VASCULAR LABORATORY POLICIES & PROCEDURES

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VASCULAR LABORATORY POLICIES & PROCEDURES MANUAL

ON DISK, ON TARGET, ON TIME. For any lab that is preparing for accreditation, documenting or revising its policies and procedures, or looking for an extremely convenient, authoritative, and powerful reference on noninvasive vascular procedures, here is good news. This is it. Edited by Claudia Rumwell, Michalene McPharlin, D. Eugene Strandness, and Edward G. Grant, reviewed by a fourteen-member board of prominent vascular laboratory medical directors, written by twenty-six expert technologists from the leading vascular laboratories and medical centers in the country, and endorsed by the Society of Vascular Technology, this is the first and only comprehensive policies and procedures manual published for the vascular laboratory. And it's on disk. Which means that you can load it into your PC or Apple Macintosh, put your name on it, modify it however and whenever you want, print it out in whole or in part for circulation and reference, access any policy or exam protocol in seconds, and feel terribly superior to the vascular laboratory that doesn't have it.

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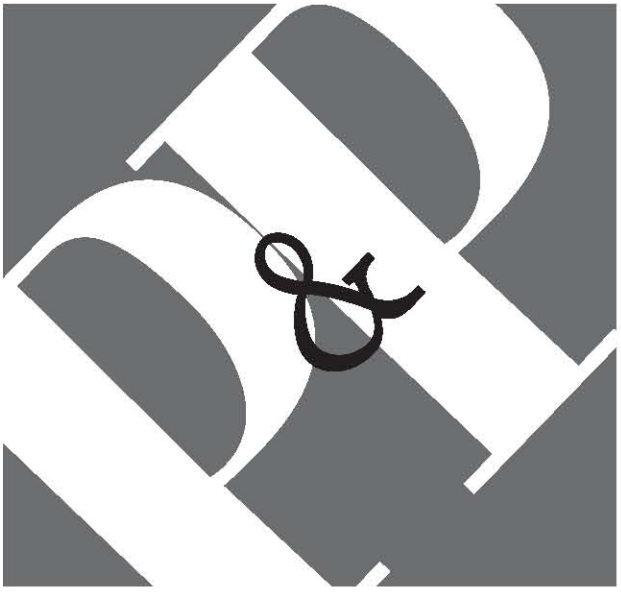

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Davies Publishing, Inc.
Publishers in Medicine and Surgery
32 South Raymond Avenue
Pasadena, California 91105-1935
Telephone 626.792.3046/*Facsimile* 626.792.5308

Printed and bound in the United States of America.

ISBN 0-941022-49-8 [PC Windows version 3.0]

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Vascular Laboratory
Policies & Procedures Manual

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Venous Procedures
Revised/Approved Date:

1 PURPOSE

To rule out or identify thrombosis in the veins of the legs, to identify the exact location and extent of the thrombus, and to allow qualitative analysis of its characteristics.

2 INDICATIONS

2.1 Leg pain of questionable etiology.

2.2 Tight, swollen leg.

2.3 Tenderness in the leg.

2.4 Feeling of heaviness in the leg.

2.5 Discoloration of the leg.

2.6 Question of pulmonary embolism.

2.7 Surveillance before or after surgery or other high-risk event.

2.8 Chronic leg ulcers or stasis color changes in the leg.

2.9 Varicose veins (preoperative scan).

3 CONTRAINDICATIONS AND LIMITATIONS

3.1 Site trauma such as open wounds over the scan area.

3.2 Casts that cannot be removed or traction that limit access to the scan areas.

3.3 Severe obesity.

3.4 Severe leg edema.

3.5 Patients who cannot be adequately positioned.

4 EQUIPMENT AND SUPPLIES

4.1 High-resolution real-time imager and integrated, pulsed, range-gated Doppler, with or without color flow imaging.

4.2 Transducer (5-10 MHz) that allows visualization to 6 cm as well as excellent views in the near field. Some systems may require the use of two separate probes to accomplish this (a 10 MHz probe for work within the first 3 cm below the skin and a 5 MHz probe for deeper vessels).

4.3 Doppler color flow imaging is helpful but not essential.

4.4 Continuous-wave Doppler capability is optional.

4.5 Tilt table or bed that can produce a reversed Trendelenburg's position.

4.6 Gel and optional gel warmer.

4.7 Face towels or paper hand towels for gel removal.

4.8 Material for hard copy documentation, e.g., videotape, color video printer, multi-image radiographic film.

5 PATIENT PREPARATION

5.1 Explain the procedure to the patient.

5.2 Have the patient disrobe from the waist down and put on a gown.

5.3 Place the patient on the table or bed in a supine position with the hips slightly rotated externally and the knees slightly bent.

5.4 Documentsymptomology or appropriate indications and other relevant medical history.

5.5 Place the bed or table in a reversed Trendelenburg's position (head elevated about 10-20°). Note: This is essential to a proper examination.

5.6 The room should be warm. If the room is cool and temperature cannot be regulated, warm the patient by using heated blankets or other measures.

6 PROCEDURE: GENERAL CONSIDERATIONS

6.1 Proper vessel visualization:

The vessel must be visualized clearly in a transverse view. It should appear round (if not, check to ensure proper elevation of the bed or have the patient dangle the leg off the side of the bed). The size of the vessels can also be affected by the position of the bed or the room temperature.

6.2 Full compression of the vein:

Once the vein is visualized in a transverse view, light probe pressure is exerted directly over the vessel. If the vein is thrombus free, it will collapse completely. If thrombus is present, echogenic material will be visualized within the lumen, and the thrombus will limit the compression of the vessel. If the vein is incompressible, but no echogenic material is visualized, more pressure is exerted over the vein. If the accompanying artery compresses and the vein does not, thrombus can be said to be present.

6.3 Doppler and color flow information:

Optimal Doppler signals must be obtained, i.e., velocity, wall filter, and color must be set appropriately.

7 **PROCEDURE: TEST PROTOCOL**

7.1 Document Doppler signals at the common femoral, superficial femoral, popliteal, and posterior tibial veins. Use continuous-wave Doppler before imaging begins or the pulsed-wave Doppler during imaging. Listen for a spontaneous (flow that is detected even without augmentation), phasic (waxing and waning in response to respiration), and competent venous signal (flow stops in response to a Valsalva maneuver or proximal manual compression). Augmentation of the signal should be detected with distal limb compression.

Note: Signals at the posterior tibial veins may not be spontaneous or phasic.

7.2 Image the thigh veins:

Begin imaging at the groin crease. Use the transverse view so that more than one vessel can be visualized at one time and also because this view permits the most accurate assessment of vein wall compressibility. At this level, only two vessels are visible: the common femoral vein and the common femoral artery. The vein is differentiated from the artery by exerting light probe pressure. If it is thrombus free, the vein will compress while the artery will take much more pressure to close. If there is still a question about proper vessel identification, Doppler or color scanning may be used.

Once the vessels have been properly identified, focus attention on compressing

the vein to identify or rule out thrombus. If the vein compresses completely, it is thrombus free at that location (see Interpretation below). Compression is then released, and the probe is moved down the medial aspect of the thigh approximating the course of the femoral vein. Compressions should be about 1 inch apart. Using this technique, follow the femoral vein down the medial aspect of the thigh. In the distal third of the thigh, the superficial vein dives deep as it passes through the adductor canal. At this point, return to the groin crease and identify the greater saphenous vein as it separates from the femoral vein. It moves quickly toward the skin line and travels without an accompanying artery.

7.3 Image the saphenous vein:

Follow the saphenous vein down the medial portion of the thigh until it takes an anterior turn just below the knee. Follow it near the tibia as it courses down the calf. Continue to follow it into the foot just anterior to the medial malleolus. Because this vein is superficial, it can be compressed easily by the weight of the probe resting on the skin. To prevent this, apply additional gel so that the probe glides along the gel-coated skin.

7.4 Image the posterior tibial veins:

Use the space between the Achilles tendon and the medial malleolus as a landmark to locate the posterior tibial veins. At this level, the veins are paired and accompanied by the posterior tibial artery. Once these vessels are identified, follow them up the medial surface of the calf.

7.5 Image the peroneal veins:

A few inches up the calf, the peroneal veins and artery are visible. They are located by identifying the fibula (a bright reflective target about 3-5 cm deep in the calf). The peroneal vessels appear just superficial to this landmark when the vessels are being imaged from a medial projection.

7.6 Image the soleal and perforator veins:

The posterior tibial and peroneal vessels are followed up the calf. Midway up the calf, the soleal veins are identified as they connect with the posterior tibial and peroneal veins. Perforators are also seen connecting the posterior tibial and peroneal veins with the superficial system.

7.7 Image the common tibial and common peroneal trunks:

In the upper third of the calf, the two posterior tibial veins combine to form one vessel, the common tibial trunk. The two peroneal veins likewise combine to form one vessel, the common peroneal trunk.

7.8 Image the popliteal vein:

Follow the common tibial and common peroneal trunks further up the calf from a posteromedial position into the distal popliteal space, where these two trunks combine to form the popliteal vein. Scan the gastrocnemius veins. Continue to follow the popliteal vein, at the same time observing the gastrocnemius veins that join the popliteal vessel in the mid to upper popliteal space. These are paired veins that are accompanied by a very small artery.

7.9 Image the lesser saphenous vein:

The lesser saphenous vein also joins the popliteal vein at this level. Follow the lesser saphenous vein down the posterior surface of the calf until it passes between the lateral malleolus and the Achilles tendon.

7.10 Image the anterior tibial veins:

Place the probe on the anterior portion of the dorsal aspect of the foot near the ankle and identify the anterior tibial veins (paired) and the anterior tibial artery. Follow these vessels up along the lateral surface of the tibia until they pass between the heads of the tibia and the fibula just below the knee. At this point, the anterior tibial veins will penetrate deep and eventually connect with the popliteal vein.

7.11 Document findings using Doppler flow information:

Once all of the veins have been thoroughly scanned in a transverse plane using gray-scale information alone, color views are added as needed. Turn on the color and adjust the thresholds for venous imaging: this usually means adjusting for slow-velocity detection, dropping wall filters, and increasing color gains. Color is helpful:

7.11.1 Whenever thrombus is identified. The color is used to document flow around the thrombus or the presence of collateral vessels.

7.11.2 Whenever an incompressible area is encountered where corresponding echogenic material is not clearly seen. The color may document flow (if the vessel is patent) or lack of flow (if the vessel is occluded).

7.11.3 Whenever poor gray-scale views restrict proper vessel identification.

7.11.4 Whenever vessels are not accessible for good compression. Color study may show flow through a vein that was not accessible for compression, thus ruling out obstruction.

7.11.5 Whenever a question of venous insufficiency is present. Venous reflux is easily identified by noting color changes indicating flow reversal in response to a Valsalva maneuver or proximal manual compression.

Note: The presence of color flow in a vein indicates that the vessel is patent but not necessarily that it is thrombus free. This crucial distinction can be made only by compressing the vein.

8 **DOCUMENTATION**

8.1 The examination is performed with the videotape running so that the entire scan is documented. The name of the patient is entered on screen, as are the date of the examination and the leg being scanned. Each videotape is numbered for easy reference.

8.2 Color photographs are taken of selected points of interest in order to augment the videotape documentation of the examination and to provide summary information for referring physicians as well as a quick reference for the reading physician. Vessel identification and the pathology identified are annotated on these photographs.

8.3 A brief history sheet is filled out for each examination, including the name of the patient, patient number, the date of the examination, the referring physician, and any other information deemed pertinent.

8.4 A Doppler worksheet is completed that indicates that signals were heard in the common femoral, superficial femoral, popliteal, and posterior tibial veins.

8.5 A vein scan worksheet is filled out showing all of the veins that were visualized. Areas that were identified as clear are circled and labeled "clear." Areas where thrombus was located are filled in with a red pen and annotated to indicate the apparent characteristics of the thrombus. All other pathology is likewise marked on this sheet. Areas where visualization was not diagnostic are crossed off and accompanied by an explanation. This sheet should reference the videotape number where these findings can be reviewed. Any technical difficulties encountered during the examination that may influence the quality of the information are also noted on this sheet.

8.6 A preliminary report sheet is filled out for each patient. When a preliminary report is made by the technologist, the impression given to the referring physician is summarized here. The physician receiving the report, the impression given, and the technologist making the report are recorded on this form.

8.7 The aforementioned sheets are compiled into a single patient chart, which is kept on file for a minimum of 3 years. A separate 3 x 5 inch index card is created for each patient indicating the date and type of each study and an identification number by which the file can be located. This card is kept permanently.

9 INTERPRETATION

9.1 Normal Doppler signals:

The Doppler information is interpreted to be normal when:

9.1.1 Spontaneous and phasic signals are heard at all levels except at the posterior tibial veins, where signals may or may not be spontaneous or phasic.

9.1.2 Distal compression of the limb augments the Doppler signals.

9.1.3 Performance of the Valsalva maneuver causes the signals to cease.

9.2 Abnormal Doppler signals:

9.2.1 When venous Doppler signals are absent, obstruction of the vein at that level is suspected.

9.2.2 When a signal is present but is continuous, proximal obstruction or compression is suspected.

9.2.3 When distal compression does not augment the venous signal, obstruction distal to the probe is suspected.

9.2.4 Weak or damped augmentation suggests total or partial obstruction of veins distal to the probe.

Note: Normal Doppler signals may be present when thrombus is nonobstructive.

9.3 Normal imaging observations:

When imaging the vein in a transverse plane, the vein is first observed for the presence or absence of visible echogenic material. If no echogenic material is visualized, the vein is compressed using probe pressure. If the vein collapses completely and no echogenic material is seen, the vein is thrombus free at that location. Color will fill the vein completely in response to distal limb compression.

9.4 Abnormal imaging observations:

Thrombus can be said to be present when:

9.4.1 Echogenic material is visualized within the vein, and compression of the vein is observed to be limited by the contained thrombus.

9.4.2 The color moves around the echogenic material with distal limb compression if the thrombus is not fully occlusive.

9.4.3 The vein is occluded; no flow is identified within it.

Note: In some views, color flow may appear to cover a nonobstructive thrombus, especially if color gains are set too high.

9.4.4 If no echogenic material is visualized but the vein does not collapse completely with light probe compression, more pressure is exerted. If the artery next to the vein compresses and the vein does not, thrombus is likely present. Color flow imaging can be used to confirm this.

9.4.5 Once thrombus is identified, attention is focused on the characteristics of the thrombus. As a rule, acute thrombus will be:

- Lightly echogenic (almost invisible).
- Poorly attached to the vein wall.
- Spongy.
- Dilating the vein wall (if the vein is totally obstructed).

9.4.6 Chronic thrombus will:

- Appear more brightly echogenic.
- Be better attached to the vein wall.
- Have a rigid texture.
- Contract the vein wall over time (if the vein is totally obstructed).
- Be accompanied by large collateral veins nearby.

10 **REPORTING**

10.1 When an examination of an outpatient is completed, the preliminary impression is telephoned or faxed to the referring physician while the patient is getting dressed. Ideally, the technologist speaks directly with the physician before the patient is allowed to leave. If the results are normal and the physician is not available, the patient may go home and be instructed to await subsequent instructions from the physician. If the physician is not available and the results are positive, the technologist must either find a way to contact the physician or contact another physician regarding appropriate treatment. The medical director should become involved as necessary.

10.2 If the venous imaging study is done on an inpatient, the physician is called in a timely fashion, and a note is placed in the chart.

10.3 The study is reviewed by the medical director or reading physician, and an official report is dictated in a timely fashion. The dictation is transcribed by the secretary, who returns the report to the medical director or reading physician for his/her signature.

10.4 A copy of the signed report is sent to the referring physician (in the case of an outpatient), and a copy is placed in the chart (in the case of an inpatient).

10.5 A copy of the final report is placed in the patient chart (laboratory chart) along with the technical worksheets (see section 8 above). The chart is filed in the vascular lab.

11 **CLEANING AND CARE OF EQUIPMENT**

11.1 Gel is wiped off the probes after each use.

11.2 Whenever blood, body fluids, or possibly infected materials come in contact with the probe, it is cleaned as directed by the manufacturer.

12 **REFERENCES**

1. Nix L: Doppler diagnosis of deep venous thrombosis. In Hershey FB, Barnes RW, Sumner DS (eds): *Noninvasive Diagnosis of Vascular Disease*. Pasadena, Appleton Davies, 1984, pp 117, 125.

2. Talbot SR, Oliver MA: Thrombus identification and characterization. In *Techniques of Venous Imaging*. Pasadena, Appleton Davies, 1992, pp 37-58.

3. Talbot SR, Oliver MA: *Venous Imaging Techniques* [video], 2nd edition. Pasadena, Davies Publishing, 1998.