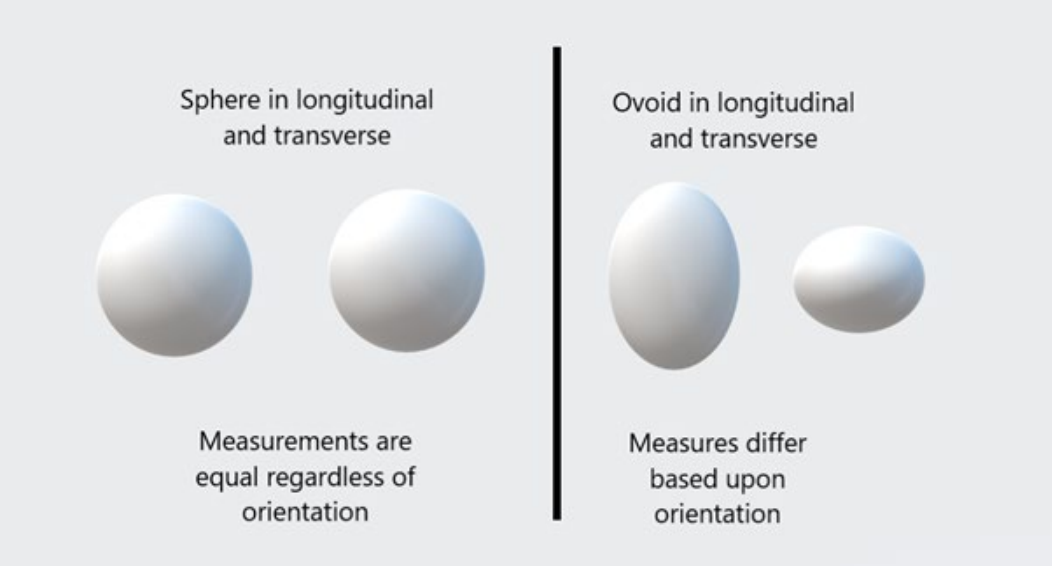
The shape of gestational sacs can vary, from spherical to ovoid.

Whilst a sphere will measure the same diameter in all directions, an ovoid may be much longer than it is wide or deep or vice versa. Therefore, taking a single measurement on an ovoid sac could lead to over or under estimation of its true size and therefore gestational age. The way around this is to calculate the Mean Sac Diameter (MSD). This is the average length from 3 measurements of the sac – top to bottom, side to side and front to back.

On a longitudinal 2D scan of the uterus and sac, the gestation sac can be measured from front to back and top to bottom. All that then remains is to measure side to side on the transverse scan. Most ultrasounds allow you to enter each measurement as you perform them. The average is then calculated, and the gestational age can be confirmed.

To see examples go to obimages.net/free-chapter-normal-abnormal-first-trimester-exam/#Early_Gestational_Sac

Clinically, MSD is useful to correlate with LMP and improve confidence in gestational age estimation. To see examples on how to estimate MSD, see: obimages.net/free-chapter-normal-abnormal-first-trimester-exam/#Mean_Sac_Diameter_MSD.



Distinguishing the yolk sac on ultrasound

As mentioned previously, the yolk sac is the next sign visible of early pregnancy on ultrasound after the gestation sac. Presence of the yolk sac allows confirmation that the pregnancy is intra-uterine. Visualisation of the yolk sac is all that is required, it does not need to be measured.

The yolk sac will appear as a smaller spherical sac within the gestation sac on ultrasound (Figure 13). It will be present before and remain present for several weeks after the embryo appears. Yolk sacs with no fetal pole are usually seen abdominally at 5 to 6 weeks gestation in an ongoing pregnancy.

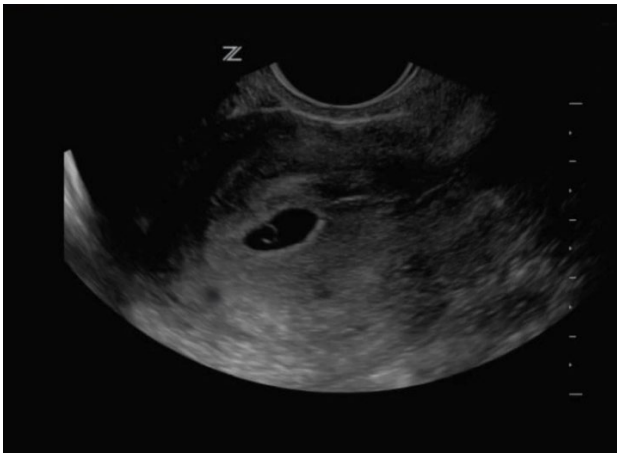


Figure 13. A retroverted uterus with a gestational sac (GS) within the endometrial echo of the uterus and contains a yolk sac (YS). Contributed by Dr. Michael Lambert

Determining crown rump length (CRL) on ultrasound

The embryo is first visible at 6 to 7 weeks of gestation. When it first appears, it is smaller than the yolk sac (Figure 14).

As the embryo grows, its length increases faster than its width, meaning it is important to measure on the longest axis. The measurement should be between the crown (top of the head) to the rump (**NOT** the lower limbs). The CRL is the most accurate way to assess gestational age between 7 and 13 weeks when using transabdominal scanning.

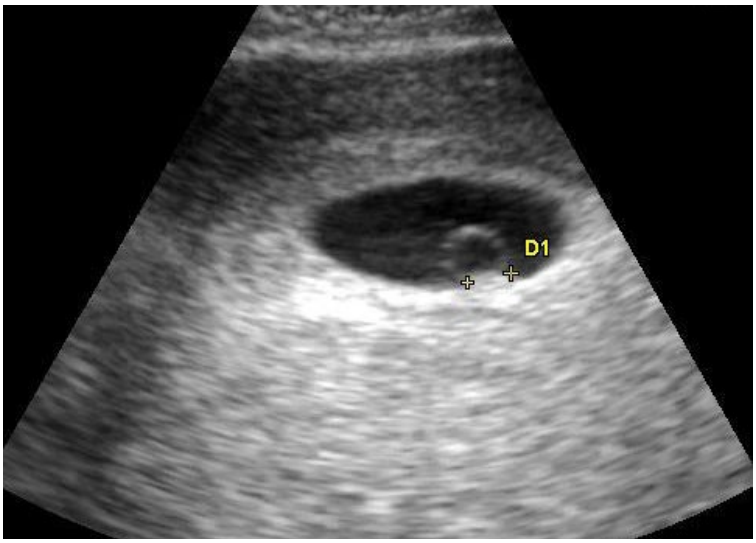


Figure 14. Embryo when it first becomes visible on ultrasound.

As mentioned previously, when it first appears, the yolk sac is bigger than the embryo and often will be viewed adjacent to it (Figure 15). It is important to ensure that you only measure the CRL and not include the yolk sac. As the length of the embryo increases it is important to measure along the longest axis (Figure 16).

Later in the first trimester, the embryo takes on an even more recognisable appearance (Figure 17). Care should be taken to ensure that the whole foetal head and rump are included when finding the long axis and the lower limbs are not included. **Clinically embryos with CRL of less than 32 mm are suitable for early medical abortion (EMA**; 32 mm correlates with approximate 10 weeks gestation).

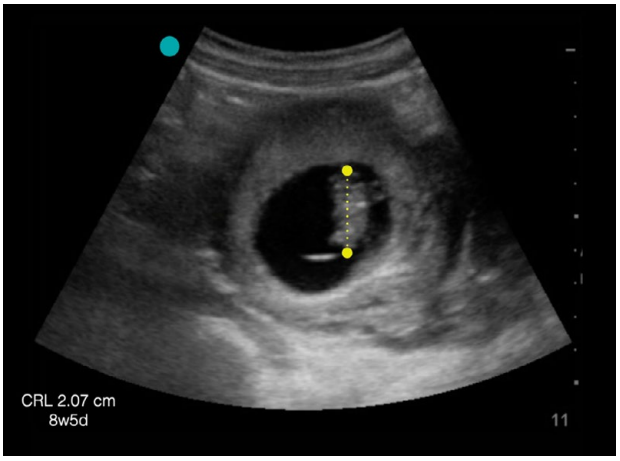


Figure 15. Ultrasound image showing the CRL with callipers for measurement. Note that the yolk sac is adjacent to but not included in the measurement. Image provided by Dr Sierra Beck.

Figure 16. Example of measuring the CRL along the longest axis on ultrasound.

Figure 17. Ultrasound image of embryo in late first trimester, including example CRL measurement (excluding lower limbs).

Distinguishing the foetal heart on ultrasound

After 7 weeks of gestation the foetal heart can be seen using an abdominal probe. It can be seen as a "flickering" within the otherwise still embryo.

Clinical note: do not diagnose/conclude that the pregnancy is not ongoing based on point of care ultrasound unless you have been specifically trained for this

Pregnancy of unknown location

Pregnancy of unknown location (PUL) is defined as a positive pregnancy test but no signs of IUP or an extrauterine pregnancy via ultrasound.

This raises the possibility of the following differential diagnoses:

- Intra-uterine pregnancy too early or small to see
- Ectopic pregnancy
- Spontaneous miscarriage with ongoing positive pregnancy test

Management of pregnancy of unknown location is outside of the scope of this course. However, it is important to recognise that IUP should typically be seen on ultrasound with a transabdominal probe at serum βhCG levels above 3,500 and around 5 ½ weeks gestation.

Distinguishing retained products of conception on ultrasound and differential diagnosis

Ultrasound is a useful tool in assessing retained products of conception. However, the ultrasound findings are rarely diagnostic alone and must be considered in conjunction with the clinical symptoms and signs, as well as information from other investigations (such as trends in serum βhCG). The empty uterus has a thin endometrial stripe (Figure 18).

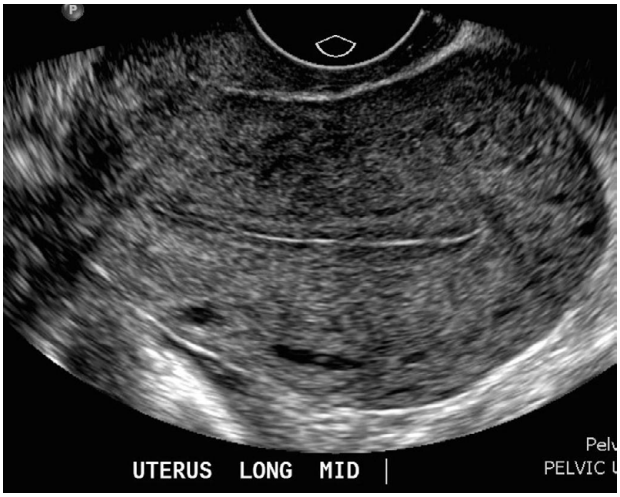


Figure 18. Ultrasound image showing the endometrial stripe (visible as a thin echogenic line) at centre of uterus. Case courtesy of Dr Alexandra Stanislavsky, Radiopaedia.org, rID: 30417

The transition in ultrasound findings associated with routine medical abortion does not involve a sudden change from IUP to a thin stripe. It involves a pathway between the two. Ultrasound scans performed soon after a miscarriage readily show the endometrium to be thickened as the uterus passes through the process of completion of the miscarriage. This should not be mistaken as retained products of conception requiring clinical management without suggestive symptoms and signs.

If retained products of conception is clinically suspected, an endometrial thickness greater than 10 mm is suggestive but does not confirm the diagnosis. An endometrial thickness of less than 10 mm makes retained products unlikely.

To measure endometrial thickness, take the thickest portion of the endometrium and measure perpendicular to the myometrium from where the myometrium ends on one side to its start on the other (Figure 19). To review images of retained products of conception, see: radiopaedia.org/articles/retained-products-of-conception

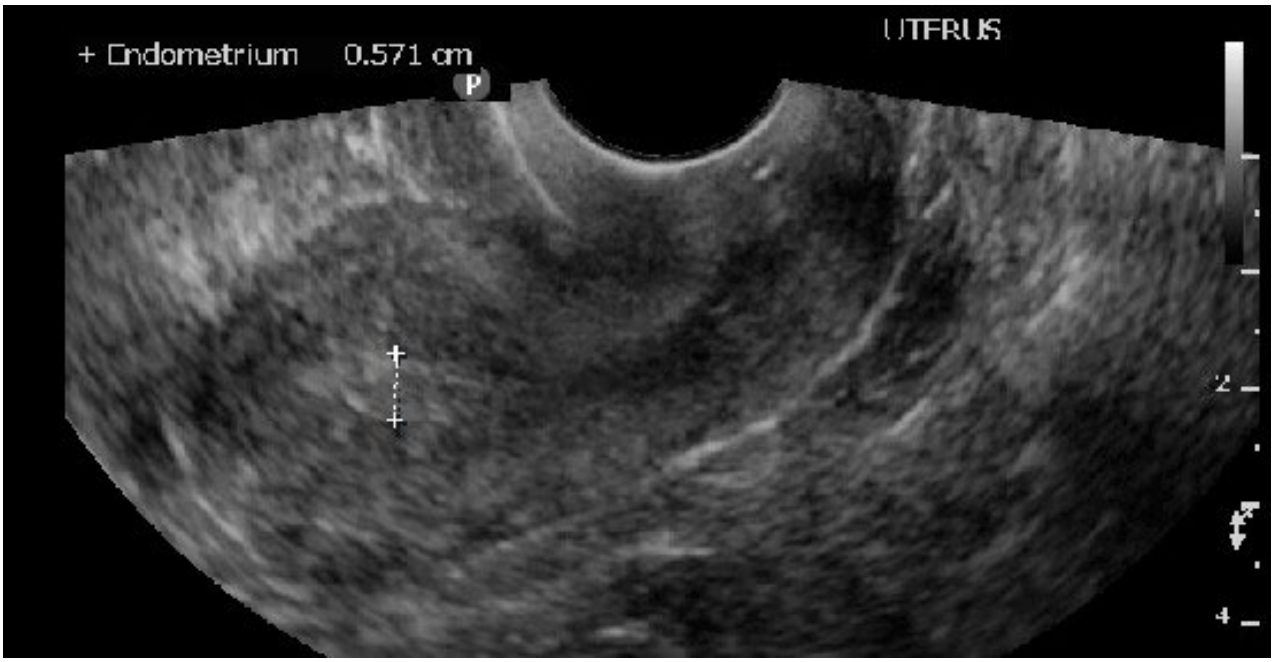


Figure 19. Example of how to measure endometrial thickness.

Distinguishing twin pregnancy on ultrasound

For the purposes of point of care ultrasound early pregnancy scanning, twin pregnancies can be diamniotic (two sacs) or monoamniotic (a single sac). Twins born from monoamniotic pregnancies are always identical, but diamniotic pregnancies can occur for identical or fraternal twins. Chorionicity is outside of scope for this course.

Both types of twin pregnancies should be visible by 7 weeks of gestation. Diamniotic pregnancies are seen at early gestations as the presence of two gestation sacs can be seen without the need for the embryo to have developed large enough to be visible (Figure 20). Monoamniotic twins show two embryos within a single sac, so appear slightly later in scanning (Figure 21).

Figure 20. Ultrasound image of diamniotic twins at 8 weeks

Figure 21. Ultrasound image of monoamniotic twins at 15 weeks

When things don't look right

Point of care ultrasound is based on the principle of answering a simple clinical question (such as "*what is the gestational age?*"); it is not intended to be a full diagnostic scan. However, there will be times when you come across something that does not look right but is outside of the scope of this training:

1. **Ectopic pregnancy**
   It is not within scope of this training to diagnose an ectopic pregnancy (or its effects) on ultrasound. However, a cystic structure seen outside of the uterus, when there is no intrauterine pregnancy seen, should raise suspicion. Ultrasound findings should always be integrated with additional symptoms, signs and clinical judgment.
2. **Ovarian cysts**
   Functional ovarian cysts are common in early pregnancy, pathological ovarian cysts less so. Direct visualisation of the ovaries is outside of the scope of this training. However, there will be a time when the clinician performing point of care ultrasound views a cystic structure outside of the uterus. Scan through cystic structures in both planes to ascertain if they are intra or extra-uterine. Should a cystic structure be seen outside of the uterus, consider referring for clinical assessment and radiology performed ultrasound.
3. **Intrauterine devices**
   Intra-uterine devices (IUDs) can be seen on ultrasound as a bright linear structures within the endometrial canal on longitudinal imaging (Figure 22).

Figure 22. Copper IUD visualised on ultrasound.

4. **Bicornuate uterus**

   Whilst the normal uterus is shaped like an upside-down pear, the morphology of bicornuate uterus can be anything from heart shaped to two separate uterus horns (Figure 23). It is most noticeable in the transverse image when scanning near the fundus where the endometrial cavity splits into two separate horns (Figure 24).

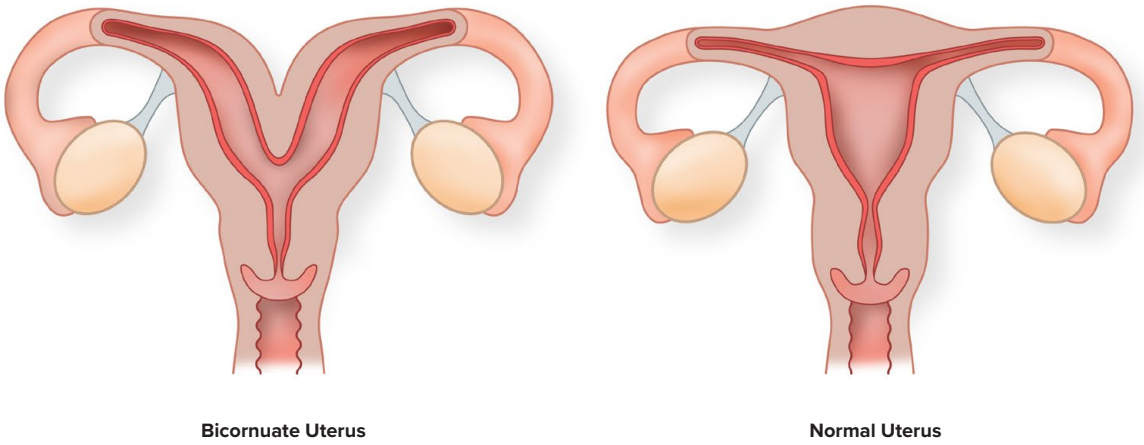


Figure 23. Diagram comparing a bicornuate (left) and normal (right) uterus.

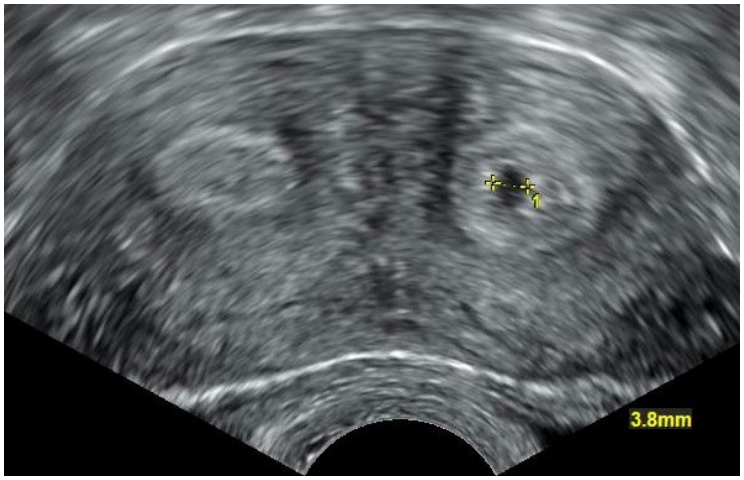


Figure 24. Transvaginal ultrasonography showing a cross-section of a bicornuate uterus, with two cavities (or "horns") to the left and right, respectively. The one to the right contains a gestational sac.

What to do when you don't know

If you come across the above findings or anything you are unsure of, consider the urgency with which a patient needs to be referred for a radiology performed ultrasound or to a specialist clinical review.

8. KEY LEARNING POINTS

- Point of care ultrasound is different from radiology performed diagnostic scanning. It should be used by trained practitioners to answer simple clinical questions. You should not attempt to make interpretations outside of your training.
- Point of care ultrasound findings should always be integrated with clinical assessment; it is an extension of the examination, not an isolated investigation
- Point of care ultrasound of early pregnancy is designed to help the clinician confirm that a pregnancy is intrauterine, and hence rule out ectopic pregnancy. However, the identification of an ectopic pregnancy is outside the scope of this module.
- Whilst ultrasound of a pregnancy should be limited to necessary scans and scan time only, there is no evidence that exposure to ultrasound harms the fetus
- A full bladder will allow the best transabdominal view of the uterus
- Transvaginal scans show greater resolution and scan with more accuracy. In general, an IUP can be seen 2 – 3 days earlier with transvaginal scanning than transabdominal scanning. However, this approach is more invasive and equipment may not be available; therefore transabdominal scanning is preferred for point of care ultrasound.
- A gestation sac should be seen in the uterus with transabdominal scanning with a serum βhCG level above 3,500 MIU/L
- Depth should be set on the scanner to include the entire uterus and for it to take up the whole depth of the screen
- Clinicians should always perform a full survey, scanning through the uterus in two planes before proceeding to take measurements for gestational age
- Scanning the entire uterus in two planes also helps to confirm that a pregnancy is intrauterine. Ensure that the gestational sac is surrounded by a thick rim of muscle through the entire scan. A gestation sac alone does not confirm an intrauterine pregnancy; you must see either a yolk sac or foetal pole inside it. Without these additional findings ectopic pregnancy has not been ruled out.
- A gestation sac should be measured in three separate axes with these diameters averaged in order to ascertain most accurate gestational age

9. QUIZ ON POINT OF CARE ULTRASOUND

Click here to access a quiz and test your understanding of the concepts discussed in the module.

10. PRACTICAL COMPETENCY

Once the course is completed, the health professional should ensure that their ability to perform, interpret and clinically integrate ultrasound findings meets an acceptable standard.

There are currently no nationally accepted standards of accreditation for point of care ultrasound, though Individual employers may have their own credentialing requirements it is essential that the individual practitioner can demonstrate that they are providing point of care ultrasound at an acceptable standard.

The remainder of this document provides the framework that the clinician can use to audit their skills as demonstration that they meet an acceptable standard of scanning before offering un-supervised point of care ultrasound. This framework is supported by The Abortion Providers Group of New Zealand (APGANZ) and the New Zealand College of Sexual and Reproductive Health (NZCSRH).

Benchmarking

Ideally, the trainee will have a suitably qualified mentor available to them to give in-person assistance during the training phase. The mentor can give practical advice on scanning techniques as well as providing review of the scan findings.

It is acknowledged that in some instances an abortion provider may be working in an environment where there is no suitably qualified individual available. In these circumstances the trainee can compare their scan interpretation with an external radiology performed scan (the result of which they are blinded to until they have completed their own scan to avoid bias) or develop a relationship with a distant suitably qualified individual who can review their scan images (taking care over patient confidentiality when transmitting images).

Note: suitably qualified individuals include a provider who has completed this accreditation programme, or other recognised and relevant point of care ultrasound training or a qualified sonographer.

Skills to be demonstrated

1. Measure gestational age from Mean Sac Diameter
2. Measure gestational age from Crown Rump Length measurement
3. Diagnose an empty uterus
4. Diagnose retained products of conception
5. Diagnose intra-uterine cystic structure suggestive of gestation sac, but not diagnostic (early sac and ability to assess if ectopic pregnancy has or has not been ruled out)
6. Diagnose twin pregnancy

Standards to be met for each skill

1. Diagnose gestational age from mean sac diameter – Total 5 scans

   Standard obtained if

   a. Review of image by suitably qualified individual. Scan quality and measurement deemed acceptable.

   or

   b. Comparison with external diagnostic scan
   If compared to external scan measurement must be accurate to within 3 days of gestational age with the external scan result.
2. Diagnose gestational age from crown rump length pregnancies 6 – 13 weeks – 10 scans
   Standard obtained if

   a. Review of image by suitably qualified individual. Scan quality and measurement deemed acceptable.

   or

   b. Comparison with external diagnostic scan
   If compared to external scan measurement must be accurate to within 4 days of gestational age with the external scan result.

3. Diagnose empty uterus in – Total 10 scans
   Endometrial thickness < 10 mm
   Standard obtained if
   a. Review of image by suitably qualified individual. Scan quality and measurement deemed acceptable.
   or
   b. Comparison with external diagnostic scan which confirms empty uterus
4. Diagnose potential retained products of conception – Total 5 scans
   (Note: ultrasound is not diagnostic for retained products of conception, but can be suggestive to support a clinical diagnosis)
   Endometrial thickness with heterogenous texture > 15 mm +/- vascularity
   Standard obtained if
   a. Review of image by suitably qualified individual. Scan quality and measurement deemed acceptable.
   or
   b. Comparison with external diagnostic scan which confirms possible retained products uterus
5. Diagnose intra-uterine sac suggestive but NOT confirming intra-uterine pregnancy – Total 10 scans
   Standard obtained if
   a. Review of image by suitably qualified individual. Scan quality and measurement deemed acceptable.
   or
   b. Comparison with external diagnostic scan which confirms intrauterine cystic structure without yolk sac.
6. Diagnose twin pregnancy – Total 1 scan
   (Note: twin pregnancy should be demonstrated in 2 planes to confirm that the finding is not artefact)
   Standard obtained if
   a. Review of image by suitably qualified individual. Scan quality and measurement deemed acceptable.
   or
   b. Comparison with external diagnostic scan which confirms twin pregnancy

Summary

Skill	Required number	Standard
Gestation sac volume	5	Within 3 days gestational age of external scan / review of image
Crown rump length	10	Within 4 days of Crown Rump Length of external scan review of image
Empty uterus	10	Endometrial thickness < 10mm
Potential retained products of conception	5	Endometrial thickness >15 mm with heterogenous texture +/- vascularity
Sac, not confirming intrauterine pregnancy	10	Sac demonstrated without yolk sac
Twin pregnancy	1	Demonstrated in 2 planes

Documentation

Each scan in the log book must have a written report of the findings as well as the ability to refer back to the saved image.

11. FURTHER READING AND RESOURCES

In an evidence review to support the National Institute for Health and Care Excellence (NICE) Abortion care guideline (NG140), it is stated that:

> *Initiating medical or surgical abortion before a definitive diagnosis of pregnancy can be made on ultrasound introduces the possibility of missing an asymptomatic ectopic pregnancy. This may have serious consequences and lead to emergency care/hospital admission, potentially impacting future fertility. Missed diagnosis of ectopic pregnancy and need for emergency care/hospital admission were therefore selected as a critical outcomes.*
>
> *The committee also agreed to prioritise patient satisfaction as a critical outcome for decision-making as abortion is an area where women are known to have strong preferences for prompt resolution. Time to completion of treatment was included as an important outcome because the possibility of having an abortion before ultrasound evidence compared to having to wait 2 to 3 weeks until the pregnancy is visible on ultrasound is likely to further influence patient preference. The need for repeat doses of misoprostol, ongoing pregnancy and complete abortion without the need for (repeat) surgical intervention were included as important outcomes due to the impact that needing a second appointment and intervention will have on both the patient and on available resources.*
>
> *The evidence showed that there were no clinically important differences in the rates of complete abortion without the need for (repeat) surgical intervention between women with definitive evidence of an IUP on ultrasound compared to women who had an ultrasound but where an IUP could not be confirmed whereas for missed diagnosis of ectopic pregnancy and ongoing pregnancy, it was unclear whether or not there was a clinically important difference. The committee noted the evidence from the review on "What factors help or hinder the accessibility and sustainability of a safe termination of pregnancy service?" which showed that women had clear preferences not to prolong waiting times, and therefore they agreed that the recommendation should be to offer immediate treatment if that was the patient's preferred option.*
>
> *In this respect the committee wanted to clarify that this recommendation does not imply that all women have to have an ultrasound scan before initiating an abortion, only that if an ultrasound has been performed that shows no definitive evidence of an intrauterine pregnancy, then the abortion can still go ahead.*
>
> *However, although the committee agreed that an abortion at this stage should only be offered to women who did not have any signs or symptoms of an ectopic pregnancy and whilst the committee were aware of other evidence that shows there is a lower incidence of ectopic pregnancy in the population requesting a termination (0.8, 0.9, 5.9 /1000 in Bizjak, Heller, and Edwards respectively) compared with an overall rate of 11/1000 in the general population (NICE, 2012), nevertheless it remains a possibility and diagnosis can be delayed if symptoms are attributed to recovery following an abortion. Whilst rare, the consequences of a missed ectopic pregnancy can be serious.*
>
> *The committee therefore agreed it was essential that women were made aware of the importance of the potential need to participate in follow-up appointments if completion of the abortion could not be confirmed at the time of treatment to facilitate early intervention, the nature of the follow-up should be decided locally given the variation in nature of provider. They noted that commonly used protocols included the use of blood tests to check that serum βhCG is declining, or urinary pregnancy testing to ensure this becomes negative after the procedure.*
>
> *If there are signs and symptoms of ectopic pregnancy (e.g., pain, bleeding) referral to an Early Pregnancy Assessment Unit (EPAU) to rule out this diagnosis should be pursued before treatment is provided. The committee were also aware of previous national guidance from the Royal College of*

Obstetricians and Gynaecologists (2011) recommending that surgical procedures could be used in abortions before ultrasound evidence of pregnancy if there are appropriate safeguards, including inspection of aspirated tissue. Whilst the study included in this review did not give cause for concern, the committee agreed that in the surgical group a similar follow-up programme to those used in the medical abortion group is needed where a gestation sac was not clearly identified in the aspirate in order to exclude an on-going pregnancy or missed ectopic pregnancy.”

Pedersen, J.K., Sira, C., Trovik, J. (2021) Handheld transabdominal ultrasound, after limited training, may confirm first trimester viable intrauterine pregnancy: a prospective cohort study. Scand J P Health Care 39:123–130. Available from: https://doi.org/10.1080/02813432.2021.1910643

“During week 6 handheld abdominal POCUS yielded a sensitivity of 63% in detecting vitality while the negative predictive value was 33%, demonstrating that a positive finding confirms a vital pregnancy, but a negative finding cannot confirm that the pregnancy is pathological. From week 7, the sensitivity was excellent: 94% in confirming vitality and a negative predictive value of 79% in confirming pathological pregnancy.”

12. FEEDBACK: NEW ZEALAND COLLEGE OF SEXUAL & REPRODUCTIVE HEALTH ABORTION TRAINING

Your feedback is invaluable to us to assist in improving the course. We would appreciate your assistance by completing the short form on the Abortion Training website feedback page.