

Duplex of Upper Extremity Vessels prior to AVF Surgery

OLYMPIC VASCULAR LAB

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PURPOSE:

To assess the patency and suitability of the arteries and veins for use as a dialysis arterio-venous fistula (AVF). The cephalic and basilic veins are preferred AVF conduits for hemodialysis. The patient is usually first referred from the nephrologist to the surgeon for AVF evaluation. After examining the patient, the surgeon selects the preferred extremity for the pre-op mapping study. If suitable vessels are identified, the necessity of performing a bilateral study can be avoided; if suitable vessels are not identified in the preferred extremity, then the contralateral extremity will need to be studied as well.

INDICATION:

Patients in renal failure who require an arterio-venous fistula for hemodialysis.

CONTRAINDICATIONS AND LIMITATIONS:

- A. The following conditions limit the areas accessible to the ultrasound beam:
 - 1. Open wound, fresh incision, ulceration, or skin staples
 - 2. Bandages and casts
 - 3. Trauma.
- B. Patient position and inability to move (e.g., surgical procedure, traction, paralysis) may limit ability to perform adequate arm vessel mapping.

EQUIPMENT AND SUPPLIES

- A. High-resolution B-mode duplex with color flow imager.
- B. Standard supplies for ultrasonic exam: acoustic coupling gel, gloves and skin wipes.
- C. Tourniquet for re-measuring vein size after initial diameter and depth measurements are performed.
- D. Although not absolutely necessary, heating pads and warm room help facilitate the exam and give a more accurate representation of vessel size.
- E. Liquid marking ink (gentian violet) if skin mapping is required.
- F. Pillow(s) or foam pad to position the patient comfortably.
- G. Material for hard copy documentation (i.e. Video tape, PAC, or MO Disc).

PATIENT PREPARATION:

- A. Explain the procedure to the patient and answer any questions.
- B. Document the pertinent history and appropriate indications.
- C. The patient may be sitting, resting supine with the arms dependent, placed in the reverse Trendelenburg position, or placed in a Trendelenburg position with hands over head. Patient position should be optimized so that gravity helps dilate the veins.
- D. Room and Patient should be warm and comfortable.
- E. A heating pad or hot water bottle can be used (with caution) around the hand during forearm or upper arm imaging or around the forearm during upper arm imaging. The pad temperature should be below 44 C.
- F. After initial measurements (diameter and depth) and especially if the veins are of small size (< 2.5cm, Silva), a tourniquet **MUST ALWAYS** be placed around the upper arm and/or the forearm to dilate the veins and optimize the procedure.
- G. Hand exercise may help dilate the veins.
- H. Tapping the veins may be helpful by inducing reactive dilatation.

PROCEDURE: GENERAL CONSIDERATIONS:

- A. Before beginning, make sure that both the Vascular Technologist and the patient are comfortable. Complex and small venous systems can take as long as 1 hour to map.
- B. Use enough gel to facilitate visualization.
- C. Marking the skin may not be needed; check with the appropriate physician. During excision, the surgeon usually traces the pathway of the vein under direct vision. Marking may help in cases of unusual anatomy or double channels or for the design of dialysis fistulas. Make sure to keep the probe perpendicular to the surface of the skin so that the line marked on the surface is directly over the vein. Use a short straw or coffee stirrer to mark the skin through the gel. After completing a section, wipe the area dry and mark with gentian violet.
- D. Identify venous branches and follow, if they are large, to their completion to avoid missing variant anatomy.
- E. Location of valve sinuses need not be noted unless stenotic or otherwise abnormal.
- F. Confirm patency of vein with pulsed Doppler or color flow imaging. If any question, position Doppler cursor within segment of vein in question and tap vein distally. Color flow examination may speed the entire examination. This only needs to be done when the vein does not coapt with compression or if there is any question of patency.
- G. The veins should be dilated as much as possible. Gravity, heating, occlusion, tapping, and hand exercise can help. However, stagnant flow forced by the application of a tourniquet may make differentiating vein walls from surrounding tissues difficult.
- H. The diameter and depth of the veins (anteroposterior and/or lateral), measured in a transverse plane without any probe compression, should be noted approximately every 2 inches or when a significant change in size is seen. Vein diameter should be measured without and then with a tourniquet. An increase of vein diameter by 50% with tourniquet is indicative of a suitable vein. If depth of vein is more than 8-10 mm (and depending on diameter of vein), the surgeon will need to consider vein transposition to a more superficial position.
- I. Thrombosed, phlebitic and sclerotic segments of the vein should be noted.
- J. Identification of the length of basilic vein is mandatory. If the basilic vein is too short, it may be unsuitable for transposition.
- K. Detailed identification of branches is not essential; however, identification of the particular variants at the median antecubital fossa is mandatory.

PROCEDURE: TEST PROTOCOL

Note 1: Bilateral Blood Pressures should be taken prior to starting exam. This will indicate if there is a significant upper extremity stenosis that could be missed by duplex.

Note 2: Although one may choose to perform study distal-to-proximal, this protocol calls for study to be performed proximal (central)-to-distal (peripheral). In this way, if a central venous stenosis is identified at the outset, further exam of the extremity is avoided and attention can be immediately directed to the contralateral extremity.

VENOUS STUDY

Arm is scanned from proximal to distal, without and then with, tourniquet. If there is a significant proximal arterial or venous narrowing or an abnormality that will jeopardize the success of the AVF, the exam is discontinued. Following the upper arm study, the forearm is studied. Avoid prolonged application of the tourniquet--repeatedly release and re-apply the tourniquet during the study. Essential parameters to be measured include: vessel depth, internal diameter (I.D.) with and without tourniquet, compliance/ability to dilate, continuity with deep system, presence of stenosis/thrombosis, flow rate. Veins should dilate by 50% with use of tourniquet. Veins should be thin walled, vary in size with respiration (the closer to the chest, the greater the variation), collapse completely with compression by transducer and augment with distal compression.

- A. Start at the Internal Jugular vein. Check for patency by identification of flow and changes in vessel size with respiration.
- B. Document flow in both the subclavian artery and vein (arterial flow should be Triphasic). Normal change of the signal during deep Inspiration and Expiration (Respiratory filling of the vein) indicates patency of the Superior Vena Cava.
- C. Locate cephalic vein junction and measure diameter and depth.
- D. Follow the cephalic vein in cross-section with intermittent probe compressions to the antecubital fossa, taking both diameter and depth measurements. Note the presence of, and map, double cephalic systems.
- E. If the upper arm cephalic vein is absent, note if a forearm cephalic vein--upper arm basilic vein connection is present.

INTERPRETATION:

- A. Patent veins greater than 2 mm in diameter usually will result in a fistula greater than 4 mm in diameter. Veins should dilate by at least 50% with use of tourniquet.
- B. Anatomic configuration alone should not be used to interpret an examination as normal or abnormal; also consider venous flow, wall and valve leaflet appearances.
- C. Phasicity with breathing and augmentation with distal compression indicate normal flow.
- D. Lack of flow or diminished augmentation on compression indicate thrombosis and/or obstruction in the same manner as in studies for deep venous thrombosis
- E. Tortuous flow channels suggest recanalization of previous thrombosis
- F. A good vein appears thin-walled and is easily compressible. A poor-quality vein appears thick-walled and has a residue under compression.
- G. If valve leaflets are visualized, they should appear thin and freely moving within the lumen. If the valve leaflet is rigid and fixed, report it as an abnormality.
- H. The interpretation should include specific statements regarding the forearm and upper arm cephalic and basilic veins and comments about anatomic variances.
- I. A copy of the arm vein mapping report, including the drawing of the veins, is sent or given to the referring physician and/or surgeon.
- J. The surgeon should be notified of any serious abnormalities such as vein absence, thrombosis, inadequate length of Basilic vein, or unusual anatomic variants.
- K. A final report is mailed or faxed to the Surgeon and the patient's Nephrologist after medical interpretation and signature. Original copy is filed in the Vascular Lab chart and a copy is also filed in the office chart.

CLEANING AND CARE OF EQUIPMENT:

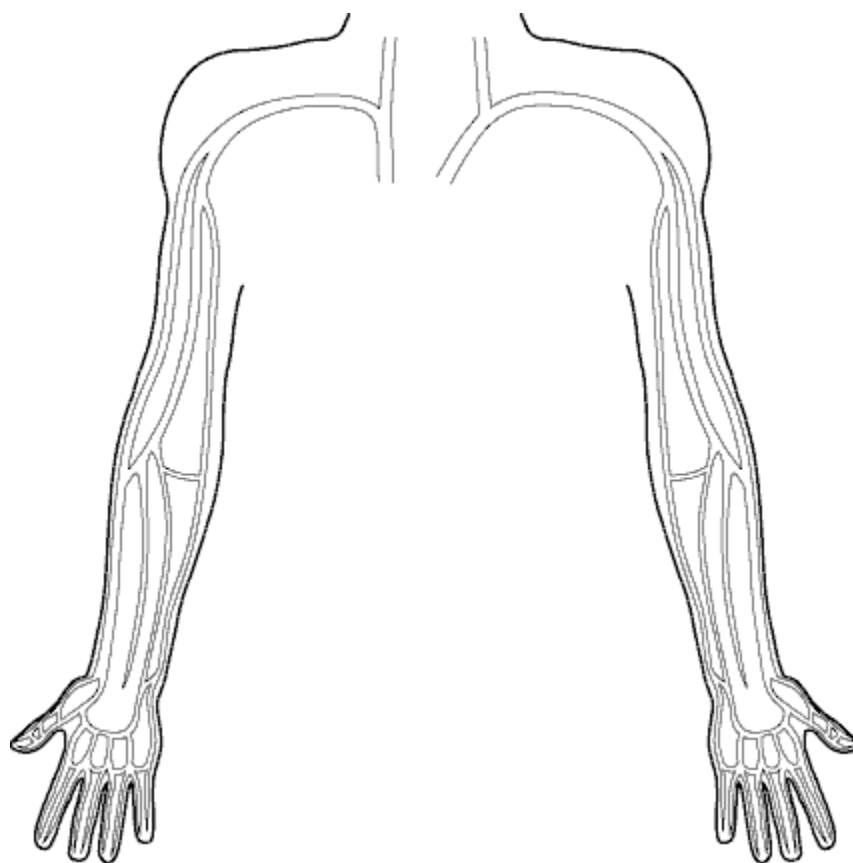
- A. Transducers and equipment are cleaned with appropriate cleaner per the manufacturer.
- B. Heating blankets, tourniquets etc. are wiped clean after use. Alcohol or stronger disinfectant is used as appropriate.
- C. General vascular laboratory routine should be followed as in any other test.

REFERENCES:

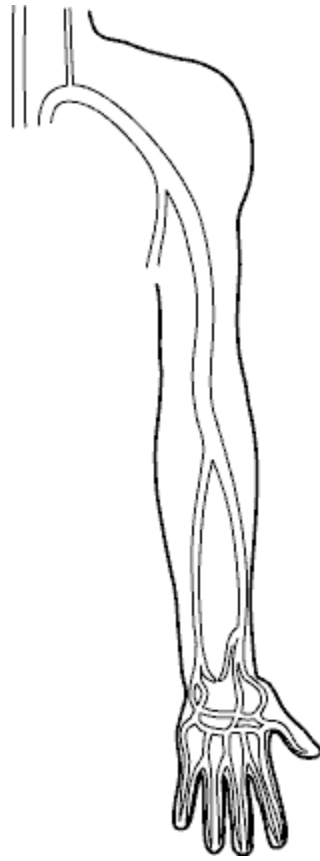
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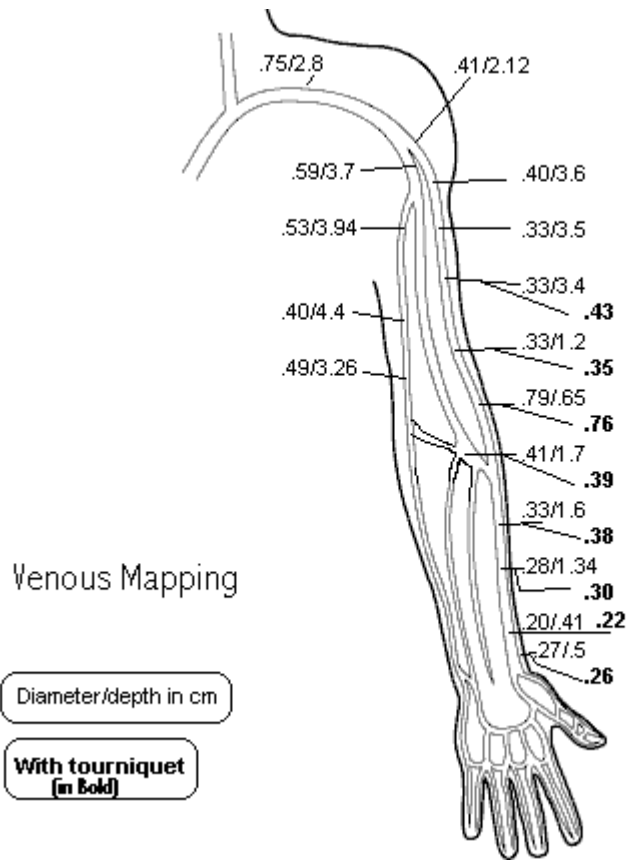
Venous Template



Arterial Template



Venous Map (example)



Arterial Map (example)

