INTRODUCTION

Definition of Preterm delivery

Preterm birth (PTB) is defined as delivery before 37 weeks of gestation. This occurs in 5% to 11% of all pregnancies, with a range as low as 4.5% in Ireland and as high as 15% in the United States. [1]

PTB is the leading cause of neonatal morbidity and mortality not attributable to congenital anomalies or aneuploidy. If an infant is born preterm the risk of death in the first year of life is 40-fold greater compared with an infant born at term. [1]

Incidence

Global incidence of preterm labor is approximately 9.6% of all births .[1] In 2007, the preterm birth rate in the United States was 12.7% with approximately 2% of infants born before 32 weeks gestation.[2] In 2010, the preterm birth rate in Australia was 8.3%,[3]an increase from 6.7% in 2003. [4]

Various Indian studies show the incidence to be between 11 and 14%. It is known that cervix plays a pivotal role in preterm delivery; hence, identification of women likely to have a preterm birth would require a simple ultrasonographical measurement of the cervical length. Ultrasonography is now routinely used for pregnancy dating, screening for anomalies and monitoring fetal growth[2].

Causes of preterm delivery

1) Infection

A. Lower genital bacterial vaginosis [BV]:

There were a significant reduction in preterm delivery and late miscarriage in women with BV who were treated with clindamycin[11].

B. Group B streptococcus:

Whether group B streprococci (GBS) is a cause of preterm delivery rather than an association remains uncertain[12].

C. Chlamydia trachomatis:

Genital chlamydial infection is now the commonest sexually transmitted disease in developed countries, especially in younger women, with infection rates in pregnancy of up to 20% in some groups[13]. It is associated with up to three times the risk of preterm delivery, even after controlling for confounding variables[14,15].

D. Other organisms:

Genital mycoplasmas (Mycoplasma hominis, Ureaplasma urealyticum and Fusobactenum) have been associated with preterm delivery, but a causative role has not been established[16-18]

Other genital organisms that have been associated with an increased risk of preterm delivery include Escherchia coli, Klebsiella, Haemophilus, Neisseria gonorrhea and Trichomonas vaginalis[19,20] but again the causative role is undetermined and some studies have either shown no effect of treatment on preterm delivery rate[21,22] or have not even shown an association[23].

E. Viral infections:

Although there is little evidence that viruses are a common cause or association of preterm delivery, they may be implicated in some cases. One possible mechanism is that viral infection of the trophoblast could play a role in placental dysfunction, leading to complications including spontaneous miscarriage, pre-eclampsia, fetal growth restriction and preterm birth[24], or preterm labour may occur secondary to host inflammatory responses to the viral infection[25] .

F. Intra-uterine infection:

Preterm delivery can result from intra-uterine infection. Intrauterine infection may occur because of:

1. Ascending infection from the vagina.
2. Blood-borne transmission via the placenta.
3. Trans-fallopian infection from the peritoneal cavity
4. Iatrogenic following invasive procedures such as amniocentesis, chorionic villus biopsy or fetal blood-sampling.

The commonest cause of intrauterine infection is ascending infection from the lower genital tract. Ascending infection may follow rupture of the membranes, but can also occur with intact membranes .[26]

There is a very strong association between intrauterine infection and preterm delivery. Up to 13% of women in preterm labour with intact membranes have positive amniotic fluid cultures. Women with preterm premature rupture of the membranes (PROM) have 35% positive amniotic fluid cultures. Positive cultures are more common in those women with PROM who are in labour (75%) than those not in labour[26].

One study has also found that over 50% of women with suspected cervical incompetence have positive amniotic fluid culture[27].There is a plausible mechanism in that bacterial products are known to include proteases and collagenases, which could weaken the membranes, together with phospholipase A2 and endotoxins are known to be able to stimulate prostaglandin production in vitro and in vivo .[27]

Prostaglandins are known to be involved in the initiation of human labour and are of course widely used for the pharmacological induction of labour. In addition, the host inflammatory response to infection causes the release of inflammatory cytokines which are involved in cervical ripening and possibly membrane rupture[27].

G. Asymptomatic bacteriuria

The exact mechanism is unknown, but there is evidence that there could be colonisation of the vagina with the same pathogen as found in the urine, and the bacteriuria may therefore be a surrogate marker for abnormal vaginal flora that could be the cause of preterm delivery[28,29,30]

2) Iatrogenic preterm labour:

A significant and increasing number of preterm deliveries are iatrogenic e.g. in cases of severe pre-eclampsia, especially in the developed world where they may account for as many as 30% of all preterm births[8].

3) Idiopathic:

In the past up to 50% of cases of preterm delivery were deemed to be idiopathic, however this may represent an overestimate and, with improvements in the ability to detect probable causation, some authors have suggested that the term should be abandoned.[9] Moreover, in clinical practice it is often impossible to determine a likely cause, and even in comparatively recent studies, idiopathic preterm delivery may account for up to 30% of cases[10]

4) Uterine Abnormalities:

Women with an abnormally shaped uterus such as a bicornuate uterus could be at risk of pre-term labour. The baby may have less room to grow and when there isn't enough room for the baby, the stretching of the uterus can cause the start of process of labour. [11]

5) Uterine overdistention:

A. Multiple Births: Occurs when more than one fetus is carried to term in a single pregnancy. Twins and other multiple births are often induced early if labour is not spontaneous. Around 50% of twin pregnancies will be born before 37 weeks and a very high percentage of higher order multiples will be born prematurely. [12]

B. Cases of polyhydramnious: preterm labor is twice common than women with uncomplicated pregnancy. [12]

6) Cervical insufficiency:

It is painless cervical dilation resulting in delivery of a live fetus during the 2nd trimester. Transvaginal cervical ultrasonography during the 2nd trimester may help assess risk. Treatment is reinforcement of the cervical ring with suture material (cerclage) or use of vaginal progesterone. Cervical insufficiency refers to presumed weakness of cervical tissue that contributes to or causes premature delivery not explained by another abnormality. Estimated incidence varies greatly (1/100 to 1/2000)[42].

Risk factors for preterm labor

A. Maternal reproductive risk factors

1. Previous preterm delivery:

A previous preterm delivery is the most significant risk factor for subsequent preterm delivery and the relative risk increases with the number of prior preterm births, from 2.2 for one prior preterm birth to 4.9 for three or more [43]. The earlier the first preterm birth, the earlier the subsequent preterm birth[44]. However most preterm births still occur in women without a prior event[45].

2. Previous abortion:

Some studies concluded that there was no increase in risk of preterm birth following spontaneous miscarriage or therapeutic termination of pregnancy [44,46]. Other studies have found that there is an increased risk, even after controlling for confounding variables, and that the risk increases with the number of prior miscarriages or induced abortions, from 1.3 after one previous abortion to 1.9 after 2 or more[47,48,49].

3. Interpregnancy interval:

An inverse relationship between the interval between pregnancies and the risk of preterm delivery. The risk of preterm delivery before 32 weeks is 30%-90% increased in women whose interpregnancy interval was less than 6 months compared with women with intervals of more than 12 months [50,51,52].

4. Parity:

Preterm delivery is commoner in first pregnancies and the risk decreases with successive pregnancies up to a parity of four [53,54]. Although there are few studies investigating effects of parity greater than four, the earlier findings were confirmed in a recent study in Abu Dhabi which found no increase in preterm delivery rate (in fact there was a significant decrease) in a large study of women with a parity often and higher compared to those of parity less than five[55].

5. Multiple pregnancy:

Multiple pregnancy is an important cause of preterm birth. Although multiple pregnancy accounts for only l%-2% of births, it accounts for up to 12% of all preterm births[56,57]. Approximately 50% of twins will deliver preterm with modem obstetric practice in the developed world[58] and for triplets and higher-order multiples, the likelihood of preterm delivery is often greater than 90%.[59] The mean gestational age at delivery is approximately 36 weeks for twin pregnancies and 33 weeks for triplet and higher-order pregnancies.[60]

6. Assisted reproduction:

The risk remains greater even when compared with naturally conceived multiple pregnancies. [61]Monochorionic twins have been found to occur eight times more often

following assisted reproduction than after natural conception. Monochorionic twins are more likely to deliver preterm than dichorionic twins. [62,63]

B. Sociodemographic risk factors:

1. Maternal age:

Both extremes of maternal age have been associated with an increased risk of preterm birth.[6]

2. Race:

Preterm delivery tends to be more common in black races and the reason is unknown.[6]

3. Socioeconomic status:

Socioeconomic status increases the rate of preterm delivery decreases, but it is always difficult to control far the often multiple and closely-associated factors.[64]

Women in poor socioeconomic groups are more likely to be younger, unmarried, to drink and smoke more, abuse illegal drugs and utilize antenatal care less than more affluent groups. However, low-socioeconomic status has been found to be an independent risk factors[64].

4. Psychiatric disease and stress:

Although there is a plausible mechanism for stress initiating preterm labour via raised corticotrophin-releasing hormone (CRH) levels, a definitive link has yet to be established. Anxiety (but not depression) has been found to be related to preterm labour, but the association was weaker in those women who had no pregnancy-related morbidity to worry about.[65]

Preterm delivery is linked with a wide range of psychiatric disorders and a large Swedish study found that schizophrenia carried a 2.4-fold risk of preterm delivery, even when all known factors were controlled for, including smoking. There is no evidence that increasing social support during the pregnancy reduces the risk of preterm delivery .[65]

5. Maternal work:

Although employed women may be healthier than the unemployed and have less socioeconomic deprivation, the effects of standing , night work and heavy physical work appear to be significant risk factors for preterm delivery.[66]

6. Nutrition and maternal weight:

There is conflicting evidence on maternal weight and BMI, but there does seem to be an association between low-maternal weight or poor weight gain during pregnancy and preterm delivery .[67,68,69,70]

7. Substance abuse:

Alcohol

Alcohol intake in the third trimester has been found to be associated with a reduced risk of preterm delivery in women who drank up to nine drinks per week, but this effect may be reversed in heavier drinkers.[57,71]

Tobacco

There appears to be a dose-related effect: the more cigarettes smoked the higher the risk. Women who smoke more than 10 cigarettes per day have a 1.7 times risk of delivery before 32 weeks.Antismoking interventions do not have a significant effect on the rate of preterm delivery.[72,73]

C. Lack of proper antenatal care

Lack of access to good-quality antenatal care is associated with intrauterine growth restriction and preterm delivery, but whether this is a causal relationship is uncertain.[81,82]

D. Medical disorders of pregnancy

Hypertensive disorders during pregnancy comprise the single largest category of disorders accounting for preterm delivery. Such disorders can cause up to 10% of all preterm deliveries by necessitating elective preterm delivery. Other important but less common causes, include diabetes mellitus, connective tissue disorders (particularly systematic lupus erythematosis (SLE), renal disease and systemic diseases. [83-86]

Any systemic infection during pregnancy (e.g. pyelonephritis, pneumonia or appendicitis) which occurs at a preterm period of gestation, may trigger labour onset. Other significant or common risk factors for preterm delivery include the presence of asymptomatic bacteriuria during pregnancy, urinary tract infection or pyelonephritis. [83-86]

Prediction of preterm labour:

A. Cervical/vaginal secretions, Fetal fibronectin

Fetal fibronectin is a protein found in amniotic fluid, placental tissue and the extracellular substance of the decidua basalis next to the placental intervillous space. The virtual disappearance of Fetal fibronectin from the vaginal secretions by 22 weeks coincides with fusion of the chorion and decidua capsularis with the decidua parietalis of the uterine wall. [90,91]

The reappearance of fibronectin before labor may represent the separation of the chorion from the decidua prior to the onset of labor.[90,91]

In women with uncomplicated pregnancies ending in term delivery, fpn can be detected in the cervical secretions of up to 50% of pregnancies in the first trimester and 30% beyond 37 weeks' gestation but is present in only 4% of normal pregnancies betw-een 21 and 37 weeks.[91]

The presence of fpn in the cervico-vaginal secretions was a good indicator of those who subsequently went on to deliver prematurely and a negative result was highly predictive of the pregnancy going to term. [89]It is a bedside test but recent ruptured membranes (< 24 hours), sexual intercourse, antepartum haemorrhage or vaginal examination may invalidate the test result, so it is not applicable to all women presenting with preterm uterine activity.[90,91]

This highlights the clinical implications of introducing a test in asymptomatic women (low-risk and high-risk) is not a clinically useful procedure. Fibronectin testing amongst asymptomatic twin pregnancies does not predict spontaneous preterm birth before 35 weeks' gestation [92].

In women experiencing preterm uterine activity, a negative test reduces the likelihood of delivery within 7-10 days of presentation from 3% to less than 1%; a positive test increases the likelihood of delivery within 7-10 days from 3% to 14% [93].

A negative test therefore implies a low risk for delivery in the near future and might form the basis for withholding interventions with subsequent reductions in hospital admissions, inter-hospital transfers and costs. So the test has some discriminative power in differentiating true from false preterm labour. [93,94]

The high negative predictive value of fpn testing for delivery within 7 days (99%) results in a low-likelihood of an infant developing potentially avoidable RDS as a consequence of withholding steroids following a false negative fpn test result at 32 weeks' gestation, the risk is approximately 0.5%.[94]

B. Amniotic Fluid Sludge

The presence of free-floating hyperechogenic material within the amniotic fluid in close proximity to the uterine cervix has been described previously in women with an episode of preterm labor [97].

It has also been described in women with a history of preterm delivery or threatened preterm labor, and in asymptomatic women at risk for spontaneous preterm delivery in the mid-trimester of pregnancy[98,99].

The term amniotic fluid ‘sludge’ has been proposed to refer to this sonographic finding and provided evidence that ‘sludge’ is an independent risk factor for impending preterm delivery, subclinical chorioamnionitis and microbial invasion of the amniotic cavity in patients with spontaneous preterm labor and intact membranes.[97]

Moreover, amniotic fluid ‘sludge’ has been identified in asymptomatic women at risk for spontaneous preterm delivery in the mid-trimester of pregnancy and is also an independent risk factor for preterm prelabor rupture of membranes (PROM) and spontaneous preterm delivery, To determine the nature of amniotic fluid ‘sludge’, the material collected under sonographic guidance was examined under the microscope and microbiological studies were performed. [99]

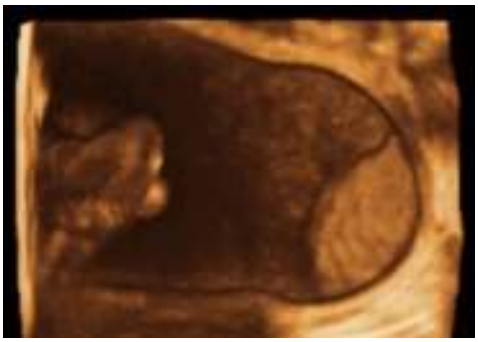

Fig. 1: Three-dimensional transvaginal ultrasound image demonstrating the presence of amniotic fluid 'sludge' in close proximity to the cervix.[99]

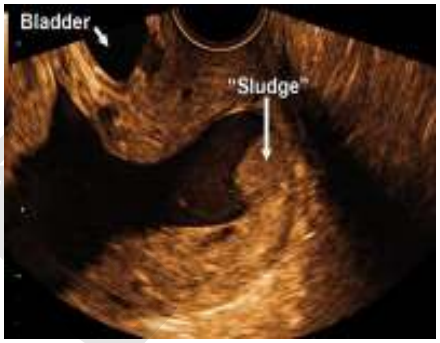

Fig. 2: Two-dimensional ultrasound image showing amniotic fluid 'sludge' in a patient with a short cervix and a cervical funnel.[99]

C. Length of cervix to predict PTl

The cervix lies caudalic to the uterine body, and is bounded superiorly by the uterine isthmus. The internal os is the anatomical and histological junction of the muscular uterus and the fibrous cervical stroma. The endocervical canal extends from the internal os to external os. [101]

Evaluation of the cervix has been used as a tool to predict PTB based on the concept that the cervix acts as an anatomic marker of the underlying pathologic process leading to preterm delivery. The cervical length (CL) has been measured using a digital examination in the past. Investigations using transvaginal ultrasound measurement as the standard confirmed that digital examination underestimates cervical length and the majority of studies found that ultrasound assessment of cervical length is superior to clinical examination for the prediction of PTB. [102]

The traditional approach to evaluate the length of the cervix is now using sonographic visualisation. There are three ultrasound approaches that may be used to measure the cervical length. These are the transabdominal (TAU), transperineal (TPU), also known as translabial and the transvaginal ultrasound (TVU) approach. [1]

Shortening and funnelling of the cervix was first described to be associated with the diagnosis of incompetence, however it was Andersen, *et al*[103], who first raised the possibility that the transvaginal sonographic measurement of CL could be used to predict a risk for preterm

delivery for a significant proportion of preterm birth. Therefore, morphological measurements on ultrasound examinations have become increasingly important.[103]

The use of transvaginal ultrasound examination of the cervix is now widely recommended as part of the surveillance of women at high risk of preterm delivery. Its use as a screening tool in a low risk population is more debatable.[103]

Cervical insufficiency is defined as the inability of the uterine cervix to retain a pregnancy in the absence of contractions or labour. Although CL is a good predictor of preterm birth, the exposure of the membranes to ascending infection seems to be the crucial precipitating factor as even a short closed cervix with a length of < 10 mm can result in a term pregnancy.[101]

Cervical length assessed by TVU is a far better predictor of PTB than past obstetric history, as the cervix shortens the likelihood of subsequent preterm delivery increases, although its accuracy is still dependent on a woman's risk status assessed by her history. The risk of PTB in a low risk woman with a cervix < 25 mm is half that of a high risk woman with a similar cervical length.[101]

Romero, et al.[105] concluded that the shorter the CL, the higher the risk of spontaneous PTB. Although a clear relationship between a shortened CL and PTB has been established, it is important to remember that most women (75%) with shortened cervices do not deliver preterm.[106]

For ease of clinical use, 25 mm has been chosen as the 'cut off' at above which a cervix can be regarded as normal, and below which can be called short.[107,108] A cervix that is less than 25 mm may be indicative of preterm birth.[107]

A cervical length < 25 mm before 28 weeks gestation is abnormal and associated with a higher incidence of PTB, women with a cervical length < 25 mm and contractions have twice the incidence of PTB than women with a cervical length < 25 mm but no contractions.[107]

Mechanisms for development of a short CL

There are three main mechanisms that have been associated with the development of an asymptomatic short CL.[109]

First, the most obvious hypothesis is that a short CL is caused by an intrinsic weakness of the cervix or cervical insufficiency (this term is preferred rather than cervical incompetence). This cervical insufficiency is due in most cases to traumatic or surgical damage, or much more rarely, a congenital disorder or a connective tissue disease.[109] It is interesting to note that almost all women, even the most high-risk, have a normal CL in the first trimester.[109]

This is probably because the pressure the growing gestational sac exerts on the cervix will be unlikely to open up even the weakest of cervices,[109] Thus screening of the CL is not very effective when performed before 14 weeks gestation.[107]

Second, another hypothesis is that a short CL is due to an inflammatory or infectious process as there is a strong association between a short CL on TVU and infection.[109]

Third, recent studies have shown that the majority of asymptomatic women with CL less than 25 mm before 24 weeks have some contractions, more than controls with a normal cervix. It is unclear whether contractions cause the short CL, or are a result of the short cervix, or whether these two factors are working synergistically.[107,109]

Pregnant women clearly experience contractions without associated cervical dilatation; sometimes, they experience cervical dilatation in the absence of contractions.[110] Most probably all three, as well as other mechanisms, often act synergistically in certain women to contribute, in each individual in different ways, to the development of a short CL.[109]

There is an increased risk of developing a short CL in patients with a previous preterm birth or a cervical suture in-situ. The risk is increased also in patients with a previous instrumentation of the cervix (Cone biopsy) or uterus (dilatation and curettage), or patients carrying a multiple pregnancy.[102,107]

Transvaginal ultrasound as a screening tool for the maternal cervix

A study conducted in 1998 by Taipale, *et al.*[111] involved a cohort of 3694 women who had a TA and TV scan of the cervix performed at 18 to 22 week scan. Another study by Hassan, *et al.*[112] looked at a retrospective cohort of 6877 patients.[111]

Both studies confirmed the relationship between the risk of preterm delivery and the functional length of the cervix but showed the limitations of this method for screening in the general population. Due to its relatively low sensitivity and low predictive value for prematurity, transvaginal sonography concomitantly with routine transabdominal screening may not be universally justified .[111]

Routine TVU of the cervix performed between 18 and 22 weeks helped to identify patients at risk of preterm delivery; nonetheless, the low prevalence of preterm births in these populations at low obstetric risk is a limitation to the development of screening which brings in either a high false-positive rate if the cut off for normal cervical length is 29 mm (3.6%), or a low sensitivity with a cut-off of 15 mm (8.2%).[113]

A recent study by Hassan, *et al*.[114] involving a trial of 32,091 women, it was found In that 2.3% or 733 of these women had a cervix length between 10–20 mm. All cervix lengths were measured using a TV approach. Half of the 733 women were treated with progesterone vaginal gel and the other half a placebo. [114]

There was a 44% reduction in the rate of spontaneous preterm deliveries before 34 weeks of pregnancy in the progesterone group.[114]

It has been suggested that a TV scan in the second trimester of singleton pregnancies carried out between 19 and 24 weeks to measure cervical length is the best method with which to identify a group of women (approximately 2% of the pregnant population) who would benefit from a prophylactic progesterone treatment to prevent spontaneous PTL[115]

At the Australasian Society for Ultrasound in Medicine (ASUM) 2011 scientific meeting Professor Jon Hyett stressed in his presentation that a failure to assess the cervical length in obstetric scans performed at less than 34 weeks could be judged as negligent. It was his opinion that the cervix could not be seen using a transabdominal scan.[116]

He recommended that all low risk asymptomatic women should now have the transvaginal scan as part of their mid trimester ultrasound scan to measure the length of the cervix. He recommended this as progesterone treatment of the cervix had been successful in reducing preterm births in 40% of women, whereas in the past cervical cerclage as the main treatment option was often ineffective.[116]

The 2009 Cochrane Review for Cervical Assessment by Ultrasound for Preventing Preterm Delivery states that currently there is insufficient evidence to recommend routine screening of asymptomatic or symptomatic pregnant women with TV ultrasound CL.[117]

The 2013 Cochrane Review for Cervical Assessment by Ultrasound for Preventing Preterm Delivery finds that TVU CL is one of the best predictors of PTB in all populations so far. They also found that at this point in time no studies using TAU for CL screening were identified, therefore there were no trials comparing TV versus TA ultrasound for CL.[118]

They concluded that there is currently insufficient evidence to recommend routine screening of asymptomatic or symptomatic pregnant women with TVU CL without a specific intervention.[118]

The recently published International Society for Ultrasound in Obstetrics and Gynaecology (ISUOG) Practice Guidelines for Performance of the Routine Mid-trimester Fetal Ultrasound Scan, also state that currently there is insufficient evidence to recommend routine TVU cervical length measurements at the mid-trimester in an unselected population.[119]

The American College of Radiology recommends TV cervical sonography as a part of every routine obstetric ultrasound in the second trimester.[120]

However routine use of ultrasound for cervical length measurement remains controversial in asymptomatic women and the American College of Obstetricians and Gynaecologists (ACOG) does not explicitly recommend this form of screening. ACOG does recommend obtaining a TVU for further assessment of the cervix if it appears short transabdominally.[120]

Transvaginal, transperineal and transabdominal ultrasonic approaches for measuring the maternal cervix

Different cervical parameters have been evaluated as predictors of PTB. CL, as measured from the internal os along the endocervical canal, is the most reproducible and reliable measurement. A short cervix is usually straight, [106] and the presence of a curved cervix generally signifies a CL greater than 25 mm. If the cervix is mildly curved a straight line measurement may be used, if the curve is more pronounced with a deviation of > 5 mm from the straight line, the CL can be measured with the sum of two straight lines. [106]

The curved cervical canal may also be measured by tracing the canal from internal to external os. [120] On some ultrasound machines there is also the option of plotting 3 or more points along a curved line to trace the endocervical canal (called a spline trace on some equipment).The maternal cervix may be imaged ultrasonically by all three TA, TP and TV approaches.[120]

A number of studies have been published in the literature with regard to the accuracy of measurements among these three methods. [120]

Transabdominal approach

The TA approach can be used to measure CL with a full and empty or partially full maternal bladder. The cervix is a dynamic organ and it is important to assess the cervix multiple times throughout the duration of the obstetric examination. The echogenic cervical canal should be seen in its full length. The adjacent hypoechoic cervical glandular tissue may also be visible.[122]

The caliper placement for the internal os should be adjacent to the cervical canal at the point where the opposing fornices of the cervix come together and form a flattened T-shape appearance or a small V-shaped notch may be seen.[122]

The calliper placement for the external os should be adjacent to the cervical canal at the point where the cervix meets the vagina. This often appears as a very slight indentation, the outline of the cervical corpus should also be used as a guide for calliper placement of the external os.[122]

The full bladder TA approach can be problematic in that pressure from the full maternal bladder can falsely elongate the cervix. Compression of the cervical canal makes it difficult to assess the cervical glandular tissue delineating the true cervical canal.[101]

It may also mask the presence of premature rupture of membranes (PROM). Persisting with an overly distended bladder also seems to increase the chance of a lower uterine contraction developing, which can then make defining the true CL technically difficult.[101]

An empty bladder may give adequate visualisation of the full cervical length. A partially full to empty bladder will reduce the compression of the cervical canal to alleviate the false elongation and the cervix should now be seen 'open' in a case of PROM. [101,122]

It is important to use a more cephalid approach on the maternal abdomen with a caudal tilt of the transducer, this utilises amniotic fluid as a window for visualisation of the cervix. Many patients exhibit the 'curved' cervix post void (Figure 2). In some patients the cervix will appear quite 'vertical' post void (Figure 3). [101]

It has been found by some authors that accurate measurements have not been obtained by the TA approach in 50% of cases, Saul, *et al*. found that a TAU CL of ≤ 30 mm was 100% sensitive for a TVU CL of ≤ 25 mm. As yet no studies using TAU for CL screening to predict preterm birth have been identified.[122] Figure 4 is an example of a TAU image of the cervix with a full bladder and Figure 5 shows the same cervix post void.[101,122]

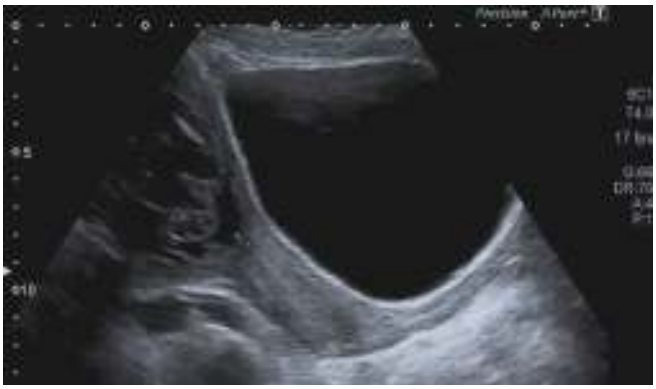

Fig. 3: Pre void TAU image of the cervix, the full bladder causes artifactual lengthening of the cervix with the cervical length measured at 61.5 mm. [101,122]

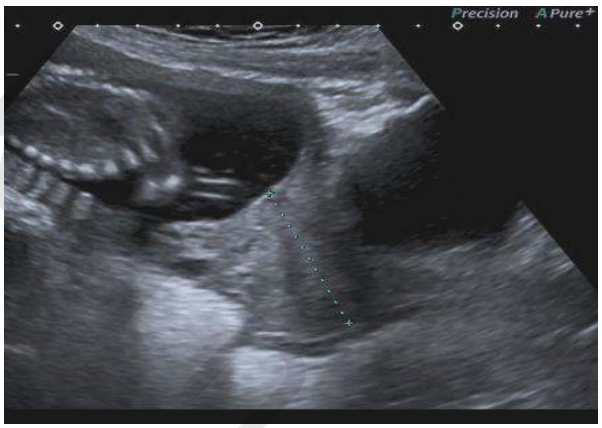

Fig. 4: Post void TAU image of the cervix with the empty bladder alleviates the artificial lengthening of the cervix, and it has a normal curved appearance with a cervical length measurement of 41.3 mm. [101]

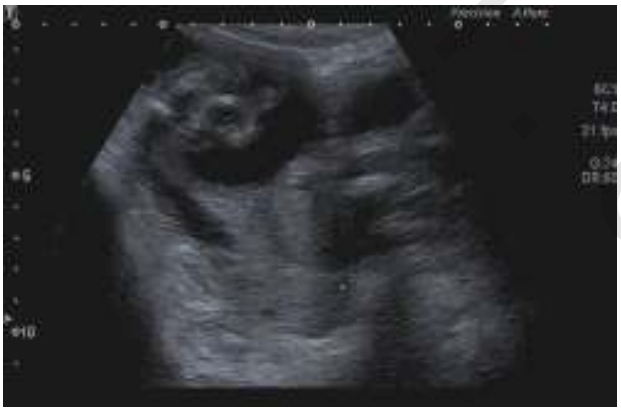

Fig. 5: Post void TAU image of the cervix demonstrating a curved appearance of the cervix. [122]

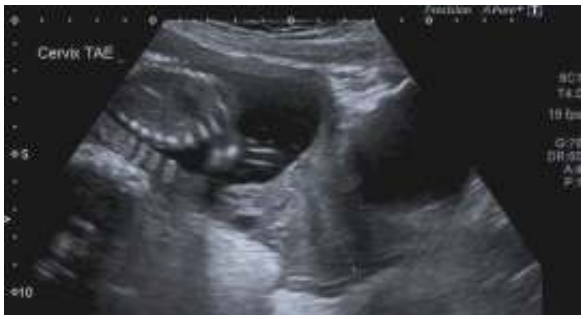

Fig. 6: Post void TAU image of the cervix demonstrating a vertical appearance of the cervix.[101,122]

Transperineal approach

The transperineal ultrasound approach can be useful for imaging the maternal cervix. This approach uses the same curvilinear transducer that is used for the transabdominal approach. The TPU approach is performed post void. The echogenic cervical canal should ideally be seen in its full length, the hypoechoic cervical glandular tissue may also be visible.[1]

The internal os should be seen at the point where the fornices of the cervix come together and form a flattened T-shape appearance or a small V-shaped notch may be seen. The external os should be adjacent to the cervical canal at the point where the cervix meets the vagina. [1]

A small echodense area may be seen on some patients. The posterior cervical corpus should also be used as a guide for calliper placement at the elevated external os. [1]

The transducer is placed in a sterile freezer bag and sterile gel is used as a coupling agent. The patient is placed in the lithotomy position with the hips elevated on a cushion and the transducer is positioned on the labia majora or perineum of the patient. [1]

The cervix is imaged from this inferior approach. The transducer is placed in a sagittal plane along the direction of the vagina, Oblique or parasagittal movements may be required to delineate the full length of the cervical canal. [1]

On TPU, the most important technical problem is the possible interference of adjacent bowel gas with cervical image, The elevated lithotomy position helps to alleviate rectal gas overlying the external os. [129]

The transducer can also be placed with a slightly anterior approach on the labia with a slight posterior angulation to help overcome shadowing from rectal gas. Another technical issue is the distance to the maternal cervix from the transducer face. [129]

In most cases a lower frequency transducer is required than the TA approach. The lower frequency required can make it difficult to appreciate the landmarks of the external os, cervical glandular tissue and internal os. This becomes more problematic in cases where a lower uterine contraction is present. [129]

This approach is often inadequate and not as easy to visualise the canal in up to 25% of women.(101) TPU has been shown to have a sensitivity of 77% in predicting PTB with a false-positive rate of 17% and a relative risk of 4.5 at the 32.5 mm cut off value, In cases where a PROM is suspected or the patient declines the TV approach the TPU is useful. (101)

In patients presenting with vaginismus the TPU approach can also be utilised.[1] TPU has an advantage over TVU in that no pressure is put on the cervix to artifactually elongate the cervical canal, as can occur in the TV approach, Figures 6 and 7 are examples of TVU and TPU CL performed on the same patient. (129)

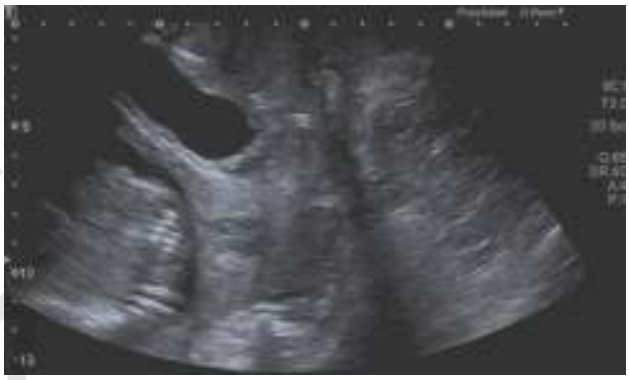

Fig. 7: TPU image of the cervix showing the cervical canal and calliper placement at the internal and external os acquired with a lower frequency curved probe (3mHz), and the cervical length is measured at 50 mm. (129)

Transvaginal approach

The transvaginal approach uses a high frequency endovaginal (intracavity) transducer. The TVU approach is performed post void. The transducer is placed in a probe cover and sterile gel is used as a coupling agent .(1)

The patient is placed in the elevated lithotomy position. On the TVU approach the internal os should be seen as flat or with a V-shaped notch, the external os should have a dimple or triangular area of echodensity and the cervical canal should be seen as echogenic with surrounding hypoechoic glandular tissue in varying degrees. Occasionally the canal may also appear hypoechoic.(1)

On TVU the most important technical pitfall is elongation of the endocervical canal due to distortion of the cervix by the transducer. The transducer is placed into the vagina a small distance to visualise the full length of the maternal cervix, (3,129) the transducer is withdrawn slightly so the image becomes out of focus, and then the transducer is repositioned till the cervix just comes into view. This technique is used to alleviate any pressure placed on the cervix which may artifactually elongate the measurement .(3,129)

The distance from the transducer face to the cervix is reduced compared to the TAU and TPU approaches and due to this a higher frequency is able to be utilised in most cases, increasing the detail of the ultrasonic landmarks of the maternal cervix. In some patients the cervix will have a more ‘sloped’ appearance and the ‘dimple’ of the external os can be more difficult to attain (Figure 8). (3,129)

In some cases it is also necessary to reduce the transducer frequency to adequately assess the full length of the cervix. The cervical glandular tissue is usually visualised with greater detail in the TVU approach (Figure 9), than the TPU approach (Figure 10), making measurements of the true cervical length technically easier with the TVU approach in cases with a lower uterine contraction,[3] though lower uterine contractions can be problematic for all approaches.[(1)]

TVU shortened CL is more sensitive (> 50%) in women with an increased risk of PTB, and in women with no risk factors of PTB it has a sensitivity of only 37%[(107,111)].

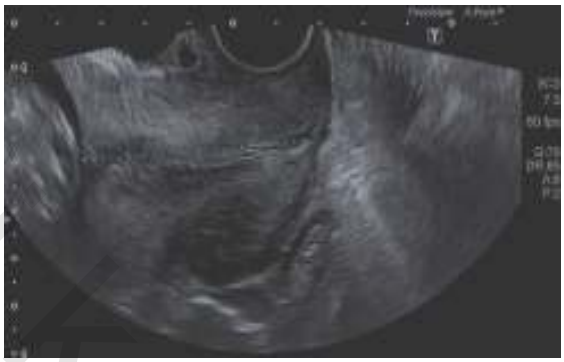

Fig. 8: TVU image of the cervix with measurement of the cervix from internal to external os using the higher frequency transvaginal probe (7.3mHz), the cervical length is measured at 50.5 mm. [(107,111)]

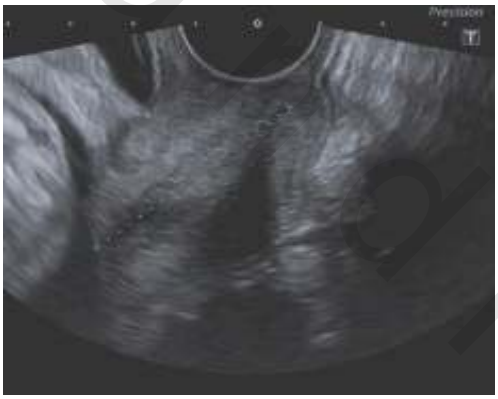

Fig. 9: TVU image of the cervix demonstrating a cervix with a â€˜slopedâ€™ appearance.[(111)]

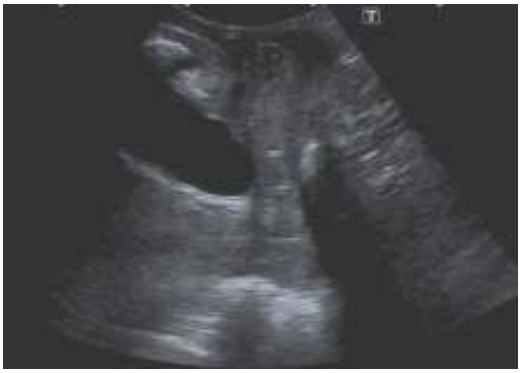

Fig. 10: TPU image of the cervix demonstrating a lower segment myometrial contraction, the internal os is difficult to identify due to the contraction. [(107)]