

National Education Curriculum
Specialty Curricula
Obstetrics and Gynecology

Obstetrics and Gynecology

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Obstetrics and Gynecology

Section I: Prudent Use

1. Discuss mechanisms to use sonography prudently in obstetrics
 2. Describe emerging technologies used in obstetrics
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I. PRUDENT USE

A. Prudent Use and Bioeffects

1. Equipment presets
 - a. Output power
 - i) Relative intensities of 2-D versus Doppler
 - ii) Mechanical index (MI)
 - iii) Thermal index (TI)
 - b. Fetal heart rate and documentation
 - i) Relative intensities of m-mode versus Doppler
 - ii) Spectral and color Doppler
 - Not recommended for first trimester
 - Indications for performance in 2nd and 3rd trimesters
 - Benefits outweighs risk
 - c. As low as reasonably achievable (ALARA)
 - i) Time efficiency
 - ii) Diagnostic indications only
2. Professional organization position statements

B. Emergent Technologies

1. 3-D
 - a. Multi-planar concepts
 - b. Advantages
 - c. Diagnostic role
2. 4-D
 - a. Surface rendering techniques
 - b. Skeletal (amplitude)
 - c. Image manipulation
3. Extended field of view
 - a. Placental location
 - b. Fetal presentation

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Rationale: Accurate assessment and performance of obstetrical sonograms require sonographers to assemble a comprehensive knowledge of the development and sonographic appearance of the fetal and extra-fetal anatomy throughout the gestational period. An understanding of the fertilization process, clinical indications for obstetrical sonograms, and sonographic characteristics of normal and abnormal gravid uterine anatomy specific to each trimester is essential for the performance of high-quality examinations.

Section II: First Trimester

1. Define terminology related to obstetrics
 2. Explain fertilization process
 3. Distinguish between layers of decidualized endometrium
 4. Identify normal anatomic features of developing embryo
 5. Describe first trimester measurement techniques for determination of gestational age
 6. Discuss normal findings of adnexa in first trimester
 7. Correlate clinical presentation with sonographic findings
 8. Differentiate the normal and abnormal appearances of a first trimester pregnancy
 9. Discuss first trimester complications
 10. Describe sonographic findings associated with ectopic pregnancy
 11. Describe the types and sonographic appearances of abortion
 12. List the clinical and sonographic findings associated with gestational trophoblastic neoplasia
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II. FIRST TRIMESTER

A. Clinical Assessment of Obstetrical Patient

1. Terminology
 - a. Gravidity
 - b. Parity
 - c. Abortion
 - d. Fundal height
 - e. Gestational age (GA)
 - f. Menstrual age (MA)
 - g. Embryologic age
 - h. Trimester
 - i. Human chorionic gonadotropin (hCG)
2. Laboratory tests for pregnancy determination
 - a. Qualitative
 - b. Quantitative
 - c. Rising pattern
 - d. Quantitative references
 - i) International reference preparation (IRP)
 - Third IRP
 - Second IRP
3. Gestational age calculation
 - a. Obstetric wheel
 - b. Naegele's rule
4. Indications for sonographic evaluation
 - a. Numerous indications

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- b. Often trimester specific
 - c. Controversy surrounding scanning without clinical indication
 - d. Pros and cons of routine scanning
 - e. Point of care
- B. Normal First Trimester
- 1. Fertilization
 - a. Haploid vs diploid
 - b. Zygote - fertilized egg
 - c. Cleavage
 - d. Morula
 - e. Blastocyst
 - f. Development of germ layers
 - 2. Decidualization
 - a. Three layers
 - i) Decidua capsularis
 - ii) Decidua parietalis
 - iii) Decidua basalis
 - b. Chorionic villi
 - i) Chorion frondosum
 - 3. Gestational Sac
 - a. Implantation location
 - b. Sonographic appearance
 - i) Echogenic ring surrounding fluid-filled space
 - ii) Double decidual sac sign
 - iii) Correlation with β -hCG values
 - iv) Mean sac diameter (MSD)
 - An average measurement of three dimensions of gestational sac
 - Accuracy
 - 4. Embryonic/fetal Membranes
 - a. Chorion
 - b. Amnion
 - c. Vitelline stalk
 - d. Allantois
 - 5. Yolk Sac
 - a. Primary or primitive yolk sac
 - b. Secondary yolk sac
 - i) First structure to be visualized within gestational sac
 - ii) Location

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- iii) Size
- c. Functions
 - i) Hemopoiesis
 - ii) Development of sex glands
 - iii) Formation of digestive tract
 - iv) Transfer of nutrients
- d. Sonographic technique
 - i) Endovaginal
 - Optimal for earliest visualization and viability assessment
 - ii) Transabdominal
 - iii) Measurements
- 6. Embryonic period
 - a. Organogenesis
 - b. Embryonic trilaminar disc
 - c. Cranial structures
 - i) Cerebral hemispheres – differentiated at week 9
 - ii) Prosencephalon – primitive forebrain
 - iii) Mesencephalon – primitive midbrain
 - iv) Rhombencephalon – primitive hindbrain
 - Anechoic cystic structure in posterior aspect of head
 - d. Head and trunk differentiation
 - e. Physiologic umbilical herniation
 - f. Spine
 - g. Limb development/limb buds
 - h. Sonographic appearance
 - i) Mean sac size consideration
 - ii) Cardiac motion
 - iii) Crown rump length (CRL)
 - iv) Nuchal translucency
- C. Uterine Assessment
 - 1. Congenital development anomalies
 - 2. Leiomyoma(s)
- D. Extrauterine Assessment
 - 1. Ovaries
 - a. Corpus luteum cyst
 - i) Most common ovarian mass seen in first trimester
 - ii) Function
 - iii) Resolution

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2. Evaluation for fluid in potential spaces
 - a. Anterior cul-de-sac
 - b. Posterior cul-de-sac
 - c. Associated fluid collection
 - i) Morison's pouch/subhepatic space
- E. First Trimester Complications
 1. Subchorionic hemorrhage
 - a. Spontaneous bleed/hematoma between chorion and endometrium
 - b. Consequences and pregnancy outcome
 2. Placental hematoma
 3. Ectopic pregnancy
 - a. Definition
 - b. Risk factors
 - i) Endometriosis
 - ii) Pelvic inflammatory disease (PID)
 - iii) Congenital abnormalities of fallopian tubes or uterus
 - iv) Tubal scarring
 - v) Intrauterine contraceptive device (IUD)
 - Use of IUD
 - Identification of types and location of IUD
 - vi) Assisted reproductive techniques
 - Permanent
 - Temporary
 - vii) Previous history of ectopic pregnancy
 - viii) Previous history of c-section
 - c. Clinical presentation
 - i) Positive β -hCG
 - ii) Discriminatory level
 - iii) Clinical triad
 - Vaginal bleeding
 - Adnexal mass
 - Pelvic pain
 - iv) Symptoms outside clinical triad
 - v) Adnexal tenderness
 - Cervical tenderness
 - Shock
 - Hypotension
 - Hemoperitoneum

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- Life-threatening
- d. Potential sites for ectopic pregnancy
 - i) Fallopian tube
 - Most prevalent
 - ii) Interstitial/cornual
 - iii) Ovarian
 - iv) Cervical
 - v) Abdominal
- e. Sonographic assessment
 - i) Endometrium
 - Absence of gestational sac
 - Thickened prominent endometrium
 - Decidual reaction
 - Pseudogestational sac
 - ii) Extrauterine/adnexal
 - Adnexal mass separate from ovary
 - Gestational ring in adnexa
 - Ring of fire on color Doppler
 - Cardiac motion within gestational ring
 - Fluid posterior cul-de-sac
 - Fluid in hepatorenal fossa (Morison's pouch)
- f. Treatment
 - i) Surgical
 - ii) Pharmacologic
- 4. Heterotopic pregnancy
 - a. Definition
 - i) Simultaneous intrauterine pregnancy and ectopic pregnancy
 - b. Risk with assisted reproductive technology
- 5. Anembryonic gestation
 - a. Definition
 - i) Presence of gestational sac without presence of embryo
 - ii) Formerly termed blighted ovum
 - b. Clinical associations
 - i) β -hCG values
 - ii) Brownish vaginal discharge
 - iii) Lack of emesis
 - iv) Small uterine size
 - c. Gestational sac considerations

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- i) Shape of sac
 - ii) Size of sac
 - iii) Yolk sac
 - iv) MSD of 25 mm without embryo
6. Pregnancy failure (spontaneous abortion)
- a. Threatened abortion
 - i) Definition
 - Clinical symptoms with normal sonographic findings
 - ii) Clinical presentation
 - Cramping
 - Vaginal spotting
 - iii) Sonographic appearance
 - b. Inevitable abortion
 - i) Definition
 - Ruptured fetal membranes or open cervical os
 - ii) Clinical presentation
 - Vaginal bleeding
 - Cramping
 - β -hCG correlation
 - iii) Sonographic appearance
 - Position of sac in lower uterine segment
 - c. Missed abortion
 - i) Definition
 - Fetal demise
 - ii) Clinical presentation
 - Variable
 - iii) Sonographic appearance
 - d. Complete abortion
 - i) Definition
 - Expulsion of all products of conception
 - ii) Clinical presentation
 - Vaginal bleeding
 - Cramping
 - β -hCG correlation
 - iii) Sonographic appearance
 - e. Incomplete abortion
 - i) Definition
 - Partial retained products of conception without viable fetus

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- ii) Clinical presentation
 - Vaginal bleeding
 - Cramping
 - β -hCG correlation
- iii) Sonographic appearance
- f. Recurrent spontaneous abortion
 - i) Previously referred to as habitual abortion
 - ii) Definition
 - Two consecutive or three total spontaneous abortions
- 7. Embryonic oligohydramnios
 - a. Definition
 - i) Gestational sac is small in comparison to crown-rump length
 - b. Sonographic appearance
- 8. Gestational trophoblastic neoplasia (GTN)
 - a. Classifications
 - i) Hydatidiform mole
 - Most common form
 - Types
 - Complete
 - Partial
 - ii) Choriocarcinoma
 - Malignant invasive form
 - b. Clinical assessment
 - i) Markedly elevated β -hCG
 - ii) Hyperemesis
 - iii) Large uterine size
 - c. Sonographic appearance
 - i) Complete mole
 - Enlarged uterus with vesicular appearance
 - ii) Partial mole
 - Large placenta
 - Gestational sac with or without fetus
 - iii) Invasive mole
 - iv) Choriocarcinoma
 - Uterine enlargement
 - Focal, echogenic myometrial nodules
 - Rare fast growing
 - v) Ovarian association

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- Theca lutein cysts
- d. Treatment and follow-up
 - i) Uterine evacuation
 - ii) Methotrexate
 - iii) Serial β -hCG
 - iv) Computed tomography (CT)
 - v) Magnetic resonance

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Section III: Fetal Assessment in the Normal Second and Third Trimesters

1. Describe the scan planes utilized in fetal sonography
 2. Illustrate the various fetal positions
 3. Identify normal fetal anatomy
 4. Describe anatomical relationship to surrounding structures
 5. Describe sonographic appearance of fetal anatomical structures
 6. Indicate measurement techniques utilized in fetal gestational age and growth assessment
-

III. FETAL ASSESSMENT IN THE NORMAL SECOND AND THIRD TRIMESTERS

A. Scan Planes

1. Maternal scan planes
2. Sagittal
3. Transverse (axial)
4. Coronal
5. Fetal planes/lie
6. Sagittal or longitudinal axis
7. Transverse or axial axis
8. Coronal axis

B. Fetal Positions/Presentation

1. Cephalic/vertex
2. Breech
 - a. Complete
 - b. Incomplete breech
 - c. Frank breech
3. Transverse
4. Oblique

C. Assessment of Fetal Anatomy

1. Cranial
 - a. Identification, sonographic appearance, and anatomical relationship
 - i) Choroid plexus
 - ii) Lateral ventricles
 - iii) Cavum septum pellucidum and vergae
 - iv) Fornix
 - v) Corpus callosum
 - vi) Interhemispheric fissure or falx cerebri (falx)
 - vii) Thalami
 - viii) Third ventricle
 - ix) Cerebral peduncles
 - x) Circle of Willis
 - xi) Posterior fossa

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- Cerebellum
- Fourth ventricle
- Cisterna magna
- b. Calvarium
 - i) Frontal bone
 - ii) Parietal bone
 - iii) Occipital bone
- c. Head shape variations
 - i) Dolichocephaly
 - ii) Brachycephaly
- d. Measurements of fetal head
 - i) Biparietal diameter (BPD)
 - Fetal axial or thalamic plane
 - Level of midline echo complex
 - Reliability with increasing gestational age
 - ii) Cephalic index (CI)
 - Evaluates head shape for reliability of BPD
 - Calculation formula
 - Normal values
 - Cephalic indices
 - Dolichocephaly
 - Brachycephaly
 - iii) Head circumference (HC)
 - Measurement obtained at same level as BPD
 - Reliability for age determination
 - iv) Lateral ventricle
 - Measurement obtained in fetal axial plane
 - Measurement criteria
 - v) Cerebellum
 - Shape
 - Transcerebellar diameter measurement obtained in fetal axial oblique plane
 - Correlation to gestational age
 - vi) Cisterna magna
 - Measurement criteria
 - vii) Nuchal fold
 - 18-22 weeks
 - Measurement criteria

2. Facial anatomy

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- a. Identification, sonographic appearance, and anatomical relationship
 - i) Sagittal or profile view
 - Frontal bone shape
 - Nose/nasal bone
 - Chin
 - ii) Coronal view
 - Upper lip
 - Orbits
 - Lens
 - Nostrils
 - Palate
 - iii) Axial or coronal view
 - Lenses of eyes
 - b. Measurements
 - i) Outer to outer orbital diameter (OOD)
 - ii) Inner orbital diameter (IOD)
 - iii) Correlation to gestational age
 - iv) Qualitative assessment
 - v) Hypertelorism vs hypotelorism
3. Spine
- a. Vertebral development
 - i) Three ossification centers
 - Centrum
 - Right and left neural processes (lateral ossification center)
 - b. Sonographic assessment
 - i) Sagittal plane
 - Vertebral body
 - Lateral ossification center
 - Caudal end tapering (conus medularis)
 - Skin integrity
 - Curvature of spine
 - ii) Coronal plane
 - Lateral ossification centers
 - iii) Transverse
 - Most important view for evaluation of spinal defects
 - Angulation of posterior centers
 - V-shaped
 - C-shaped

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- U-shaped

4. Thorax

a. Identification, sonographic appearance, and anatomical relationship

- i) Lung
- ii) Diaphragm
- iii) Larynx
- iv) Thymus
- v) Fetal position and situs
- vi) Heart
 - Cardiac axis
 - Heart/thorax ratio
 - M-mode to determine fetal heart rate
 - Optimal for practice of as low as reasonably achievable (ALARA)
 - Cardiac rhythm
 - Fetal circulation
 - Identification of normal four heart chambers
 - Left atrium lies closest to fetal spine
 - Right ventricular apex may appear thicker due to moderator band
 - Four chambers should be nearly equal in size
 - Offset position of insertion of atrioventricular valves on interventricular septum
 - Anatomy demonstrated with 4-chamber view
 - Atria
 - Foramen ovale/septum primum
 - Ventricles
 - Atrioventricular valves
 - Papillary muscles
 - Interventricular septum
 - Interatrial septum
 - Great vessels arising off ventricle
 - Aorta – left ventricular outflow tract (LVOT)
 - Pulmonary artery – right ventricular outflow tract (RVOT)
 - Anatomy demonstrated in a fetal sagittal view
 - Aortic arch and great vessel branching
 - ~ Sonographic appearance resembles a candy cane shape
 - ~ Originates from center of heart
 - Ductal arch
 - ~ Communication between main pulmonary artery and descending aorta

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- ~ Originates anteriorly from heart
- ~ Sonographic appearance resembles a hockey stick shape

- Additional anatomy to be evaluated
 - Subcostal view can demonstrate continuity of interventricular septum to aortic root
 - Entrance of inferior vena cava and superior vena cava into right atrium
 - Entrance of pulmonary veins into left atrium

5. Abdomen/pelvis

a. Identification, sonographic appearance, and anatomical relationship

i) Abdominal wall

- Umbilical cord insertion
- Anterior muscles
 - Pseudoascites

ii) Gastrointestinal

- Liver
- Esophagus
- Gallbladder
- Stomach
- Intestines
 - Small intestine
 - Colon

iii) Genitourinary system

- Kidneys
 - Location
 - Sonographic assessment
 - ~ Number of kidneys
 - ~ Size
 - ~ Echogenicity pattern
 - ~ Renal pelvis
 - ~ Color Doppler to verify two kidneys if necessary
 - Renal function association to amniotic fluid
- Ureters
- Bladder
 - Sonographic assessment
 - ~ Fill/empty cycle
- Adrenals
 - Sonographic appearance

iv) Genitalia

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- Documentation of fetal gender
 - Genitourinary anomalies
 - ~ Congenital adrenal hyperplasia
 - Multiple gestation
 - Sex-linked anomaly
- v) Measurements of abdomen
 - Abdominal circumference
 - Includes skin and fat
 - Transverse axis at level of umbilical vein and portal sinus junction
 - Correlation to gestational age and fetal weight
 - Renal length
 - Indications for measurement inclusion
 - Length measure in fetal sagittal plane
 - Renal pelvis
 - ~ AP measurement
- 6. Skeleton
 - a. Osteogenesis
 - b. Appendicular skeleton
 - i) Sonographic identification of bones
 - Femur
 - Tibia/fibula
 - Feet
 - Humerus
 - Radius/ulna
 - Hands
 - Digits
 - c. Pelvis
 - i) Iliac wings
 - d. Measurements
 - i) Long bone measurements
 - Femur
 - Femur/foot ration in circumstances of a short femur
 - Humerus
 - ii) Indications for long bones assessment
 - iii) Correlation to gestational age
- 7. Estimation of fetal weight
 - a. Formulas used
 - b. Generated through biometry

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- c. Standard errors
- d. Gestational age dependent
- e. Variances

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Section IV: Extra-Fetal Assessment of the Second and Third Trimesters

1. Describe techniques utilized for assessment of the cervix
 2. Describe developments, functions, and sonographic appearance of the placenta
 3. List anomalies associated with the placenta and their sonographic appearances
 4. Differentiate anomalies of the umbilical cord and their significance
 5. Identify normal and abnormal Doppler waveforms of the umbilical artery
 6. Discuss the production, role and regulation of amniotic fluid
 7. Describe technique for obtaining an amniotic fluid index (AFI)
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IV. EXTRA-FETAL ASSESSMENT OF THE SECOND AND THIRD TRIMESTERS

A. Cervix

1. Role of sonography in assessment of cervix
 - a. Related to risk for premature birth and morbidity
 - b. Evaluation for determination of cervical length, or funneling
2. Indications for cervical evaluation
 - a. History of premature labor
 - b. History of premature birth
 - c. Multiple gestation
 - d. Premature rupture of membranes
 - e. Uterine anomaly
 - f. Low lying placenta
 - g. Other
3. Sonographic technique
 - a. Patient position
 - b. Application of fundal pressure
 - c. Cervical mobility evaluation
 - d. Transabdominal
 - i) Length may vary with bladder filling decreasing reliability
 - e. Translabial
 - i) May be referred to as transperineal
 - ii) Used when endovaginal approach is contraindicated
 - iii) Empty bladder
 - iv) Cervix is oriented horizontally on the image
 - f. Endovaginal
 - i) Considered gold-standard approach
 - ii) Higher frequency transducer
 - iii) Too much pressure on cervix shortens length
 - g. Measurement from external os to internal os
 - i) Linear technique
 - ii) Trace technique

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4. Incompetent cervix
 - a. Clinical diagnosis
 - b. Treatment options
 - i) Bedrest
 - ii) Cerclage
 - iii) Progesterone therapy

B. Placenta

1. Development of placenta - embryogenesis
 - a. Decidual changes
 - i) Decidua basalis
 - Develops to become maternal surface of placenta
 - Referred to as basal plate
 - ii) Decidua capsularis
 - Lies closest to endometrium
 - iii) Decidua vera
 - Also known as decidua parietalis
 - Endometrial changes on side opposite site of implantation
2. Functional unit
 - a. Chorionic villi
 - b. Chorion frondosum
 - i) Referred to as chorionic plate
3. Circulation
 - a. Role of uterine spiral arteries
 - b. Intervillous spaces
 - c. Maternal blood returns via network of veins
 - i) Basilar veins
 - ii) Subchorionic veins
 - iii) Interlobar veins
 - iv) Marginal veins
4. Physiology
 - a. Respiration
 - b. Nutrition
 - c. Excretion
 - d. Protection
 - e. Storage
 - f. Hormone production
 - i) Human chorionic gonadotropin
 - ii) Estrogen

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iii) Progesterone

5. Positions
 - a. Anterior
 - b. Posterior
 - c. Lateral - left or right
 - d. Fundal
 - e. Combination
 - f. Relationship to internal os
 - i) Low-lying placenta
 - ii) Placenta previa
6. Maturity and grading criteria
 - a. Grading scale of 0-3
 - b. Maturity
 - i) Causes for premature maturation
 - Maternal hypertension
 - Maternal cigarette smoking
 - Intrauterine growth restriction
 - Multiple gestation
 - ii) Causes for delayed maturation
 - Maternal diabetes
 - c. Placental lakes
7. Size considerations
 - a. Weight
 - b. Overall size hard to measure
 - c. Anteroposterior dimension
 - d. Associations with large placenta
 - i) Maternal diabetes
 - ii) Isoimmunization
 - iii) Placental abruption
 - iv) Feto-maternal hemorrhage
 - v) Intrauterine infection
 - vi) Non-immune hydrops
 - vii) Chromosomal anomaly
 - viii) Uterine anomaly
 - ix) Twin-to-twin transfusion syndrome
 - x) Congenital neoplasm
 - xi) Other
 - e. Associations with small placenta

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- i) Intrauterine growth restriction
 - ii) Placental infarction
 - iii) Chromosomal anomaly
 - iv) Intrauterine infection
8. Placenta abnormalities
- a. Placenta previa
 - i) Placenta completely or partially covering internal os
 - Requires cesarean section for delivery
 - ii) Risk factors
 - Multigravida and multiparous women
 - Prior cesarean section
 - History of therapeutic abortion
 - Advanced maternal age
 - Closely spaced pregnancies
 - Abnormal fetal position
 - Maternal anemia
 - History of uterine leiomyomata
 - History of uterine infections
 - Other
 - iii) Classifications of previa
 - Complete
 - Partial
 - Low-lying
 - iv) Clinical symptoms
 - Painless vaginal bleeding
 - Presents in second and third trimesters
 - v) Sonographic considerations
 - Transabdominal approach
 - Over distention of bladder may cause false-positive appearance
 - Partial void technique assists in determining most accurate assessment
 - Limited visualization in third trimester with cephalic presentations and a posterior placenta
 - ~ Reverse trendelenburg position may assist visualization of internal os
 - Endovaginal
 - Most accurate approach
 - Translabial approach
 - Also known as transperineal

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- Relationship of placental edge to internal os
 - Measurement of distance of edge of placenta to center of internal os
- b. Abnormal placental attachment
 - i) Abnormal adherence of all or part of placenta to myometrium
 - ii) Referred to as morbidly adherent placenta (MAP)
 - iii) Classifications
 - Accreta
 - Increta
 - Percreta
 - iv) Risk factors
 - Placenta previa
 - Previous cesarean section
 - Advanced maternal age
 - Prior uterine surgery
 - v) Sonographic evaluation
 - Most common insertion site is lower uterine segment in patients with placenta previa
 - Absent or thin hypoechoic interface between placenta and myometrium
 - Color doppler can identify increased vascularity at abnormal insertion site
 - Translabial approach may be useful for evaluation of lower uterine segment in third trimester
 - MRI frequently used as an imaging adjunct
 - Prominent vascular lacunae visible with grayscale and color Doppler
 - vi) Maternal consequences
 - Placenta may not expel causing excessive hemorrhage
 - High maternal mortality rate with increta and percreta without diagnosis
- 9. Developmental variants and abnormalities
 - a. Succenturiate placenta
 - i) Presence of one or more accessory lobes connected to placenta by blood vessels
 - ii) Sonographic considerations
 - Connection with placenta by vascular band
 - Color Doppler
 - iii) Associated with vasa previa
 - b. Circumvallate/circummarginate placenta
 - i) Abnormal attachment of placental membranes to fetal placental surface
 - ii) Sonographic considerations
 - Elevated and thickened placental margin
 - Thickened rolled edges

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iii) Clinical risks

- Premature rupture of membranes
- Premature labor
- Placental abruption
- Intrauterine growth restriction
- Fetal anomalies
- Retained placenta

c. Abnormal cordal attachments

i) Battledore placenta

- Umbilical cord attaches to placental margin; often referred to as marginal placenta
- Clinical consequences

ii) Velamentous placenta

- Umbilical cord inserts beyond margin of placenta beneath membranes
- Area of cord closest to placenta is not covered by Wharton's jelly
- Association with fetal growth restriction (FGR)
- Risk of vasa previa

d. Masses and lesions

i) Chorioangioma

- Most common benign tumor of placenta
- Sonographic presentation
 - Located just beneath chorionic plate
 - Small
 - Well-circumscribed solid mass
 - Variable echogenicity
- Fetal consequences
 - Size dependent
 - Fetal growth restriction (FGR)/ fetal growth restriction (FGR)
 - Polyhydramnios
 - Cardiomegaly
 - Hydrops
 - Demise

ii) Less common masses

- Hemangioma
- Teratoma
- Thrombosis
- Hematoma

10. Placental abruption

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- a. Premature separation of placenta from endometrial surface
 - i) Clinical symptoms
 - Vaginal bleeding
 - Pain
 - Tense uterine wall
 - Shock
 - Preterm labor
 - b. Risk factors
 - i) Previous history of abruption
 - ii) Trauma
 - iii) History of placenta previa
 - iv) Maternal hypertension
 - v) Uterine leiomyoma
 - vi) Short umbilical cord
 - vii) Methamphetamine use
 - viii) Uterine anomalies
 - c. Types
 - i) Retroplacental
 - Results from rupture of spiral arteries
 - High-pressure bleed
 - Sonographic presentation
 - Thickened placenta
 - Retroplacental clot may be visualized
 - ii) Marginal
 - Rupture of marginal vein
 - Low-pressure bleed
 - Sonographic presentation
 - Anechoic or hypoechoic subchorionic area
 - d. Fetal consequences
 - Premature labor or delivery
 - Fetal demise
 - e. OB emergency
11. Fetal membrane abnormalities
- a. Amniotic band syndrome
 - i) Malformations caused by fibrous strands entangling or trapping fetal parts
 - ii) Fetal anomalies associations
 - Craniofacial defects
 - Limb defects

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- Visceral defects
- b. Amniotic sheets
 - i) Associated with intrauterine synechiae
 - ii) Clinical significance is unclear
- C. Umbilical Cord
 - 1. Embryology
 - 2. Wharton's jelly
 - 3. Anatomy
 - a. One umbilical vein
 - i) Function
 - b. Two umbilical arteries
 - i) Derived from fetal internal iliac arteries
 - ii) Function
 - c. Sonographic assessment
 - i) Transverse section of umbilical cord
 - ii) Arteries adjacent to fetal bladder
 - iii) Cord insertion into fetal abdomen
 - iv) Cord insertion into placenta
 - v) Coiling
 - 4. Abnormalities
 - a. Single umbilical artery
 - i) Sonographic presentation
 - Transverse view demonstrates two vessels
 - One umbilical artery lateral to fetal bladder
 - Artery obliteration after ACI
 - ii) Associations
 - Congenital anomalies
 - Chromosomal anomalies
 - Intrauterine growth restriction
 - Premature delivery
 - Perinatal death
 - b. Short umbilical cord
 - i) Cord length less than 35 centimeters (cm)
 - ii) Associations
 - Oligohydramnios
 - Restricted amniotic space
 - Intrinsic fetal anomaly
 - Cord compression

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- Fetal distress
- c. Long umbilical cord
 - i) Cord length greater than 80 cm
 - ii) Associations
 - Polyhydramnios
 - Nuchal cord
 - True cord knots
 - Fetal distress
 - Cord stricture or torsion due to excessive fetal motion
- d. Cord masses
 - i) Omphalomesenteric cyst
 - ii) Allantoic cyst
 - iii) Hemangioma
 - iv) Thrombosis
 - v) Herniation
- e. Cord knots
 - i) True
 - ii) False
- f. Nuchal cord
- g. Vasa previa
 - i) Presence of umbilical cord vessels across internal os
 - ii) Risk factors
 - Abnormal fetal position
 - Long umbilical cord
 - Polyhydramnios
 - Velamentous insertion of cord
 - Marginal insertion of cord into low-lying placenta
 - Succenturiate lobe
 - iii) Sonographic presentation
 - Presence of vessels in lower uterine segment
 - Color Doppler
 - iv) Fetal consequences
 - Fetal exsanguination with vaginal delivery
 - Premature rupture of membranes
- 5. Umbilical artery doppler
 - a. Indications
 - i) Intrauterine growth restriction
 - ii) Abnormal biophysical profile

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- iii) Abnormal amniotic fluid index
 - iv) Multiple gestation
 - b. Sonographic technique
 - i) Color Doppler useful adjunct
 - ii) Pulsed wave Doppler/sample gate placement
 - iii) Waveform analysis
 - Diastolic component
 - Low resistant
 - Abnormal characteristics
 - ~ Decreased
 - ~ Absent
 - ~ Reversed
 - c. Calculations
 - i) Systolic /diastolic ratio
 - ii) Pulsatility index
 - iii) Resistive index
 - iv) MCA/UA
- D. Amniotic Fluid
- 1. Structures responsible for production
 - a. Amniotic membrane
 - b. Umbilical cord
 - c. Lungs
 - d. Skin
 - e. Kidneys
 - 2. Functions
 - a. Cushion to protect fetus
 - b. Allows for activity and movement
 - c. Prevents adherence of amnion to embryo
 - d. Promotes lung growth
 - e. Regulates temperature
 - f. Reservoir for fetal metabolites
 - 3. Fluid regulation
 - a. First trimester
 - i) Membranes
 - ii) Lungs
 - iii) Skin
 - iv) Non-keratinization
 - b. Second and third trimesters

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- i) Urine
- ii) Fetal swallowing
- 4. Fluid volume
 - a. Correlation to gestational age
 - b. Qualitative assessment
 - i) Subjective evaluation by sonographer
 - Excessive fluid
 - Decreased fluid
 - c. Quantitative methods
 - i) Amniotic fluid index (AFI)
 - Sonographic technique
 - Parallel to maternal sagittal plane
 - Vertical fluid pocket
 - Four quadrants
 - Calculation
 - Criteria for oligohydramnios and polyhydramnios
 - Reproducibility
 - Gestational age related
 - ii) Single pocket assessment
 - Maximum vertical pocket (MVP)
 - Sonographic technique
 - Parallel to maternal sagittal plane
 - Criteria for oligohydramnios and polyhydramnios
- 5. Abnormal fluid volume
 - a. Polyhydramnios
 - i) Defined as an amniotic fluid volume greater than 2000 ml
 - ii) Associated anomalies
 - Gastrointestinal
 - Central nervous system
 - Cardiovascular system
 - Twin-to-twin transfusion
 - Skeletal system
 - Respiratory system
 - Maternal diabetes
 - Chromosomal abnormalities
 - Other
 - b. Oligohydramnios
 - i) Reduction in amount of amniotic fluid

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ii) Associated conditions

- Abnormalities
- Genitourinary
 - Most common
- Chromosomal anomalies
- Fetal growth restriction (FGR)
- Ruptured membranes
- Post-term pregnancy
- Hypertension

iii) Fetal risks

- Dependent on timing and severity of onset of oligohydramnios
- Consequences may include
 - Skeletal and facial deformities
 - Pulmonary hypoplasia
- Associated with fetal demise

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Section V: Assess Abnormal Fetal Growth

1. Discuss clinical indications and manifestations of intrauterine growth restriction
 2. Identify etiologies of intrauterine growth restriction
 3. Differentiate sonographic findings of symmetric fetal growth restriction and asymmetric intrauterine growth restriction
 4. Explain parameters evaluated during performance of a biophysical profile
 5. Discuss role of Doppler in fetal well-being assessment
-

V. ASSESS ABNORMAL FETAL GROWTH

A. Fetal Growth Restriction (FGR)

1. Defined as a fetal weight at or below 10th percentile for a given gestational age
2. Clinical associations
 - a. Small for gestation age (SGA)
 - i) Discrepant fundal height
 - b. Maternal hypertension
 - c. Decreased fetal movement
3. Types
 - a. Symmetric
 - i) Physical parameters are all decreased in size
 - ii) Associated with severe insult in first trimester
 - iii) Etiology
 - Chromosomal abnormality
 - Fetal alcohol syndrome
 - Intrauterine infection
 - Severe maternal malnutrition
 - Genetic defects
 - Chromosomal aberrations
 - Microcephaly
 - Skeletal dysplasia
 - Uncontrolled diabetes
 - b. Asymmetric
 - i) Etiologies and risk factors
 - Maternal
 - Poor nutrition
 - Adverse social-economic conditions
 - Tobacco
 - Drug use
 - Alcoholism
 - Heart condition
 - Anemia

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- Diabetes (type I)
 - History of small for gestational age (SGA)
 - Post-maturity
 - Irradiation
 - High altitude
 - Under age 17 and over age 35
 - Chronic renal disease
 - Placenta
 - Placental insufficiency
 - Abruption
 - Infarcts
 - Placental neoplasm(s)
 - Fetal
 - Isoimmunization
 - Multiple gestation
 - Congenital anomalies
 - Other
- c. Clinical associations
 - i) Small for uterine size (also known as size smaller than dates)
 - ii) Maternal hypertension
 - iii) Pre-eclampsia
- d. Sonographic assessment
 - i) Abdominal circumference small for gestational age
 - ii) Head circumference/ abdominal circumference ratio
 - Brain-sparing effect
 - iii) Doppler middle cerebral artery
 - Increased diastolic flow, lower resistive index and S/D ratio
 - iv) Estimated fetal weight (EFW)
 - v) Possible progression to symmetric IUGR
 - vi) Placenta
 - May be associated with thin placenta
 - Advanced grade of placenta may be seen prematurely
 - Amniotic fluid volume may be decreased
 - vii) Serial examinations are required for accurate assessment with prior dating
- e. Postpartum risks and complications of fetus and neonate
 - i) Asphyxia
 - ii) Meconium aspiration
 - iii) Low birth weight

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iv) Decreased Apgar score

v) Stillbirth

B. Macrosomia

1. Definitions

a. Estimated fetal weight (EFW)

i) > 4500 grams in non-diabetic mother

ii) > 4000 grams in diabetic mother

b. Fetal weight calculation above 90th percentile for gestational age

2. Risk factors

a. Gestational diabetes mellitus

b. Type 1 or type 2 diabetes

c. Multiparity

d. Advanced maternal age

e. Excessive maternal weight gain and/or obesity

f. Post-term delivery

g. History of large for gestational age (LGA) fetus

3. Sonographic assessment

a. Abdominal circumference

i) Most reliable

b. BPD

i) Non-reliable predictor

c. Chest circumference

d. Placenta

i) > 4 cm thickness

e. Overall sonographic prediction is poor

4. Complications

a. Fetal shoulder dystocia

b. Increased mortality and morbidity

C. Assessment of Fetal Well-Being

1. Biophysical profile (BPP)

a. Assessment of fetal well-being or fetal distress

b. Performance criteria

i) Gross body movement; fetal movement (FM)

ii) Fetal tone (FT)

iii) Maximum vertical pocket (MVP) or AFI

iv) Fetal breathing movements (FBM)

v) Nonstress test (NST)

c. Scoring method

d. Time limit

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2. Doppler flow studies
 - a. Umbilical artery
 - i) Systolic-to-diastolic ratio; S/D ratio
 - ii) Resistive index (RI)
 - iii) Pulsatility index (PI)
 - iv) Waveform analysis
 - b. Middle cerebral artery (MCA)
 - i) Indications
 - Fetal anemia
 - IUGR
 - Hydrops
 - Isoimmunization
 - ii) Sonographic technique
 - Axial plane
 - Color Doppler
 - Spectral Doppler
 - Output power considerations
 - Direction and waveform characteristics
 - Spectral Doppler indices
 - Pulsatility index
 - Resistive index
 - S/D ratio
 - Peak systolic velocity
 - c. Ductus venosus
 - i) Indications
 - Abnormal MCA Doppler
 - Venous pulsation in second and third trimester
 - ii) Sonographic technique
 - Color Doppler for identification
 - Spectral Doppler
 - Venous pulsations
 - ~ First trimester
 - ❖ Pulsations seen
 - Second and third trimester
 - ~ Waveform transitions from pulsations to continuous
 - iii) Venous pulsations associations
 - IUGR
 - Congenital heart disease

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- Congestive heart failure
- Increased mortality

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Section VI: High Risk Obstetrics

1. Define terminology associated with multifetal fertilization and development
 2. Discuss sonographic approach in assessment of multifetal gestations
 3. Describe risks associated with individual classifications
 4. List risks to fetuses of mothers with maternal illnesses or diseases
 5. Differentiate fetal risks between maternal diabetes mellitus and gestational diabetes
-

VI. HIGH RISK OBSETRICS

A. Multifetal Gestation

1. Incidence of multiple gestation
 - a. Age
 - b. Race
 - c. Heredity
 - d. Assisted reproductive technology
 - e. Ovulation induction agents
2. Clinical associations
 - a. Size greater than dates
 - b. Elevation of maternal serum alpha-fetoprotein (MSAFP)
3. Terminology (twins)
 - a. Zygosity - number of ovum fertilized
 - i) Monozygotic
 - ii) Dizygotic
 - b. Chorionicity - number of placentas
 - i) Monochorionic
 - ii) Dichorionic
 - c. Amnionicity - number of amniotic sacs
 - i) Monoamniotic
 - ii) Diamniotic
4. Classifications
 - a. Monozygotic
 - i) Frequency of occurrence
 - ii) Development combinations
 - Diamniotic, dichorionic
 - Division of zygote within first three days after conception
 - Diamniotic, monochorionic
 - Division of zygote between day 4 and day 8 after conception
 - Monoamniotic, monochorionic
 - Division of zygote after day 8 from conception
 - Conjoined
 - Division of zygote after day 13 may result in conjoined twins

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- b. Dizygotic gestations
 - i) Frequency of occurrence
 - ii) Non-identical fetuses
 - iii) Diamniotic, dichorionic development
- 5. Sonographic assessment for classification
 - a. First trimester
 - i) Number of gestational sacs and placenta(s)
 - ii) Twin-peak sign
 - Thick membranes
 - b. Second and third trimester
 - i) Membrane
 - ii) Number of placenta(s)
 - iii) Gender
- 6. Sonographic growth assessment of multifetal gestation
 - a. Number of fetuses
 - b. Fetal lie
 - c. Number of placentas
 - d. Presence or absence of membrane
 - e. Measurements obtained are same as with singletons
 - f. Evaluation of normal fetal growth parameters
 - g. Documentation of fetal heart rates
 - h. Qualitative assessment of amniotic fluid or MVP
 - i. Identification of bulging membrane
 - j. Discordance
 - i) Definition
 - ii) Calculation
 - iii) Significance
 - k. Principally similar for higher order multiple pregnancies
- 7. Risks and complications
 - a. Pregnancy induced hypertension
 - b. Premature rupture of membranes
 - c. Intrauterine growth restriction
 - d. Fetal papyraceous
 - e. Vanishing twin
 - f. Monochorionic twin syndromes
 - i) Increased risk for fetal anomalies
 - ii) Increased risk for fetal demise
 - iii) Twin-to-twin transfusion syndrome (TTTS)

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- Abnormal arteriovenous shunt
- Discordant growth
 - Donor twin
 - Recipient twin
- Treatment
 - Amniotic fluid reduction
 - Laser ablation of arterial venous communication

iv) Twin reverses arterial profusion (TRAP)

- Acardiac twin

g. Monoamniotic risks

i) Conjoined twins

- Classifications
 - Thoracopagus
 - Omphalopagus
 - Thoraco-omphalopagus
 - Craniopagus
 - Pygopagus
 - Ischiopagus

ii) Cord entanglement

- High risk of fetal demise

B. Maternal Illnesses

1. Diabetes mellitus

a. Type I

b. Type 2

c. Associated fetal effects

i) Macrosomia

- Shoulder dystocia

ii) Spontaneous abortion

iii) Polyhydramnios

- Pre-term labor
- Premature rupture of membranes (PROM)

iv) Placentomegaly

v) Congenital malformations

- Cardiovascular
- Caudal regression syndrome
- Renal
- Gastrointestinal
- Neural tube defects

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- vi) Stillbirth
- 2. Gestational diabetes
 - a. Onset with pregnancy
 - b. Diagnosis
 - c. Sonographic associations
 - i) Macrosomia
 - ii) Polyhydramnios
 - Pre-term labor
 - Premature rupture of membranes (PROM)
 - iii) Placentomegaly
- 3. Hypertension
 - a. Elevated blood pressure
 - i) Types
 - Chronic hypertension
 - Pregnancy induced hypertension (PIH)
 - Preeclampsia
 - ~ Edema
 - ~ Rapid weight gain
 - ~ Proteinuria
 - ~ Hypertension
 - Severe preeclampsia
 - Eclampsia
 - ~ Seizures
 - ~ Headaches
 - ~ Blurred vision
 - ~ Coma
 - ~ Death
 - b. Fetal associations
 - i) Oligohydramnios
 - ii) IUGR
 - iii) Premature labor
 - iv) Increased incidence of abruptio placenta
 - v) Placental infarcts
 - vi) Small or thin placenta
 - vii) Stillbirth
 - c. Treatment
 - i) Bedrest
 - ii) Medication for hypertension

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4. TORCH
 - a. Acronym for a group of maternal infections
 - i) Toxoplasmosis
 - ii) Others
 - iii) Rubella
 - iv) Cytomegalovirus
 - v) Herpes simplex virus
 - b. Role of sonography
 - i) Fetal growth assessment
 - ii) Amniotic fluid assessment
 - iii) Fetal well-being
 - iv) Calcifications
 - v) Hydrops
5. Isoimmunization
 - a. Etiology
 - i) Rh isoimmunization
 - ii) Rh- patient carrying an rh+ fetus
 - iii) Fetal hemolysis
 - iv) First pregnancy versus subsequent pregnancies
 - RhoGAM
 - b. Fetal consequences
 - i) Fetal anemia
 - ii) Congestive heart failure
 - iii) Hydrops fetalis
 - c. Sonographic assessment
 - i) Percutaneous umbilical blood sampling (PUBS)
 - ii) Fetal hydrops
 - iii) Guidance for intrauterine transfusions
 - iv) MCA velocity
 - v) Amniocentesis
 - d. Treatment
 - i) Intra-uterine blood transfusion
6. Thrombophilias
 - a. Consequences
 - i) DVT
 - ii) Fetal loss
 - iii) Placental abruption
 - iv) IUGR

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7. Other maternal infections

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Section VII: Fetal Structural Abnormalities

1. Discuss various fetal abnormalities and their sonographic appearances
 2. Define terminology and associations of fetal face abnormalities
 3. Define terminology and associations of skeletal anomalies
 4. Correlate clinical assessments with fetal abnormalities
-

VII. FETAL STRUCTURAL ABNORMALITIES

A. Fetal Face

1. Terminology and associations
 - a. Hypotelorism
 - i) Associated with holoprosencephaly
 - b. Hypertelorism
 - i) Associations
 - Cephaloceles
 - Craniosynostosis
 - Median cleft syndrome
 - Trisomy 18
 - c. Microphthalmia
 - d. Anophthalmia
 - e. Macroglossia
 - i) Associated with trisomy 21
 - ii) Beckwith Wiedemann syndrome
 - f. Micrognathia
 - i) Associations
 - Pierre Robin syndrome
 - Trisomy 13
 - Trisomy 18
 - Musculoskeletal syndromes
2. Cleft lip and palate
 - a. Most common facial abnormality
 - b. Two major groups
 - i) Upper lip and anterior maxilla with or without involvement of soft and/or hard palate
 - ii) Cleft involving hard and soft without cleft lip
 - iii) Bilateral versus unilateral
 - c. Association with other anomalies
 - i) Trisomy 13
 - ii) Anencephaly
 - iii) Holoprosencephaly
 - iv) Autosomal dominant syndromes

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- v) Autosomal recessive syndromes
- d. Sonographic assessment
 - i) Cleft lip
 - ii) Cleft palate
 - iii) Role of 3-D and 4-D
- B. Fetal Neck
 - 1. Cystic hygroma
 - a. Etiology
 - i) Lymphatic system
 - b. Locations
 - c. Associations
 - i) Chromosomal
 - Turner's syndrome
 - Down's syndrome
 - ii) Fetal
 - Congenital heart defects
 - Hydrops fetalis
 - Edema
 - d. Sonographic presentation
 - i) Cystic structure posterior neck
 - ii) Septations
 - iii) Size
 - iv) Potential regression
 - v) Oligohydramnios
 - vi) Presents at <20 weeks GA
- C. Fetal Head and Brain
 - 1. Clinical associations
 - a. Elevated maternal alpha-fetoprotein (MSAFP)
 - b. Increased fundal height
 - 2. Head shape abnormalities
 - a. Lemon shape
 - b. Strawberry shape
 - c. Brachycephaly
 - d. Dolichocephaly
 - e. Cloverleaf shape
 - i) Kleeblattschädel
 - 3. Ventriculomegaly
 - a. Measurement criteria

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- b. Hydrocephalus
- c. Pathogenesis
 - i) Communicating vs non-communicating hydrocephalus
 - ii) Stenosis of aqueduct of Sylvius
 - iii) Excess cerebrospinal fluid production
 - iv) Decreased cerebrospinal absorption
 - v) Cerebral atrophy
 - vi) Primary failure of brain growth
 - vii) Abnormal karyotypes
 - viii) Dandy-Walker syndrome
 - ix) Spinal abnormalities
- d. Sonographic criteria and findings
 - i) Presence of excess fluid in lateral, 3rd, or 4th ventricles
 - ii) Evaluate brain texture
 - iii) Atria of lateral ventricle exceeds 10mm
 - iv) Dangling choroid sign
 - v) Associated findings may include
 - Polyhydramnios
 - Abnormal fetal lie
 - Fetal hydrops
 - Meningomyelocele
 - Other cranial or spinal anomalies
- 4. Anencephaly and acrania
 - a. Description
 - i) Anencephaly is absence of skull and cerebral hemispheres
 - ii) Acrania is absence of skull
 - b. Sonographic considerations
 - i) Acrania
 - Absence of skull
 - Presence of brain
 - Atrophic changes
 - ii) Anencephaly
 - Rudimentary brain tissue
 - Bulging fetal orbits giving a frog-like appearance
 - Presence of facial bones
 - iii) Polyhydramnios
 - iv) Increased fetal activity
- 5. Cephalocele

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- a. Description
 - i) Herniation of intracranial structures through a defect in cranium
 - b. Terminology
 - i) Cranial meningocele
 - ii) Encephalocele
 - c. Locations of defect
 - i) Posterior aspect of skull
 - Most common
 - ii) Parietal suture
 - iii) Frontal suture
 - d. Anomaly associations
 - e. Sonographic presentation
 - i) Bony defect in skull
 - ii) Extracranial mass
 - iii) Ventriculomegaly
 - iv) Microcephaly
6. Holoprosencephaly
- a. Abnormality in development of forebrain
 - b. Chromosomal associations
 - i) Trisomy 13
 - c. Classifications
 - i) Alobar
 - ii) Semilobar
 - iii) Lobar
 - d. Sonographic appearance and associations
 - i) Large, midline, cystic space with peripheral cerebral tissue
 - ii) Absence of falx and corpus callosum
 - iii) Facial anomalies
 - Hypotelorism
 - Cyclopia
 - Midline facial clefts
 - iv) Hydrocephalus
 - v) Microcephaly
 - vi) Polyhydramnios
 - e. Prognosis
 - i) Dependent on classification and severity
7. Dandy-Walker complex
- a. Etiology

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- i) Dysgenesis of cerebellar vermis
 - ii) Cisterna magna enlargement
 - iii) Fourth ventricle is continuous with a cystic space
 - b. Sonographic appearance
 - i) Large, cystic structure in posterior fossa
 - Continuous with enlarged fourth ventricle
 - ii) Enlargement of posterior fossa
 - iii) Cerebellar hemispheres may be separated and flattened
 - iv) Ventriculomegaly
 - v) Polyhydramnios
- 8. Arnold Chiari type II malformation
 - a. Displacement of posterior fossa structures into cervical canal
 - i) Anatomic involvement
 - Pons
 - Fourth ventricle
 - Medulla
 - Cerebellum
 - b. Sonographic findings
 - i) Cerebellum and 4th ventricle displacement
 - Banana sign
 - ii) Cisterna magna obliteration
 - iii) Frontal horns of lateral ventricles
 - iv) Depressed frontal bones
 - Lemon head shape
 - c. Associated with spinal dysraphia
- 9. Hydranencephaly
 - a. Etiology
 - i) Destructive insult to brain
 - b. Sonographic appearance
 - i) Macrocephaly
 - ii) Large anechoic area in cranial vault surrounding midbrain and basal ganglia
 - iii) Occasionally absent falx
 - iv) Variable presence of 3rd ventricle
 - v) Tentorium separating normal posterior fossa from anterior and middle cranial fossae
 - vi) Polyhydramnios
 - vii) Occasionally small portions of occipital lobes
- 10. Microcephaly
 - a. Definition

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- i) Small head with more than 3 standard deviations below normal
 - b. Associations
 - i) Intrauterine infections
 - ii) Aneuploidy
 - iii) Central nervous system anomalies
 - c. Sonographic criteria
 - i) Small BPD (other parameters are normal)
 - ii) Increased or decreased HC/AC ratio
 - iii) Poor cranial growth on serial sonograms
 - iv) Abnormal intracranial architecture
 - v) High false positive rate
11. Agenesis of corpus callosum
- a. Description
 - i) Failure of development of part or all of corpus callosum
 - b. Associated with
 - i) Trisomy 13
 - ii) Trisomy 18
 - iii) Trisomy 21
 - iv) Triploidy
 - v) Holoprosencepaly
 - vi) Median facial clefts
 - vii) Dandy-Walker syndrome
 - c. Sonographic appearance
 - i) Absence of all or part of corpus callosum
 - ii) Absence of cavum septum pellucidum
 - iii) Elevation and dilation of 3rd ventricle
 - iv) Widely separated lateral ventricular frontal horns
 - v) Colpocephaly
 - Ventricles may demonstrate teardrop shape
12. Vein of Galen aneurysm
- a. Rare arteriovenous malformation
 - b. Sonographic assessment
 - i) Cystic space in midline of brain
 - ii) May be irregular in shape
 - iii) Color Doppler confirms vascular and turbulent nature
 - c. Associations
 - i) Cardiomegaly
 - ii) Nonimmune hydrops

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iii) Ventriculomegaly

13. Schizencephaly

- a. Characterized by clefts in cerebral cortex
- b. Sonographic assessment
 - i) Fluid filled cleft(s) in cerebral cortex
 - ii) Unilateral or bilateral
 - iii) Associated with
 - Absence of cavum septum pellucidum
 - Absence of corpus callosum

14. Lissencephaly

- a. Brain surface is smooth without normal sulci and gyri
- b. Sonographic assessment
 - i) Difficult to diagnose until third trimester when sulci and gyri may be seen
 - ii) Ventriculomegaly
- c. Associated with
 - i) Agenesis of corpus callosum
 - ii) Dandy-Walker malformation
 - iii) Colpocephaly
 - iv) Other syndromes

15. Porencephalic cysts

- a. Cysts filled with cerebrospinal fluid that communicate with ventricular system
- b. Sonographic assessment
 - i) Cyst in brain parenchyma
 - ii) Cyst communicates with ventricular system or subarachnoid space
 - iii) May be asymptomatic

D. Spinal Abnormalities

1. Spina bifida

- a. Terminology
 - i) Spina bifida
 - ii) Spina bifida occulta
 - iii) Meningocele
 - iv) Myelomeningocele
 - v) Rachischisis
- b. Pathogenesis
 - i) Multifactorial genetic
 - ii) Folic acid deficiency
 - iii) Maternal diabetes
 - iv) Trisomy 18

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- c. Clinical associations
 - i) Elevated MSAFP
 - ii) Elevated acetyl cholinesterase (ACHE)
 - iii) May be large for gestational age if polyhydramnios is present
 - d. Sonographic assessment
 - i) Lumbar region is most common
 - ii) Posterior transaxial scan
 - iii) Position of laminae and pedicles
 - iv) Level of defect
 - v) Cleft in skin
 - vi) Mass extending of spine
 - vii) Upper and lower limb movement
 - viii) Evaluate fetal head for shape anomalies
 - Lemon sign
 - Banana sign
 - ix) Evaluate skeletal system, talipes, leg movement
 - e. Associated cranial anomalies
 - i) Hydrocephalus
 - ii) Encephalocele
 - iii) Arnold Chiari II malformation
 - f. Fetal surgery may be an option
2. Scoliosis and kyphosis
- a. Scoliosis
 - b. Kyphosis
 - c. Anomaly associations
 - i) Spina bifida
 - ii) Abdominal wall defects
 - iii) Skeletal dysplasia
 - d. Sonographic assessment
 - i) Scoliosis
 - Lateral longitudinal view
 - ii) Kyphosis
 - Coronal plane
 - Posterior longitudinal
3. Caudal regression
- a. Sequence of anomalies
 - i) Femoral hypoplasia
 - ii) Leg anomalies

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- iii) Sacral agenesis
- iv) Lumbar spine abnormalities
- b. Associated with diabetes mellitus
- c. Sonographic appearance
 - i) Short femurs
 - ii) Sacral agenesis
 - iii) Legs may be flexed and abducted at hips
- 4. Sirenomelia
 - a. Pathogenesis
 - i) Arterial insufficiency to lower limbs
 - b. Fusion of legs with deformed or absent feet
 - i) Sonographic findings
 - ii) Oligohydramnios
 - iii) Fusion of legs
 - iv) Single foot or absence of feet
 - c. Prognosis
 - i) Usually fatal due to pulmonary hypoplasia sequential to oligohydramnios
- 5. Sacrococcygeal teratoma
 - a. Incidence
 - b. Gender tendency
 - c. Etiology
 - i) Contains all three germ layers
 - d. Sonographic assessment
 - i) Mass in buttocks area adjacent to spine
 - ii) Solid or complex appearance
 - iii) Calcifications frequently present
 - iv) External mass is most common presentation
 - v) Functional AV fistula
 - Hydrops
 - High flow
 - vi) Fetal surgery may be an option
- E. Fetal Thorax
 - 1. Congenital diaphragmatic hernia
 - a. Protrusion of abdominal contents into thorax through a defect in diaphragm
 - b. Pathophysiology
 - i) Results from failure of pleuroperitoneal membrane
 - ii) Usually occurs on left
 - iii) Loops of bowel or most of abdominal contents may herniate
 - iv) Compression of lung may cause pulmonary ipsilateral hypoplasia and respiratory distress
 - c. Sonographic appearance

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- i) Displaced heart
 - ii) Cystic mass (stomach) in thorax
 - iii) Absence of intraabdominal stomach
 - iv) Bowel in chest
 - Hypoechoic or cystic in appearance
 - Fetal surgery
2. Fetal hydrothorax
- a. Pleural effusion
 - b. Common associations
 - i) Hydrops fetalis
 - ii) Congestive heart failure
 - iii) Chromosomal anomalies
 - c. Sonographic appearance
 - i) Anechoic area in one or both sides of chest
 - ii) Depending on size of effusion, compression of lung can result in pulmonary hypoplasia and displace heart
 - d. Fetal shunting
3. Cystic adenomatoid malformation (CAM)
- a. Also referred as congenital cystic adenomatoid malformation (CCAM) or congenital pulmonary airway malformation (CPAM)
 - b. Benign tumor of lung
 - c. Usually a unilateral finding involving a single lobe
 - d. Types and sonographic appearances
 - i) Type I
 - Single or multiple large cysts measuring 2 cms or greater
 - ii) Type II
 - Multiple small cysts less than 1 cm in diameter
 - iii) Type III
 - Multiple tiny cysts giving a bulky hyperechoic appearance
 - iv) May be spontaneous
 - e. Associated findings
 - i) Polyhydramnios
 - ii) Mediastinal shift
 - iii) Hydrops fetalis
4. Bronchopulmonary sequestration
- a. Pulmonary mass separate from normal tracheobronchial tree
 - i) Intralobar
 - ii) Extralobar
 - b. Sonographic appearance

Obstetrics and Gynecology

- i) Well-defined echogenic mass
 - ii) Usually triangular in shape
 - c. Differentials
 - i) CAM
 - ii) Mediastinal teratoma
- 5. Pulmonary hypoplasia
 - a. Underdevelopment of fetal lungs
 - b. Factors associated with normal lung growth
 - i) Adequate amniotic fluid
 - ii) Adequate thoracic space
 - iii) Lung fluid
 - iv) Fetal breathing movements
 - c. Manifestations of abnormal lung growth
 - i) Oligohydramnios
 - ii) Skeletal dysplasias
 - iii) Decreased chest circumferences
 - iv) Congenital diaphragmatic hernia
 - v) Pulmonary mass
 - vi) Various assessment methods
- F. Cardiac Anomalies (most common, not all inclusive)
 - 1. Most common major fetal anomaly
 - 2. Can be an isolated finding or associated with other anomalies, particularly abnormal karyotypes
 - 3. Congenital defects
 - a. Valvular
 - i) Epstein anomaly
 - ii) Valvular atresia
 - b. Septal
 - i) Ventricular septal defect (VSD)
 - ii) Atrial septal defect (ASD)
 - iii) Atrioventricular septal defect (AVSD)
 - c. Great vessel
 - i) Transposition of great vessels
 - Great vessels may give a parallel appearance
 - ii) Truncus arteriosus
 - Single common arterial trunk
 - iii) Double outlet right ventricle
 - d. Tetralogy of Fallot
 - i) Most common form of cyanotic heart disease

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- ii) Criteria
 - Perimembranous ventricular septal defect
 - Outlet of conal ventricular defect
 - Pulmonic stenosis
 - Pulmonary artery hypoplasia
 - Right ventricular hypertrophy
- e. Hypoplastic ventricle
 - i) Hypoplasia
 - ii) Underdevelopment of either right or left ventricle
 - iii) Results in a non-functional ventricle
- 4. Cardiac masses
 - a. Rhabdomyoma
 - i) Echogenic mass(es) within fetal heart
 - ii) May be associated with hydrops
 - iii) Etiology may be tuberous sclerosis
- 5. Arrhythmias
 - a. Types
 - i) Tachycardia
 - ii) Bradycardia
 - iii) Irregular
 - b. Sonographic assessment
 - i) M-mode placement though atria and ventricle simultaneously
 - ii) Hydrops
- G. Fetal Abdominal Wall Defects
 - 1. Gastroschisis definition
 - a. Defect of abdominal wall adjacent to insertion of umbilical cord
 - b. Pathogenesis
 - c. Sonographic appearance
 - i) Free-floating loops of bowel in amniotic fluid
 - ii) Defect adjacent to umbilical cord
 - Defect to right of umbilical cord most common
 - iii) Associated with IUGR and oligohydramnios
 - d. Prognosis
 - i) Usually good
 - ii) Isolated defect
 - 2. Omphalocele
 - a. Definition
 - i) Pathologic herniation of abdominal contents into umbilical cord

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- b. Pathogenesis
 - c. Association with chromosomal abnormalities or complexes
 - i) Trisomies
 - ii) Pentalogy of Cantrell
 - iii) Beckwith-Weidemann syndrome
 - d. Sonographic appearance
 - i) Herniated mass is contiguous with umbilical cord
 - ii) Herniated contents are covered by membrane
 - iii) Herniated abdominal contents may include
 - Bowel
 - Liver
 - Mesentery
 - Omentum
 - Pancreas
 - Spleen
 - e. Prognosis
 - i) Organ involvement
 - Omphaloceles containing bowel containing carry increased risk for chromosomal anomalies
 - Good when isolated
3. Pentalogy of Cantrell
- a. Five abnormalities
 - i) Anterior diaphragmatic hernia
 - ii) Omphalocele
 - iii) Cardiac anomalies
 - iv) Defect of diaphragmatic pericardium
 - v) Lower sternal defect
 - Ectopia cordis
 - b. Prognosis
 - i) Universally fatal
4. Limb-body wall complex
- a. Structures involved
 - i) Limb defects
 - ii) Anterior body defects
 - iii) Encephalocele
 - iv) Internal organ malformations
 - v) Very short or absent umbilical cord
 - b. Prognosis

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- i) Universally fatal
- 5. Bladder and cloacal exstrophy
 - a. Midline defects of infraumbilical anterior abdominal wall
 - b. Bladder exstrophy
 - i) Inappropriate eversion of bladder mucosa
 - ii) Usually isolated
 - iii) Sonographic findings
 - Inability to identify fetal bladder
 - Lower anterior abdominal soft-tissue mass
 - c. Cloacal exstrophy
 - i) More complex due to lack of separation of urogenital septum from rectum
 - ii) May result in two hemibladders
 - iii) Frequently associated with other anomalies
- H. Gastrointestinal Abnormalities
 - 1. Esophageal atresia
 - a. Congenital atresia of esophagus
 - b. Usually associated with a tracheo-esophageal fistula (TEF)
 - c. Types
 - i) Type A
 - Esophageal atresia without TEF
 - ii) Type B
 - Esophageal atresia with TEF at proximal esophageal segment
 - iii) Type C
 - Esophageal atresia with TEF to distal esophageal segment
 - Most common presentation
 - iv) Type D
 - Esophageal atresia with TEF to both proximal and distal esophageal segments
 - v) Type E
 - Tracheoesophageal fistula without esophageal atresia
 - d. Sonographic assessment
 - i) Visualization and size of stomach depends on presence of TEF
 - ii) Polyhydramnios
 - iii) Difficult diagnosis to make
 - 2. Duodenal atresia
 - a. Obstruction of duodenum of varied etiology
 - b. Sonographic appearance
 - i) Classic double-bubble sign representing stomach and proximal portion of duodenum

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- ii) Polyhydramnios
- c. Association with trisomy 21
- 3. Meconium ileus
 - a. Obstruction due to impaction of meconium
 - b. Association with cystic fibrosis
 - c. Sonographic findings
 - i) Dilatation of small bowel
 - ii) Large bowel is decreased in size
 - iii) Echogenic bowel
- 4. Hirschsprung's disease
 - a. Rare disorder of functional bowel obstruction
 - b. Sonographic findings
 - i) Multiple dilated loops of bowel
 - ii) Polyhydramnios
- I. Genitourinary Abnormalities
 - 1. Sonographic approach to evaluation of genitourinary abnormalities
 - a. Kidneys
 - i) Presence and number of kidneys
 - ii) Shape
 - iii) Size
 - iv) Echogenicity
 - v) Renal pelvis
 - Dilatation
 - b. Ureter
 - i) Non-visualized
 - ii) Dilated
 - c. Bladder
 - i) Presence or absence
 - ii) Size
 - d. Amniotic fluid volume
 - i) Normal versus oligohydramnios
 - e. Identification of fetal gender
 - 2. Renal agenesis
 - a. Bilateral
 - i) Associations
 - Oligohydramnios
 - Pulmonary hypoplasia
 - Facial anomalies

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- Mortality
- b. Sonographic presentation
 - i) Severe oligohydramnios after mid-second trimester
 - ii) Absent kidneys and bladder
 - iii) Fetal adrenals may mimic kidneys
 - iv) Color Doppler used to confirm absence of renal arteries
- c. Unilateral
 - i) Sonographic findings
 - Presence of one kidney
 - Normal bladder appearance
 - Normal amniotic fluid volume
- 3. Potter's classifications
 - a. Type I: infantile polycystic kidney disease (ARPKD)
 - i) Autosomal recessive
 - ii) Sonographic presentation
 - Enlarged kidneys bilaterally
 - Increased echogenicity of kidneys with loss of corticomedullary differentiation
 - Bladder may be small or absent
 - Oligohydramnios
 - b. Type II: multicystic dysplastic kidney (MCDK)
 - i) Incidence
 - Most common form of renal cystic disease in infants and neonates
 - ii) Sonographic appearance
 - Enlarged kidney with multiple cysts of varying size
 - If unilateral
 - Normal bladder
 - Normal amniotic fluid volume
 - If bilateral
 - Non-functioning bladder
 - Oligohydramnios
 - c. Type III: adult polycystic kidney disease (ADPKD)
 - i) Autosomal dominant
 - ii) Family history
 - iii) Sonographic findings
 - May have normal appearing kidneys
 - Can appear echogenic or enlarged
 - Bladder will be present

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- Normal amniotic fluid volume
- d. Type IV: obstructive cystic dysplasia
 - i) Etiology
 - Onset in first or early second trimester
 - Bladder obstruction
- 4. Obstructive urinary tract abnormalities
 - a. Terminology
 - i) Hydronephrosis
 - ii) Pyelectasis
 - b. Ureteral obstruction
 - i) Ureteropelvic junction (UPJ)
 - ii) Renal pelvis will be dilated
 - iii) Ureterovesical junction (UVJ)
 - Renal pelvis and ureter will be dilated
 - c. Bladder outlet obstruction
 - i) Bilateral hydronephrosis and dilated ureters
 - ii) Posterior urethral valve (PUV)
 - Most common male fetus
 - iii) Bladder dilatation with a keyhole resembling appearance
 - iv) Oligohydramnios
 - d. Sonographic assessment
 - i) Amniotic fluid volume
 - Indirect assessment of renal function
 - Pulmonary hypoplasia
 - ii) Renal pelvis measurements
 - iii) Level of obstruction
 - iv) Fetal gender
 - v) Bladder appearance
 - vi) Renal parenchyma
 - vii) Fetal therapy proposed
- 5. Prune Belly syndrome
 - a. Complex malformation
 - i) Anterior abdominal wall distension
 - ii) Urinary tract obstruction
 - iii) Cryptorchidism
 - b. Pathophysiology
 - c. Sonographic appearance
- 6. Testicular hydrocele

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- a. Description
 - i) Accumulation of fluid in tunica vaginalis
- b. Sonographic criteria
 - i) Fluid surrounds entire testicle
- 7. Ovarian cyst
 - a. Functional
 - b. Sonographic appearance
- J. Musculoskeletal Abnormalities
 - 1. Abnormalities of cartilage and/or bone growth and development
 - 2. Most common types
 - a. Achondrogenesis
 - b. Thanatophoric dysplasia
 - c. Camptomelic dysplasia
 - d. Osteogenesis imperfecta
 - e. Achondroplasia
 - f. Talipes
 - g. Many others
 - i) Isolated to bone
 - ii) Associated anomalies
 - h. Many genetic
 - i) Dominant
 - ii) Recessive
 - 3. Terminology
 - a. Rhizomelia
 - b. Mesomelia
 - c. Micromelia
 - d. Acromelia
 - e. Talipes equinovarus
 - f. Syndactyly
 - g. Polydactyly
 - 4. Clinical management
 - a. Family history
 - b. Serial sonograms for growth
 - 5. Sonographic assessment
 - a. Amniotic fluid volume
 - b. Limb length
 - i) Proximal segments
 - ii) Distal bone segments
 - c. Bone mineralization

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- d. Bone appearance
 - i) Fractures
 - ii) Curvature
 - iii) Bowing
- e. Skull shape
 - i) Clover leaf skull - kleeblattschädel
 - ii) Craniosynostosis
 - iii) Frontal bossing
 - iv) Facial features
- f. Thorax
 - i) Size
 - Pulmonary hypoplasia
 - ii) Rib length
- 6. Skeletal dysplasias
 - a. Thanatophoric dysplasia (two types)
 - i) Key features
 - Rhizomelia
 - Bowed long bones
 - Narrow thorax
 - Normal trunk length
 - Large head size
 - Severely flattened vertebral bodies
 - Association with pathologic anomalies
 - Horseshoe kidney
 - Atrial septal defects
 - Imperforate anus
 - Cloverleaf skull - kleeblattschädel
 - ii) Sonographic appearance
 - Short-limbed dwarfism
 - Cloverleaf skull
 - Hypoplastic thorax
 - Polyhydramnios
 - iii) Prognosis
 - Lethal
 - Dominant
 - b. Achondrogenesis
 - i) Failure of ossification process
 - ii) Two types

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- Type I (Parenti-Fraccaro)
 - Key features
 - ~ Incomplete ossification of-spine
 - ~ Rib fractures
 - ~ Extreme dwarfism
 - ~ Arms extremely short and stubby
 - ~ Head proportional to trunk
- Type II (Langer-Saldino)
 - Key features
 - ~ Head large compared to body
 - ~ Prominent skin folds over a short neck
 - ~ Small chest
 - ~ Distended abdomen
 - ~ Short limbs held away from body
- iii) Sonographic appearance
 - Severely shortened limbs
 - Lack of vertebral ossification
 - Large head with normal to slightly decreased ossification of cranium
- iv) Prognosis
 - Lethal
 - Recessive type I; type II dominant
- c. Achondroplasia
 - i) Types
 - Homozygous
 - Heterozygous
 - ii) Sonographic appearance
 - Rhizomelia
 - Macrocephaly
 - Trident hands
 - Depressed nasal bridge
 - Frontal bossing
 - Presents in mid-to-late second trimester
 - iii) Prognosis
 - Non-lethal
 - Dominant
- d. Osteogenesis imperfecta
 - i) Pathophysiology
 - Disorder of production, secretion, or function of collagen

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- Hypomineralization
- ii) Multiple types exist
 - Type I
 - Autosomal dominant
 - Normal to decreased bone echogenicity
 - Innumerable fractures
 - Severe bone shortening
 - Type IIB
 - Autosomal recessive
 - Normal bone echogenicity
 - Numerous fractures
 - Moderate femur shortening
 - Type IIC
 - Autosomal recessive
 - Normal bone echogenicity
 - Numerous fractures
 - Moderate shortening of all extremity bones
 - Type III
 - Autosomal recessive
 - Decreased bone echogenicity
 - Numerous fractures
 - Moderate femur bone shortening
 - Severe handicaps
 - Type IV
 - Autosomal dominant
 - Normal bone echogenicity
 - Isolated fractures
 - Absence of bone shortening
- iii) Prognosis
 - Lethal
 - Types IIB, IIC
- e. Camptomelic dysplasia
 - i) Characterized by bent or bowed limbs
 - ii) Associated anomalies
 - Congenital heart disease
 - Hydronephrosis
 - Hydrocephalus
 - iii) Sonographic appearance

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- Bowing of long bones
 - Lower limb most commonly affected
- IUGR
- Female genitalia with XY karyotype
- f. Dysostosis
 - i) Absence or malformation of individual bones
 - ii) Prenatal diagnosis is difficult except in cases of cloverleaf skull
- g. Talipes (equinovarus)
 - i) Inversion of foot and flexion of sole
 - ii) Causes
 - Oligohydramnios
 - Amniotic band syndrome
 - Uterine tumors
 - Spina bifida
 - Chromosomal abnormalities
 - Isolated
 - Other
 - iii) Sonographic appearance
 - Orientation of foot and leg bones
- 7. Postural/movement abnormalities
- K. Other
 - 1. Fetal hydrops
 - a. Definition
 - i) Condition characterized by excessive fluid accumulation in fetal extravascular compartments, body cavities, and subcutaneous tissues
 - b. Other findings
 - i) Polyhydramnios
 - ii) Enlarged fetal liver and/or spleen
 - iii) Subcutaneous edema and thickening
 - iv) Enlarged cord
 - c. Types
 - i) Nonimmune hydrops fetalis pathology associations
 - Fetal anomalies
 - Cystic hygromas
 - Diaphragmatic hernia
 - Neoplasms
 - Fetal anemia
 - Chromosomal anomalies

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- Cardiovascular malformations
 - Infections
 - Cardiac failure
 - Arrhythmias
 - Placental abnormalities
 - Chorioangioma
 - Twin to twin transfusion
 - Other
- ii) Immune hydrops fetalis
- Erythroblastosis fetalis
 - Caused by immunologic response
 - Isoimmunization
 - Rhesus (Rh)
 - Other

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Section VIII: Genetic Abnormalities and Syndromes

1. List maternal serum markers associated with chromosomal anomalies
 2. Characterize sonographic findings with genetic syndromes
-

VIII. GENETIC ABNORMALITIES AND SYNDROMES

- A. Maternal Serum Markers for Screening
 1. Alpha fetoprotein (AFP)
 - a. Maternal serum alpha fetoprotein (MSAFP)
 - b. Amniotic fluid alpha fetoprotein (AFAFP)
 2. Quad screen
 3. Non-invasive prenatal testing (NIPT)
 4. First trimester
 - a. Pregnancy associated plasma protein-a
 - b. Human chorionic gonadotropin (hCG)
- B. Genetics
 1. Terminology
 - a. Karyotype
 - b. Autosomal recessive
 - c. Autosomal dominant
 - d. Mosaicism
 - e. Translocation
 - f. Multifactorial
- C. Sonographic Markers
 1. Nuchal translucency
 - a. Measurement technique
 - i) Gestational age
 - b. Abnormal criteria
 - c. Associations
 - i) Aneuploidy
 - ii) Fetal cardiac anomalies
 - iii) Cystic hygroma
 2. Second trimester trisomy 21 markers
 - a. Nuchal fold
 - b. Absent or hypoplastic nasal bone
 - c. Protruding tongue
 - d. Esophageal atresia
 - e. Duodenal atresia
 - f. Echogenic bowel
 - g. Pyelectasis

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- h. Shortened long bones
 - i. Echogenic intra-cardiac focus
 - j. Absent or hypoplastic middle phalanx of 5th digit
 - k. Clinodactyly
 - l. IUGR
 - 3. Second trimester neural tube defect (NTD) findings
 - a. Elevated MSAFP if open defect
 - b. Ventral wall defect
 - c. Absent or reduced fetal extremity movements
- D. Chromosomal Anomalies
 - 1. Trisomy 21
 - a. Down's syndrome
 - b. Sonographic associations
 - i) Sonographic markers as listed above
 - ii) Duodenal atresia (third trimester)
 - iii) Heart defects
 - Ventricular septal defect
 - Atrioventricular canal defect
 - iv) Mild ventriculomegaly
 - 2. Trisomy 18
 - a. Edward's syndrome
 - b. Sonographic associations
 - i) Heart defects
 - ii) Clenched hands
 - iii) Omphalocele
 - iv) Micrognathia
 - v) Talipes
 - vi) Rocker bottom feet
 - vii) Cystic hygroma
 - viii) Choroid plexus cysts
 - ix) Renal anomalies
 - x) Cleft lip and palate
 - xi) Congenital diaphragmatic hernia
 - xii) Cerebellar hypoplasia
 - xiii) Meningomyelocele
 - xiv) SUA
 - c. IUGR and hydramnios
 - 3. Trisomy 13

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- a. Patau's syndrome
 - b. Sonographic associations
 - i) Heart defects
 - ii) Omphalocele
 - iii) Polydactyly
 - iv) Talipes
 - v) Rocker bottom feet
 - vi) Cystic hygroma
 - vii) Cleft lip and palate
 - viii) Renal anomalies
 - ix) Meningomyelocele
 - x) Micrognathia
 - xi) Holoprosencephaly
 - xii) Microcephaly
 - c. Fetal growth restriction (FGR) and hydramnios
4. Turner's syndrome
- a. XO syndrome
 - b. Occurs in females only
 - c. Sonographic associations
 - i) Cystic hygroma
 - ii) Heart defects
 - Coarctation of aorta
 - Ventricular septal defect (VSD)
 - Tetralogy of fallot
 - iii) Hydrops
 - iv) Renal anomalies
 - v) Shortened femurs
 - d. Fetal growth restriction (FGR) and oligohydramnios
 - e. Prognosis
 - i) High risk for in utero demise
 - ii) Survivors have ovarian dysgenesis and short stature
5. Triploidy
- a. Complete extra set of chromosomes
 - b. Vast majority spontaneously abort prior to 20 weeks
 - c. Sonographic associations
 - i) Heart defects
 - ii) Omphalocele
 - iii) Renal anomalies

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- iv) Cranial defects
- v) Facial defects
- d. Fetal growth restriction (FGR), oligohydramnios, and placental changes
- e. Maternal associated conditions
 - i) Preeclampsia
 - ii) Gestational trophoblastic disease
 - iii) Theca lutein cysts
- 6. VACTERL
 - a. Grouping of complex anomalies
 - i) Vertebral defects
 - ii) Anal atresia
 - iii) Cardiac anomalies
 - iv) Tracheoesophageal fistula
 - v) Renal anomalies
 - vi) Limb dysplasia

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Section IX: Interventional Procedures

1. List invasive and interventional techniques utilized in obstetrics
 2. Discuss indications for invasive diagnostic procedures utilized in obstetrics
 3. Discuss role of sonography with interventional procedures
-

IX. INTERVENTIONAL PROCEDURES

A. Chorionic Villus Sampling (CVS)

1. Biopsy of chorionic villi or placenta
 - a. Performed early in pregnancy (10 to 14 weeks)
2. Indications
 - a. Increased risk of diagnosable genetic disorders
 - b. Advanced maternal age
3. Risk associations
 - a. Transcervical approach increases risk of infection
 - b. Slightly higher fetal loss as compared to amniocentesis
 - c. Possible limb reduction if performed earlier than 9 weeks
4. Sonographic assessment
 - a. Gestational age criteria
 - b. Transabdominal approach
 - c. Transcervical approach
 - d. Placental localization
 - e. Sonography during procedure
 - i) Monitor heart rate
 - ii) Check for procedural bleeding
 - f. Sonography after procedure
 - i) Fetal heart rate
 - ii) Check for procedural bleeding

B. Amniocentesis

1. Removal of amniotic fluid
 - a. Performed after 14 weeks gestation
2. Indications
 - a. Genetic assessment
 - i) Performed after 14 weeks gestation
 - ii) Advanced maternal age
 - iii) History of fetal karyotype abnormality
 - iv) Abnormal prenatal genetic screening
 - v) Either parent with known balanced rearrangement
 - b. Lung maturity
 - i) Performed in mid to late third trimester
 - ii) Indicated when premature delivery is contemplated

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- c. Fetal infections
- d. Isoimmunization
- 3. Risk associations
- 4. Sonographic assessment
 - a. Sonography is performed before amniocentesis to confirm
 - i) Gestational age
 - ii) Fetal viability
 - iii) Position of placenta
 - iv) Localize amniotic fluid pocket to avoid placenta, fetus and cord
 - b. Sonography during procedure
 - i) Localize pocket of fluid with sonography under sterile technique
 - ii) Visualize needle for insertion and placement into amniotic fluid
 - iii) For genetic testing 20-30 cc of fluid is removed and sent for cell culture, karyotyping and biochemical analysis
 - c. Sonography after procedure
 - i) Fetal heart-rate
- C. Percutaneous Umbilical Blood Cord Sampling (PUBS)
 - 1. Cordocentesis
 - a. Sonography-guided sampling of umbilical cord blood in utero
 - 2. Indications
 - a. Diagnostic
 - i) Evaluation of fetal hematocrit
 - ii) Genetic testing
 - iii) Fetal blood analysis
 - b. Therapeutic
 - i) Blood transfusion
 - ii) Administration of fetal drugs in utero
 - c. Risks
 - i) Risks greater than with CVS or amniocentesis
 - ii) Fetal maternal hemorrhage
 - iii) Trauma
 - iv) Infection
 - v) Premature rupture of membranes
 - vi) Premature labor
 - vii) Fetal distress
 - d. Technique
 - i) Sterile technique
 - ii) Localization for needle insertion site
 - iii) Post-procedure monitoring

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- D. Advanced in Utero Treatments Can be Performed For
1. Bladder obstruction
 2. Fetal thoracentesis
 3. Laser ablation for twin-to-twin transfusion syndrome (TTTS)
 4. Shunt placement
 5. Open neural tube defects
 6. Congenital diaphragmatic hernia
 7. Other

Obstetrics and Gynecology

Section X: Post-Partum Complications

1. Discuss role of sonography in post-partum period
 2. Discuss role of sonography in post-partum infection
 3. List causes for post-partum hemorrhage
-

X. POST-PARTUM COMPLICATIONS

A. Hemorrhage

1. Causes

- a. Abnormal attachment of placenta to myometrium
 - i) Placental accreta
 - ii) Placental increta
 - iii) Placental percreta
- b. Lacerations of vagina and cervix
- c. Retained products of conception
 - i) Sonographic appearance
- d. Uterine atony
- e. Coagulopathy

2. Risks

- a. Decreased hematocrit
- b. Hypotension
- c. Hysterectomy
- d. Renal failure
- e. Shock
- f. Death

B. Infection

1. Increased risk with cesarean section delivery

2. Endometritis

- a. Description
 - i) Infection of endometrium with potential extension into myometrium and parametrial tissues
- b. Clinical associations
 - i) Fever
 - ii) Uterine tenderness
 - iii) Abnormal bleeding
 - iv) Odorous lochia
- c. Sonographic appearance

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Section XI: Performance Standards and Documentation

1. Discuss minimum requirements in performance of obstetrical sonograms specific to first trimester, second and third trimesters
 2. A clinical history and indications for examination should be documented for all examinations
-

XI. PERFORMANCE STANDARDS AND DOCUMENTATION

A. First Trimester

1. Sonograms can be performed either transabdominal approach, endovaginal approach, or use of both techniques
 - a. Anatomy should be evaluated and documented
 - i) Visualization and location of gestation sac
 - ii) Presence or absence of yolk sac
 - iii) Identification of embryo
 - iv) Presence or absence of cardiac activity
 - M-mode for heart rate
 - Color Doppler to confirm absent cardiac activity
 - v) Gestational age determination
 - Mean sac diameter if no embryo present
 - Crown-rump length
 - vi) In multiple gestation: fetal number, chorionicity and amnionicity
 - vii) Uterine, adnexal, and cul-de-sac assessment

B. Second and Third Trimester

1. Fetal number
2. Fetal position
3. Fetal viability and M-mode for heart rate
4. Fetal measurements for size and growth
 - a. Biparietal diameter
 - b. Head circumference
 - c. Abdominal circumference
 - d. Femur length
 - e. Estimated fetal weight (EFW)
5. Fetal anatomy
 - a. Lateral ventricle
 - b. Choroid plexus
 - c. Cisterna magna
 - d. Cerebellum
 - e. Nuchal fold (18-22 weeks)
 - f. Upper lip
 - g. Face profile
 - h. Midline falx

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- i. Cavum septum pellucidum
- j. Spine
- k. Heart
 - i) 4-chamber
 - ii) RVOT
 - iii) LVOT
 - iv) Three vessel view (3vv) / three vessel tracheal view (3vtv)
- l. Lungs
- m. Diaphragm
- n. Aorta
- o. Stomach
- p. Kidneys
- q. Bladder
- r. Umbilical cord insertion
 - i) Number of vessels
 - ii) Placental insertion
 - iii) Fetal umbilical insertion
- s. All extremities
- t. Lower leg/foot position
- 6. Gender, if medically indicated
- 7. Placenta
 - a. Position
 - b. Appearance
 - c. Relationship to internal os
 - d. Cord insertion to placenta
- 8. Amniotic fluid
 - a. Subjective <24 weeks
 - b. Quantitative AFI or MVP >24 weeks
- 9. Maternal anatomy
 - a. Uterus
 - b. Ovaries/adnexa
 - c. Cervix
 - i) Color Doppler if low placenta (r/o vasa previa)

Obstetrics and Gynecology

Rationale: Accurate assessment and performance of gynecologic/female pelvis sonograms requires sonographers to assemble a comprehensive knowledge of the anatomy, physiology, pathophysiology, and sonographic appearances of the female reproductive system. An understanding of the embryologic development, pre-menarchal, menarchal, and postmenopausal female reproductive system is essential for the performance of high quality examinations.

Section XII: Gynecology – Anatomy , Physiology, and Pathology

1. Describe the embryology, anatomy, function and normal sonographic appearances of the female pelvis
2. Discuss the sonographic techniques, including emerging technologies, used to evaluate the female pelvis
3. Identify the clinical indications and laboratory values associated with abnormalities and diseases of the female reproductive system
4. Describe congenital abnormalities and pathology in terms of sonographic appearance, sequelae, and associated pathologies

XII. ANATOMY, PHYSIOLOGY, AND PATHOLOGY

A. Normal Pelvic Anatomy

1. Embryology
 - a. Uterus, fallopian tubes and vagina formed by fusion of mullerian ducts
 - b. Ovaries develop from external cortex of gonadal ridge
2. Uterus
 - a. Hollow, pear-shaped muscular organ with a network of arteries and veins
 - i) Cervix
 - Proximal portion of uterus
 - ii) Isthmus
 - Narrow portion connecting body/corpus with cervix
 - iii) Corpus
 - Largest portion of the uterus
 - iv) Fundus
 - Distal portion containing cornua housing interstitial portion of fallopian tubes
 - b. Tissue layers
 - i) Serosa
 - Surrounds uterus
 - Not sonographically distinct
 - ii) Myometrium
 - Muscular middle layer
 - Junctional zone
 - iii) Endometrium
 - Innermost layer; highly vascular
 - Consists of basal and functional layers
 - Endometrial canal contiguous with vagina and fallopian tubes
 - c. Location
 - i) In true pelvis posterior to urinary bladder and anterior to rectum

Obstetrics and Gynecology

- ii) Aligned with mid-sagittal plane
 - iii) Body and fundus are loosely held in place by broad and round ligaments
 - iv) Uterosacral ligaments hold cervix in place
 - d. Size
 - i) Related to age, menstrual status, and parity status
 - ii) Measure length, width, height
 - e. Positions of the uterus
 - i) Most common axis is anteverted/anteflexed with non-distended bladder
 - ii) Variations in uterine position
 - Retroverted
 - Retroflexed
 - Dextroposition
 - Levoposition
 - Dextroflexed
 - Levoflexed
 - f. Sonographic appearance
 - i) Myometrium
 - Typically homogeneous
 - Mid-level gray echogenicity
 - Peripheral anechoic structures (vessels)
 - ii) Endometrium
 - Varies in echogenicity and thickness cyclically
 - Varies in thickness with menopausal status and hormone replacement therapy
 - Measurement of thickness
- 3. Vagina
 - a. Vagina extends from vulva to the uterus
 - b. Consists of muscular layers and inner mucosa
 - c. Relational anatomy
 - d. Sonographic appearance
 - i) Highly reflective
- 4. Ovaries
 - a. Location
 - i) Lateral to uterus
 - ii) Posterior and distal to fallopian tubes
 - iii) Posterior to broad ligament
 - iv) Not covered by peritoneum
 - v) Anterior/medial to internal iliac vessels

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- b. Connections
 - i) Mesovarium ligament to broad ligament
 - ii) Inferior to uterus by utero-ovarian ligament
 - iii) To fallopian tube by fimbriae ovarica
 - iv) Lateral pelvis by suspensory ligaments
 - v) Medial, lateral, and posterior borders of each ovary are free
 - c. Description
 - i) Oval/almond-shaped structures
 - ii) May assume more elongated or rounded shape
 - iii) Outer cortex and inner medulla
 - iv) Surface smooth early in life, becoming markedly pitted or puckered with years of ovulatory activity
 - v) Atrophy following menopause
 - d. Size
 - i) Length, width, thickness
 - ii) Volume
 - Premenarchal
 - Menarchal
 - Postmenopausal
 - e. Sonographic appearance
 - i) Solid structure with peripheral anechoic follicles
 - ii) Low to medium-level echogenicity
 - iii) Dominant follicle (graafian follicle) identified prior to ovulation
5. Fallopian tubes
- a. Description
 - i) Paired muscular tubular structures
 - ii) Extends from cornua of uterus laterally
 - b. Size
 - i) Length
 - ii) Diameter
 - c. Divisions
 - i) Interstitial
 - ii) Isthmus
 - iii) Ampulla
 - iv) Infundibulum
 - Contains fimbriae (includes fimbriae ovarica)
 - d. Layers
 - i) Serosa
 - ii) Middle muscular layer

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- iii) Internal circular layer of muscular fibers
- e. Sonographic appearance
 - i) Normal fallopian tube not visualized
- 6. Supporting pelvic structures
 - a. Bones
 - i) Sacrum
 - ii) Coccyx
 - iii) Two innominate bones
 - Ilium
 - Pubis
 - Ischium
 - b. Regions
 - i) Greater or false pelvis
 - ii) Lesser or true pelvis
 - c. Ligaments
 - i) Broad ligament
 - ii) Round ligament
 - iii) Cardinal ligament
 - iv) Uterosacral ligament
- 7. Pelvic musculature
 - a. Psoas major muscle
 - b. Iliopsoas muscle
 - c. Obturator internus
 - d. Piriformis
 - e. Levator ani
 - f. Rectus abdominis muscle
- 8. Potential spaces
 - a. Posterior cul-de-sac/rectouterine pouch/pouch of Douglas
 - b. Anterior cul-de-sac/vesicouterine pouch
- 9. Pelvic vasculature
 - a. Abdominal aorta bifurcates into right and left common iliac arteries
 - i) Bifurcate into external and internal iliac arteries
 - b. External iliac artery is in the false pelvis
 - i) Becomes femoral artery
 - c. Internal iliac artery
 - i) Also known as hypogastric artery
 - ii) Subdivides into varying number of branches including uterine and ovarian arteries
 - d. Uterine vasculature

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- i) Venous drainage of uterus is analogous with arterial supply
- ii) Uterine arteries
 - Arises from internal iliac artery
- iii) Arcuate arteries
- iv) Radial arteries
 - Penetrate myometrium
- v) Straight arteries
 - Basal layer of endometrium
- vi) Spiral arteries
- e. Ovarian arterial supply comes from abdominal aorta
 - i) Ovarian/gonadal arteries
 - ii) Branch of uterine artery
 - iii) Ovary has dual blood supply
- f. Ovarian venous drainage
 - i) Right ovarian vein drains into IVC
 - ii) Left ovarian vein drains into left renal vein
- g. Vaginal blood supply
 - i) Vaginal branches of uterine artery
 - ii) Venous drainage is analogous to arterial supply
- h. Fallopian tubes are supplied by anastomosed ovarian and uterine branches
- 10. Doppler evaluation
 - a. Endovaginal imaging
 - b. Angle independent waveform analyses
 - i) S/D ratio (also referred to as A/B ratio)
 - ii) Resistive index (RI)
 - iii) Pulsatility index (PI)
 - c. Normal uterine Doppler
 - i) Demonstrates high resistance flow
 - d. Reproductive age female
 - i) Ovarian arterial flow varies with menstrual cycle
- 11. Related imaging studies
 - a. Abdominal sonography
 - b. Computed tomography (CT)
 - c. Magnetic resonance imaging (MRI)
 - d. Radiographic procedures
 - i) Intravenous urography (IVU)
 - ii) Voiding cystourethrogram (VCUG)
 - iii) Barium studies

Obstetrics and Gynecology

iv) Hysterosalpingography (HSG)

B. Physiology

1. Endocrine cycle

- a. Menstrual cycle, ovarian cycle, and endometrial changes
 - i) Controlled by hormones
- b. Menstrual cycle depends on functional integrity of three endocrine sources
 - i) Hypothalamus
 - Produces follicle stimulating hormone releasing factor (FSHRF) and luteinizing hormone releasing factor (LHRF)
 - ii) Pituitary gland
 - Produces follicle stimulating hormone (FSH) and luteinizing hormone (LH)
 - FSH responsible for ripening of graafian follicle
 - LH induces ovulation
 - iii) Ovarian axis
 - Secretes estrogen and progesterone
 - Contributes to the amount of FSH and LH produced and secreted by pituitary
- c. Estrogen
 - i) Principle modulator of hypothalamus-pituitary activity
 - ii) Stimulates endometrial growth
 - iii) Sensitizes the muscle to induce rhythmic contractions of fallopian tubes
 - iv) Stimulates cervical mucous secretion
 - v) Induces proliferation of vaginal epithelium
 - vi) Stimulates growth of breast duct system
 - vii) Responsible for development of female body contours
- d. Progesterone
 - i) Increases rapidly after ovulation
 - ii) Peaks about seven days post ovulation
 - iii) Is secreted by the corpus luteum during second half of cycle
 - Corpus luteum regresses without fertilization
 - Progesterone level decreases
 - Decreased estrogen and progesterone leads to disintegration of endometrial lining and menstruation occurs
 - iv) Functions
 - Induction of secretory activity in endometrial glands
 - Desensitizes myometrium to oxytocic activity
 - Modifies histological appearance of vaginal epithelium
 - Inhibits secretory activity of cervical glands
 - Increases basal body temperature

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- Stimulates development of alveolar system
- Inhibits secretion of LH, thus inhibiting ovulation

2. Ovarian cycle

- At birth, each ovary contains approximately 200,000 primary follicles
- Around first day of menstrual cycle four or five primary follicles begin to grow
 - Follicle growth produces low levels of estrogen and minute amounts of progesterone
- At approximately fourth to fifth day, one follicle develops into secondary follicle
- Preovulatory phase
 - Day six to thirteen
 - Secondary follicle matures into graafian follicle
 - Other maturing follicles undergo atresia
 - Luteinizing hormone (LH) surge 24-36 hours prior to ovulation
- Ovulation occurs approximately on day 14
 - Mature ovum is expelled
 - Ruptured graafian follicle is healed by capillary bleeding and is absorbed
- Luteal phase
 - Day 15 to day 28
 - Follicular cells transform into a golden-colored body called corpus luteum
 - Corpus luteum grows for seven to eight days
 - Secretes estrogen and increasing amount of progesterone
 - Prepares endometrium to receive fertilized ovum
 - Without fertilization corpus luteum regresses
 - Menstruation occurs
 - Cycle is repeated
 - With fertilization and implantation
 - hCG produced by zygote
 - corpus luteum persists

3. Menstrual and/or endometrial cycle

- Periodic discharge of blood, mucous, tissue, fluid and epithelial cells
- Rhythmic cycle based on approximately 28 days
 - Menses
 - Days 1 to 5
 - Postmenstrual phase
 - Days 6 to 9
 - Thin endometrium
 - Proliferative phase
 - Days 6 to 13

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- Increased thickness of the mucosa
- iv) Secretory phase
 - Days 13 to 28
 - Thickening of endometrium
- 4. Pregnancy test
 - a. Beta human chorionic gonadotropin (β -hCG)
 - b. Derived from trophoblast
 - c. Urine pregnancy test
 - i) False negatives
 - ii) False positives
 - d. Serum pregnancy test
 - i) More sensitive than urine
 - ii) Use when considering ectopic pregnancy
 - iii) Standards for reporting β -hCG Milli-international units (mIU)
 - iv) International reference preparation (IRP)
 - v) Second international standard (2nd IS)
 - vi) Sonographic correlation with β -hCG levels
- 5. Human chorionic gonadotropin (hCG)
 - a. Produced by trophoblast
 - b. Forms basis of most pregnancy tests
 - c. Rises rapidly after 6th week of gestation
 - d. 9-10 weeks plateaus and then declines
 - e. Levels diminish following parturition
- 6. Fertilization
 - a. Sperm motility
 - b. Sperm dissolves portion of ovum membrane
 - c. Fertilization usually occurs in distal portion of the fallopian tube
 - d. Fertilized ovum develops zona pellucida
 - i) The fertilized ovum is called a zygote
 - e. Zygote
 - f. Cleavage
 - g. Morula
 - h. Blastocyst
 - i) Differentiation
 - i. Implantation
- C. Infertility/Endocrinology
 - 1. Methods of contraception
 - a. Hormonal

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- i) Oral contraceptives
 - ii) Depo-medroxyprogesterone acetate
 - iii) Levonorgestrel implants
 - iv) Post-coital hormonal contraception
 - b. Barrier method
 - i) Diaphragm
 - ii) Cervical cap
 - iii) Condoms
 - c. Intrauterine contraceptive device (IUD)
 - i) Foreign body (usually t-shaped) placed in fundal portion of endometrial cavity
 - ii) Ovulation and corpus luteum formation are not impaired
 - iii) Risks
 - iv) Sonographic appearance
 - Highly reflective structure
 - Entrance-exit reflections
 - Posterior shadowing
 - Radiograph may be performed when not identified sonographically
 - d. Vaginal ring
2. Surgical fertility control
 - a. Bilateral tubal ligation
 - b. Hysterectomy
 - c. Elective abortion
3. Infertility
 - a. Definition
 - i) Pregnancy does not result after one year of normal sexual activity without contraception
 - b. Incidence
 - c. Causes
 - d. Patient management
 - e. Medications
 - f. Assisted reproductive technology (ART) and sonographic guidance
 - i) Techniques
 - Gamete intrafallopian transfer (GIFT)
 - Zygote intrafallopian tube transfer (ZIFT)
 - In vitro fertilization (IVF)
 - ii) Patient physiologic changes
 - iii) Sonographic role of monitoring of ART
 - Follicular study

D. Postmenopausal

Obstetrics and Gynecology

1. Appearance
 - a. Uterus decreases in size
 - b. Ovaries decrease in size
 2. Hormonal changes due to estrogen deficiency
 - a. Vagina loses rugosity
 - b. Endocervical cells produce less cervical mucous
 - c. Hormone replacement therapy
 - i) Estrogen
 - ii) Progesterone
- E. Pelvic Pathology
1. Uterus
 - a. Pediatric pelvis
 - i) Precocious puberty
 - Abnormal early development of sexual maturity
 - Sonographic appearance
 - Adult shape uterus
 - Ovarian volume greater than 1 cm³
 - ii) Abnormal fluid collections due to obstruction of genital tract
 - Hydrometra
 - Abnormal collection of fluid within uterine cavity
 - Occurs most commonly in premenarchal patients
 - Etiology
 - ~ Imperforate vaginal hymen
 - ~ Congenital vaginal atresia
 - Pyometra
 - Fluid collection that is mucinous and infectious
 - Hydrometrocolpos
 - Fluid accumulation in vagina and uterus
 - Hematometocolpos
 - After menarche, the menses accumulate within vagina and uterine cavity
 - Older women may experience fluid and/or menses accumulation within uterine cavity secondary to cervical obstruction due to malignancy or cervical stenosis
 - Symptoms
 - Vague pelvic discomfort
 - Pain with defecation and/or urination
 - May be asymptomatic
 - Sonographic appearance

Obstetrics and Gynecology

- Anechoic and distended uterine cavity and cervical canal
 - With hematometra or pyometra, cavity may contain echogenic fluid-debris levels
 - iii) Sexual ambiguity
 - Etiology
 - Male pseudohermaphroditism (46, XY)
 - Female pseudohermaphroditism (46, XX)
 - True hermaphroditism (46, XX or 46, XY)
 - Chromosomal abnormalities
 - Ambiguous genitalia
 - Treatment
 - iv) Congenital uterine anomalies (may have associated renal anomalies)
 - Uterus didelphys
 - Bicornuate uterus
 - Uterus bicornuate bicollis
 - Uterus bicornuate unicollis
 - Uterus septus
 - Subseptus
 - Uterus unicornuate
 - Uterine aplasia
- b. Endometrial hyperplasia
 - i) Abnormal thickening of endometrium due to estrogen over-stimulation
 - ii) Associated with tamoxifen
 - iii) Clinical symptoms
 - Uterine bleeding
 - iv) Sonographic appearance
 - Thickened endometrium with or without cystic changes
- c. Endometrial polyps
 - i) Overgrowth of endometrial tissue
 - ii) Clinical symptoms
 - Abnormal vaginal bleeding
 - iii) Sonographic appearance
 - Diffuse or focal endometrial thickening
- d. Endometrial carcinoma
 - i) Associated with estrogen stimulation
 - ii) Clinical symptoms
 - Postmenopausal vaginal bleeding
 - iii) Sonographic appearance

Obstetrics and Gynecology

- Normal endometrium (rare)
- Thickened endometrium with or without focal irregularity
- Enlarged uterus with endometrium demonstrating a mixed echogenicity in later stages
- Endometrial adhesions
 - Synechiae/Asherman syndrome
 - Bands of endometrial tissue associated with trauma or surgery
- e. Leiomyoma (myoma, fibroid)
 - i) Most common benign gynecological tumor
 - Single or multiple
 - Degeneration
 - May enlarge over time
 - ii) Signs and symptoms
 - Asymptomatic
 - Pelvic pain
 - Menorrhagia
 - Enlarged uterine size
 - Menstrual irregularity
 - iii) Classifications
 - Intramural
 - Subserosal
 - Submucosal
 - Pedunculated
 - iv) Sonographic appearance
 - Variable echogenicity
 - Hypoechoic
 - Homogeneous
 - Heterogeneous
 - Shadowing
 - Well-defined borders
 - Solid
 - Doppler
 - Stalk flow
- f. Adenomyosis
 - i) Endometrial implants lie within myometrium
 - ii) Signs and symptoms
 - Pelvic cramping
 - Dysmenorrhea

Obstetrics and Gynecology

- Uterine enlargement
- iii) Sonographic appearance
 - Hypoechoic uterus
 - Heterogeneous myometrium
 - Diffusely enlarged
 - Myometrial cysts
 - Honeycomb or swiss-cheese appearance
- g. Nabothian cyst
- i) Benign cervical cyst
- h. Cervical carcinoma
 - i) Etiology
 - Mostly related to HPV infection
 - ii) Risk factors
 - Early sexual encounters
 - Multiple sexual partners
 - Sexually transmitted infection
 - Exposure to human papilloma virus (HPV)
 - iii) Peak incidence post-pubescent women
 - iv) Squamous cell carcinoma most common
 - v) Signs and symptoms
 - Vaginal discharge
 - Bleeding
 - Malodorous discharge
 - Palpable pelvic mass
 - vi) Sonographic appearance
 - Normal
 - Enlarged, bulky cervix
 - Solid mass in cervix
 - Hematometra or pyometra with cervical stenosis
 - Extension of disease to pelvic sidewalls, bladder, and rectum
- i. Leiomyosarcoma
 - i) Rare malignant tumor
 - ii) Signs and symptoms
 - Asymptomatic
 - Uterine bleeding
 - iii) Sonographic appearance
 - Similar to leiomyoma
 - Cystic degeneration

Obstetrics and Gynecology

- Inhomogeneous uterine mass
- Local invasion or distant metastases

2. Ovarian

a. Functional masses

i) Follicular cyst

- Occurs when dominant follicle fails to ovulate
- May lead to menstrual irregularities
- Sonographic appearance
 - Anechoic
 - Thin wall
 - Posterior enhancement
 - Unilateral
 - Normally < 2 cm

ii) Corpus luteum cyst

- Forms after the dominant follicle ruptures and ova is expelled
 - Hemorrhage occurs at rupture site
- Signs and symptoms
 - Pelvic pain
 - Nausea and vomiting
 - Enlarged, tender ovary
- Sonographic appearance
 - Complex cyst
 - Unilateral
 - Normally > 4 cm
- Corpus luteum cyst of pregnancy
 - Supports early pregnancy
 - Sonographic appearance
 - ~ Thin-walled
 - ~ Unilateral
 - ~ Fluid in posterior cul-de-sac with rupture

iii) Theca lutein cysts

- Develop with high levels of human chorionic gonadotropin (hCG)
- Associations
 - Increased levels of hCG
 - Gestational trophoblastic neoplasia
 - Ovarian hyperstimulation syndrome
 - Multiple pregnancy and singleton gestations
- Sonographic appearance

Obstetrics and Gynecology

- Bilateral
 - Large, multilocular cysts
- b. Benign
 - i) Paraovarian cysts
 - Arise from gartner's duct remnants or from hydatid of Morgagni
 - Found within broad ligament
 - Sonographic appearance
 - Thin-walled
 - Anechoic
 - Variable size
 - ii) Serous cystadenoma
 - Common, benign epithelial tumor
 - Sonographic appearance
 - Unilateral
 - Cystic structure with low-level debris
 - Smooth walls
 - May contain septae
 - iii) Mucinous cystadenoma
 - Benign epithelial tumor
 - Sonographic appearance
 - Multi-septate tumor
 - Large
 - Mid-level internal echoes
 - iv) Mature cystic teratoma
 - Commonly termed dermoid
 - Germ cell tumor
 - Usually seen in young women of reproductive age
 - Signs and symptoms
 - Mild to acute pain
 - Adnexal fullness
 - Pressure symptoms
 - Sonographic appearance
 - Cystic to complex
 - Calcification with shadowing
 - Tip of the iceberg sign
 - v) Fibroma
 - Stromal tumor
 - Associated with Meigs' syndrome

Obstetrics and Gynecology

- Pelvic mass
 - Hydrothorax
 - Ascites
 - Signs and symptoms
 - Local pelvic pain
 - Pressure symptoms when large
 - Asymptomatic when small
 - Sonographic appearance
 - Unilateral
 - Solid
 - Hypoechoic with posterior attenuation
- vi) Theca cell tumor
- Benign, solid, unilateral mass most commonly found in menopausal or postmenopausal women
 - Signs and symptoms
 - Pelvic pain
 - Pressure
 - Sonographic appearance
 - Ovarian enlargement
 - Solid
 - Attenuating
 - Calcifications may be seen
 - Cystic degeneration may occur
- vii) Brenner tumor
- Uncommon, solid mass
 - May be associated with Meigs' syndrome
 - Rarely malignant
- viii) Endometrioma
- Large cysts filled with dark brown fluid; “chocolate cyst”
 - Occurs with endometriosis
 - Ectopic endometrial tissue found on structures within abdominal-pelvic cavity
 - Signs and symptoms
 - Dyspareunia
 - Metromenorrhagia
 - Dysmenorrhea
 - Sonographic appearance
 - Anechoic (rare)
 - Well defined

Obstetrics and Gynecology

- Low-level echogenicity
- Cystic mass filled with low-level echoes and acoustic enhancements
- Punctate calcifications
- c. Malignant
 - i) Epithelial ovarian cancer
 - Most common type of ovarian cancer
 - More common in postmenopausal women
 - Risk factors
 - Age
 - Family history of ovarian or breast cancer
 - Nulliparity
 - Infertility
 - Late menopause
 - Prolonged ovulatory activity
 - Clinical signs and symptoms
 - Abdominal pain
 - GI symptoms
 - Pressure
 - Vaginal bleeding
 - Weight change
 - Endocrine imbalance
 - Elevated CA 125
 - Sonographic appearance
 - Ovarian mass
 - Cystic components
 - Thick septations
 - Mural nodules
 - Calcifications with or without shadowing
 - Low-level echoes within cystic component
 - Decreased vascular impedance
 - Extra-ovarian findings
 - ii) Germ cell
 - Dysgerminoma
 - Frequency of occurrence
 - ~ Rare, malignant epithelial tumor
 - Sonographic appearance
 - ~ Solid
 - ~ Homogeneous

Obstetrics and Gynecology

- ~ Irregularly defined
- ~ Hyperechoic
- ~ May see cystic degeneration
- Immature/malignant teratoma
 - Frequency of occurrence
 - ~ Rare malignant tumor
 - ~ Occurring more frequently in children and young adults
 - Sonographic appearance
 - ~ Unilateral
 - ~ Solid
 - ~ Well-defined
 - ~ Variable echogenicity
 - ~ Cystic degeneration may be seen
- iii) Sex cord stromal tumors
- iv) Metastasis
 - Krukenburg's tumor
 - Secondary ovarian carcinoma from primary neoplasm of gastrointestinal tract
- d. Ovarian torsion
 - i) Partial or complete rotation of pedicle secondary to ovarian mass or cyst
 - Occlusion or decrease of blood inflow and outflow
 - ii) Signs and symptoms
 - Sudden onset of severe pelvic pain
 - Nausea, vomiting
 - Palpable adnexal mass
 - iii) Sonographic appearance
 - Ovarian enlargement
 - Hyperechoic ovary
 - Heterogeneous
 - Dilated vessels on periphery of ovary
 - Doppler may demonstrate absent or decreased blood flow
- e. Polycystic ovarian disease
 - i) Identified in young women
 - ii) Stein-Leventhal syndrome
 - Polycystic ovaries
 - Hirsutism
 - Amenorrhea
 - Enlarged ovaries

Obstetrics and Gynecology

- Obesity
- Impaired fertility
- iii) Sonographic appearance
 - Bilaterally, mildly enlarged ovaries
 - Multiple peripheral small cysts
- 3. Pelvic inflammatory disease (PID)
 - a. Inflammatory condition of uterus, cervix, ovaries, fallopian tubes and peritoneal surfaces
 - b. Etiology
 - i) Sexually transmitted infection (STI)
 - ii) Intrauterine device (IUD) use
 - iii) Extension of lower abdominal and/or pelvic abscesses
 - iv) Complication of postabortion or childbirth
 - c. Classifications
 - i) Acute
 - ii) Chronic
 - d. Signs and symptoms
 - i) Severe pelvic pain
 - ii) Fever
 - iii) Shaking/chills
 - iv) Leukocytosis
 - v) Vaginal discharge
 - vi) Irregular vaginal bleeding
 - vii) Rebound tenderness
 - viii) Pain with cervical manipulation
 - ix) Dyspareunia
 - e. Complications
 - i) Endometritis
 - Sonographic appearance
 - Normal
 - Thickened endometrium
 - Air or fluid in endometrial cavity
 - Increased vascularity
 - ii) Salpingitis
 - Sonographic appearance
 - Distended fallopian tubes with thickened walls and pyosalpinx in acute phase
 - Hydrosalpinx in chronic phase
 - iii) Tubo-ovarian abscess (TOA)

Obstetrics and Gynecology

- Result of very severe pelvic infection
- Signs and symptoms
 - High fever
 - Elevated WBC
 - High erythrocyte sedimentation (ESR)
 - Severe lower abdominal pain
 - Nausea and vomiting
 - RUQ pain
 - Possible peritonitis
 - Fitz-Hugh-Curtis syndrome
- iv) Doppler flow studies
 - Uterine artery Doppler
 - Uterine neoplasms
 - Ovarian Doppler
 - Ovarian neoplasms
 - Endometrial
- v) Correlative and/or prior imaging
 - Radiographic procedures
 - Fluoroscopic studies
 - Intravenous urogram (IVU) or Intravenous pyelography (IVP)
 - Voiding cystourethrogram (VCUG)
 - Computed tomography (CT)
 - Magnetic resonance (MRI)

Obstetrics and Gynecology

Section XIII: Gynecology – Patient Care and Imaging Techniques

1. List pertinent information derived from the patient interview and/or review of medical chart that is obtained prior to the sonogram
 2. Describe the sonographic techniques, including emerging technologies, used to evaluate the female pelvis
 3. Describe the protocol and procedure for transabdominal and endovaginal female pelvis sonograms
-

XIII. PATIENT CARE AND IMAGING TECHNIQUES

A. Patient Assessment

1. Patient history
 - a. Menstrual history
 - i) Implantation breakthrough bleeding
 - b. History of pain/fever
 - c. Pregnancy test and type of test
 - d. History of vaginal bleeding
 - e. Abdominal and pelvic surgeries
 - f. IUD usage
 - g. Reason for referral
 - h. History of smoking and alcohol use
 - i. Medications
 - j. Pertinent laboratory tests
 - k. Palpable pelvic mass
 - l. Obstetrical history
 - m. History of disease and/or anomaly
 - n. History of assisted reproduction
 - i) Pertinent family history

B. Scanning Techniques

1. Transabdominal imaging
 - a. Adequate filling of urinary bladder
 - b. Patient supine
 - c. Transducer selection
2. Endovaginal imaging
 - a. Empty urinary bladder
 - b. Lithotomy position
 - c. Transducer selection and disinfection
 - d. Transducer covers
 - i) Latex
 - ii) Non-latex
 - e. Lubricants
3. Transperineal scanning
4. Anatomical evaluation and documentation

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- a. Gynecologic examination
 - i) Bladder
 - Anechoic
 - Size, shape
 - Bladder wall
 - Distention
 - ii) Uterus
 - Endometrium
 - Myometrium
 - Borders
 - Position
 - Echogenicity
 - Measurements
 - Length
 - Width
 - Height
 - Cervix
 - iii) Ovaries
 - Echogenicity
 - Location
 - Size
 - Measurements (length, width, height)
 - Adjacent adnexa
 - iv) Potential spaces
 - v) Evaluation of anomalies
 - Location
 - Size
 - Borders
 - Contents
 - Presence of ascites
 - Evaluate kidneys if needed

C. Procedures

1. Sonohysterography
2. Follicular aspiration
3. Abscess drainage

D. Adjunctive Technologies

1. 3-D imaging
2. Volume rendering

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3. Focused ultrasonic ablation of tumors
4. Guidance for cryoablation

Obstetrics and Gynecology

Abbreviations

A

AC	Abdominal Circumference
ACHE	Acetyl cholinesterase
AFAFP	Aminotic Fluid Alpha Feto Protein
AFI	Amniotic Fluid Index
AFP	Alpha Feto Protein
ALARA	As Low as Reasonably Achievable
ADPKD	Autosomal Dominant Polycystic Kidney Disease or Adult Polycystic Kidney Disease
ARPKD	Autosomal Recessive Polycystic Kidney Disease
ART	Assisted Reproductive Technology
ASD	Atrial Septal Defect
AVSD	Atrioventricular Septal Defect

B

β-hCG	Beta-Human Chorionic Gonadotropin
BPD	Biparietal Diameter
BPP	Biophysical Profile

C

CAM	Cystic Adenomatoid Malformation
CI	Cephalic Index
CPAM	Congenital Pulmonary Airway Malformation
CRL	Crown Rump Length
CT	Computerized Tomography
CVS	Chorionic Villus Sampling

D

DVT	Deep Venous Thrombosis
-----	------------------------

E

ESR	Erythrocyte Sedimentation Rate
EFW	Estimated Fetal Weight

F

FBM	Fetal Breathing Movement
FL	Femur Length

Obstetrics and Gynecology

FM	Fetal Movement (Gross)
FSH	Follicle Stimulating Hormone
FSHRF	Follicle Stimulating Hormone Releasing Factor
FT	Fetal Tone

G

GA	Gestational Age
GIFT	Gamete Intrafallopian Transfer
GTN	Gestational Trophoblastic Neoplasia
GTT	Glucose Tolerance Test

H

HC	Head Circumference
hCG	Human Chorionic Gonadotropin
HPV	Human Papilloma Virus
HSG	Hysterosalpingography

I

IOD	Inner Orbital Diameter
IRP	International Reference Preparation
IRPKD	Infantile Recessive Polycystic Kidney Disease
IUD/IUCD	Intrauterine Contraceptive Device
IUGR	Intrauterine Growth Restriction
IUP	Intrauterine Pregnancy
IVC	Inferior Vena Cava
IVF	In Vitro Fertilization
IVP	Intravenous Pyelogram
IVU	Intravenous Urogram

L

LGA	Large for Gestation Age
LH	Luteinizing Hormone
LHRF	Luteinizing Hormone Releasing Factor
LMP	Last Menstrual Period
LVOT	Left Ventricular Outflow Tract

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M

MA	Menstrual Age
MAP	Morbidity Adherent Placenta
MCA	Middle Cerebral Artery
MCDK	Multicystic Dysplastic Kidney
MHz	Megahertz
MI	Mechanical Index
MIU	Milli-International Units
MRI	Magnetic Resonance Imaging
MSAFP	Maternal Serum Alpha-Feto Protein
MSD	Mean Sac Diameter
MVP	Maximum Vertical Pocket

N

NST	Non-Stress Test
NTD	Neural Tube Defect

O

OFD	Occipital Frontal Diameter
OOD	Outer Orbital Diameter

P

PI	Pulsatility Index
PID	Pelvic Inflammatory Disease
PIH	Pregnancy Induced Hypertension
PROM	Premature Rupture of Membranes
PUBS	Percutaneous Umbilical Blood Sampling
PUV	Posterior Urethral Valve

R

RI	Resistive Index
RVOT	Right Ventricular Outflow Tract

S

2ndIS	Second International Standard
SGA	Small for Gestation Age
S/D ratio	Systolic/Diastolic Ratio
SHG	Sonohysterography

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STI	Sexually Transmitted Infection
SUA	Single Umbilical Artery
SVC	Superior Vena Cava

T

TEF	Tracheo-Esophageal Fistula
TI	Thermal Index
TOA	Tubo-Ovarian Abscess
TRAP	Twin Reversed Arterial Perfusion
TTTS	Twin-to-Twin Transfusion Syndrome

U

UPJ	Ureteropelvic Junction
UVJ	Ureterovesical Junction

V

VCUG	Voiding Cystourethrogram
VSD	Ventricular Septal Defect

Z

ZIFT	Zygote Intrafallopian Tube Transfer
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Utilized References

1. AIUM Practice Parameter for Female Pelvis and Obstetrics Retrieved from: <http://www.aium.org/resources/practice> parameters
2. Allan, PL., et al., Clinical Doppler Ultrasound. London: Churchill Livingstone; 2000.
3. ARDMS Obstetrics and Gynecology Content Outline. Retrieved from: www.ardms.org
4. ARRT Sonography content outline. Retrieved from: www.arrt.org
5. Callen, PW., Ultrasonography in Obstetrics and Gynecology. 5th ed. Philadelphia: WB Saunders Co; 2008.
6. Copel, JA, Reed, KL. (eds.) Doppler Ultrasound in Obstetrics and Gynecology. New York: Raven Press Ltd; 1995.
7. Hagen-Ansert, SL., (ed.). Textbook of Diagnostic Ultrasonography. 9th ed. St. Louis: Mosby Inc; 2018.
8. Henningsen, C., Kuntz, K., Youngs, D., Clinical Guide to Ultrasonography. 2nd ed. St. Louis, Mosby, 2013.
9. Rumack, C., Levine, D., Diagnostic Ultrasound 6th ed. New York: Elsevier 2024.
10. Stephenson, S., Dmitrieva, J., Diagnostic Medical Sonography Obstetrics & Gynecology. 4th ed. New York: Wolters Kluwer; 2022.
11. Tempkin, BB., Ultrasound Scanning Principles and Protocols. 3rd ed. Philadelphia: WB Saunders Co; 2014.
12. Young, D. National Certification Examination Review: Obstetrics and Gynecology. Society of Diagnostic Medical Sonography 2009.