

4. Daigle, R. (2002). Techniques in Non-Invasive Vascular Diagnosis (2nd ed.). Littleton, CO : Summer Publishing.
5. Hofer, M., ed. (2004). Teaching Manual of Color Duplex Sonography: A Workbook...New York: Thieme.

OTHER REFERENCE MATERIAL BASIC TO COURSE:

1. Hickey, Goldberg (1999). Ultrasound Review of the Abdomen. Male Pelvis. & Small Parts. Philadelphia: Lippincott-Raven.
2. Hagen-Ansert, S. (2001). Textbook of Diagnostic Ultrasonography, (5th ed.), Vol. One. St. Louis: Mosby.
3. Tempkin, B. (1999). Ultrasound Scanning: Principles and Protocols (2nd ed.). Philadelphia: W.B. Saunders & Co.

COURSE DELIVERY FORMAT:

Hybrid Format – This format requires significant online activity. Students in hybrid classes must access course content and assessments using the Internet in order to pass the class, whether it meets full-time or part-time in the classroom. Faculty need not hand out a copy of the syllabus and any other required course material, including their contact information.

PRESENTATION METHODS:

- A. Interactive Presentations
- B. Audio-Visual / Multi-Media Aids
- C. Online Platform Support
- D. Laboratory Correlation with Simulations & Demonstrations
- E. Independent Studies
- F. Group Studies
- G. Assessment Reviews

INSTRUCTIONAL TOPICS. Specific instructional activities and objectives are listed at the end of this syllabus related to each of the following topics:

1. Abdominal Musculature, Abdominal Wall, and Diaphragm
2. Peritoneal Cavity, Mesenteries, and Retroperitoneum
3. Abdominal Vasculature Overview
4. Renals and Correlative Vasculature
5. Abdominal Doppler Considerations
6. Abnormal Abdominal Vasculature
7. Abnormal Renal Vasculature and Renal Transplants
8. Hepatic Vasculature and Flow
9. Ankle Brachial Indices – with Resting and Exercise Labs
10. Lower Venous Imaging for Deep Venous Thrombosis
11. Lower Venous Imaging for Incompetence

OUTCOMES & OBJECTIVES

ISLOs - INSTITUTIONAL STUDENT LEVEL OUTCOMES: Specific definitions of each may be found in your Program Handbook. Graduates of the accredited diagnostic medical sonography programs will demonstrate reflective outcomes related to knowledge, skills and attitudes that a community college graduate is expected to develop, to include:

- ISLO1. Effective Communication**
- ISLO2. Critical Thinking and Analytical Skills**
- ISLO3. Information Technology Skills**
- ISLO4. Societal & Cultural Awareness**
- ISLO5. Foundational Knowledge in a Specialty**
- ISLO6. Work Ethic**

PSLOs - PROGRAM STUDENT LEVEL OUTCOMES: This course is offered in conjunction with other pre-requisite and/or co-requisite courses as part of the accredited sonography program. At the end of the program year, the student will demonstrate mastery of the following knowledge, skills, attitudes and/or values as related to all program learning.

- PSLO1.** Obtain, review, and integrate pertinent patient history and supporting clinical data to facilitate optimum diagnostic results. **(RELATES TO ISLO 5)**
- PSLO2.** Perform appropriate procedures and record anatomic, pathologic, and/or physiologic data for interpretation by a physician. **(RELATES TO ISLO 5)**
- PSLO3.** Record, analyze, and process diagnostic data and other pertinent observations made during the procedure for presentation to the interpreting physician. **(RELATES TO ISLO 3)**
- PSLO4.** Exercise discretion and judgment in the performance of sonographic and/or other diagnostic services. **(RELATES TO ISLO 2)**
- PSLO5.** Demonstrate appropriate communication skills with patients and colleagues. **(RELATES TO ISLO 1)**
- PSLO6.** Act in a professional and ethical manner. **(RELATES TO ISLO 6)**
- PSLO7.** Provide patient education related to medical ultrasound and/or other diagnostic vascular techniques, and promote principles of good health. **(RELATES TO ISLO 4)**

CSLOs - COURSE STUDENT LEVEL OUTCOMES: To be better prepared to interact and function in the sonography department upon course completion, the student will achieve the following course outcomes.

- CSLO1.** Properly prepare the patient for abdominal vascular and lower extremities sonographic examinations, to include an evaluation of patient clinical and laboratory histories in order to properly assess vascular physiology on assigned studies. **(RELATES TO PSLO 1)**
- CSLO2.** Utilize the proper basic scanning protocols for performing the various vascular examinations addressed within this course, while developing an understanding of the various modes of ultrasound used in the evaluation of vascular pathology. **(RELATES TO PSLO 2)**
- CSLO3.** Obtain a familiarity with the physiologic and pathologic processes within the abdominal vascular and lower venous extremities, with a limited understanding of indirect arterial disease assessment of the lower extremities. **(RELATES TO PSLO 2)**
- CSLO4.** Accurately document the appropriate landmarks, utilizing suitable terminology, within an abdominal vascular examination. **(RELATES TO PSLO 4)**
- CSLO5.** Utilize hemodynamic principles within established studies for patient assessment, assessing flow factors related with abdominal vascular structures. **(RELATES TO PSLO 3)**
- CSLO6.** Recognize the potential need to expand the scope of the study to include other anatomical areas beyond the basic protocols. **(RELATES TO PSLO 4)**

- CSLO7.** Recognize the sonographic appearance of the various soft tissue organs and related surrounding structures associated with the evaluation of vascular anatomy and specific scanning and assessment considerations. **(RELATES TO PSLO 2)**
- CSLO8.** Sonographically recognize normal variants of vascular structures introduced within this course. **(RELATES TO PSLO 4)**
- CSLO9.** Assess the lower venous vasculature, along with related abdomino-pelvic structures, for echogenicity, compressibility, and flow factors, according to appropriate protocol. **(RELATES TO PSLO 2)**
- CSLO10.** Record ankle-brachial indices (ABIs/AAls) to determine potential arterial disease in the lower extremities. **(RELATES TO PSLO 3)**

LEARNING INDICATORS AND OBJECTIVES: These objectives assist in assuring the student will be better prepared to interact and function with instrumentation in the sonography department upon course completion. These learning indicators have also been included, and sometimes expanded upon, within each of the Topic sections of this syllabus, to correlate with assignments for the purpose of focused student comprehension.

- LO1.** Describe proper patient preparation required for sonographically evaluating the abdominal organs and related structures. **(CSLO 1)**
- LO2.** Using the proper sonographic terms, describe the location, normal echogenicity and echotexture patterns of the specified internal abdominal muscles, as well the linea alba, rectus abdominis, external obliques and rectus sheath. **(CSLO 4)**
- LO3.** Assess the diaphragm, including the location, function, and crura. **(CSLO 4)**
- LO4.** Describe the location and sonographic appearance of the muscles visualized in a pelvic sonogram. **(CSLO 7)**
- LO5.** Identify the layers of the peritoneum, differentiating intraperitoneal from extraperitoneal organs and structures, also defining peritoneal cavity differences from male to female humans. **(CSLO 4)**
- LO6.** Describe other body omenta, recesses and spaces associated with potential pathology. **(CSLO 4)**
- LO7.** Delineate differences between arterial and venous composition, function, echogenicity and layering of walls and lumen, including blood flow characteristics, with particular emphasis on the abdominal aorta and the inferior vena cava. **(CSLO 5)**
- LO8.** Assess the aorta with the major anterior and lateral branches and the organs supplied by those branches. **(CSLO 2)**
- LO9.** Assess the inferior vena cava and major tributaries with the organs that are drained by them, also describing the normal location and course of the IVC. **(CSLO 2)**
- LO10.** Assess the portal vein and tributaries including location, size and course with associated organs or structures, also describing the echogenicity of the walls and lumen. **(CSLO 2)**
- LO11.** List the diagnostic tests associated with the aorta, IVC and portal venous system. **(CSLO 1)**
- LO12.** Assess the kidney with the internal anatomy including: renal capsule, cortex, medullary pyramids, major and minor calyces, renal pelvis, hilum, and sinus; as well as the vascular anatomy, including the main renal vein and artery, interlobar artery, arcuate artery, and interlobular artery and show their relationship with the internal anatomy. **(CSLO 4)**
- LO13.** Calculate renal length and renal volume for comparative analysis. **(CSLO 6)**
- LO14.** Utilize appropriate ultrasound instrumentation for the assessment of the normal location and sonographic appearance (size, echogenicity, texture, borders, vasculature, and other related structures) for the urinary system, including anatomical relationships of adjacent structures. **(CSLO 2)**
- LO15.** Identify normal variants of the kidneys, as well as common disease processes, through their descriptions, sonographic appearances, and associated protocol, when discovered. **(CSLO 8)**
- LO16.** Apply Doppler techniques to diagnose a vascular-related problem in the abdomen. **(CSLO 5)**
- LO17.** Compare the characteristics of laminar flow and plug flow. **(CSLO 5)**
- LO18.** Differentiate the components of a spectral wave form, such as high resistance and low resistance arterial flow. **(CSLO 5)**
- LO19.** Define the characteristics and diagnostic significance of monophasic, biphasic and triphasic wave forms in various vessels. **(CSLO 5)**
- LO20.** Recognize pre-stenotic, stenotic and post-stenotic vascular flow by Doppler characteristics. **(CSLO 5)**

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- LO21.** Demonstrate the effect(s) that collateral vessels have on blood flow, thus representative angiography and Doppler findings. **(CSLO 3)**
 - LO22.** Delineate vascular disease associated with the inferior vena cava (IVC). **(CSLO 3)**
 - LO23.** Classify the various mechanisms of atherosclerotic disease, discussing what related findings the sonographer might expect to image in vessels. **(CSLO 3)**
 - LO24.** Identify an aortic aneurysm according to its size, type, characteristics, and treatment options. **(CSLO 3)**
 - LO25.** Document any flow pattern changes in the mesenteric vessels from a fasting state to postprandial state, also noting the criteria for > 70% mesenteric disease. **(CSLO 5)**
 - LO26.** Differentiate acute and chronic mesenteric ischemia, as well as compression syndrome from mesenteria ischemia. **(CSLO 3)**
 - LO27.** Recognize hepatopetal and hepatofugal flow patterns in the liver as related to the positioning of the transducer angle in relation to the area of the patient. **(CSLO 5)**
 - LO28.** Assess the kidneys for renal disease (e.g., transplant or RAS) according to 2-D imaging, Doppler waveform velocities, and resistive indices. **(CSLO 3)**
 - LO29.** Obtain a renal-to-aorta ratio (RAR), as well as Doppler assessment of the cortical renal vessels, specifying any level of stenosis. **(CSLO 5)**
 - LO30.** Recognize fibromuscular dysplasia (FMD) through 2-D imaging, while also recognizing the expected spectral waveform associated with this finding. **(CSLO 8)**
 - LO31.** Differentiate hepatic veins from portal veins sonographically, from perspectives of both directional flow and placement, and appearance; while also explaining the difference in spectral waveform (flow characteristics) of the hepatic veins from most veins in the body. **(CSLO 7)**
 - LO32.** Explain the cause of a natural portal shunt, identifying the most common natural pathway (of collaterals). **(CSLO 3)**
 - LO33.** Explain the route of the TIPS procedure, identifying the vessels to which the blood is shunted from the portal vein. **(CSLO 2)**
 - LO34.** Classify the sonographic findings of Budd-Chiari syndrome. **(CSLO 7)**
 - LO35.** Describe peripheral arterial disease (PAD) in the lower extremities according to its risk factors, classic patient symptoms, and sonographic findings. **(CSLO 3)**
 - LO36.** Practice performance of an ABI at both rest and exercise for distal vascular assessment. **(CSLO 10)**
 - LO37.** Delineate the venous effects that should be recorded sonographically during a lower venous exam with specifically defined maneuvers. **(CSLO 9)**
 - LO38.** Differentiate the various sonographic findings of venous thrombosis, based upon its age and other study considerations. **(CSLO 8)**
 - LO39.** Emphasize the importance of the venous valves in the lower extremities according to location, function and sonographic assessment for insufficiency. **(CSLO 9)**

REQUIRED ASSESSMENTS

Syllabus Review	Submit Syllabus Acknowledgement Statement				ISLO 1
Laboratory Detail	Fulfillment of Lab Duty Assignment (e.g., Clean up, laundry)			PSLO 6	ISLO 6
Topic 1 Objectives	Part 1 Instructional Objectives in Syllabus + Includes review questions for Ansert text reading	LO 2 LO 3 LO 4	CSLO 4 CLSO 7	PSLO 4 PLSO 2	ISLO 2 ILSO 5
Topic 2 Objectives	Part 2 Instructional Objectives in Syllabus + Includes review questions for Ansert text reading	LO 5 LO 6	CSLO 4	PSLO 4	ISLO 2
Topic 3 Objectives	Part 3 Instructional Objectives in Syllabus	LO 7 LO 8, 9, 10 LO 11	CSLO 5 CSLO 2 CSLO 1	PSLO 3 PSLO 2 PSLO 1	ISLO 3 ISLO 5

Topic 3 Workbook	Curry & Tempkin workbook, Ch. 5	LO 7 LO 8	CSLO 5 CSLO 2	PLSO 3 PSLO 2	ISLO 3 ISLO 5
Topic 3 Workbook	Curry & Tempkin workbook, Ch. 6	LO 7 LO 9	CSLO 5 CSLO 2	PLSO 3 PSLO 2	ISLO 3 ISLO 5
Topic 3 Workbook	Curry & Tempkin workbook, Ch. 7	LO 7 LO 10	CSLO 5 CSLO 2	PLSO 3 PSLO 2	ISLO 3 ISLO 5
Protocol Assignment	Aorta/Great Vessels Protocol Cards (Follow Instructions provided by instructor; graded based on Protocol Card Assessment Tool)	LO 7 LO 8 LO 9	CSLO 5 CSLO 2	PLSO 3 PSLO 2	ISLO 3 ISLO 5
Laboratory 1a	Activity 1: Abd. Vasc. Scan Lab (Completion of Scan Lab Sheet)	LO 7 LO 8 LO 9	CSLO 5 CSLO 2	PLSO 3 PSLO 2	ISLO 3 ISLO 5
Laboratory 1a	Activity 2: Internet Assignment – GE Basic Abdomen CME (online quiz grade to be submitted to drop box)	LO 7 LO 8, 9, & 10 LO 11	CSLO 5 CSLO 2 CSLO 1	PSLO 3 PSLO 2 PSLO 1	ISLO 3 ISLO 5
Laboratory 1a	Activity 3: CD-Rom-Planes & Vascular Topics (Student to Outline Key Points)	LO 7 LO 8, 9, & 10 LO 11	CSLO 5 CSLO 2 CSLO 1	PSLO 3 PSLO 2 PSLO 1	ISLO 3 ISLO 5
Laboratory 1b	Activity 4: Renal Scan Lab (Completion of Scan Lab Sheet)	LO 12 LO 13 LO 15 LO 14	CSLO 4 CSLO 6 CSLO 8 CSLO 2	PSLO 4 PSLO 2	ISLO 2 ISLO 5
Laboratory 1b	Activity 5: CD-Rom-Kidneys & Urinary Tract Topics (Student to Outline Key Points)	LO 12 LO 13 LO 14 LO 15	CSLO 4 CSLO 6 CSLO 8 CSLO 2	PSLO 4 PSLO 2	ISLO 2 ISLO 5
Laboratory 1b	Activity 6: (2) Renal Diagrams (Complete & Submit for grade)	LO 12	CSLO 4	PSLO 4	ISLO 2
Imaging Quiz	Image Identification & Anatomical Relationship Quiz: Vasculature & Renal	LO 8, 9, 10, 15 LO 12	CSLO 2 CSLO 4	PSLO 2 PSLO 4	ISLO 5 ISLO 2
Exam 1	Covers Topics & Materials on: Topic 1 – Abd. Musculature Topic 2 - Peritoneum & Retroperitoneum Topic 3 – Abd. Vasculature	LO 1-11	CSLO 1 CSLO 2 CSLO 4, 6 & 8 CSLO 5	PSLO 1 PSLO 2 PSLO 4 PSLO 3	ISLO 5 ISLO 2 ISLO 3
Topic 4 Objectives	Part 4 Instructional Objectives in Syllabus	LO 12 LO 13 LO 14 LO 15	CSLO 4 CSLO 6 CSLO 8 CSLO 2	PSLO 4 PSLO 2	ISLO 2 ISLO 5
Topic 4 Workbook	Curry & Tempkin workbook, Ch. 12	LO 12 LO 14 LO 15	CSLO 4 CSLO 8 CSLO 2	PSLO 4 PSLO 2	ISLO 2 ISLO 5
Protocol Assignment	Renal Protocol Cards (Follow Instructions provided by instructor; graded based on Protocol Card Assessment Tool)	LO 12 LO 13 LO 14 LO 15	CSLO 4 CSLO 6 CSLO 8 CSLO 2	PSLO 4 PSLO 2	ISLO 2 ISLO 5
Exam 2	Covers Topics & Materials on: Topic 4 – Renals	LO 1 LO 15 LO 12 LO 13	CSLO 1 CSLO 2 CSLO 4 CSLO 6	PSLO 1 PSLO 2 PSLO 4	ISLO 5 ISLO 2

		LO 14	CSLO 8		
Topic 5 Objectives	Part 5 Instructional Objectives in Syllabus	LO 16,17, 18, 19 LO 20	CSLO 5 CSLO 3	PSLO 3 PSLO 2	ISLO 3 ISLO 5
Topic 6 Objectives	Part 6 Instructional Objectives in Syllabus	LO 21,22, 23, 24,26 LO 25	CSLO 3 CSLO 5	PSLO 2 PSLO 3	ISLO 5 ISLO 3
Protocol Assignment	Pre-Stent & Post-Stent Aorta Eval. Protocol Cards(protocols provided in presentation; graded based on Protocol Card Assessment Tool)	LO 20,23, & 24	CSLO 3	PSLO 2	ISLO 5
Protocol Assignment	Pre- and Post-Prandial Mesenteric Eval. Protocol Cards(protocols provided in presentation; graded based on Protocol Card Assessment Tool)	LO 1 LO 20, 26 LO 25	CSLO 1 CSLO 3 CSLO 5	PSLO 1 PSLO 2 PSLO 3	ISLO 5 ISLO 3
Exam 3	Covers Topics & Materials on: Topic 5 – Abdominal Doppler Topic 6 – Abnormal Abdominal Vasc.	LO 16- 26	CSLO 5 CSLO 3	PSLO 3 PSLO 2	ISLO 3 ISLO 5
Topic 7 Objectives	Part 7 Instructional Objectives in Syllabus	LO 28 LO 29 LO 30	CSLO 3 CSLO 5 CSLO 8	PSLO 2 PSLO 3 PSLO 4	ISLO 5 ISLO 3 ISLO 2
Topic 8 Objectives	Part 8 Instructional Objectives in Syllabus	LO 27 LO 31, 34 LO 32 LO 33	CSLO 5 CSLO 7 CSLO 3 CSLO 2	PSLO 3 PSLO 2	ISLO 3 ISLO 5
Laboratory 2a	Activity 1: Scan Lab -RAS & Calculating RIs	LO 28 LO 29	CSLO 3 CSLO 5	PSLO 2 PSLO 3	ISLO 5 ISLO 3
Laboratory 2a	Activity 2: Internet Assignment – GE Renal Arteries CME (online quiz grade to be submitted to drop box)	LO 28 LO 29 LO 30	CSLO 3 CSLO 5 CSLO 8	PSLO 2 PSLO 3 PSLO 4	ISLO 5 ISLO 3 ISLO 2
Laboratory 2a	Activity 3: Vasc. Symposium CD-Rom- Renal Duplex Scanning (Student will sign & submit participation form)	LO 28 LO 29 LO 30	CSLO 3 CSLO 5 CSLO 8	PSLO 2 PSLO 3 PSLO 4	ISLO 5 ISLO 3 ISLO 2
Laboratory 2b	Activity 4: Internet Assignment – TIPS CME (online quiz grade to be submitted to drop box – Do Not Pay for CME!)	LO 33	CSLO 2	PSLO 2	ISLO 5
Protocol Assignment	Renal Art. Stenosis (RAS) + Renal Transplant Protocol Cards (protocols provided in presentation; graded based on Protocol Card Assessment Tool)	LO 28 LO 29	CSLO 3 CSLO 5	PSLO 2 PSLO 3	ISLO 5 ISLO 3
Exam 4	Covers Topics & Materials on: Topic 7 – Abn. Renals/Renal Vasc. Topic 8 – Hepatoportal Vascular Flow	LO 27-34	CSLO 5 CSLO 3 CSLO 7 CSLO 2 CSLO 8	PSLO 3 PSLO 2 PSLO 4	ISLO 3 ISLO 5 ISLO 2
Topic 9 Objectives	Part 9 Instructional Objectives in Syllabus	LO 35 LO 36	CSLO 3 CSLO 10	PSLO 3 PSLO 4	ISLO 3 ISLO 2
Laboratory 3	Activity 1: Lab to Record ABIs (at rest & w/ exercise)	LO 36	CSLO 10	PSLO 4	ISLO 2
Laboratory 3	Activity 2: JDMS CME Article – Art. Evaluation of Lower Extremity	LO 19 LO 35 LO 36	CSLO 5 CSLO 3 CSLO 10	PSLO 3 PSLO 4	ISLO 3 ISLO 2

Protocol Assignment	ABI (rest & exercise) + Reactive Hyperemia Protocol Cards (protocols provided in presentation; graded based on Protocol Card Assessment Tool)	LO 36	CSLO 10	PSLO 4	ISLO 2
Topic 10 Objectives	Part 10 Instructional Objectives in Syllabus	LO 37 LO 38	CSLO 9 CSLO 8	PSLO 2 PSLO 4	ISLO 5 ISLO 2
Topic 10 Workbook	Curry & Tempkin workbook, pp. 447-449	LO 38	CSLO 8	PSLO 4	ISLO 2
Topic 11 Objectives	Part 11 Instructional Objectives in Syllabus	LO 37 LO 39	CSLO 9	PSLO 2	ISLO 5
Laboratory 4a	Activity 1: Scan LE for DVT	LO 38	CSLO 8	PSLO 4	ISLO 2
Laboratory 4b	Activity 2: Scan LE for venous insufficiency (complete clinic manual simulation)	LO 39	CSLO 9	PSLO 2	ISLO 5
Protocol Assignment	Lower Extremity Venous for DVT Protocol Cards (protocols provided in presentation; graded based on Protocol Card Assessment Tool)	LO 38	CSLO 8	PSLO 4	ISLO 2
Protocol Assignment	Lower Extremity Venous for Insufficiency (w/ perforator valve imaging) Protocol Cards (protocols provided in presentation; graded based on Protocol Card Assessment Tool)	LO 39	CSLO 9	PSLO 2	ISLO 5
Final Exam	Comprehensive Final covers Parts 1-11, With emphasis on Topic 9 – ABIs with Lab Topic 10 – Lower Venous for DVT Topic 11 – Lower Venous for Insufficiency	LO 1 LO 20,21, 23, 35 LO 37, 39 LO 19 LO 36 LO 38	CSLO 1 CSLO 3 CSLO 9 CSLO 5 CSLO 10 CSLO 8	PSLO 1 PSLO 2 PSLO 3 PSLO 4	ISLO 5 ISLO 3 ISLO 2

EXAMS:

The student will be tested on comprehension of anatomic, physiologic, and correlative processes, as well as patient scanning considerations of the abdominal vasculature and lower venous, ABIs.

- Four (4) non-cumulative objective tests – 50% of final course grade
 - Four (4) test scores will be calculated as 12.5% each of final grade
 - All exam scores, however, MUST be passing (70% or higher) /or/ remediation will be expected.*
- One (1) comprehensive final exam -15% of final grade
 - No remediation attempts will be allowed for comprehensive final exams.

*Remediation of an exam must take place if the student does not pass the exam with a score of 70% or greater.

The policy of the CSTCC DMS program is to allow remediation of one(1) non-cumulative exam per course. This means that:

- When a final exam is cumulative, it is not eligible for remediation. (The student must pass with a minimum score of 70% to progress to the next course or to complete the program if the course exists in the final semester.)
- If a student has already remediated an exam during this same course, the student is no longer eligible for additional remediation within the specified course. (Students will continue to be eligible for a one-time remediation within another course during the same semester, however.)
- When sitting for a remediation exam, the student is expected to achieve a minimum score of 80% in order to progress to the next course or to complete the program if the course exists in the final semester.
- Although the student is allowed the opportunity for remediation for the sake of progression, the student's

original exam grade will be posted for final grade calculation purposes.

Students who do not pass the remediation attempt with a minimum score of 80%, or students who have already remediated and do not achieve a minimum score of 70% on a following examination will not be allowed to progress in the course or program. Such students will have the opportunity to apply for readmission to the program during the following program year.

LABORATORY AND HOMEWORK EXPECTATIONS:

Completion of assigned reading and homework objectives/exercises between class sessions is required.

1. Demonstrations/Simulations where applicable. Laboratories will be conducted to correspond with lectures and homework assignments.
2. Scanning participation and Multimedia/Classroom assignments will be graded for an assigned laboratory grade and will count towards 15% of the final grade.
3. Each student will create and maintain a protocol booklet of images for specific components of the abdominal procedure, which will count towards 5% of the final grade.
4. There is an exercise manual which students will complete prior to laboratory sessions, as part of homework assignments. These are listed in the syllabi, according to the corresponding lecture week and will count as 5% of the final student grade.

FIELD WORK:

Clinical correlation should be made to all instructional learning, with clinical assignments often given as or related to homework throughout the program. Students may be asked to present cases or bring case information into the classroom setting. HIPAA Regulations must be adhered to in such instances, with the **HIPAA Privacy Statement** submitted with the case, and the **Case Rubric** utilized if a full case is assigned by the instructor. These forms are located in your Syllabus following the Syllabus Acknowledgement Statement.

In many instances, you may use a full case work-up in this course as a required clinical case study assignment AFTER it has been presented in class. However, you must bring the cases for this course to your class session with you, so do NOT expect to turn in the same case for clinical requirements during the same class week, as clinical assignments are due on Monday mornings and students should not expect to have them returned.

OBJECTIVES COMPLETION:

Students will be expected to perform **instructional objectives** located within the topic overviews for each section *independently*, in addition to other chapter objectives that may also be assigned. These objectives will be turned in prior to each exam that correlates to this material in the student's dropbox (either online or on campus).

The student's completion of instructional objectives directly assists in preparing the student for the assessment on related material, so a grade is assigned for their completion. The student should consider these as the "Entrance Ticket" to the exam. The instructor reserves the right to refuse the student entry to the exam without first submitting these objectives.

Note that the student should preferably use the online dropbox and ONLY use the on-campus one if online submission is not available or achievable. (The student should choose only one means or the other of submission; do not duplicate assignment submission into both places, please.)

In this course, additional credit may be assigned to a specific topic portion of instructional objectives when a student completes and presents a voluntary case study. Mandatory case studies receive their own grades.

OTHER EVALUATION METHODS:

Attendance and Participation will be taken into consideration when assigning the final grade, with points being deducted for absenteeism or tardiness. The instructor reserves the right to adjust final semester grades according to these considerations.

Attendance and other relevant classroom policies are further addressed in the DMS Student Handbook, where the student has previously given signature to acceptance of these policies.

Notation indicating percentage of grade attributable to each of the above items:

Exam 1	12.5%
Exam 2	12.5%
Exam 3	12.5%
Exam 4	12.5%
Comp. Final Exam	15%
Laboratory	15%
Homework assignments	5%
Protocol Cards	5%
Objectives Completion	10%

The final grades of A, B, C, D, or F will be assigned on the basis of the numerical average determined by the objective examinations and completion of assignments, with the following point ranges:

A	(90-100)
B	(80-89)
C	(70-79)
D	(65-69)
F	(64 or less)

In the event that a student fails an exam and has exhausted all remediation attempts, the student will NOT be awarded a grade higher than a D, regardless of how the numeric grade would otherwise calculate. Students must successfully complete all work with passing competency grades for each assignment to achieve a minimum of a C in the course, thereby maintaining eligibility for program progression.

SYLLABUS STATEMENTS

STUDENT-INSTRUCTOR COMMUNICATION

All sonography program students are required to set up a TigerMail account and supply this official college email address to the program director at the beginning of the program year. Your director and/or instructor will use your TigerMail account to relay any *program-specific* information to you. The link to set up this account can be found on the campus TigerWeb home page, which will first require input of your Student campus ID (your "A" number) and setting up your own password.

Any email communications that are *course-specific* will be addressed by your instructor through the e-Learn (online course platform) email system. Your instructor(s) will demonstrate the use of this tool during your sonography orientation. Please utilize the e-Learn email system within your course when asking a *course-specific* question or submitting *course-specific* information to your instructor.

You may email your instructor at his/her Chattanooga State email address (rather than the e-Learn site) or call and leave a message on your instructor's voice mail when your question or information is either program-specific or your course-specific question has not been answered according to the procedure established in the following paragraph.

It is my goal, as your sonography course instructor, to answer your emails and voice mails within 48 hours during the regular program week (Mon-Fri) and within 72 hours when a weekend is involved. However, please understand that the sonography program requires faculty to travel to clinic sites and other professional events (often for multiple consecutive days) as part of my program duties. I will continue to make reasonable attempts to check my email and/or voice mail within the stipulated timeframe above. However, in an emergency where you have not received an adequate response in a timely manner, please leave a message with our secretary at 423-697-3360, specifically explaining your need, so that she may attempt to reach me or someone else who can assist you immediately. Thank you.

ASSIGNMENT GRADING

Students are asked to submit graded documents either within their Dropbox (online) or Inbox (on campus) by the designated due date. Your instructor will have submitted items graded no later than the following class week, where you will either receive confirmation of a grade in your Dropbox Comments (online) or your graded materials will be located in your Outbox (on campus). Your instructor will notify you of any grading delays beyond this standard, along with the anticipated time you may expect to receive your returned graded assignment.

Where instructor dates are provided (on the course online calendar, syllabus, lesson plans and/or in each topic segment), late work will be accepted only under extenuating circumstances and upon completion and submission of the Extension Request Form together with explanation and proof of need for an extension (i.e. doctors certificate, etc.). All accepted late assessment, regardless of cause, may be penalized.

If the course is not completed prior to the end of the term, the student will receive an Incomplete and will have two additional weeks into the following semester to complete the course work (unless the instructor has approved a later date in advance, due to approval of the extension request form). After such time, an Incomplete will be changed to a Failure of the course.

EXTENSION POLICY

Assignments will not be accepted after 2 weeks from the end of the assigned course week. Late assignments can only receive a maximum of 75% of the grade assigned. (Extreme extenuating circumstances, such as a health issue, may receive special consideration.)

ADA STATEMENT

Students who have educational, psychological, and/or physical disabilities may be eligible for accommodations that provide equal access to educational programs and activities at Chattanooga State. These students should notify the instructor immediately, and should contact Disabilities Support Services within the first two weeks of the semester in order to discuss individual needs. The student must provide documentation of the disability so that reasonable accommodations can be requested in a timely manner. All students are expected to fulfill essential course requirements in order to receive a passing grade in a class, with or without reasonable accommodations.

DISRUPTIVE STUDENTS

The term "classroom disruption" means – student behavior that a reasonable person would view as substantially or repeatedly interfering with the activities of a class. A student who persists in disrupting a class will be directed by the faculty member to leave the classroom for the remainder of the class period. The student will be told the reason(s) for such action and given an opportunity to discuss the matter with the faculty member as soon as practical. The faculty member will promptly consult with the division dean and the college judicial officer. If a disruption is serious, and other reasonable measures have failed, the class may be adjourned, and the campus police summoned. Unauthorized use of any electronic device constitutes a disturbance. Also, if a student is concerned about the conduct of another student, he or she should please see the teacher, department head, or division dean.

AFFIRMATIVE ACTION

Students who feel that he or she has not received equal access to educational programming should contact the college affirmative action officer.

ACADEMIC INTEGRITY/ACADEMIC HONESTY

In their academic activities, students are expected to maintain high standards of honesty and integrity. Academic

dishonesty is prohibited. Such conduct includes, but is not limited to, an attempt by one or more students to use unauthorized information in the taking of an exam, to submit as one's own work, themes, reports, drawings, laboratory notes, computer programs, or other products prepared by another person, or to knowingly assist another student in obtaining or using unauthorized materials. Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students guilty of academic misconduct, either directly or indirectly through participation or assistance, are immediately responsible to the instructor of the class. In addition to other possible disciplinary sanctions, which may be imposed through the regular institutional procedures as a result of academic misconduct, the instructor has the authority to assign an "F" or zero for an activity or to assign an "F" for the course.

SYLLABUS GUIDELINES STATEMENT

The instructor reserves the right to modify this syllabus in writing anytime during the course of the semester.

This course is governed by the policies and procedures as stated in the current:

- Chattanooga State Student Handbook
- CSTCC Nursing/Allied Health Student Handbook
- CSTCC Diagnostic Medical Sonography Student Handbook.

Additional or more specific guidelines may apply.

PROGRAM POLICIES: This class is governed by the policies and procedures stated in the current Chattanooga State Diagnostic Medical Sonography Student Handbook. Additional or more specific guidelines may apply.

COLLEGE POLICIES: This class is governed by the policies and procedures stated in the current Chattanooga State Student Handbook. Additional or more specific guidelines may apply.

STUDENT ACKNOWLEDGEMENT STATEMENT

By my signature below, I attest that I have received and reviewed the US 206 course syllabus for Fall _____ course no. _____
Semester Year

I understand the course requirements with regard to attendance, grading, objectives, course policies and procedures, including those regarding my conduct in this course. I agree to be held accountable for my performance and actions according to such requirements and also agree to the provisions of the *Syllabus Guidelines Statement* as written within the course syllabus.

Student Name (Please Print): _____

Student Signature: _____ Date: _____

Chattanooga State Community College Diagnostic Medical Sonography Program
HIPAA Privacy Statement Related to Sharing of Case Study Information for Educational Purposes

Course #: _____ Semester/Year: _____

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Case Study #: _____ Instructor: _____

The submitted archived images/reports associated with this case study are to be used only by the ChSCC DMS/CVS Programs for case study information, according to the current HIPAA agreement that has been signed by all relevant parties. No portion is to be shared for any other purpose outside of the agreed upon scope to pursue academic knowledge for professional necessity. Any parties viewing such information are within this same instructional scope and also agree that no information about this patient or case will be discussed or used outside of this environment.

Any cases remaining with the instructor will be stored in a case file that is either physically locked in the digital imaging room or file room storage facility or digitally stored on a password protected computer that will only be accessed by parties covered within the designated instructional scope OR will be disposed of in the same manner as all privacy records on campus. Any case study records returned to the student MUST be immediately returned to the clinical site from which they were released for use.

The Student submitting this case should designate one of the following options, related to the extent of privacy information included:

- Submitted documents and/or images DO NOT contain any recognizable patient identification.
- Submitted documents and/or images DO NOT contain any recognizable facility identification.
- Submitted documents and/or images DO contain information that is recognizable but CANNOT be removed. The Data archiving/PACS system does NOT allow the removal of data or I am NOT provided with any alternate capability to hide patient information.
 - The recognizable data is related to patient identification.
 - The recognizable data is related to facility identification.
- Students are not permitted to remove Images/reports associated with case studies from this facility. Relevant Data pertaining to this case study must be reviewed on site by ChSCC faculty.

Student Signature: _____ Date of Signature: _____

**Chattanooga State Community College
Diagnostic Medical Sonography Program**

Case Study Assessment Guide

	Criteria				
	17	15	13	11	Points
Indications/ Presenting Symptoms	Completeness of case history to include: Age, gender, presentation of symptoms/indications, and prior diagnosis or problems.	Case history is complete except one criterion is omitted.	Case history partially complete, two criteria are omitted.	Limited Case history included.	
Sonographic Findings	Excellent description of a specific US exam (with submitted images) to include: US appearance using appropriate medical terminology to describe pathology/findings in students' own words.	Very Good description of US findings and use of terminology, however, one abnormality is omitted. Appropriate images are submitted.	Good description of US findings, however, one abnormality is omitted and/or inappropriate terminology is used. Only a limited number of images are included.	US findings are limited to a copied radiology report. No images/few images are submitted.	
Scanning Problems/ Caveats Involved and How These Were overcome	Scanning caveats/problems are thoroughly discussed along with a description of how these were overcome.	Scanning caveats/problems are discussed along with a limited description of how these were overcome.	Scanning caveats/problems are discussed along with no description of how these were overcome.	Scanning caveats/problems and a description of how these were overcome were not discussed, only limited entry, such as "no problems"	
Applicability to Present Didactical Studies	Student relates in excellent detail how this case applies to their present didactic studies.	Student relates in very good detail how this case applies to their present didactic studies.	Student relates in good detail how this case applies to their present didactic studies.	Student relates in very limited detail how this case applies to their present didactic studies.	
New Clinical Applicability	Student relates in excellent detail how new technology, instrumentation or other procedures were used to obtain diagnosis for this case.	Student relates in good detail how new technology, instrumentation or other procedures were used to obtain diagnosis for this case.	Student relates in limited detail how new technology, instrumentation or other procedures were used to obtain diagnosis for this case.	Student relates in very limited or no detail how new technology, instrumentation or other procedures were used to obtain diagnosis for this case.	
Additional Information	Excellent additional information is gathered concerning this specific case or pathology including (if available): lab results, imaging reports and /or images from other modalities, surgical notes, pathology reports, and research information concerning the abnormality/pathology.	Good additional information is gathered concerning this specific case or pathology to including (if available): lab results, imaging reports and /or images from other modalities, surgical notes, pathology reports, and research information concerning the abnormality/pathology.	Additional information is gathered concerning this specific case or pathology including (if available): lab results, imaging reports and /or images from other modalities, surgical notes, pathology reports, and research information concerning the abnormality /pathology.	Only limited additional information is gathered concerning this specific case or pathology.	
				Total →	

US 206

Part 1

Abdominal Musculature, Abdominal Wall, and Diaphragm

Fall

Reading Assignment(s): Hagen-Ansert, Chapter 2, pages 25-41
Hickey & Goldberg, pages 191-193

Homework Assignment(s): Instructional Objectives
Hagen-Ansert, Chapter 2, All Review Questions

Instructional Objectives: Due on exam date

1. Using the proper sonographic terms, describe the normal echogenicity and echotexture patterns of the psoas and quadratus lumborum muscles.
2. Describe the location of the psoas and quadratus lumborum muscles.
3. Describe the diaphragm, including the location, function, and crura.
4. List the structures that make up the anterior abdominal wall.
5. Describe the linea alba and the rectus abdominus muscle.
6. Draw and label a diagram of the anterior abdominal muscles demonstrating the linea alba, rectus abdominus muscle, external oblique muscle, and rectus sheath.
7. Describe the location and sonographic appearance of the iliopsoas muscle.
8. List the skeletal muscles that line the pelvic floor and describe their function.
9. Name the pelvic muscle can mimic an ovary.
10. Describe the location and sonographic appearance of the obturator internus muscles.
11. Discuss the term levator ani and its function.

Topic Outline:

- I. Abdominal Musculature and Abdominal Wall
 - a. Sonographic terminology
 - b. Sonographic appearance of muscles in the abdomen and pelvis
 - c. Intra-abdominal muscles
 1. Quadratus lumborum
 2. Psoas major
 3. Iliacus
 4. Iliopsoas
- II. Abdominal wall
 - a. Anterior structures

- b. Posterior structures
 - c. Lateral structures
 - d. External oblique muscles
 - e. Internal oblique muscles
 - f. Linea alba
 - g. Rectus abdominus
 - III. Ghost image artifact
 - a. Rectus abdominus muscle
 - IV Diaphragm
 - a. Crura of the diaphragm
 - 1. Right crus
 - 2. Left crus
 - b. Ultrasound appearance of the diaphragm
 - V. Subphrenic spaces
 - a. Liver/diaphragm
 - b. Spleen/diaphragm
 - VI. Pelvic muscles
 - a. Pelvic diaphragm
 - 1. Pubococcygeus muscles
 - 2. Ileoococcygeus muscles
 - 3. Coccygeus muscles
 - b. Piriformis muscles
 - c. Obturator internus muscles
 - d. Levator ani muscles
 - 1. Pubococcygeus muscles
 - 2. Iliococcygeus muscles
-

US 206

Part 2

Peritoneal Cavity, Mesenteries, and Retroperitoneal Structures

Fall

Reading Assignment(s): S. Hagen-Ansert, Chapter 2
Hickey & Goldberg Ch. 10, Pg. 185-191,197, & 203

Homework Assignment(s): Instructional Objectives
Hagen-Ansert, Chapter 2, All Review Questions

Instructional Objectives: Due on exam date

1. Identify the layers of the peritoneum and discuss their function.
2. List the structures found posterior to the peritoneum.
3. Name the intraperitoneal organs.
4. Discuss the pattern that fluid accumulation (ascites) takes within the peritoneum (example: where does it start and where does it go next).

5. Define the term intraperitoneal.
6. Describe the difference(s) of the peritoneal cavity in the male versus the female.
7. Describe the greater omentum and its functions.
8. Give a detailed description of the location of the lesser sac and name the pathology that is commonly found in this location.
9. Describe the location of the hepatorenal recess, identify another name for this space, and tell why the sonographer should examine this area carefully.
10. List the types of fluid that may communicate throughout the peritoneum.
11. Describe the locations of the subphrenic spaces.
12. Draw a diagram of the midline sagittal plane of the female pelvis and label the structures (to include: uterus, urinary bladder, rectum, pubic symphysis, anterior cul-de-sac and poster cul-de-sac).

Topic Outline:

- I. Abdominal Peritoneum
 - a. Description
 - b. Function
 - c. Layers
- II. Peritoneal cavity
 - a. Fluid accumulation
 - b. Intraperitoneal structures
 - c. Retroperitoneal structures
 - d. Mesentery
 - e. Omentum
 1. Greater omentum
 2. Lesser omentum
 - f. Lesser sac
 - g. Epiploic foramen
 - h. Subphrenic space
 - i. Hepatorenal recess
 - j. Paracolic gutters
- III. Pelvic peritoneal Cavity
 - a. Description
 - b. Female pelvis
 1. Anterior cul-de-sac
 2. Posterior cul-de-sac

US 206

Part 3

Abdominal Vasculature

Fall

Reading Assignment(s): Curry & Tempkin, Chapters 5, 6, & 7

Homework Assignment(s): Instructional Objectives
Curry & Tempkin Workbook, Chapters 5, 6, & 7

Instructional Objectives: Due on exam date

1. Name the three layers of an artery.
 2. Draw a table delineating the differences between an artery and a vein.
 3. Describe the normal location, course and size of the abdominal aorta.
 4. Draw a diagram of the aorta with the major anterior and lateral branches and the organs supplied by those branches and label.
 5. Describe the echogenicity of the walls and lumen of the aorta and its branches using sonographic terminology.
 6. List the diagnostic tests associated with the aorta.
 7. Describe the normal location and course of the inferior vena cava.
 8. Draw a diagram of the IVC and major tributaries with the organs that are drained by them and label.
 9. Discuss the function of the IVC.
 10. Contrast the sonographic appearance of the aorta and its branches with that of the IVC and its tributaries.
 11. List the diagnostic tests associated with the IVC.
 12. Describe the normal location, size, and course of the portal vein.
 13. Draw a diagram of the portal vein and tributaries including location and the associated organs and label.
 14. Describe the function of the portal venous system.
 15. Describe the echogenicity of the walls and lumen of the portal vein and its tributaries using sonographic terminology.
 16. Discuss diagnostic tests associated with the portal venous system.
-

Topic Outline:

- I. Vascular Anatomy
 - a. Principle wall layers
 - b. Vein and artery differences
 1. Thickness of wall layers
 2. Rate of blood flow
 3. Valves
 4. Anatomical Relationships
 5. Flow characteristics
 6. Changes with respiration
 7. Exceptions
- II. Normal Sonographic Appearance
 - a. Long-axis
 - b. Short axis
 - c. Proper measurements
 1. AP most accurate
 2. Lumen vs. outer wall measurement
 - d. Reference to Doppler
 1. 2-D imaging vs. Doppler flow/color
- III. Normal Abdominal Aorta
 - a. Anatomical course
 - b. Size
 - c. Physiology
 - d. Major branches
 1. Celiac trunk
 - left gastric artery
 - splenic artery
 - common hepatic artery
 2. Superior mesenteric artery
 3. Inferior mesenteric artery
 4. Renal arteries
 5. Gonadal arteries
 6. Common iliac arteries
 - external
 - internal
- IV. Normal Inferior Vena Cava
 - a. Physiology
 - b. Major tributaries
 1. Common iliac veins
 - external
 - internal
 2. Gonadal veins
 3. Renal veins
 4. Suprarenal veins
 5. Hepatic veins
 - c. Anatomical course
 - d. Size
- V. Normal Portal Venous System
 - a. Definition
 - b. Physiology
 - c. Main portal vein
 1. Confluence
 2. Main tributaries
 - Splenic vein
 - Superior mesenteric vein

- Inferior mesenteric vein
 - 3. Branches
 - Left portal vein
 - Right portal vein
 - 4. Anatomical course
 - 5. Size
- VI. Sonographic images and imaging techniques

US 206

Part 4 Normal Renal and Retroperitoneal Anatomy and Physiology

Fall

Reading Assignment(s): Curry & Tempkin, Chapter 12
 Hagen-Ansert, Chapter 9, pages 245 – 270

Homework Assignment(s): Instructional Objectives
 Curry & Tempkin Workbook, Chapter 12

Instructional Objectives: Due on exam date

1. List the organs in the urinary system and describe their principle functions.
2. Draw a diagram of the kidney with the internal anatomy including: renal capsule, cortex, medullary pyramids, major and minor calyces, renal pelvis, hilum, and sinus.
3. Using proper sonographic terms, describe the sonographic appearance of the adult kidneys, ureters, and bladder (include echogenicity, texture, contour or shape, and size).
4. Describe the normal location for the organs of the urinary system (include anatomical relationships of adjacent structures, such as the kidneys lie lateral to the psoas muscles).
5. Draw a diagram of the kidney showing the renal vasculature including the main renal vein and artery, interlobar artery, arcuate artery, and interlobular artery and show their relationship with the internal anatomy.
6. Describe the following normal renal variants and their sonographic appearance: dromedary hump, hypertrophied column of Bertin, junctional parenchymal defect, duplex collecting system, horseshoe kidney, and extra renal pelvis.
7. List the laboratory tests used to evaluate the urinary system and discuss the clinical indications associated with abnormal values.
8. Identify the locations that should be evaluated when an ectopic kidney is suspected.
9. Compare the appearance and size of the adult kidney with the kidney of a neonate or child.
10. Contrast the sonographic appearance of a simple cyst, parapelvic cyst, and hydronephrosis.
11. Describe how to obtain and calculate a renal volume.
12. List the three sonographic criteria used to diagnose a simple cyst with ultrasound.

Topic Outline:

- I. Retroperitoneal Spaces
 - a. Anterior pararenal space
 - b. Posterior pararenal space
 - c. Perirenal spaces
 1. Left
 2. Right
- II. Urinary System
 - a. Relational anatomy
 - b. Location, shape, and size
 1. Right kidney
 2. Left kidney
 3. Ureters
 4. Urinary bladder
- III. Renal Structure
 - a. Parenchyma
 1. Cortex
 2. Medulla
 - Medullary pyramids
 - b. Sinus
 1. Renal pelvis
 2. Minor Calyces
 3. Major Calyces or infundibulum
 4. Renal vessels
 5. Fat, nerves, and lymphatics
 - c. Capsules
 1. Renal capsule
 2. Gerota's fascia
 3. Adipose tissue
- IV. Renal Function
 - a. Maintain body's chemical equilibrium
 1. Homeostasis
 - b. Dispose of metabolic waste products by excreting urine
 - c. Blood pressure regulation
 1. rennin secretion
 - d. Maintenance and balance of blood levels
- V. Renal Laboratory Data
 - a. Urinalysis
 - b. Serum Creatinine
 - c. Blood urea nitrogen
- VI. Renal Vascular Supply
 - a. Arteries
 - b. Veins
 - c. Doppler waveform patterns
- VII. Sonographic Applications
- VIII. Normal Sonographic Appearance
 - a. Kidney
 1. Adult
 - Shape
 - Size
 - Echogenicity
 2. Pediatric/neonate

- Shape
 - Size
 - Echogenicity
- b. Ureter
 - c. Bladder
- IX. Required protocol images
- X. Renal Variants of Normal and Congenital Anomalies
- a. Dromedary hump
 - b. Hypertrophied column of Bertin
 - c. Duplex Collecting System
 - d. Horseshoe kidney
 - e. Ectopic kidneys
 - f. Crossed renal ectopia
 - g. Cross fused renal ectopia
 - h. Extrarenal pelvis
 - i. Renal Agenesis
 - j. Hypoplastic Kidneys
 - k. Renal sinus lipomatosis
 - l. Persistent fetal lobulations
 - m. Renal Dysplasia
 - 1. Multicystic Dysplastic Kidney Disease (MCDK)
 - 2. Polycystic Renal Disease, (Infantile type) IPKD
 - 3. Polycystic Renal Disease (Adult type) APKD
- XI. Renal Pathologies Specific to Sonographic Findings
- a. Simple Cyst
 - b. Parapelvic Cyst
 - c. Hydronephrosis
 - d. Ureteropelvic Junction Obstruction (UPJ)

US 206

Part 5 Abdominal Doppler

Fall

Reading Assignment(s): Zwiebel, Ch. 3, 28, 29 30, 31

Homework Assignment(s): Instructional Objectives

Instructional Objectives: Due on exam date

1. Describe the Doppler Effect.
2. List ways that Doppler/color Doppler can help diagnose a vascular problem.
3. Doppler/color Doppler ultrasound is a clinically useful tool in diagnosing many disease processes of the abdomen. Identify at least two specific disease processes or pathologies and tell how Doppler/color Doppler can be utilized.

4. Describe hepatopetal and hepatofugal flow patterns in the liver.
5. Compare the characteristics of laminar flow and plug flow.
6. Discuss color flow Doppler and its applications.
7. Describe how an arterial stenosis would appear on pulsed and color flow Doppler.
8. Explain the flow pattern changes in the SMA from a fasting state to postprandial.
9. Draw an example of a spectral wave form and label the individual components (window, velocity, baseline, peak systole, end diastole, dicrotic notch, and envelope).
10. Draw examples of a venous wave form and an arterial wave form.
11. Draw examples of a high resistance and low resistance arterial waveform and explain their differences.

Topic Outline:

- I. Introduction of Doppler
- II. Doppler Effect
 - a. Definition
 - b. Medical Applications
 1. Doppler imaging
 - Presence and direction of blood flow
 - Flow velocities/variance or range of velocities within the vessel
 - Flow disturbances
- III. Doppler
 - a. Doppler angle
 - b. Pulsed wave Doppler versus color Doppler
 - c. Spectral analysis
 1. Components of spectral display
 2. Display of normal vascular flow
 - Laminar flow
 - Plug flow
 - High resistance versus low resistance flow patterns
 3. Display of a stenosis
 - Spectral broadening
 4. Systole
 5. Diastole
- IV. Aorta wave forms compared to other abdominal vessels
 - a. Aorta versus renal artery
 - b. Aorta versus IVC and portal vein
- V. Blood flow direction
 - a. Flow towards the transducer - traditionally shown above the baseline
 - b. Flow away from the transducer - traditionally shown below the baseline
- VI. Normal Doppler waveform examples of abdominal vessels
 - a. Aorta
 - b. Renal artery
 - c. Interlobar artery
 - d. Renal vein
 - e. Superior mesenteric artery
 1. Before eating/high resistance waveform

- 2. Postprandial (after eating)/low resistance waveform
 - f. IVC
 - g. Hepatic veins
 - h. Main portal vein
 - VII. General Doppler Applications
 - VIII. Doppler Applications specific to the abdominal disease processes
 - IX. Color Flow Scanning
-

US 206

Part 6 Abnormal Abdominal Vasculature

Fall

Reading Assignment(s): Zwiebel, Ch. 3, 28, 29 30, 31

Homework Assignment(s): Instructional Objectives

Instructional Objectives: Due on exam date

1. Draw a table contrasting the arterial and venous systems, in terms of:
 - a. Wall layers;
 - b. Waveform signals;
 - c. Respiratory considerations;
 - d. Other considerations of importance.
2. List the major tributaries of the aorta, providing a drawing of each of their “normal” waveform patterns.
3. Record the major tributaries of the inferior vena cava and identify the organ(s) drained by each one.
4. Identify the types of aortic aneurysms, describing their characteristics and drawing an example of each.
5. Identify the important sonographic characteristics associated with an aortic aneurysm.
6. Explain how one determines if a vessel has a flow pattern that is high or low resistance.
7. Draw examples of monophasic, biphasic and triphasic waveforms.
8. Explain the differences in waveforms at pre-stenotic, stenotic and post-stenotic points within a vessel.
9. Classify the various mechanisms of atherosclerotic disease.
10. Describe the effect(s) that collateral vessels have on blood flow and representative Doppler findings.
11. List the most common clinical symptoms related to an abdominal aortic aneurysm.
12. Differentiate a pseudoaneurysm from a dissecting aneurysm.

13. Describe the sonographic appearance of tumor or thrombus in arteries and veins.
14. Identify the importance of the following measurements, as related to an abdominal aorta:
 - a. 3 cm
 - b. 5 cm
 - c. 6 cm
15. Describe the two(2) types of repairs for AAA.
16. List and define the four(4) types of endoleaks that may occur as a complication of aortic graft repair.
17. Add the following protocols to your protocol cards (and show to your instructor):
 - a. Pre-Stent AAA Evaluation
 - b. Post-Stent AAA Evaluation
18. List some possible abnormal vascular findings associated with the IVC.
19. Describe the importance of identifying acute mesenteric ischemia.
20. Describe the clinical presentation of chronic mesenteric ischemia.
21. Differentiate the pre-prandial and post-prandial Doppler waveforms in mesenteric ischemia.
22. Add the following protocols to your protocol cards (and show to your instructor):
 - a. Pre-prandial mesenteric evaluation
 - b. Post-prandial mesenteric evaluation
23. Identify the criteria for > 70% stenosis in mesenteric arterial disease.
24. Identify the method for differentiating compression syndrome versus mesenteric ischemia.
25. Define the following key words:

Aneurysm	Mycotic aneurysm
Arteriosclerosis	Petechiae
Collaterals	Resistive index
Ectasia	Sepsis
Embolism	Spectral broadening
Hyperemia	Marfan's syndrome
Hypoxia	Tardus Parvus
Infarction	Thrombosis
Ischemia	Tortuous

Topic Outline:

- I. Abdominal vascular review
 - a. Vessel walls
 1. Wall layers
 2. Sonographic appearance
 - b. Great vessels
 1. Aorta
 - Branches
 2. IVC
 - Tributaries

3. Sonographic appearance
4. Relational anatomy

II. Spectral Analysis Review

- a. Relation of Spectral components to flow
 - i. Systole
 - ii. Diastole
 - iii. Acceleration to peak
 - iv. Dampened waveforms
 - v. Spectral windows
 - Spectral broadening
- b. Venous versus Arterial flow
- c. Flow Patterns
 - i. Resistance
 - ii. Pulsatility
 1. monophasic
 2. biphasic
 3. triphasic
 - iii. Stenotic flow patterns
 1. spectral broadening
 2. turbulence

III. Vascular Disturbances

- a. Risk factors
- b. Mechanisms
 - i. Stenosis
 - ii. Thrombosis
 1. arterial
 2. venous
 - iii. Embolism
 1. danger
 2. corrective factors
 - iv. Aneurysm

IV. Aneurysms

- a. Review of wall layers
- b. Major categories
 1. True
 2. False
- c. Abdominal Aortic Aneurysm
 1. Types of Aortic Aneurysms
 - Fusiform
 - Saccular
 - Dissecting
- d. How to Measure an Aneurysm
- e. Causes of Aneurysms
- f. Aneurysm Symptoms
- g. Effects of Abdominal Aortic Aneurysms
- h. Surgical Intervention
 1. Types of repair
 2. Sonographic assessments
 - a. pre-stent evaluation
 - b. post-stent evaluation
 3. Graft complications

- V. Non-Sclerotic Lesions: Venous Pathology
 - a. Thrombosis
 - b. IVC abnormalities
 - 1. Thrombosis
 - 2. Double IVC
 - 3. Inferior Vena Cava dilatation
 - 4. Tumors of the IVC
 - Tumor invasion

 - VI. Mesenteric Ischemia
 - a. Presentations
 - b. Treatment
 - c. Other Considerations
 - i. Literature criteria
 - ii. Compression syndrome
 - d. Sonographic Assessment
 - i. Pre-prandial protocol
 - ii. Stenotic criteria
 - iii. Post-prandial protocol
 - 1. "normal"
 - 2. abnormal

 - VII. Arteriosclerosis
 - a. Progression of Atheromatous Disease
 - b. Atherosclerosis
 - Different forms
 - Disease features
 - c. Complications of Atheromatous Disease
 - d. Effects of Atheromatous Disease
-

US 203

Part 7

Renal Vascular Disease

Fall

Reading Assignment(s): Zwiebel & Pellerito, Ch. 33, pp. 611-631
Handout

Homework Assignment(s): Instructional Objectives

Instructional Objectives: Due on exam date

- 1. Create protocol cards for a study to assess for Renal Arterial Stenosis (RAS).
 - a. Provide a drawing of the aorta with the expected placement of the Doppler sample site, along with the expected waveform.
 - b. Provide a drawing of the renal artery with the expected placements of all Doppler sample sites, along with an expected spectral analysis waveform.

- c. Provide the range(s) of RAR that signify stenosis of the renal artery.
 - d. Provide the range of peak velocities that signify stenosis.
2. Create protocol cards for a study to assess the Renal Allograft (Transplant).
 - a. Don't forget to include a list of 2-D images.
 - b. Don't forget to include the areas to assess, along with expected RI's.
3. Describe the kidneys' primary function in very simple and direct terms.
4. Describe the main reasons for performing the two(2) primary renal lab exams:
 - a. BUN
 - b. Creatinine
5. Describe the expected normal echogenicity comparison between the right kidney and liver (or left kidney and spleen).
6. Provide the expected range of length measurements for a normal adult kidney.
7. Provide the expected cortical thickness of a normal adult kidney.
8. Explain the benefits of color Doppler versus the need for spectral Doppler analysis when assessing for RAS.
9. Diagram a normal aortic waveform and a normal renal artery waveform.
10. Diagram the renal vascular pathway within the kidney, providing expected "normal" waveforms for each of the vessels.
11. Clarify the importance of demonstrating perfusion within the renal kidney, and how the waveform appears when the kidney is not perfusing well.
12. Delineate the most common reasons for RAS.
13. List some patient history considerations of RAS.
14. Demonstrate (through a drawing) the appearance of Fibromuscular Dysplasia (FMD), also showing the expected spectral waveform based on this finding.
15. Describe the sonographic assessment technique for renal venous thrombosis.
16. Depict the sonographic presentation differences between acute and chronic renal failure.
17. Explain the need for hemodialysis and what it does.
18. Explain why it is important to also assess the native renal beds when asked to assess a renal transplant.
19. Differentiate the four(4) most common types of fluid collections in a post-transplant patient.
20. Describe the role of Doppler in the transplant patient.
21. Provide the normal range of Resistive Indices (RIs) for the transplant patient.
22. Provide the RI and PI (pulsatility index) values associated with rejection.
23. Describe the "hallmark symptoms" of acute transplant rejection.

24. Give the common Doppler findings associated with acute transplant rejection.
25. Furnish the common Sonographic Criteria of Transplant Rejection, as given in the presentation.
26. Present the systolic velocities and velocity ratio for RAS of a transplant.
27. Explain which vessels are most commonly compared in the velocity ratio for a transplant kidney and why.
28. Define the following key terms:

Azotemia	Hydronephrosis
Abscess	Leukonychia
Acute Tubular Necrosis	Lymphocele
Endarterectomy	Pyurea
Fibromuscular Dysplasia	Seroma
Hematuria	Urinoma
Hemodialysis	

Topic Outline:

- I. Urinary System Review
 - a. General Info on Kidneys
 - i. Renal Structures
 1. Renal Parenchyma
 2. Renal Sinus
 - a. Hilum
 - b. Pelvis
 3. Ureters
 4. Bladder
 - ii. Renal Function
 - b. Lab Data
 - i. Creatinine
 - ii. BUN
 - c. Sonographic Considerations
 - i. Appearance of Kidneys
 1. Size
 2. Echogenicity
 - ii. Applications
- II. Renal Vascularity
 - a. Renal Artery(ies)
 - b. Renal Vein
 - c. Sonographic Considerations
 - i. 2-D/Grayscale
 - ii. Color Doppler
 1. mean velocities
 2. flow disturbances
 - iii. Power Doppler
 1. perfusion
 2. insufficiency
 - iv. Spectral Doppler
 1. RAR
 2. velocities
 - a. renal artery
 - b. segmental

c. interlobar

- III. Renal Arterial Stenosis (RAS)
 - a. Causes
 - i. Atherosclerosis
 - ii. Scarring/Injury
 - iii. Fibromuscular Dysplasia
 - 1. patient history
 - 2. presentation
 - a. string of beads
 - b. waveforms
 - 3. findings
 - 4. treatment
 - b. Patient History
 - c. Sonographic Assessment
 - i. Preparation and technique for exam
 - ii. Scanning considerations
 - 1. 2-D
 - 2. Doppler
 - 3. RAS criteria
 - a. RAR
 - b. Elevated velocities
 - d. Repair
 - i. Endarterectomy
 - ii. Bypass
 - iii. Stents
- IV. Renal Vein Thrombosis
 - a. Cause Considerations
 - b. Sonographic Evaluation
- V. Renal Vascular Pathology Progression
 - a. Malfunctioning Kidney
 - i. Etiologies
 - ii. Categories
 - 1. Acute renal failure
 - 2. Chronic renal failure
 - iii. Causes
 - iv. Sonographic appearance
 - 1. acute
 - 2. chronic
 - b. Treatment for Renal Failure
 - i. Hemodialysis
 - 1. fistula
 - 2. graft
 - 3. catheter
 - ii. Peritoneal hemodialysis
 - iii. Renal transplant
- VI. Renal Transplant (Allograft)
 - a. Patient risk factors
 - b. Procedure
 - c. Placement
 - d. Rejection
 - i. Sonogram
 - 1. w/in 48 hours to determine

2. Within specific timeframes thereafter
 3. Or as problems arise
 - ii. Transplant Complications
 1. fluid collections
 - a. urinoma
 - b. hematoma
 - c. seroma
 - d. abscess
 - e. lymphocele
 - f. lab work to differentiate
 - iii. Failure causes
 1. acute tubular necrosis
 2. vascular occlusion
 - a. RAS
 - b. Renal vein thrombosis
 3. fluid collections
 - iv. Types of Rejection
 1. acute
 2. chronic
 - e. Doppler studies for Rejection
 - i. Main renal artery
 - ii. Interlobars and arcuates
 - iii. Perfusion by power Doppler
 - iv. Anastomosis site
 - v. Ratio between renal artery and external iliac
 - f. Sonographic Criteria of Transplant Rejection
 - i. Increased renal volume
 - ii. Increased echogenicity of cortex
 - iii. Increased prominence of renal pyramids
 - iv. Focal hypoechoic areas in cortex
 - v. Decreased echogenicity of renal sinus
 - vi. Increased flow resistance in small parenchymal arteries
 - g. Doppler Features of Rejection
 - i. High resistance indices
 1. $RI > 0.7$
 2. $PI > 1.8$
 - ii. High systolic velocities
 1. $> 190 \text{ cm/sec}$ w/ post-stenotic turbulence
 2. $> 250 \text{ cm/sec}$
 3. Velocity ratio > 3
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Part 8 Hepatic Vasculature and Flow

Fall

Reading Assignment(s): Zwiebel, Ch. 32
Hickey & Goldberg, Ch. 7, pg. 146-150 (on WebCT as handout)

Homework Assignment(s): Instructional Objectives

Instructional Objectives: Due on exam date

1. Provide a few "liver facts" to explain why hepatic pathology can influence so much of the body's metabolic and vascular functions.
2. Differentiate hepatic veins from portal veins sonographically, from perspectives of both directional flow and placement, and appearance.
3. Explain the simplest method for a sonographer to differentiate the portal vein from an enlarged common bile duct.
4. Diagram the lobes of the liver through the location of vascular landmarks, also explaining the importance of this knowledge.
5. Describe the difference in spectral waveform of the hepatic veins from most veins in the body, explaining the reason for the difference in flow characteristics.
6. Explain the importance of the ligamentum teres, particularly concerning its patency in the adult patient.
7. Diagram the portal triad, identifying all of its components.
8. Specify flow characteristics of the normal hepatic artery.
9. Identify the portion of the liver that lies anterior to the IVC.
10. Name the vessels which come together to form the portal vein.
11. Define the flow characteristics for a normal portal vein, specifying its velocity and pressure ranges.
12. Specify the best primary scanning approach to imaging the main portal vein.
13. List the sonographic characteristics associated with portal vein hypertension, including both 2-D and Doppler findings.
14. Differentiate the meanings of hepatopetal (hepatopedal) versus hepatoportals flow of the portal vein.
15. Name the three(3) most common causes of flow impedance of the portal vein.
16. List the associated findings of cirrhosis that can be identified sonographically.
17. Explain the cause of a natural portal shunt, identifying the most common natural pathway (of collaterals).
18. Identify the most common patient symptom/concern of portal venous hypertension.
19. Define "TIPS."
20. Explain the route of the TIPS procedure, identifying the vessels to which the blood is shunted from the portal vein.
21. Identify the most common cause of stenosis within the TIPS.
22. List some common sonographic findings associated with an occluded TIPS.
23. Characterize Budd-Chiari syndrome by its most obvious finding.
24. Classify the sonographic findings of Budd-Chiari syndrome.

Topic Outline:

- I. Liver Anatomical Overview
 - A. Sectional Anatomy
 - B. Sonographic Anatomical Assessment
- II. Liver Vasculature
 - A. Portal System
 - 1. Direction of flow
 - 2. Spectral analysis
 - 3. Portal hypertension
 - a. portal size
 - b. collateralization
 - B. Hepatic System
 - 1. Direction of flow
 - 2. Spectral analysis
 - C. Hepatic Artery
- III. Hepatic Disease
 - A. Hepatitis
 - 1. Types
 - 2. Clinical symptoms
 - a. Lab values
 - b. Patient presentation
 - 3. Sonographic appearance of diffuse hepatocellular disease
 - B. Cirrhosis
 - 1. Types
 - 2. Pathologic mechanisms
 - 3. Clinical symptoms
 - a. Lab values
 - b. Patient presentation
 - 4. Sonographic appearance
 - C. Hepatic Vascular Flow Abnormalities
 - 1. Portal Venous Hypertension
 - a. PV diameter
 - b. Respiratory response
 - c. Flow direction
 - i. Hepatopetal
 - ii. Hepatoportal
 - d. Velocity and waveform
 - e. Splenic size
 - f. Portosystemic collaterals
 - g. Thrombus formation
 - 2. Hepatocellular Carcinoma
 - 3. Budd-Chiari Syndrome
 - a. Etiology
 - b. Prognosis
 - 4. Liver Transplant
 - a. Sonographic evaluation
 - b. Complications
 - 5. Miscellaneous abnormalities
 - D. Transjugular Intrahepatic Portosystemic Shunt (TIPS)
 - 1. Shunt approach
 - 2. Sonographic Assessment for shunt patency

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Part 9

ABIs (Ankle-Brachial Indices) for Arterial Disease

Fall

Reading Assignment(s): Zwiebel & Pellerito, Ch. 13; Ch. 14, pp. 265-274; Ch. 15, pp. 275-279, pp. 281-282, p. 284 (Chart 15-1), p. 285 (begin w/ LE Art. Exam) - 293.

Homework Assignment(s): Instructional Objectives

Instructional Objectives: Due on exam date

1. Describe the classic patient symptoms of PAD in the lower extremities.
2. Identify the main symptom of PAD.
3. List the potential findings of chronic arterial insufficiency. (Don't forget the 4 P's).
4. Identify risk factors for PAD.
5. Differentiate acute versus chronic lower limb ischemia.
6. Provide an explanation regarding the findings of elevated pallor versus dependent rubor in the foot of a PAD patient.
7. Name some of the contraindications for performing the ABI study, providing an appropriate explanation for each.
8. Explain the advantages of performing indirect physiologic testing to assess for PAD of the lower extremities.
9. Explain the primary diagnostic consideration for brachial pressures that differ by 20 mmHg.
10. Chart the grading categories of lower peripheral arterial disease using the ABI pressure index (and being as specific as possible).
11. Provide the most likely explanation for a patient with an ABI of 1.48.
12. Define the range within the ABI pressure index chart that would meet the criteria for consideration of a stress ABI study.
13. Describe the ideally controlled setting for a stress ABI.
14. Explain how to differentiate single level obstruction, multi-level obstruction, and ischemic rest pain when interpreting the results of the stress ABI study.
15. Clarify the need for the Reactive Hyperemia Testing.
16. Define the following terms:
 - a. Critical limb ischemia
 - b. Gangrene
 - c. Hyperemia
 - d. Intermittent claudication
 - e. Mönckeberg sclerosis
 - f. Necrosis
 - g. Pallor
 - h. Paresis
 - i. Rest pain
 - j. Rubor

Protocol Cards: Due on exam date (prepare during lab time)

1. Prepare protocol cards for an ABI study in both the resting and post-exercise state.
 2. Prepare protocol cards for the Reactive Hyperemia test.
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Topic Outline:

- I. Clinical Presentation of Peripheral Arterial Disease (PAD)
 - a. Manifestation of Atherosclerosis
 - i. Risk factors
 - ii. Influence to lower extremities
 - b. Patient Symptoms and Signs
 - i. Classic Symptoms
 - intermittent claudication
 - rest pain
 - progression of symptoms
 - ii. Chronic Arterial Insufficiency
 - 4 P's
 - Pallor
 - Pain
 - Paresis
 - Pulselessness
 - coldness of feet
 - dependent rubor
 - cyanotic toes
 - ulceration
 - non-healing wound
 - leg necrosis /or/ even gangrene
 - atrophic calf muscles
 - absent/diminished pulses
 - arterial bruits in leg
 - clinical evidence of AAA
- II. Testing of Lower Extremities
 - a. Goals
 - b. Pertinent Patient History
 - i. Questions
 - ii. Assessment of risk factors
 - iii. Assessment for physical signs of disease
 - iv. Palpation of pulses
 - v. CONTRAINDICATION: suspected DVT patient!
 - vi. CONTRAINDICATION: known high-level diabetics with calcified arteries will not test properly, as their vessel walls will not collapse with compression
 - Clues to calcified arteries
 - ABI > 1.4
 - High closing pressure (cessation of Doppler signal during inflation) w/ low opening pressure
 - c. Types of Testing
 - i. Imaging Method
 - ii. Indirect Physiologic Methods
 - advantages
 - types of indirect methods
 - PVR
 - Waveform analysis
 - Segmental limb pressures (SLP) with Ankle/Brachial Indices (ABIs)
 - Exercise stress test (post-reactive hyperemia) w/ ABIs
- III. Performing the ABI
 - a. Obtain bilateral arm pressures
 - i. CONTRAINDICATION: do not take a pressure in an arm with a shunt or graft!

- Alternate methods:
 - PPF on index fingers
 - Stethoscope on brachial artery
 - ii. Record highest systolic pressure
 - iii. Note: if performing for upper extremities, note any extreme difference in pressures (> 15-20 mmHg)
- b. Obtain pedal pressures
 - Alternate method: PPGs on great toes
 - ii. Dorsalis pedis
 - iii. Posterior tibial
 - iv. Record the higher pressure on each side
- c. Calculate Ankle-to-Brachial Index (ABI) - aka Ankle-to-Arm Index (AAI)
 - i. Use highest brachial (arm) systolic pressure
 - ii. Divide each ankle pressure by this number
- d. Perform a comparison to a Resting ABI Chart, for results
- e. Decide on whether to end testing or continue
 - i. If ABIs are unequivocally normal, end testing
 - ii. If ABIs are abnormal, consider segmental pressures to determine region of disease
 - Decrease in pressure > 30 mmHg between 2 consecutive levels is significant; would suggest obstructive level
 - Horizontal difference from one leg to the other of 20-30 mmHg suggests obstructive disease at or above level in leg w/ lower pressure
 - iii. If ABI < 0.9-0.95, stress testing is appropriate

IV. Performing ABI Stress Test

- a. Contraindications:
 - i. Shortness of breath (SOB)
 - ii. Hypertension
 - iii. Cardiac problems
 - iv. Stroke
 - v. Walking problems
 - An alternate toe-raise technique can be performed; though not as accurate, has value
- b. Technique for exercise testing:
 - i. Have patient walk in a controlled setting, usually:
 - Constant-load treadmill
 - 10% elevation
 - 1.5 mph
 - Length of time is either:
 - i. Maximum of 5 minutes, or
 - ii. Until symptoms become severe, where patient must stop
 - ii. Document all conditions, including onset of symptoms and their progression
 - iii. Obtain post-exercise pressures
 - Record higher brachial arterial pressure
 - Record ankle pressure
 - iv. Repeat pressures every 2 minutes:
 - until they return to pre-exercise values
 - may take up to 20 minutes
 - record time for recovery to take place
 - v. Interpretation of results:
 - Normal arteries increase in pressure after exercise
 - Abnormal disease may decrease (minimally or severely)
 - Interpretation is also based on length of time to recover, symptoms, duration of exercise.
 - vi. Obstruction interpretation by ABIs alone

- d. The sonographic appearance of paired lower extremity veins
2. Explain the importance of vein compliance in assisting with blood flow back towards the heart.
3. Differentiate vessel compressibility in conditions of high transmural pressure versus low transmural pressure.
4. Explain the caveat involving lack of compression of the vein at the level of Hunter's canal.
5. Describe the effects of the muscle pump mechanism.
6. List the common signs and symptoms associated with:
 - a. Acute DVT
 - b. Chronic DVT
7. Define the more common risk factors associated with DVT.
8. Describe the effects of edema from obstructive venous disease (deep venous thrombosis).
9. Delineate the venous effects that should be recorded sonographically during a venous exam with the following maneuvers:
 - a. Respiration
 - b. Valsalva maneuver
 - c. Augmentation with distal compression
10. Identify the most common areas for intraluminal thrombi to occur within the vein.
11. Differentiate the visual finding of venous ulceration versus that of arterial ulceration.
12. Describe the etiology of Virchow's Triad.
13. Differentiate the various sonographic findings of a venous thrombus, based on its age. (Also include an explanation of how vessel walls can be influenced in a chronic venous thrombus.)
14. Briefly provide an explanation of each of these invasive and therapeutic procedures, related to DVT:
 - a. Contrast venography (gold standard)
 - b. Isotope venography
 - c. Lung perfusion scan
 - d. Anticoagulant therapy
 - e. IVC (bird's nest) filter
15. Define/describe the following key terms:
 - a. Augmentation
 - b. Bifid veins
 - c. Cellulites
 - d. Compliance
 - e. Edema
 - i. Pitting
 - ii. Non-pitting
 - f. Gaiter zone
 - g. Hydrostatic pressure
 - h. Perforators
 - i. Phasicity of flow
 - j. Phlegmasia alba dolens
 - k. Phlegmasia cerulean dolens
 - l. Spontaneity
 - m. Thrombophlebitis
 - n. Transmural pressure

Protocol Cards: Due on exam date

Prepare protocol cards for a lower venous imaging study to R/O DVT.

Topic Outline:

- III. Lower Venous Anatomy
 - a. Deep Venous System
 - b. Superficial Venous System
 - c. Perforators
 - d. Calf Muscle Veins

- IV. Venous Hemodynamics
 - a. Venous Resistance
 - i. Pressure gradient
 - ii. Hydrostatic pressure
 - b. Phasic changes in flow
 - i. Cardiac influence
 - ii. Respiratory variation
 - c. Calf Veno-Motor Pump

- V. Etiology and Risk Factors of DVT
 - a. Incidence
 - b. Risk factors
 - c. Symptoms of Acute DVT
 - i. Differentiation of symptoms of superficial thrombophlebitis
 - 1. local erythema
 - 2. local pain/tenderness
 - 3. palpable subcutaneous "cord"
 - ii. Differentiation from persistent, chronic symptoms (not acute)
 - 1. increased echogenicity in thrombus
 - 2. contracted vein (same size or smaller than adjacent artery)
 - 3. large collaterals
 - 4. recanalization with possible fibrous bands
 - 5. phleboliths
 - iii. Differentiation from anterior leg symptoms
 - iv. True DVT symptoms
 - 1. acute onset of persistent calf pain/tenderness (usu. medial or posterior calf)
 - 2. persistent calf/leg swelling
 - 3. phlegmasia cerulean dolens
 - a. massive thigh and calf swelling
 - b. cyanotic limb
 - c. caused by ileo-femoral thrombosis
 - d. Etiology: Virchow's Triad
 - i. Stasis
 - ii. Vein wall (intimal) injury
 - iii. Hypercoagulability

- VI. Lower Venous Duplex Imaging Technique
 - a. Scan technique
 - i. Reverse Trendelenberg
 - ii. Pressurizing veins for increased visualization
 - b. Transverse 2-D imaging with compression
 - c. Doppler Technique
 - i. Color
 - ii. Spectral
 - 1. respiratory phasicity
 - 2. augmentation
 - iii. color imaging of calf veins
 - iv. perforators

- VII. Caveats
 - a. Difficult patients, large legs
 - i. Extrinsic compression to contralateral leg
 - 1. Bilateral continuous flow considerations
 - 2. Unilateral continuous flow considerations
 - ii. Comparison on contralateral waveforms

- b. Inadvertent venous compression (heavy hand)
- c. Difficult to compress at adductor canal
- d. Potential Bifid veins (femoral and popliteal)
- e. Partial thrombus obscured by color Doppler settings
- f. Lack of significant respiratory variation in some patients

VIII. Differential Diagnoses

- a. Popliteal cyst
- b. Hematoma
- c. Lymphadema
- d. Lymph nodes
- e. Cellulitis
- f. Other differentials
 - i. Tumor
 - ii. Abscess
 - iii. Arterio-venous fistula



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Part 11 Lower Venous for Insufficiency

Fall

Reading Assignment(s): Zwiebel, Ch. 26 & 27

Homework Assignment(s): Instructional Objectives

Instructional Objectives: Due on exam date

1. List the typical number of valves in the following locations:
 - a. Greater saphenous vein
 - b. Lesser saphenous vein
 - c. Soleal sinuses
 - d. Perforators
 - e. Infrapopliteal (deep veins)
 - f. Popliteal and superficial femoral
 - g. Common femoral
 - h. External iliac veins
 - i. Common iliac veins
 - j. Internal iliac veins
 - k. Inferior vena cava
2. Explain the importance of the venous valves, particularly their placement within the lower venous system.
3. Describe the most common reason for chronic venous insufficiency.
4. Identify the most common areas for intraluminal thrombi to occur within the vein.
5. List the most common signs and symptoms of venous insufficiency in the lower limbs.
6. Identify the common sonographic/vascular lab findings of venous insufficiency.
7. Differentiate the causes of primary and secondary varicose veins in the legs.
8. Briefly provide an explanation of each of these invasive and therapeutic procedures, related to venous

insufficiency:

- a. Sclerotherapy
- b. Saphenous vein stripping

9. Contrast venography (Define/describe the following key terms:

- a. Hydrostatic pressure
- b. Incompetence
- c. Pressure gradient
- d. Stasis dermatitis

Protocol Cards: Due on exam date

3. Prepare protocol cards for the following lower venous insufficiency studies:

- a. Doppler Insufficiency Protocol: Deep Veins
- b. Doppler Insufficiency Protocol: Superficial Veins
- c. Doppler Insufficiency Protocol: Perforators
- d. Evaluation of Varicosities

Topic Outline:

- I. Review of Lower Venous Anatomy
 - g. Deep Venous System
 - h. Superficial Venous System
 - i. Perforators
 - j. Calf Muscle Veins

- II. Review of Venous Hemodynamics
 - k. Venous Resistance
 - i. Pressure gradient
 - ii. Hydrostatic pressure
 - l. Phasic changes in flow
 - i. Cardiac influence
 - ii. Respiratory variation
 - m. Calf Veno-Motor Pump
 - n. Incompetent Venous Valves
 - i. Symptoms of venous insufficiency
 - 1. recurrent swelling (low into foot)
 - 2. chronic limb swelling
 - 3. varicosities
 - 4. venous claudication
 - 5. stasis dermatitis
 - 6. ulceration
 - ii. Causes of venous insufficiency
 - 1. primary venous insufficiency
 - a. congenital absence of valves
 - b. less common
 - 2. secondary venous insufficiency
 - a. damaged valves from previous thrombosis
 - b. most common

- III. Lower Venous Duplex Imaging Technique
 - a. Various assessment techniques
 - i. Color Doppler
 - ii. Photoplethysmography

- iii. Plethysmography
 - b. Doppler Insufficiency Protocol: Deep Veins
 - i. reverse Trendelenburg position (~30 deg elevation)
 - c. Doppler Insufficiency Protocol: Superficial Veins
 - d. Doppler Insufficiency Protocol: Perforators
 - e. Evaluation of Varicosities
-