



NIH PUBLIC ACCESS

Author Manuscript

Am J Obstet Gynecol. Author manuscript; available in PMC 2014 October 01.

Published in final edited form as:

Am J Obstet Gynecol. 2013 October ; 209(4): 365.e1–365.e5. doi:10.1016/j.ajog.2013.07.032.

Adherence to Criteria for Transvaginal Ultrasound Imaging and Measurement of Cervical Length

JD Iams, WA Grobman, A Lozitska, CY Spong, G Saade, BM Mercer, AN Tita, DJ Rouse, Y Sorokin, RJ Wapner, KJ Leveno, MS Esplin, JE Tolosa, JM Thorp, SN Caritis, and JP Van Dorsten for the *Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network, Bethesda, MD*

Departments of Obstetrics and Gynecology, The Ohio State University, Columbus, OH (J.D.I.); Northwestern University, Chicago, IL (W.A.G.); University of Texas Medical Branch, Galveston, TX (G.S.); Case Western Reserve University-MetroHealth Medical Center, Cleveland, OH (B.M.M.); Alabama at Birmingham, Birmingham, AL (A.T.); Brown University, Providence, RI (D.J.R.); Wayne State University, Detroit, MI (Y.S.); Columbia University, New York, NY (R.J.W.); University of Texas Southwestern Medical Center, Dallas, TX (K.J.L.); University of Utah Health Sciences Center, Salt Lake City, UT (M.S.E.); Oregon Health & Science University, Portland, OR (J.E.T.); University of North Carolina at Chapel Hill, Chapel Hill, NC (J.T.); University of Pittsburgh, Pittsburgh, PA (S.N.C.); Medical University of South Carolina, Charleston, SC (P.V.D.); and The George Washington University Biostatistics Center, Washington, DC (A.L.); and the *Eunice Kennedy Shriver National Institute of Child Health and Human Development, Bethesda, MD (C.Y.S.)*

Abstract

Background—Adherence to published criteria for transvaginal imaging and measurement of cervical length is uncertain. We sought to assess adherence by evaluating images submitted to certify research sonographers for participation in a clinical trial.

Study Design—We reviewed qualifying test results of sonographers seeking certification to image and measure cervical length in a clinical trial. Participating sonographers were required to access training materials and submit 15 images, three each from five pregnant women not enrolled in the trial. One of two sonologists reviewed all qualifying images. We recorded the proportion of images that did not meet standard criteria (excess compression, landmarks not seen, improper image size, or full maternal bladder) and the proportion in which the cervical length was measured incorrectly. Failure for a given patient was defined as more than one unacceptable image, or more than two acceptable images with incorrect caliper placement or erroneous choice of the “shortest best” cervical length. Certification required satisfactory images and cervical length measurement from four or more patients.

Results—327 sonographers submitted 4905 images. 271 sonographers (83%) were certified on the first, 41 (13%) on the second, and 2 (0.6%) on the third submission. 13 never achieved certification. Of 314 who passed, 196 submitted 15 acceptable images that were appropriately measured for all five women. There were 1277 deficient images: 493 were acceptable but incorrectly measured images from sonographers who passed certification because mis-measurement occurred no more than twice. Of 784 deficient images submitted by sonographers

Corresponding author: Jay D. Iams MD, The Ohio State University Wexner Medical Center, 5th Floor, 395 West 12th Avenue, Columbus OH 43210-1267, Telephone 614-293-4929//FAX 614-293-8993, iams.1@osu.edu.

Presented 2/14/23 at the 33rd Meeting of the Society for Maternal Fetal Medicine.

Reprints are not available from the authors.

Disclosures: None

who failed the certification, 471 were rejected because of improper measurement (caliper placement and/or failure to identify the shortest best image), and 313 because of failure to obtain a satisfactory image (excessive compression, required landmarks not visible, incorrect image size, brief examination, and/or full maternal bladder)

Conclusion—Although 83% of sonographers were certified on their first submission, more than one in four ultrasound images submitted did not meet published quality criteria. Increased attention to standardized education and credentials is warranted for persons who perform ultrasound examinations of the cervix in pregnancy.

Keywords

cervix; preterm birth; ultrasound

Introduction

The American College of Obstetricians and Gynecologists (ACOG) recently issued a revised practice bulletin on prediction and prevention of preterm birth after publication of clinical trials that reported reduced risk of preterm birth in women with short cervix treated with progesterone supplementation¹. The ACOG practice bulletin notes that although progesterone supplementation "...has the potential to reduce the preterm birth rate ..., (and) is cost effective, safe, accepted by patients, and widely available", it also cautions that universal application of cervical length screening raises concerns about "... quality assurance of the screening test (*transvaginal cervical ultrasound*) ... and the potential for patients to receive unnecessary or unproven interventions." Thus an improperly performed transvaginal ultrasound measurement of cervical length could be the cause of unneeded treatment, or of a missed opportunity to prevent preterm birth. These concerns highlight the importance of proper training and credentialing of persons who obtain and measure cervical ultrasound images, especially for a procedure that may become a part of routine prenatal care. Although there are published criteria to image and measure the cervix with transvaginal sonography²⁻⁵, adherence to these criteria has not been assessed in research or clinical practice settings. Our objective was to assess the quality of transvaginal ultrasound images and cervical length measurements obtained by sonographers seeking credentials to participate in a clinical research study.

Methods

The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Maternal-Fetal Medicine Units (MFMU) Network has performed several studies in which transvaginal ultrasound images were obtained to measure cervical length. Sonographers who have performed cervical ultrasound for published Network studies were required to review training materials and submit images for review to become certified before participating in the study. The training materials demonstrate the technique for obtaining an accurate, reproducible image, criteria for a satisfactory image, and proper caliper placement to measure cervical length. The instructions are summarized in Table 1 and the criteria in Table 2.

After review of these materials, sonographers who performed cervical length measurements in published MFMU Network trials each submitted 15 images obtained during a clinically indicated examination (three images from each of five women who are between 16 and 32 weeks' pregnant and not enrolled in the trial). Images were returned to the MFMU Network sites after review, with comments attached when images or measurements were not acceptable. Thus the summary reports, but not the images themselves, were available for this study. Sonographers who did not meet criteria for certification did not perform ultrasound

examinations for MFMU Network studies. Ultrasound certification scoring forms have been retained by the George Washington Biostatistics Coordinating Center. Forms submitted by sonographers who sought certification for the MFMU Network's randomized trial of 17 alpha-hydroxyprogesterone caproate for prevention of preterm birth in nulliparous women with a short cervix < 30 mm⁶ were available for this analysis. Almost all images for this trial were reviewed centrally by one sonologist (JDI); a second sonologist (WAG) reviewed images if the primary reviewer was unavailable.

The criteria that define an acceptable image that is consistently obtained and measured have not changed since first described⁷ and codified²⁻⁵ (Table 2). An unacceptable image is defined as one that demonstrates any of the following characteristics: *excess compression* of the cervix (defined by unequal thickness of the anterior and posterior cervix), any *landmark not well seen* (maternal bladder edge, amniotic fluid, internal os, external os, and canal visible throughout its length), *inappropriate image size* (cervix does not comprise 65–75% of the image), or *full maternal bladder*. An unacceptable image that demonstrates compression of the anterior cervix and failure to image the external cervical os is shown in Figure 1. An *incorrect measurement* is one in which calipers are not placed where the anterior and posterior surfaces of the cervical canal diverge and/or along the entire length of the cervical canal. Sonographers are asked to record the shortest of three satisfactory images (the “shortest best”) as the cervical length. Averaging or selection of a more appealing image with a longer measurement is unacceptable because it introduces operator-specific variation. Application of fundal or suprapubic pressure (FP or SPP, respectively) was recorded directly on the image. The duration of examination was assessed by the time interval between the first and third image as indicated on each image. We reviewed qualifying test results and recorded the frequency of and reasons for unacceptable images and incorrect measurements. Failure of the sonographer to obtain and measure the cervix of a given patient was defined as more than one unacceptable image, or more than two acceptable images with incorrect caliper placement or choice of “shortest best” cervical length. An inventory of submitted images with test results was retained in a Microsoft Excel database that was utilized to determine the percentages of failed images and the percentages of reasons for failure.

Because a sonographer seeking certification could submit additional images after an initial failed attempt, and a successful certification could include either one unacceptable image or no more than 2 acceptable images that were not properly measured, this report is limited to enumerating the reasons for improper image creation, reasons for improper measurement, and reasons for sonographer failure.

Collection of images for certification was approved by site and central institutional review boards as part of the study. This study of certification data was approved with waiver of consent by the biomedical institutional review board at The Ohio State University Wexner Medical Center.

Results

Three hundred twenty-seven sonographers submitted 4905 images for credentialing for the trial. Sonographers who failed the initial review submitted a variable number of additional images to achieve certification; thus the total number of images reviewed exceeded 15 per certified sonographer. Three hundred fourteen sonographers achieved certification; 271 (83%) on the first, 41 (13%) on the second, and 2 (0.6%) on the third submission of fifteen images. Thirteen were never certified. The characteristics of images submitted by sonographers who passed and failed are displayed in Figure 2. One hundred ninety-six sonographers submitted 15 acceptable images that were properly measured (2940 images);

118 sonographers submitted 688 acceptable and properly measured images but also submitted 493 acceptable images that were not properly measured. Of these, 267 had incorrect caliper placement, and 204 failed to identify the shortest best image. These errors were easily identified and corrected in subsequent submissions. Of greater concern were 313 images that lacked the features required in an acceptable image: 212 displayed excessive cervical compression, 71 lacked one or more landmarks, and 30 had other deficiencies such as a full maternal bladder, improper image size, or inadequate duration of the examination

Sonographers who did not pass did not participate in this or any other NICHD-sponsored study that required cervical length measurement.

Comment

Eighty three percent of sonographers earned certification on their first submission of 15 images, and almost all succeeded after remediation on the second attempt. Sixty percent of certification failures were due to measurement deficiencies and 40% were related to unacceptable images. More than 25% (1277/4905) of cervical ultrasound images submitted by sonographers seeking credentialing did not meet established quality criteria. The most serious error, failure to create an image that displayed all required standard features, occurred in 283 images, 5.8% of all submitted.

These findings are limited to sonographers at 14 Network sites, and thus cannot be considered to be representative of the current status of cervical sonography in the United States. However, the participating sites were all teaching centers with experience in transvaginal sonography before the trial was initiated, and where standards for image collection and measurement could be expected to be average or better. Furthermore, the images employed for this analysis were submitted specifically for certification, and thus reflect standards used by the sonographers. Unfortunately, we do not have complete information about the source, duration, or content of any training in cervical sonography that applicants might have had before they collected images. Although all sonographers were asked to review the study-specific training materials before collecting images for certification, their degree of compliance with this request is also uncertain.

The release of ACOG Practice Bulletin 130¹ can be expected to lead to increased use of transvaginal sonography to identify women with increased risk of preterm birth who may benefit from progesterone prophylaxis. The Bulletin notes concerns about quality assurance for cervical ultrasound screening, but also states that transvaginal sonography is the only acceptable method to identify women with short cervix, an important risk factor for preterm birth. Alternate methods such as transabdominal ultrasound and digital examination are currently not recommended as screening tests for short cervix¹.

The rates of unacceptable images and measurements observed in our study suggest that programs to educate and certify sonographers should be adopted before universal cervical length screening is considered.

Acknowledgments

The project described was supported by grants from the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) [HD21410, UL1 RR024153; UL1 TR000005; HD27869, HD27915, HD27917, HD34116, HD34208, 5UL1RR025764, HD36801, HD40500, HD40512, HD40544, M01 RR00080, UL1 RR024989 (NCRR), HD40545, HD40560, HD40485, HD53097, HD53118] does not necessarily represent the official views of the NCRR, *Eunice Kennedy Shriver* NICHD, or NIH.

The authors thank the following subcommittee members who participated in protocol development and coordination between clinical research centers (Gail Mallett, RN, BSN, CCRC and Cynthia Milluzzi, RN), and protocol/data management and statistical analysis (Elizabeth Thom, Ph.D.).

References

1. American College of Obstetricians and Gynecologists. Prediction and prevention of preterm birth. Practice Bulletin No. 130. *Obstet Gynecol.* 2012; 120:964–73. [PubMed: 22996126]
2. Burger M, Weber-Rossler T, Willman M. Measurement of the pregnant cervix by transvaginal sonography: an interobserver study and new standards to improve interobserver variability. *Ultrasound Obstet Gynecol.* 1997; 9:188–93. [PubMed: 9165682]
3. Vayssiere C, Morniniere C, Camus E, LeStrat Y, Poty L, Fermanian J, Ville Y. Measuring cervical length with ultrasound: evaluation of the procedures and duration of a learning method. *Ultrasound Obstet Gynecol.* 2002; 20:575–9. [PubMed: 12493046]
4. Fetal Medicine Foundation. accessed at <http://www.fetalmedicine.com/fmf/online-education/05-cervical-assessment/>
5. Cervical Length Education And Review (CLEAR). perinatalquality.org. accessed at <https://www.perinatalquality.org/CLEAR/Registration/wfProviderRegistrationInfo.aspx>
6. Grobman WA, Thom EA, Spong CY, Iams JD, Saade GR, Mercer BM, et al. 17 alpha-hydroxyprogesterone caproate to prevent prematurity in nulliparas with cervical length less than 30 mm. *Am J Obstet Gynecol.* 2012 Nov; 207(5):390.e1–8. [PubMed: 23010094]
7. Iams JD, Goldenberg RL, Meis PJ, Mercer BM, Moawad A, Das A, et al. The length of the cervix and the risk of spontaneous premature delivery. *N Engl J Med.* 1996; 334:567–72. [PubMed: 8569824]

Appendix

In addition to the authors, other members of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Maternal–Fetal Medicine Units Network are as follows:

- The Ohio State University, Columbus, OH – F. Johnson, D. Cline, C. Latimer, S. Frantz, S. Fyffe, P. Shubert (St. Ann’s), L. Gerwig (St. Ann’s)
- Northwestern University, Chicago, IL – A. Peaceman, M. Dinsmoor (North Shore University Health System), G. Mallett, J. Senka (NorthShore University Health System)
- University of Texas Medical Branch, Galveston, TX – J. Moss, A. Salazar, G.D.V. Hankins, G. Olson, A. Jackson, C. Sutherland
- Case Western Reserve University-MetroHealth Medical Center, Cleveland, OH – C. Milluzzi, W. Dalton, J. Russo, S. Myers, T. Waters, T. Dotson
- University of Alabama at Birmingham, Birmingham, AL – W. Andrews, A. Northen, J. Sheppard, J. Grant, D.J. Rouse
- Brown University, Providence, RI – D. Allard, J. Hunt, J. Tillinghast, M. Bethelmy, D. Gardner, C. Duquette
- Wayne State University, Detroit, MI – N. Hauff, G. Norman, M. King (RDMS), D. Allen (RDMS), T. Smith
- Columbia University, New York, NY – R. Miller, S. Bousleiman, L. Plante (Drexel), C. Tocci (Drexel), A. Ranzini (St. Peter’s), M. Lake (St. Peter’s), M. Hoffman (Christiana), S. Lynch (Christiana)

- University of Texas Southwestern Medical Center, Dallas, TX – J. Dashe, L. Moseley, J. Kingsbery, V. Bludau, R. Benezue
- The University of Texas Health Science Center at Houston-Children’s Memorial Hermann Hospital, Houston, TX – S. Blackwell, F. Ortiz, P. Givens, B. Rech, C. Moran
- University of Utah Health Sciences Center, Salt Lake City, UT – P. Reed, K. Hill, M.W. Varner, A. Weaver (McKay-Dee), S. Alexander (LDS Hospital), D. Thompson-Garbrecht (Intermountain Medical Center), J. Miller (UVRMC)
- Oregon Health & Science University, Portland, OR – J. Tolosa, R. Acosta (Providence Sacred Heart Medical Center), C. Flores (Providence Sacred Heart Medical Center), M. Ricon, W. Smith (Kaiser Permanente), S. Butcher (Kaiser Permanente), S. Segel, L. Pereira
- University of North Carolina at Chapel Hill, Chapel Hill, NC – K. Dorman, K. Pena-Centeno, K. Clark, S. Timlin
- University of Pittsburgh, Pittsburgh, PA – M.H. Birkland, H. Simhan, P. Cotroneo, R. Zubic, D. Nowinski
- The George Washington University Biostatistics Center – S. Gilbert, A. Lozitska
- The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, Bethesda, MD – S. Tolivaisa

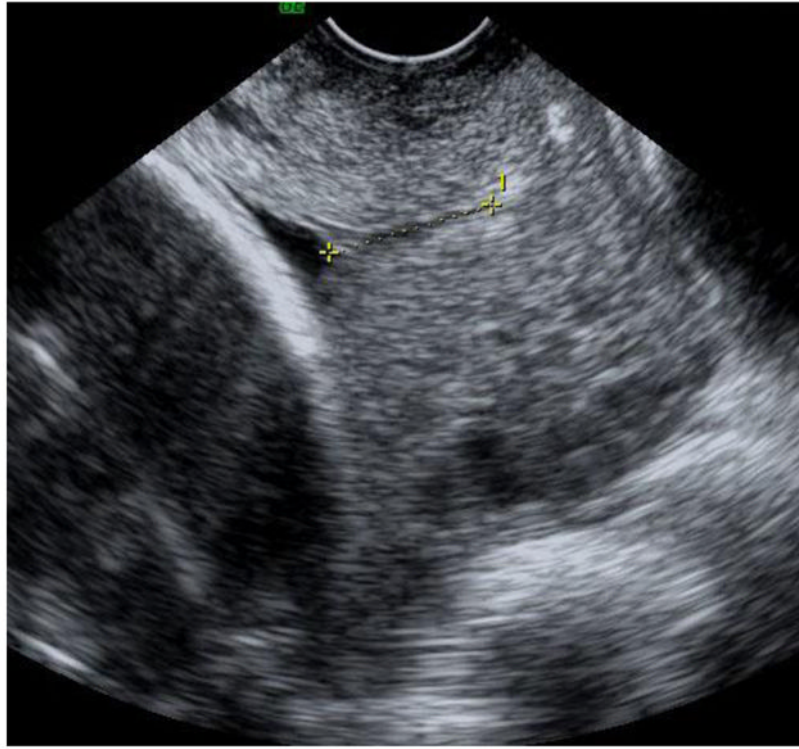


Figure 1. Transvaginal ultrasound image of the cervix demonstrating compression of the anterior cervix and failure to image the external os.

Cervical Ultrasound Images Submitted for Review

n = 4905

Eunice Kennedy Shriver NICHD MFMU SCAN Trial

Passed

2940 Acceptable Images Properly Measured
By sonographers who passed w/ 100% scores on 1st Submission
+
688 Acceptable Images Properly Measured by sonographers who passed on 1st or a subsequent submission

3628 Acceptable Images Properly Measured Passing Submissions

Failed

313 Unacceptable Images

- 212 Excess Probe Pressure
- 71 Landmarks Not Visible
- 30 Other

+

471 Acceptable Images Improperly Measured

- 267 Poorly Measured > 2
- 204 Incorrect Shortest Best

+

493 Acceptable Images In Passing Submissions Poorly Measured ≤ 2 times by sonographers who passed on 1st or a subsequent submission

1277 Failed Submissions

Figure 2.
Cervical Ultrasound Images Submitted for Review
n = 4905
Eunice Kennedy Shriver NICHD MFMU SCAN Trial

Table 1**Instructions for Obtaining and Measuring the Cervix with Transvaginal Ultrasound**

-
- 1 Ask patient to void.
 - 2 Label the ultrasound image with center number, date, your initials and the patient's screening number, or complete a label with the required information and affix it to the back of the image.
 - 3 Use sterile ultrasound gel. Apply gently to avoid bubbles inside the probe cover – air does not transmit ultrasound.
 - 4 Insert probe under real-time observation. Look for familiar anatomy, e.g., bladder, amniotic fluid, fetal motion. The bladder should not appear full. If you can't easily find the bladder, amniotic fluid & internal os, think about placenta previa.
 - 5 Find the midline sagittal plane. Look in proximal one third of the image for internal os, and then, keeping the internal os in view, adjust the probe to find the long axis of the cervical canal and the external os.
 - 6 Enlarge the image to fill approximately 75% of the screen.
 - 7 Once the cervical canal is identified, check the landmarks: empty bladder, internal os, external os, and subjectively equal width of the anterior and posterior cervix.
 - 8 Once a good image is identified, pull probe back until image blurs slightly, then reapply just enough pressure to restore a good image of the cervix.
 - 9 Measure the cervical length by placing the calipers where the anterior and posterior walls touch, and record the shortest distance between the "notches". This should be done on at least three separate images. One good way to obtain the shortest best cervical length is to measure the length repeatedly until the variation between measurements is less than 10%.
-

Table 2

Criteria for an Acceptable Cervical Ultrasound Image and Measurement of Cervical Length* (* from citations 4 and 5)

IMAGE QUALITY

- **Image Creation**
 - Cervix fills 67–75% of Image
 - Maternal Bladder is Empty
 - Exam Performed 3 Minutes
 - Pressure Applied
 - ◆ Fundal or Supra-pubic
 - Anterior & Posterior Cervix of Equal Size
- **Landmarks Identified**
 - Internal & External Os Identified
 - Canal Visible Throughout
 - Funneling Noted Yes/No
 - Debris Noted Yes/No

MEASUREMENT

- **Calipers Placed Properly**
 - Internal Os
 - External Os
 - In Segments if Deviation from Canal to Straight Line at Midpoint is 3 mm
 - **Shortest Best Image Chosen**
 - Choose & Record the Shortest Best Cervical Length of 3 Excellent Images That All Meet All Criteria
 - Not the “prettiest” image
-