Course Description
This course will provide the student with ongoing instruction in non-invasive vascular sonography and testing. The day-to-day operation of the vascular laboratory includes patient testing, interpreting the results of the tests performed, managing paperwork, and interacting with technologists, physicians and other healthcare professionals. Various forms of instrumentation and techniques are used for the non-invasive assessment of vascular patients. Ultrasound, plethysmography and transcutaneous monitoring are among the most common. This course continues the instruction on use of instrumentation and methodologies applied to expanded vascular testing, what data are collected & measured, interpretation of results, and testing limitations. Instruction will include normal and abnormal anatomy, physiology and pathophysiology.

Through lectures and laboratory workshop training non-invasive vascular sonographic and physiologic testing modalities will be applied to additional vasculature and vascular beds.

Credits/Modes of Instruction
Non-invasive Vascular Diagnostics II will consist primarily of 48 classroom hours (web enhanced), approximately ½ hour of weekly reading, 16 hours of project preparation time, and 1 hour of weekly laboratory sessions. Other time will be necessary for the student to manage in the preparation and completion of quizzes, examinations, term paper preparation and 1 student presentation. 3 credits will be awarded upon successful completion of course requirements.

Prerequisites
CVXS4511 Non-invasive Vascular Diagnostics I. Students matriculated in the Cardiac Sonography Program.

Instructor
Garth Nanni, office 908-889-2468, email nannigs@shp.rutgers.edu
Office hours by appointment

Course Goals and Objectives:

Goals
The goal of this course is to apply the modalities and methods previously learned in CVXS4511 Non-invasive Vascular Diagnostics I to new areas of the body and expand the student’s understanding of normal and abnormal anatomy, physiology and pathophysiology in those areas. Students must have sound knowledge of these methods to produce diagnostic quality examinations.
**Objectives**
The general objective of this course is to build on the student’s knowledge of vascular testing and expand skills to additional areas of the body. At the conclusion of this course the student will be able to perform/demonstrate the following:

1. Hemodynamic principles in review.
2. Identify the major arteries of the upper and lower extremities and the branches of the abdominal aorta
3. Differentiate between arterial and venous wall anatomy at the microscopic level
4. List the risk factors and mechanisms for arterial disease
5. List the most common sites for arterial disease in the peripheral arterial system
6. Differentiate fusiform, saccular, and dissecting aneurysms
7. List common nonatherosclerotic vascular disorders
8. Differentiate the symptoms of acute arterial occlusion and chronic arterial occlusive disease
9. Relate the difference between primary and secondary Raynaud’s syndrome
10. Describe the capabilities, limitations, protocols/techniques and diagnostic criteria for noninvasive peripheral arterial test procedures
11. Define correlative imaging techniques
12. Describe the current treatment options for patients with peripheral arterial disease
13. Identify the arteries and veins of the abdomen and list the major branches of the abdominal aorta
14. List the common risk factors for abdominal arterial and venous disorders
15. Describe the mechanisms of disease for renovascular hypertension, renal fibromuscular dysplasia, abdominal aortic aneurysm, portal hypertension and acute and chronic mesenteric ischemia
16. Describe the variations in vascular resistance in the mesenteric arterial system during fasting and post-prandial states
17. Relate the clinical presentation of patients with abdominal aortic aneurysm, portal hypertension, and chronic mesenteric ischemia
18. Describe the capabilities, limitations, patient positioning, protocols/techniques, and current diagnostic criteria for duplex sonography of the abdominal aorta, renal and mesenteric arteries and the hepatoportal system
19. Differentiate normal and abnormal Doppler spectral waveforms from the hepatic and portal veins and the inferior vena cava
20. Describe the correlating imaging modalities used for confirmation of abdominal vascular disease
21. Describe the current treatment options for patients with renovascular hypertension, mesenteric ischemia, abdominal aortic aneurysm and portal hypertension

**Course Requirements**

**Requirements for Completion**

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Quizzes</td>
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<tr>
<td>Mid-term Examination</td>
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<tr>
<td>Final Examination</td>
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<tr>
<td>Student case presentations*</td>
<td>10%</td>
</tr>
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<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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*The course requires the completion case studies that are present to the class by the student. The instructor will provide details of the case studies by the second week of the term. Students will be assigned dates for presentations.

**Special Enrollment Requirements**

The student will need the use of a computer with internet access for web enhanced components (Moodle course management software).

**Evaluation, Feedback and Grading**

**Evaluation/Assessment Methods**

The efficacy of this course will be assessed through:
- student evaluation of the course and instructor
- student adaption of material to clinical education
- ongoing analysis of test scores
- certification exam results (as applicable)

**Feedback on Progress**

The student will receive feedback on progress via review of quizzes and examinations.

**Course Evaluation by Students**

At the conclusion of the course, students will complete the standard SHP course evaluation form available by hardcopy distributed by the instructor or via the Moodle course management system.

The program faculty and staff also monitor national credentialing examinations (offered American Registry of Diagnostic Medical Sonography and Cardiovascular Credentialing International) for graduate pass rates as a measure of course/program effectiveness.

The program also conducts an employer survey post graduation as a further measure of course/program effectiveness.

Any additional suggestions/comments during the semester may be solicited.

**Grade Determination**

A grade of 80% has been established as the satisfactory level for all academic and clinical courses in the Cardiac Sonography program. A final grade below 80% at any time during enrollment in the program may subject a student to dismissal. A student who receives two final grades below 80% will automatically be dismissed from the program.

The grade for this course will be letter grade as noted below.
<table>
<thead>
<tr>
<th>Weighted Average of All Requirements</th>
<th>Final Letter Grade</th>
<th>Grade Quality Description</th>
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<tbody>
<tr>
<td>93-100%</td>
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<tr>
<td>90-92.9%</td>
<td>A-</td>
<td>Pass</td>
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<tr>
<td>87-89.9%</td>
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<tr>
<td>83-86.9%</td>
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<td>80-82.9%</td>
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<td>77-79.9%</td>
<td>C+</td>
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<tr>
<td>73-76.9%</td>
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<td>70-72.9%</td>
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<td>67-69.9%</td>
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<tr>
<td>63-66.9%</td>
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<tr>
<td>&lt;63</td>
<td>F</td>
<td>Fail</td>
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</tbody>
</table>

*Should the student's final average fall in the range: ≥75% & <80% they will be afforded an opportunity to retake a failed mid-term or final examination to achieve a passing final average. This is with the understanding that the highest final average for grading achievable will be 80%. Retake of an examination is at the discretion of the instructor in consultation with the program director taking into consideration the student’s standing in other courses (i.e. a student with multiple failed or failing courses may not be afforded the examination retake opportunity).

**Faculty/Student Honor Code**

(Refer to your SHP Student Handbook at [http://shp.rutgers.edu/current_students/pdf/Handbook.pdf](http://shp.rutgers.edu/current_students/pdf/Handbook.pdf))

The faculty of Rutgers – School of Health Professions believe that students must observe and support high standards of honesty and integrity in all aspects of education, practice, and research. For this reason, all matriculated and non-matriculated students in this course are expected to abide by the School's Faculty/Student Honor Code and accept responsibility to help ensure that these standards are maintained by reporting violations of the Honor Code observed in others. All violations will be considered with gravest concern and may be punishable with sanctions as severe as suspension or dismissal.

**General Learning Resources**

**Required Textbook(s)**
Other Required Learning Resources
Recommended or Supplemental Learning Resources
None

Course Units/Schedule

Peripheral Arterial

Week 1/2

A. Anatomy review
   1. Upper extremity arteries
   2. Abdominal aorta
      a. Functional division
      b. Branches
   3. Lower extremity arteries
   4. Microscopic anatomy of the arterial wall, capillaries, arterioles

B. Risk Factors
   1. Controllable risk factors
   2. Uncontrollable risk factors

C. Mechanisms of Disease
   1. Atherosclerosis
   2. Embolization
   3. Aneurysm
      a. Fusiform
      b. Saccular
      c. Dissecting (arterial)
      d. Pseudoaneurysm
   4. Nonatherosclerotic lesions
      a. Arteritis
      b. Vasospastic disorders
      c. Aortic coarctation
      d. Entrapment syndromes
      e. Popliteal adventitial cystic disease

D. Signs and Symptoms
   1. Chronic occlusive disease
      a. Claudication
      b. Ischemic rest pain
      c. Trophic changes
   2. Acute arterial occlusion
      a. Embolic
      b. Thrombotic
      c. Trauma
      d. Six P’s
   3. Vasospastic disorders
      a. Digital cold sensitivity
   4. Physical examination
      a. Skin (dermal) changes
      b. Palpation of pulses
c. Auscultation of pulses

**Week 3/4**

E. Noninvasive Test Procedures
   1. Indirect (physiologic) testing
      a. Segmental systolic pressure measurements
      b. Constant-load treadmill exercise testing
      c. Reactive hyperemia
      d. Plethysmography
   2. Direct testing
      a. Continuous wave (CW) Doppler evaluation
      b. Duplex imaging/color flow imaging

F. Correlative and/or Prior Imaging
   1. Conventional arteriography
      a. Interpretation
      b. Stenosis
      c. Occlusion
      d. Collaterals/intracranial cross-filling
      e. Limitations
   2. Digital subtraction angiography
   3. Interpretation
   4. Stenosis
   5. Occlusion
   6. Collaterals/intracranial cross-filling
   7. Limitations
   8. Computed tomographic arteriography
   9. Interpretation
   10. Stenosis
   11. Occlusion
   12. Collaterals/intracranial cross-filling
   13. Limitations
   14. Magnetic resonance angiography
   15. Current clinical use
   16. Interpretation
   17. Stenosis
   18. Occlusion
   19. Collaterals/intracranial cross-filling
   20. Limitations

**Week 5**

G. Treatment
   1. Indications for treatment
   2. Medical
   3. Surgical

**Abdominal Vasculature**

**Week 6/7/8**

H. Mechanisms of Disease
   1. Renovascular hypertension
      a. Consistent clinical features
      b. Etiology
   2. Mesenteric angina/ischemia
3. Portal hypertension
   a. Portal splenic vein thrombosis
   b. Cirrhosis
   c. Budd-Chiari syndrome

4. Abdominal aortic aneurysm
   a. Size
   b. Location
   c. Classification
   d. Etiology

I. Signs and Symptoms
   1. Arterial
      a. Acute mesenteric ischemia
      b. Chronic mesenteric ischemia
      c. Renal
      d. Aneurysm
   2. Venous
      a. Portal
      b. Hepatic
      c. IVC

**Week 9/10**

J. Noninvasive Test Procedures
   1. Direct-duplex imaging/color flow imaging
      a. Patient positioning
      b. Examination protocol
      c. Imaging and spectral Doppler techniques
         i) Aorta
         ii) Celiac, splenic, and hepatic arteries
         iii) Mesenteric arteries
         iv) Renal arteries
         v) IVC
         vi) Hepatic veins
         vii) Portal, splenic, and mesenteric veins
         viii) Renal veins
      d. 2-D interpretation
         i) Normal characteristics
         ii) Abnormal characteristics
         iii) Measurements
      e. Spectral Doppler interpretation
         i) Normal characteristics
         ii) Abnormal characteristics
         iii) Measurements
      f. Waveform analysis
         i) Triphasic
         ii) Biphasic
         iii) Monophasic
         iv) Continuous, non-phasic
         v) Pulsatile
g. Color Doppler interpretation
   i) Presence/absence of flow
   ii) Direction of flow
   iii) Flow characteristics
h. Capabilities
i. Limitations

Week 11/12
K. Correlative and/or Prior Imaging
   1. Conventional arteriography
      a. Interpretation
      b. Limitations
   2. Digital subtraction arteriography
      a. Interpretation
      b. Limitations
   3. Computed tomographic arteriography
      a. Interpretation
      b. Limitations
   4. Magnetic resonance arteriography (MRA)
      a. Current clinical use
      b. Interpretation
      c. Limitations

Week 13/14
L. Treatment
   1. Indications for treatment
   2. Medical
   3. Surgical
   4. Endovascular

Week 15/16
M. Course review
N. Student Presentations
O. Final Examination

The course will take place during the Spring program semester - see program schedule on the group website, Rutgers-SHP internet portal.

Information for Students with Disabilities
Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: http://shp.rutgers.edu/current_students/disability_services/register_ds.html. If the documentation supports your request for reasonable accommodations, your campus’s disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the Rutgers Office of Disability Services website at: https://webapps.rutgers.edu/student-ods/forms/registration

Reference