



# Curriculum and competency assessment program for training maternal-fetal medicine fellows in the performance of the detailed obstetric ultrasound examination

## A consensus report

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This document was developed by a joint task force of the Society for Maternal-Fetal Medicine (SMFM) and the American Institute of Ultrasound in Medicine (AIUM).

### Introduction

In 2018, a multidisciplinary task force published a consensus report outlining an ultrasound curriculum and competency assessment tool for use in obstetric and gynecologic residency programs.<sup>1</sup> This document outlined the rationale for standardized ultrasound training among residents, citing both the integral role of ultrasound in the clinical practice of obstetrics and gynecology and the need for formal educational strategies and competency assessments in light of resident work hour restrictions. The residency ultrasound training document was based on published guidelines<sup>2,3</sup> and was intended to provide tools to facilitate ultrasound training in residency programs, with learning objectives stratified by postgraduate year.

With 3-5% of pregnancies being complicated by fetal structural anomalies,<sup>4</sup> second trimester ultrasound is recommended in all pregnancies to evaluate the fetal anatomy and screen for these abnormalities.<sup>5</sup> While a standard fetal anatomic ultrasound examination (*Current Procedural Terminology* (CPT) code 76805) is recommended for low-risk pregnancies, a detailed fetal anatomic ultrasound examination (CPT 76811) is recommended in pregnancies with an increased risk of fetal structural abnormalities.<sup>6,7</sup> Common indications for the detailed fetal ultrasound examination are formally outlined in a consensus statement published in 2014 by the American Institute of Ultrasound in Medicine (AIUM) and the Society for Maternal-Fetal Medicine (SMFM) as well as in a 2019 AIUM document entitled "Practice Parameter for the Performance of Detailed 2nd and 3rd Trimester Diagnostic Obstetric Ultrasound Examinations".<sup>7-9</sup> These documents also specify the maternal and fetal structures included in the 76811

examination, that are beyond those included in the standard fetal anatomic ultrasound examination (76805).<sup>7</sup> Of note, the 2014 Consensus statement stratified the additional components into those that should be evaluated as part of all 76811 examinations and those that should be evaluated "when medically indicated".<sup>8,9</sup> In contrast, the 2019 Practice Parameter is less prescriptive and instead suggests that the "specific elements of a given detailed obstetric ultrasound examination may be individualized" depending on the indication for the sonographic evaluation and the findings during the examination.<sup>7</sup>

Recognizing the increased knowledge required and complexity of the detailed obstetric sonographic evaluation, it is recommended that physicians performing and/or interpreting the 76811 ultrasound examinations be either fellowship-trained in Maternal-Fetal Medicine or Obstetricians or Radiologists who have completed 1 or more years of dedicated ultrasound education and experience with structured training in detailed fetal anatomic imaging.<sup>7,10</sup> Evidence of structured training includes involvement in the supervised performance, interpretation and reporting of a minimum of 100 detailed fetal anatomic ultrasounds in patients at risk for structural anomalies, including at least 25 fetuses with major morphologic abnormalities.<sup>10</sup> Given the importance of the detailed fetal anatomic ultrasound in clinical practice and the training required beyond residency to perform and interpret this examination, the SMFM and AIUM assembled a joint task force to develop educational materials for use in training and competency assessment of Maternal-Fetal Medicine fellows performing the 76811 ultrasound examination. Maternal-Fetal Medicine fellowship training programs may choose to adopt all or part of these materials in their programs or modify these materials to fit their program setting. Furthermore, this document can be

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used by sonographers and other physicians who want to expand their ultrasound training and skills.<sup>10</sup>

### Task Force Development

Task force participants included representatives from the Society for Maternal-Fetal Medicine (SMFM) and the American Institute of Ultrasound in Medicine (AIUM). An initial face-to-face meeting of the task force was held at the 2017 Annual Meeting of the Society for Maternal-Fetal Medicine with members from each organization, as well as several fellows from accredited maternal-fetal medicine training programs. The task force opted to form two distinct subcommittees, one focusing on the development of a curriculum and competency assessment tool for the 76811 ultrasound examination and a separate subcommittee focused on developing a curriculum on ultrasound detection of fetal anomalies.<sup>11</sup> Thereafter, each subcommittee worked in parallel through conference calls and in-person meetings to develop associated content and materials. This document outlines the final curriculum and competency assessment tools developed by the 76811 subcommittee.

### 76811 Curriculum

The 2014 “Consensus Report on the Detailed Fetal Anatomic Ultrasound Examination” and 2019 AIUM Practice Parameters are the foundation of the 76811 maternal fetal medicine fellow ultrasound curriculum.<sup>7–9</sup> The curriculum outlines learning objectives which include understanding not only the indications for the detailed fetal anatomic examination (Table 1), but also the importance of ultrasound practice accreditation and ongoing continuing medical education as well as the experience necessary for physicians to maintain expertise in performing and/or interpreting the 76811 examinations after initial training (Table 2).<sup>10,12</sup>

The most significant learning objective for fellows is that they be able to list and describe the sonographic features of the maternal and fetal structures included in the standard obstetric ultrasound examination and the additional fetal structures unique to the detailed fetal anatomic ultrasound examination.<sup>6,7</sup> In addition to the components of the detailed fetal anatomic survey (Table 3), extended cardiac views, spectral and color Doppler ultrasound and specific biometric components were added to this training curriculum given their importance in maternal-fetal medicine and the frequency with which they may be indicated in clinical practice (Table 4). The fellows must be familiar with recommended ultrasound terminology, fetal biosafety considerations including the As Low As Reasonably Achievable (ALARA) principle, as well as being able to produce a final written report of a detailed obstetrical ultrasound examination.<sup>13–18</sup>

In contrast to the residency curriculum<sup>1</sup>, which prescribed specific learning objectives for each year of training allowing a gradual progression of ultrasound knowledge over the course of a residency, the fellowship curriculum offers a set of learning objectives which can be applied at the timing or rate that best fits an individual training program. Although all

**TABLE 1**

#### **Fellow learning objective: Be able to define indications for the detailed fetal anatomic ultrasound examination (CPT: 76811)\*<sup>7</sup>**

Previous pregnancy with a congenital, genetic, or chromosomal abnormality;

Known or suspected fetal anomaly in the current pregnancy;

Known or suspected fetal growth restriction in the current pregnancy;

Fetus at increased risk for a congenital anomaly due to:

- Maternal pregestational diabetes or gestational diabetes diagnosed prior to 24 weeks' gestation
- Conception via assisted reproductive technology
- High maternal body mass index ( $\geq 30 \text{ kg/m}^2$ )
- Multiple gestation
- Abnormal maternal serum analytes
- Teratogen exposure
- First-trimester nuchal translucency measurement of 3.0 mm or greater

Fetus at increased risk for a genetic or chromosomal abnormality such as the following:

- Parental carrier of a chromosomal or genetic abnormality
- Maternal age of 35 years or older at delivery
- Positive screening test for aneuploidy including cell-free DNA
- Aneuploidy marker noted on an ultrasound examination
- First-trimester nuchal translucency measurement of 3.0 mm or greater.

Other conditions affecting the fetus (e.g., congenital infections, maternal drug use, isoimmunization, oligohydramnios, polyhydramnios)

Suspected placenta accreta spectrum (PAS) or risk factors for PAS such as placenta previa in the third trimester or placenta overlying prior cesarean scar site

\* The listed indications are select examples and not meant to be all-inclusive.<sup>7</sup>

**TABLE 2**

#### **Fellow learning objective: Understand the qualifications for initial and ongoing performance and/or interpretation of the detailed fetal anatomic ultrasound examinations as defined by the American Institute of Ultrasound in Medicine<sup>7,10,12</sup>**

Initial structured fellowship training in detailed anatomic imaging, including the supervised performance, interpretation and reporting of a minimum of 100 detailed fetal anatomic assessments in patients at increased risk for structural or genetic conditions. At least 25 of these must be in fetuses with major morphologic abnormalities.

AIUM accreditation of facilities including ongoing quality assurance correlating outcomes of anomalous cases with prenatal sonographic findings

Maintenance of continuing competence through interpretation and reporting of a minimum of 100 diagnostic detailed fetal anatomic examinations per year including the performance, interpretation and/or review of 10 abnormal examinations. Completion of 10 hours of AMA PRA Category 1 Credits™ in ultrasound evaluation of fetal anomalies every 3 years

**TABLE 3**

**Fellow learning objective: Maternal, fetal, and placental structures included in the standard (76805) and detailed (76811) fetal ultrasound examinations**

Components included in the STANDARD obstetric ultrasound examination (76805) <sup>6</sup>	Components <sup>‡</sup> unique to the DETAILED obstetric ultrasound examination (76811) <sup>7</sup>
<b>Anatomical components of the fetal head and neck</b>	
Lateral cerebral ventricles	3rd ventricle
Choroid plexus	4th ventricle
Midline falx	Lateral ventricular wall integrity, contour, ependymal lining
Cavum septum pellucidi	Corpus callosum
Cerebellum	Cerebellar Lobes and Vermis
Cisterna magna	Integrity and shape of cranial vault
	Brain parenchyma
	Neck
<b>Anatomical components of the fetal face</b>	
Upper lip	Profile
	Nasal bone (15-22 weeks)
	Orbits
	Lens
	Nose and Lips
	Palate
	Maxilla
	Mandible
	Tongue
	Ear position and size
<b>Anatomical components of fetal chest</b>	
Cardiac activity	Situs
4-chamber view, heart size, position	Aortic arch
Left ventricular outflow tract	Superior and inferior venae cavae
Right ventricular outflow tract	Ductal arch
3-vessel view*	Interventricular septum
3-vessel and trachea view*	3-vessel view
	3-vessel and trachea view
	Lungs
	Integrity of diaphragm
	Ribs

(continued)

**TABLE 3**

**Fellow learning objective: Maternal, fetal, and placental structures included in the standard (76805) and detailed (76811) fetal ultrasound examinations** (continued)

Components included in the STANDARD obstetric ultrasound examination (76805) <sup>6</sup>	Components <sup>‡</sup> unique to the DETAILED obstetric ultrasound examination (76811) <sup>7</sup>
<b>Anatomical components of the fetal abdomen</b>	
Stomach (presence, size, and situs)	Small and large bowel
Kidneys	Adrenal glands
Urinary bladder	Gallbladder
Fetal abdominal cord insertion	Liver
Umbilical cord vessel number	Renal arteries
	Spleen
	Integrity of abdominal wall
<b>Anatomic components of fetal spine</b>	
Cervical	Integrity of spine
Thoracic	Integrity of overlying soft tissue
Lumbar	Shape and curvature
Sacral spine	Conus medullaris
<b>Anatomical components of the fetal extremities</b>	
Legs	Number, architecture, and position
Arms	
Hands	Digits of hands: number and position
Feet	Digits of feet: number and position
<b>Anatomical components of fetal genitalia</b>	
Fetal genitalia <sup>#</sup>	External genitalia
<b>Components of the placenta</b>	
Location	Accessory/succenturiate lobe with connecting vascular supply and relation to internal cervical os
Relationship to internal os	
Appearance	Masses
Placental cord insertion	Implantation site with evaluation of abnormal adherence
<b>Components of maternal anatomy</b>	
Cervix (transvaginal when indicated)	
Uterus	
Adnexa	

(continued)

TABLE 3

**Fellow learning objective: Maternal, fetal, and placental structures included in the standard (76805) and detailed (76811) fetal ultrasound examinations** (continued)

Components included in the STANDARD obstetric ultrasound examination (76805) <sup>6</sup>	Components <sup>‡</sup> unique to the DETAILED obstetric ultrasound examination (76811) <sup>7</sup>
<b>Standard components of pregnancy evaluation</b>	
Fetal number	
Presentation	
Qualitative or semiquantitative estimate of amniotic fluid	
<b>Fetal biometric components</b>	
Biparietal diameter	Nuchal fold thickness (16-20 wks)
Head circumference	Cerebellum
Femur length	Inner and outer orbital diameter
Abdominal circumference	Humerus
Estimated fetal weight	Radius and Ulna
	Tibia and Fibula

**Standard components of pregnancy evaluation**

Fetal number

Presentation

Qualitative or semiquantitative estimate of amniotic fluid

**Fetal biometric components**

Biparietal diameter

Nuchal fold thickness (16-20 wks)

Head circumference

Cerebellum

Femur length

Inner and outer orbital diameter

Abdominal circumference

Humerus

Estimated fetal weight

Radius and Ulna

Tibia and Fibula

\* To be performed as part of standard examination if technically feasible.<sup>6</sup>; # To be performed as part of standard examination in multiple gestations and if medically indicated.<sup>6,7</sup>; ‡ Evaluation of additional elements not listed in the table may be warranted in some clinical scenarios.<sup>7</sup>

TABLE 4

**Additional MFM fellow learning objectives**

ALARA (As Low as Reasonably Achievable) Principle: Thermal Index type and ratio, Dwell time, Sensitive organs

Multiple gestation: amnionity and chorionicity

Pulmonary Veins

Biometry: Atria of the lateral cerebral ventricle

Biometry: Thoracic circumference and cardiac circumference

Biometry: Foot length

Spectral Doppler evaluation of the umbilical artery: indications, technique, and interpretation

Spectral Doppler evaluation of the middle cerebral artery: Indications, technique, and interpretation

Spectral Doppler evaluation of the ductus venosus: Indications, technique, and interpretation

Spectral Doppler evaluation of the uterine artery: Indications, technique, and interpretation

Appropriate application and interpretation of color Doppler ultrasound

Documentation of a detailed fetal anatomic ultrasound examination - final written report

competencies required in postgraduate years 1-4, as well as all of the optional obstetric competencies (three-vessel and trachea view, orbits, umbilical artery Doppler velocimetry and nuchal translucency measurement).<sup>1</sup> Maternal-fetal medicine fellows who have not achieved the aforementioned residency competencies are expected to do so in addition to pursuing the fellowship competencies. Some competencies that may have previously been achieved during residency are re-assessed due to their critical nature in fetal evaluation and the more comprehensive analysis and reporting expected of a Maternal Fetal Medicine subspecialist.<sup>7,18</sup>

Components recommended for fellowship competency assessment (Table 5) include the majority of the structures in the 76805 and 76811 fetal ultrasound examinations that were not included as residency competencies, as well as the aforementioned additional cardiac views, specific biometric measurements and Doppler studies. Because some of these components are likely to be evaluated in only the rarest of cases, each fellowship competency was classified either as a core competency to be demonstrated by all maternal-fetal medicine trainees or as an optional competency that could be required at the discretion of their program (Table 5).

For each targeted component designated for competency assessment in fellowship, a list of criteria was defined outlining the expected magnification, anatomic plane, and landmarks required for an image, image set or video clip to represent an adequate sonographic evaluation of the targeted component. For most targeted components, a single image or video clip is adequate and must demonstrate at least 75% of its required criteria to achieve a passing score.

accredited maternal-fetal medicine fellowship programs in the United States require formal training in obstetric ultrasound, there is significant variation in the timing and duration of this training. Some fellowship programs concentrate clinical time early in fellowship while others defer it to later in the 3-year program. Similarly, some programs require their fellows to complete more than one year of ultrasound training during their fellowship, while others allow fellows to do the minimum requirement of 3 months.<sup>19</sup> By configuring the 76811 curriculum as a single set of learning objectives, it can be adapted as needed to coincide with a fellow's ultrasound training whenever it may occur in their program, and may be utilized in the training of providers outside of a formal fellowship program.<sup>10,19</sup>

### 76811 Competency Assessment

Competency assessment to perform the detailed fetal anatomic ultrasound examination is evaluated through objective review of submitted still images and/or video clips, observation of real-time scanning or a combination of methods to determine the trainee's ability to define the sonographic landmarks and normal appearance of each targeted structure. Critically, competency assessment for fellows builds upon residency training and assumes the fellow has previously achieved all of the obstetric and gynecologic

**TABLE 5**  
**List of MFM Fellowship competencies (core and optional)**

**CORE COMPONENTS**

Choroid plexus
Cavum Septi Pellucidi
Lateral cerebral ventricular wall integrity, contour, ependymal lining, 3 <sup>rd</sup> ventricle
Cerebellar hemispheres, vermis and 4 <sup>th</sup> ventricle
Corpus callosum
Profile: Neck, maxilla, mandible, and nasal bone
Cardiac activity (M-mode)
4-chamber view
Interventricular septum (grey scale and color Doppler ultrasound)
3-vessel view
3-vessel and trachea view (grey scale and color Doppler ultrasound)
Left ventricular outflow tract
Aortic arch
Right ventricular outflow tract and ductal arch
Superior and inferior vena cavae
Lungs
Integrity of diaphragm
Coronal abdomen (anterior): Liver and bowel (small and large)
Coronal abdomen (posterior): Renal arteries (color or power Doppler ultrasound)
Spine: Shape and curvature, overlying skin integrity
Elbow(s): architecture, position, movement
Knee(s): architecture, position, movement
Wrist(s) with hand: architecture, position, movement
Ankle(s) with foot: architecture, position, movement
Digits of hands: number and position
Digits of feet: appearance and position
Fetal external genitalia: Female
Fetal external genitalia: Male
Placenta: Location, appearance, placental cord insertion, and implantation site including features of abnormal adherence (placenta accreta spectrum)
Placenta: Relation of placenta to internal os, including transvaginal imaging
Multiple gestation: amnionicity and chorionicity
<b>Biometry:</b>
Nuchal fold thickness (16-20 wks)
Cerebellar Hemispheres

(continued)

**TABLE 5**  
**List of MFM Fellowship competencies (core and optional) (continued)**

Atria of the lateral ventricles
Inner and outer orbital diameters
Nasal Bone Length (15-22 weeks)
Diaphysis length: Humerus
Diaphysis length: Radius and ulna
Diaphysis length: Tibia and fibula
Thoracic and cardiac circumference
Foot length
<b>Doppler Imaging:</b>
Spectral Doppler evaluation of umbilical artery
Spectral Doppler evaluation of the middle cerebral artery
<b>General:</b>
As Low As Reasonably Achievable Principle (ALARA)
Formal written ultrasound report
<b>OPTIONAL COMPONENTS</b>
Lens
Palate
Tongue
Ear position and size
Ribs
Pulmonary veins (color Doppler ultrasound)
Adrenal gland
Gallbladder
Spleen
Conus medullaris
Spectral Doppler evaluation of the ductus venosus
Spectral Doppler evaluation of the uterine artery

MFM fellows should have successfully achieved competency in all required obstetric and gynecologic structures and all optional obstetric components based on the residency ultrasound curriculum.<sup>1</sup> Maternal-fetal medicine fellows who have not achieved the aforementioned residency competencies are expected to do so in addition to pursuing the fellowship competencies. Some competencies achieved as part of the residency curriculum are re-assessed due to their critical nature in the structural evaluation of a fetus and the more comprehensive analysis and reporting required of a Maternal Fetal Medicine subspecialist.<sup>7,18</sup>

**Competency assessment for MFM fellows:**

A passing score for each sonographic evaluation submitted for a targeted component requires demonstration of  $\geq 75\%$  of criteria for the single image, image set or videoclip. Criterion marked with a red asterisk (\*) for a specific targeted component **must** be demonstrated to successfully pass the sonographic assessment, regardless of the overall score. Competency is considered to have been achieved after 5 passing sonographic evaluations of a targeted component on 5 different gestations has been validated. Submission of normal anatomy is optimal to demonstrate criteria.

Scanning should be performed in compliance with the ALARA principle.<sup>14-17</sup> The Output Display Standard (ODS) should be monitored. In most cases, a thermal index for bone (TIB) at a ratio of  $\leq 0.7$  is adequate to provide diagnostic quality images.<sup>16</sup> The ODS must be included on images utilizing Doppler or when evaluating sensitive fetal tissues such as the fetal orbits containing the lens of the eyes.<sup>15</sup>



Sonographic evaluation of some targeted components may require more than one image to demonstrate the designated criteria, in which case the submitted image set should attain a minimum score of 75% to pass image review. In addition, to be considered passing, each submitted sonographic evaluation (single image/image set or videoclip) must demonstrate certain explicitly required criterion; failure to demonstrate these mandatory features results in failure, even if the overall score is  $\geq 75\%$ . Details regarding each targeted component designated for competency assessment including imaging criteria and passing scores, are presented in the [Supplementary Appendices 1 and 2](#) at the end of this document.

Five passing sonographic evaluations obtained from five different fetuses is suggested to demonstrate competency for each targeted component. The suggestion that five passing images or video clips be required to establish competency mirrors the requirement set forth in the residency document.<sup>1</sup> This suggestion was based on expert consensus and literature demonstrating that ultrasound trainees can achieve mastery of technique and consistent measures after five successful iterations.<sup>20,21</sup>

Ideally maternal fetal medicine fellows should be trained to independently perform the detailed obstetric ultrasound examination and therefore competency should be demonstrated through submission of images and/or video clips personally acquired by the fellow or alternatively, direct observation of the fellow scanning in real-time. Individual fellowship programs can determine how the sonographic evaluation of a targeted structure for competency assessment should be acquired and in what format it should be assessed.

## Conclusion

This document, developed by SMFM and AIUM, presents a consensus-based curriculum and competency assessment tools to train MFM fellows in the performance of the detailed fetal anatomic ultrasound examination. Given the diversity of MFM fellowship programs, this document is intended to represent the minimum requirement for maternal-fetal medicine fellowship training but can be modified to best fit a particular program's setting and population. In addition, the document can be used as a reference for non-traditional trainees and for those refreshing their skills.<sup>10</sup> Utilization of these materials should promote consistency in prenatal imaging thereby enhancing the performance and diagnostic accuracy of the detailed fetal anatomic ultrasound examination and improving detection of fetal structural anomalies.<sup>7,10,12</sup> Independent practice in maternal-fetal medicine also requires training in the recognition of abnormalities and the evaluation, counseling, and obstetric management thereof. Fellowship programs may choose to utilize SMFM / AIUM's *Fetal Anomalies Resource Library* for this purpose.<sup>11</sup> ■

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### **Supplementary Appendix 1 Targeted CORE components and image criteria for MFM Fellows including representative images needed to obtain competency**

1. Choroid plexus
2. Cavum Septi Pellucidi
3. Lateral Cerebral Ventricle
4. 3rd ventricle
5. Cerebellar hemispheres, vermis and 4<sup>th</sup> ventricle
6. Corpus callosum
7. Profile: Neck, maxilla, mandible, and nasal bone
8. Cardiac activity (M-mode)
9. 4-chamber view
10. Interventricular septum (grey scale and color Doppler ultrasound)
11. 3-vessel view
12. 3-vessel and trachea view (greyscale and color Doppler ultrasound)
13. Left Ventricular outflow tract
14. Aortic arch with at least one head and neck vessel
15. Right ventricular outflow tract and Ductal arch
16. Superior and inferior venae cavae
17. Lungs
18. Integrity of diaphragm
19. Longitudinal abdomen (anterior): Liver and bowel (small and large)
20. Coronal abdomen (posterior): Renal arteries (color or power Doppler ultrasound)
21. Spine: Shape and curvature, integrity of overlying skin
22. Elbows: architecture, position, and movement
23. Knees: architecture, position, and movement
24. Wrists with ipsilateral hand: architecture, position, and movement
25. Ankles with ipsilateral foot: architecture, position, and movement
26. Digits of hands: number and position
27. Digits of feet: appearance and position
28. Fetal external genitalia: Female

29. Fetal external genitalia: Male
30. Placenta: Location, appearance, cord insertion, and implantation site including features of abnormal adherence (placenta accreta spectrum)
31. Placental location and relation to internal cervical os. (Transvaginal imaging)
32. Multiple Gestation: amnionicity and chorionicity
33. Biometry: Nuchal fold (16-20 weeks)
34. Biometry: Cerebellar hemispheres
35. Biometry: Atria of the lateral ventricle
36. Biometry: Inner and outer orbital diameters
37. Biometry: Nasal Bone Length (15-22 weeks)
38. Biometry: Humerus (diaphysis length)
39. Biometry: Radius and ulna (diaphysis length)
40. Biometry: Tibia and fibula (diaphysis length)
41. Biometry: Thoracic and cardiac circumference
42. Biometry: Foot length
43. Spectral Doppler evaluation of the umbilical artery
44. Spectral Doppler of the middle cerebral artery
45. Documentation of ultrasound examination: final written report

### **Supplementary Appendix 2 Targeted OPTIONAL components and image criteria for MFM Fellows including representative images needed to obtain competency**

1. Lens (both eyes)
2. Palate
3. Tongue
4. Ear position and size (both sides)
5. Ribs
6. Pulmonary Veins (color Doppler ultrasound)
7. Adrenal gland(s)
8. Gallbladder
9. Spleen
10. Conus medullaris
11. Spectral Doppler evaluation of the ductus venosus
12. Spectral Doppler evaluation of the uterine artery