Sonography of the Cervix –
the "Why" in Why We Do What We Do!

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Mani Montazemi, RDMS, has indicated that he has no relationships to disclose relating to the subject matter of this educational activity.

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Preterm birth (<37 weeks gestation) currently affects 8-10% of all pregnancies and constitutes the largest single problem in modem perinatology. Until recently, the diagnosis of preterm labor was dependent upon serial digital examinations of the cervix to detect changes over time. Recently reported studies, however, confirm that digital palpation can examine only the lower half of the cervix (i.e., the vaginal portion), and cannot evaluate the upper cervical segment situated behind the bladder.

It is not surprising; therefore, those studies comparing cervical length using vaginal sonography versus digital examination report the digital exam to consistently underestimate cervical length. Because of these anatomic constraints, the digital examination cannot adequately examine the area of the internal cervical os, the critical site that signals abnormalities associated with preterm dilatation. In addition, the subjective nature of the digital approach has been shown to be inaccurate due to interobserver variation and an unacceptably high number of false positive determinations. Other theoretical limitations include the risk of infection and ruptured membranes.

A major advancement in the fight against preterm birth has been the introduction of cervical sonography. Unlike the digital examination, sonographic measurement of cervical length generates an image that may be reviewed and standardized, thus avoiding the inherent subjectivity of the digital examination.

The Normal Cervix

During pregnancy, the cervix does not elongate appreciably, but it thickens primarily due to marked proliferation of the endocervical mucosa. It normally measures between 2.6 and 5.0 cm in length. Four cm constitutes the 75th percentile, 3.5 cm the 50th percentile, 3.0cm the 25th percentile, and 2.6cm the 10th percentile. The normal endocervical canal is non-dilated and does not contain fluid. Endocervical mucus is usually echogenic, although sometimes its appearance is sonolucent, mimicking fluid. The normal internal os is located anterior and superior to the posterior and inferior external os.

Sonographic Methods for Imaging the Cervix
Transabdominal Approach

Because most obstetrical examinations are done transabdominally, this is the most common but least reliable imaging method for evaluating the cervix. Often, especially toward the end of pregnancy, the fetal head may obscure the cervix. Attempts to elevate the head may be accomplished either manually, or by applying gentle suprapubic pressure against the presenting part, using a sector transducer. If the maternal bladder is not distended, these maneuvers usually fail.

Pitfalls

Problems with a transabdominal approach may occur with both over and under distension of the maternal bladder. Over distension results in compression of the walls of the lower uterine segment and cervix. This causes an apparently closed and elongated cervix, which may appear deceivingly normal in women with cervical effacement, shortening, or frank dilatation. With a low placenta, compression of the lower segment may simulate placenta previa.

A decompressed maternal bladder often technically precludes adequate visualization of the cervix. This is due to the combined effects of acoustic shadowing over the area of interest (from the pubic symphysis as well as refractive shadowing from the bladder/uterine interface), loss of the acoustic window provided by the urinary bladder and/or amniotic fluid, and an inability to elevate the fetal head or other presenting part.

Even if the cervix is visible on a transabdominal scan, it is usually not imaged optimally. Because the external os is virtually never identified, a technically correct measurement of cervical length is not possible. In any patient with a clinical suspicion for cervical pathology, additional scanning using either transperineal or transvaginal scanning should be undertaken.

Sonographic Methods for Imaging the Cervix
Transperineal or Translabial Approach
In many ultrasound laboratories, translabial scanning, which was introduced by Jeanty and colleagues in 1986, is currently the preferred method for examining the uterine cervix. Since the bladder is empty, this approach overcomes the limitations of transabdominal scanning, and the cervix is easily seen.

The technique for doing a translabial scan consists of placing the patient supine, with knees bent and hips abducted. After covering a standard 3.5 MHz sector transducer and applying acoustic couplant or K-Y gel to the outer surface, the transducer is placed between the labia majora at the vaginal introitus. It may be advantageous to begin scanning in a coronal plane to identify the cervix, which will resemble its appearance as seen during speculum examination. Once the cervix is clearly identified, the transducer is slowly rotated to a sagittal position, while constantly visualizing the echogenic endocervical canal.

In the sagittal plane, the cervix has a cylindrical shape. The distance between the internal and external os should be measured to obtain cervical length. The internal os is normally located at the level where the cervical canal meets the amniotic sac. The external os may be difficult to precisely define due to acoustic shadowing from rectal gas, but is usually defined at the level where the cervical canal can no longer be seen. In Hertzberg et al's experience, in approximately 14% of patients the region of the external cervical os is obscured by bowel gas. This problem can sometimes be overcome by either scanning the patient in lateral decubitus positions (both right and/or left), or elevating the hips and buttocks on a thick pad or pillow. To minimize interobserver error, measurements should be obtained only when the entire cervical length is visible, and when the anterior and posterior lips of the cervix are symmetrically thick.

In patients at risk for cervical shortening or incompetence, Guzman and colleagues recommend using a transvaginal approach and applying transfundal pressure scanning for approximately 15 seconds in the direction of the uterine axis. In their experience, approximately 50% of women in the high risk group respond to this maneuver with shortening of the cervix and protrusion of membranes and fluid into the endocervical canal. Because some patients had an initially completely normal appearing cervix, this important maneuver can identify additional women who require cerclage. Similar cervical changes can also be elicited by measuring cervical length after the patient has been upright for 15 minutes. If a cerclage is not placed in these women, follow-up sonography reveals progressive and significant cervical shortening.

Pitfalls

The most common technical problem is inability to precisely measure cervical length due to acoustic shadowing from rectal gas obscuring the external cervical os. As previously mentioned, rescanning in decubitus position, or elevating the patient's hips can sometimes help. Water in the vagina can also be used to define the external os.

Inexperienced scanners may mistake the urethra for the cervix, and the urinary bladder for amniotic fluid. Initial scanning in a coronal plane frequently facilitates orientation and results in precise localization of the cervix. In patients without a prominent mucus plug, the relatively sonolucent inner fibromuscular stroma of the cervix can mimic fluid within the endocervical canal. Appropriate gain settings should minimize this pitfall. Other mimickers of endocervical fluid include Nabothian cysts, paracervical veins and, in patients with ruptured membranes, fluid in the posterior vaginal fornix.

If the presenting part (usually the fetal head) is low in the pelvis, and if the placenta is posterior, it may by very difficult to determine the precise termination of the placenta relative to the internal cervical os. This is particularly true in cases of posterior partial or marginal placenta previa. Complete previa, however, is usually readily visible as it crosses completely in front of the cervix.

Sonographic Methods for Imaging the Cervix
Transvaginal Approach

A survey of the literature suggests that transvaginal scanning is more accepted by obstetricians, while translabial scanning is favored by radiologists. To technically optimize the transvaginal study, a standard obstetrical table with stirrups is preferred. The tip of the transducer should be inserted into the distal vagina, just beyond the introitus. Using this approach, and especially if water is instilled into the vagina, may provide a superior method to image the external cervical os.

Pitfalls

If the transducer is inserted too far, it may physically impress and compress the cervix, resulting in distortion and a falsely elongated cervical length. In addition, the external os may be suboptimally seen, due to near field reverberation. Potential complications of this approach include stimulating contractions in women with preterm labor, contributing to infection in patients with ruptured membranes, and inducing vaginal bleeding in patients with placenta previa.

Cervical Changes

Although the clinical scenario is vitally different, from an imager's point of view cervical changes are essentially identical in patients in term labor, preterm labor, or with cervical incompetence. By serially monitoring cervical changes during normal labor (using a transperineal approach), Zilianti and colleagues recorded the dynamic process of cervical effacement and dilatation.

In each of these conditions, cervical dilatation begins at the level of the internal os and progresses distally. Zilianti graphically illustrated and denoted the changes of the relationship of the internal os to the lower uterine segment and endocervical canal using the mnemonic "T, Y, V, U" (or as jokingly described by Iams as "Trust Your Vaginal Ultrasound!). At the onset of labor, the internal os is relatively flat or "T" shaped; with invagination of membranes and amniotic fluid into the proximal endocervical canal, the shape progressively assumes the appearance of the letters "Y, V, and U." The most accepted terminology for these changes is "funneling," although "wedging or

beaking" have also been used. Eventually, the entire endocervical canal becomes filled with fluid and if the membranes remain intact, they may be seen to bulge into the vagina. Concurrent with dilatation, the length of the cervix becomes effaced or shortened. Both dilatation and effacement typically progress simultaneously although, in a given patient, one or the other event may appear to predominate.

Different investigators recommend quantitating these cervical changes using a variety of measuring techniques. These include measuring the width of the funnel, determining the percentage funneling, or detecting the cervical index. The simplest, most reproducible measurement in terms of sensitivity and predictive value, however, appears to be the residual closed length of cervix. This calculation takes into account both dilatation and effacement, and can be obtained by measuring from the distal apex of endocervical funneling at the internal os to the point of the dimple of the external os.

Pitfalls
Sometimes, resolving lower uterine segment contractions may result in an appearance that mimics preterm cervical dilatation. This potential pitfall can be avoided by recognizing that in cases of pseudodilatation the apparent cervical length exceeds 5 cm, there is normal appearing cervical tissue distal to the area of dilatation, and there is rounding of the myometrium (due to the resolving contraction) surrounding the dilated area. In problematic cases, this area should be rescanned, because these changes are transitory and resolve in less than an hour.

Since cervical changes are dynamic during labor, the appearance of the cervix may change during the course of the sonographic examination. Typically, it appears relatively normal during cervical contraction, and patulous during relaxation. Occasionally, sonographers may document transient and dramatic cervical dilatation that cannot be confirmed at subsequent digital examination. These transient but important observations underscore the need to observe the appearance of the cervix several times during the course of a single obstetrical sonographic study, and suggest that a single "snapshot" image of the cervix may be insufficient for thorough cervical evaluation. When a patient is encountered with these changes, she should be considered at risk, because clinical follow-up reveals that 61-74% have preterm labor or deliver prematurely. According to Hertzberg's analysis, the most potent indices relative to outcome are the diameter of the internal os funneling, and the length of intact cervix caudal to the funneling (when the cervix appears most abnormal). Neither the magnitude of cervical change nor the measurements obtained when the cervix is most normal are predictive of when delivery will occur.

Common indications for examining the cervix include:
- Assessing cervical effacement and dilatation in patients with preterm labor
- Diagnosing cervical incompetence
- Evaluating patients with vaginal bleeding to look for placenta previa

Cervical Dilatation
In a patient with persistent uterine contractions, the clinical diagnosis of preterm labor is made when cervical change is noted on serial digital examinations. Therapy consists of bed rest and tocolytic therapy. In contrast, cervical incompetence is characterized by passive and painless cervical dilatation in the absence of uterine contractions; this results in recurrent mid-trimester

abortion. In these patients, therapy consists of placing a cervical cerclage. Unfortunately, many women are encountered with elements of both entities; this makes it difficult to clearly differentiate these two conditions, and to determine optimal therapy.

Sonographic evaluation of patients with either preterm labor or an incompetent cervix reveals identical findings. In both situations, there are varying degrees of cervical dilatation, funneling, and effacement that progress from the internal toward the external os. Also, for both conditions, the strongest prognostic indicator for preterm delivery directly relates to the residual length of closed cervix. Analysis by Iams and colleagues suggests that 30 mm is the best cutoff to maximize sensitivity and specificity for predicting premature delivery. The investigation to support this critical measurement showed that all 24 subjects who delivered prematurely had a cervical length less than 30 mm, while none of 15 women who had a cervical length of at least 30 mm delivered spontaneously before 36 weeks.

Although traditional teaching focuses on the cervix as being either "competent" or "incompetent," recent pioneering work by Iams and associates challenge this concept, and suggest that cervical competence represents a continuum that relates to cervical length and pregnancy history. This group showed that the length of the cervix is directly correlated with the risk of preterm labor as a continuum; risk increases with progressive cervical shortening. Thus, we should not distinguish patients with ''an incompetent cervix'' from a second group of patients with an "abnormal, but competent cervix.

Cerclage Evaluation

Because only the distal half of the cervix is intravaginal, and because the overwhelming number of cerclages are placed surgically using a vaginal approach, most cerclages are located in the distal half and many in the distal third of the cervix. In patients with severe cervical hypoplasia, transabdominal ultrasound guidance may be useful to improve cerclage placement. In most patients, the cerclage is easily identified on ultrasound examination as several brightly echogenic foci located within cervical tissue, and usually associated with acoustic shadowing. Several studies show that a failing cerclage can be suggested by sonography when there is funneling of the internal cervical os. In the experience of Anderson and colleagues, who examined patients with an empty bladder and used a vaginal approach (with and without fundal pressure), there was almost a six fold increased likelihood of preterm delivery with shortening of the upper cervical segment to <10mm or with significant funneling. The upper segment was defined as the portion of cervix proximal to the suture; significant funneling was diagnosed when the diameter of the proximal funnel and its length each measured at least 10 mm. These investigators suggest that in patients with cerclage, sonographic examinations should be done at 4 week intervals. If shortening of the upper cervical segment or funneling is observed, limited activity and increased patient surveillance is recommended. Other experts in this field suggest an even more aggressive approach in women diagnosed with early cerclage failure, and have found that hospitalization and tocolytic therapy greatly improve pregnancy outcome.

Conclusion

Translabial and transvaginal sonography can each provide unique information that can facilitate a sonographic examination, and can provide information that otherwise might not be readily available. These examinations are easy to perform and, in the appropriate clinical setting, should become an integral part of the sonographic study.