

ACCF 2013 Appropriate Use Criteria for Peripheral Vascular Ultrasound and Physiological Testing Part II: Testing for Venous Disease and Evaluation of Hemodialysis Access

Guidelines and References

Upper Extremity Venous Evaluation

Table 1. Venous Duplex of the Upper Extremities for Patency and Thrombosis

Indication		
Limb Swelling		
1.	<ul style="list-style-type: none"> Unilateral – acute 	<p>American College of Radiology. ACR Appropriateness Criteria. Suspected Upper Extremity Deep Vein Thrombosis Clinical condition: Suspected upper-extremity deep vein thrombosis. Rating upper extremity ultrasound with Doppler 9 (highest, usually appropriate)</p> <p>American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound Practice Guideline for the Performance of Peripheral Venous Ultrasound Examination. Revised 2010. III. The indications for peripheral venous ultrasound examinations include, but are not limited to:</p> <ol style="list-style-type: none"> Evaluation of possible venous thromboembolic disease or venous obstruction in symptomatic or high-risk asymptomatic individuals. Assessment of venous insufficiency, reflux, and varicosities Assessment of dialysis access. Venous mapping prior to surgical procedures Evaluation of veins prior to venous access. <p>Follow-up of patients with known venous thrombosis near the end of anticoagulation to determine if residual venous thrombosis is present.</p>
2.	<ul style="list-style-type: none"> Unilateral – chronic, persistent 	None
3.	<ul style="list-style-type: none"> Bilateral – acute 	None

	<ul style="list-style-type: none"> • Suspected central venous obstruction 	
4.	<ul style="list-style-type: none"> • Bilateral – chronic, persistent • No alternative diagnosis identified (e.g., no CHF or anasarca from hypoalbuminemia) • Suspected central venous obstruction 	None
Limb Pain (Without Swelling)		
5.	<ul style="list-style-type: none"> • Non-articular pain in the upper extremity (no indwelling upper extremity venous catheter) 	None
6.	<ul style="list-style-type: none"> • Non-articular pain in the upper extremity with indwelling upper extremity venous catheter 	None
7.	<ul style="list-style-type: none"> • Tender, palpable cord in the upper extremity 	None
Shortness of Breath		
8.	<ul style="list-style-type: none"> • Suspected pulmonary embolus (no indwelling upper extremity venous catheter) 	None
9.	<ul style="list-style-type: none"> • Suspected pulmonary embolus with indwelling upper extremity venous catheter. 	None
10.	<ul style="list-style-type: none"> • Diagnosed pulmonary embolus (no indwelling upper extremity venous catheter) 	None
11.	<ul style="list-style-type: none"> • Diagnosed pulmonary embolus with indwelling upper extremity venous catheter. 	None
Fever		
12.	<ul style="list-style-type: none"> • Fever of unknown origin (no indwelling upper extremity venous catheter) 	None
13.	<ul style="list-style-type: none"> • Fever with indwelling upper extremity venous catheter 	None
Known Upper Extremity Venous Thrombosis		
14.	<ul style="list-style-type: none"> • New upper extremity pain or swelling while on anticoagulation 	None
15.	<ul style="list-style-type: none"> • New upper extremity pain or swelling, not on anticoagulation (i.e., contraindication to anticoagulation) 	None

16.	<ul style="list-style-type: none"> • Before anticipated discontinuation of anticoagulation treatment 	None
17.	<ul style="list-style-type: none"> • Shortness of breath in a patient with known upper extremity DVT 	None
18.	<ul style="list-style-type: none"> • Surveillance after diagnosis of upper extremity superficial phlebitis • Not on anticoagulation, phlebitis location ≤ 5 cms from deep vein junction 	None
19.	<ul style="list-style-type: none"> • Surveillance after diagnosis of upper extremity superficial phlebitis • Not on anticoagulation, phlebitis location ≥ 5 cms from deep vein junction 	None
Vein Mapping Prior to Bypass Surgery (Coronary or Peripheral)		
20.	<ul style="list-style-type: none"> • In the absence of adequate leg vein for harvest 	None
21.	<ul style="list-style-type: none"> • In the presence of adequate leg vein for harvest 	None
Screening Examination for Upper Extremity DVT†		
22.	<ul style="list-style-type: none"> • Prior to pacemaker or implantable cardiac defibrillator placement 	None
23.	<ul style="list-style-type: none"> • Prolonged ICU stay (e.g., > 4 days) • No indwelling upper extremity venous catheter 	None
24.	<ul style="list-style-type: none"> • Prolonged ICU stay (e.g., > 4 days) with indwelling upper extremity venous catheter 	None
25.	<ul style="list-style-type: none"> • Monitoring indwelling upper extremity venous catheter that is functional 	None
26.	<ul style="list-style-type: none"> • In those with high-risk: acquired, inherited or hypercoagulable state 	None
27.	<ul style="list-style-type: none"> • Positive D-dimer test in a hospital inpatient 	None

†Screening examination performed in the absence of upper extremity pain or swelling

References:

American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound Practice Guideline for the Performance of Peripheral Venous Ultrasound Examination. Revised 2010.

American College of Radiology. ACR Appropriateness Criteria. Suspected Upper Extremity Deep Vein Thrombosis. Last updated 2011.

Bates, Shannon M, Jaeschke R, Stevens SM, et al. Diagnosis of DVT. Antithrombotic Therapy and Prevention of Thrombosis 9th ED: American College of Chest Physicians. Evidence Based Practice Guidelines Chest 2012;141(2):1412S1.

Constans J, Salmi LR, Sevestre-Pietri MA, et al. A clinical prediction score for upper extremity deep venous thrombosis. Thromb Haemost. 2008;99:202-7.

Lower Extremity Venous Evaluation

Table 2. Venous Duplex of the Lower Extremities for Patency and Thrombosis

Indication		
Limb Swelling		
28.	<ul style="list-style-type: none"> Unilateral – acute 	<p>American College of Radiology. ACR Appropriateness Criteria on Suspected Lower Extremity Deep Vein Thrombosis. J Am Coll Radiol 2011;8:383-387. Clinical condition: Suspected Lower Extremity DVT. Ultrasound, lower extremity with Doppler with compression – Rating 9 (highest, usually appropriate)</p> <p>Joint American Academy of Family Physicians/American College of Physicians Panel on Deep Venous Thrombosis/Pulmonary Embolism. Current diagnosis of venous thromboembolism in primary care: a clinical practice guideline from the American Academy of Family Physicians and the American College of Physicians. Ann Intern Med. 2007 Mar 20;146(6):454-8. Recommendation 3: Ultrasound is recommended for patients with intermediate to high pretest probability of DVT in the lower extremities.</p> <p>American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound</p>

		<p>Practice Guideline for the Performance of Peripheral Venous Ultrasound Examination. Revised 2010.</p> <p>III. The indications for peripheral venous ultrasound examinations include, but are not limited to:</p> <ol style="list-style-type: none"> 1. Evaluation of possible venous thromboembolic disease or venous obstruction in symptomatic or high-risk asymptomatic individuals. 2. Assessment of venous insufficiency, reflux, and varicosities 3. Assessment of dialysis access. 4. Venous mapping prior to surgical procedures 5. Evaluation of veins prior to venous access. 6. Follow-up of patients with known venous thrombosis near the end of anticoagulation to determine if residual venous thrombosis is present.
29.	<ul style="list-style-type: none"> • Unilateral – chronic, persistent 	None
30.	<ul style="list-style-type: none"> • Bilateral – acute 	None
31.	<ul style="list-style-type: none"> • Bilateral – chronic, persistent • No alternative diagnosis identified (e.g., no CHF or anasarca from hypoalbuminemia) 	None
Limb Pain (Without Swelling)		
32.	<ul style="list-style-type: none"> • Non-articular pain in the lower extremity (e.g., calf or thigh) 	None
33.	<ul style="list-style-type: none"> • Knee pain 	None
34.	<ul style="list-style-type: none"> • Tender, palpable cord in the lower extremity 	None
Shortness of Breath		
35.	<ul style="list-style-type: none"> • Suspected pulmonary embolus 	None
36.	<ul style="list-style-type: none"> • Diagnosed pulmonary embolus 	None
Fever		

37.	<ul style="list-style-type: none"> Fever of unknown origin (no indwelling lower extremity venous catheter) 	None
38.	<ul style="list-style-type: none"> Fever with indwelling lower extremity venous catheter 	None
Known Lower Extremity Venous Thrombosis		
39.	<ul style="list-style-type: none"> Surveillance of calf vein thrombosis for proximal propagation in patient with contraindication to anticoagulation (within 2 weeks of diagnosis) 	None
40.	<ul style="list-style-type: none"> New lower extremity pain or swelling while on anticoagulation 	None
41.	<ul style="list-style-type: none"> New lower extremity pain or swelling, not on anticoagulation (i.e., contraindication to anticoagulation) 	None
42.	<ul style="list-style-type: none"> Before anticipated discontinuation of anticoagulation treatment 	None
43.	<ul style="list-style-type: none"> Shortness of breath in a patient with known lower extremity DVT 	None
44.	<ul style="list-style-type: none"> Surveillance after diagnosis of lower extremity superficial phlebitis Not on anticoagulation, phlebitis location \leq 5 cms from deep vein junction 	None
45.	<ul style="list-style-type: none"> Surveillance after diagnosis of lower extremity superficial phlebitis Not on anticoagulation, phlebitis location \geq 5 cms from deep vein junction 	None
Vein Mapping Prior to Bypass Surgery (Coronary or Peripheral)		
46.	<ul style="list-style-type: none"> In the absence of prior lower extremity vein harvest or ablation procedure 	None
47.	<ul style="list-style-type: none"> In the presence of prior lower extremity vein harvest or ablation procedure 	None
Screening Examination for Lower Extremity DVT†		
48.	<ul style="list-style-type: none"> After orthopedic surgery 	<p>American Academy of Orthopaedic Surgeons Clinical Practice Guideline Summary. Prevention of Symptomatic Pulmonary Embolism in Patients Undergoing Total Hip or Knee Arthroplasty. <i>Journal of the American Academic of Orthopaedic Surgeons</i> 2009; 17:183.</p> <p>Recommend against routine post-operative duplex ultrasonography screening of patients who undergo elective hip or knee arthroplasty. (Grade of Recommendation: Strong)</p> <p>American College of Chest Physicians Evidence-Based Clinical</p>

		Practice Guidelines (8th Edition). Prevention of Venous Thromboembolism. Chest 2008 June;133(6 Suppl):381S-453S. 3.5.2. For asymptomatic patients following major orthopedic surgery, we recommend against the routine use of DUS screening before hospital discharge (Grade 1A).
49.	<ul style="list-style-type: none"> • Prolonged ICU stay (e.g., > 4 days) 	None
50.	<ul style="list-style-type: none"> • In those with high-risk: acquired, inherited or hypercoagulable state 	None
51.	<ul style="list-style-type: none"> • Positive D-dimer test in a hospital inpatient 	None
Post Endovenous (Great or Small) Saphenous Ablation		
52.	<ul style="list-style-type: none"> • Lower extremity swelling or pain 	None
53.	<ul style="list-style-type: none"> • Routine post procedural follow-up, no lower extremity pain or swelling Within 10 days post procedure 	None
Other Symptoms or Signs of Vascular Disease		
54.	<ul style="list-style-type: none"> • Physiologic testing positive for venous obstruction 	None
55.	<ul style="list-style-type: none"> • Patent foramen ovale with suspected paradoxical embolism for patient without lower extremity pain or swelling obstruction 	None

†Screening examination performed in the absence of lower extremity pain or swelling

References:

AbuRahma AF, Saiedy S, Robinson PA, et al. Role of Venous Duplex Imaging of the Lower Extremities in Patients with Fever of Unknown Origin. Surgery. 1997 ;121:366-71.

Bates, Shannon M, Jaeschke R, Stevens SM, et al. Diagnosis of DVT. Antithrombotic Therapy and Prevention of Thrombosis 9th ED: American College of Chest Physicians. Evidence Based Practice Guidelines Chest 2012;141(2):1412S1

American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound Practice Guideline for the Performance of Peripheral Venous Ultrasound Examination. Revised 2010.

Geerts WH, Bergqvist D, Pineo GF et al. Prevention of venous thromboembolism: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). Chest 2008 June;133(6 Suppl):381S-453S.

Ho VB, van Geertruyden PH, Yucel EK, et al. American College of Radiology. ACR Appropriateness Criteria on Suspected Lower Extremity Deep Vein Thrombosis. J Am Coll Radiol 2011;8:383-387.

Johanson NA, Lachiewicz PF, Lieberman JR, et al. American Academy of Orthopaedic Surgeons Clinical Practice Guideline Summary. Prevention of Symptomatic Pulmonary Embolism in Patients Undergoing Total Hip or Knee Arthroplasty. Journal of the American Academy of Orthopaedic Surgeons 2009; 17:183.

Kazmers A, Groehn H, Meeker C. Do patients with Acute Deep Vein Thrombosis Have Fever? Am Surg. 2000;66:598-601.

Mourad O, Palda V, Detsky AS. A Comprehensive Evidence-Based approach to Fever of Unknown Origin. Arch Intern Med. 2003;163:545-51.

Qaseem A, et al; Joint American Academy of Family Physicians/American College of Physicians Panel on Deep Venous Thrombosis/Pulmonary Embolism. Current diagnosis of venous thromboembolism in primary care: a clinical practice guideline from the American Academy of Family Physicians and the American College of Physicians. Ann Intern Med. 2007 Mar 20;146(6):454-8.

Table 3. Duplex Evaluation for Venous Incompetency

Indication		Appropriate Use Rating
Venous Insufficiency (Venous Duplex with Provocative Maneuvers for Incompetency)		
56.	• Active venous ulcer	International Union of Phlebology consensus document. Part I. Basic principles. Eur J Vasc Endovasc Surg. 2006 Jan;31(1):83-92. Epub 2005 Oct 14. 2.1.1. Primary uncomplicated great saphenous territory varicose veins
57.	• Healed venous ulcer	
58.	• Spider veins (telangiectasias)	
59.	• Varicose veins, entirely asymptomatic	
60.	• Varicose veins with lower extremity pain or heaviness	

61.	<ul style="list-style-type: none"> Visible varicose veins with chronic lower extremity swelling or skin changes of chronic venous insufficiency (e.g., hyperpigmentation, lipodermatosclerosis) 	<p>Whether all patients require scanning is debated. Clinical assessment with or without pocket (continuous wave, CW) Doppler will miss up to 30% of important connections from deep to superficial veins and information on affected veins when compared to duplex scanning.</p> <p>2.1.2. Primary uncomplicated small saphenous territory varicose veins Duplex scanning is considered to be essential prior to treatment to determine whether there is a saphenopopliteal junction (SPJ), to record its level, and to show complex anatomy such as a common insertion with the gastrocnemius veins.</p> <p>2.1.3. Non-saphenous varicose veins Veins such as those related to pelvic/perineal vein reflux, varices unrelated to the great or small saphenous veins, or isolated lateral thigh varicose veins will be demonstrated to indicate that saphenous ligation or stripping may not be required.</p> <p>2.1.4. Recurrent varicose veins Duplex scanning is considered to be essential to establish the complex anatomy and haemodynamics of recurrent varices to show whether surgery or endovenous treatment is appropriate.¹</p> <p>2.1.5. Chronic venous disease with complications Duplex scanning is considered to be essential to assess the relative involvement of the deep and superficial venous systems to predict the likely outcome after treating superficial disease alone and to select patients suitable for consideration of deep venous reconstruction.</p> <p>2.1.6. Duplex ultrasound surveillance after treatment This may be used to assess the outcome of therapy and for early detection of recurrence. This is likely to be the only way to obtain level I evidence as to outcome in the future.</p> <p>2.1.8. Explanation</p>
62.	<ul style="list-style-type: none"> Skin changes of chronic venous insufficiency without visible varicose veins (e.g., hyperpigmentation, lipodermatosclerosis) 	
63.	<ul style="list-style-type: none"> Lower extremity pain or heaviness without signs of venous disease 	
64.	<ul style="list-style-type: none"> Mapping prior to venous ablation procedure 	
65.	<ul style="list-style-type: none"> Prior endovenous (great or small) saphenous ablation procedure with new or worsening varicose veins in the ipsilateral limb 	
66.	<ul style="list-style-type: none"> Prior endovenous (great or small) saphenous ablation procedure with no residual symptoms. 	

		<p>Duplex ultrasonography can localise and specify the source of the venous problem to provide a map to help select best treatment and evaluate outcome for the venous problems discussed above.</p> <p>The care of patients with varicose veins and associated chronic venous diseases: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. <i>J Vasc Surg.</i> 2011 May;53(5 Suppl):2S-48S.</p> <p>2.1 We recommend that in patients with chronic venous disease, a complete history and detailed physical examination are complemented by duplex scanning of the deep and superficial veins. The test is safe, noninvasive, cost-effective, and reliable. 1 A</p> <p>7.3 We recommend duplex scanning for follow-up of patients after venous procedures who have symptoms or recurrence of varicose veins.</p> <p>Multi-disciplinary quality improvement guidelines for the treatment of lower extremity superficial venous insufficiency with ambulatory phlebectomy from the Society of Interventional Radiology, Cardiovascular Interventional Radiological Society of Europe, American College of Phlebology and Canadian Interventional Radiology Association. <i>J Vasc Interv Radiol</i> 2010 January;21(1):1-13.</p> <p>Duplex ultrasound is essential in all patients with CEAP classification of C2 or higher and in patients with clinical symptoms of leg pain, swelling, or night cramps to identify reflux and patency and to establish the pattern of disease.</p> <p>American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound</p>
--	--	---

		<p>Practice Guideline for the Performance of Peripheral Venous Ultrasound Examination. Revised 2010.</p> <p>III. The indications for peripheral venous ultrasound examinations include, but are not limited to: Assessment of venous insufficiency, reflux, and varicosities</p>
--	--	--

References:

American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound Practice Guideline for the Performance of Peripheral Venous Ultrasound Examination. Revised 2010.

Coleridge-Smith P, Labropoulos N, Partsch H, et al. Duplex ultrasound investigation of the veins in chronic venous disease of the lower limbs--UIP (International Union of Phlebology) consensus document. Part I. Basic principles. *Eur J Vasc Endovasc Surg.* 2006 Jan;31(1):83-92. Epub 2005 Oct 14.

Gloviczki P, Comerota AJ, Dalsing MC, et al. The care of patients with varicose veins and associated chronic venous diseases: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. *J Vasc Surg.* 2011 May;53(5 Suppl):2S-48S.

Kundu S, Grassi CJ, Khilnani NM et al. Multi-disciplinary quality improvement guidelines for the treatment of lower extremity superficial venous insufficiency with ambulatory phlebectomy from the Society of Interventional Radiology, Cardiovascular Interventional Radiological Society of Europe, American College of Phlebology and Canadian Interventional Radiology Association. *J Vasc Interv Radiol* 2010 January;21(1):1-13.

Table 4. Venous Physiological Testing (Plethysmography) With Provocative Maneuvers to Assess for Patency and/or Incompetency

Indication	Appropriate Use Rating
Limb Pain, Swelling or Other Signs of Venous Disease	
67.	<ul style="list-style-type: none"> • Active venous ulcer <p>The care of patients with varicose veins and associated</p>

68.	<ul style="list-style-type: none"> Varicose veins, entirely asymptomatic 	<p>chronic venous diseases: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. J Vasc Surg. 2011 May;53(5 Suppl):2S-48S.</p> <p>3.1 We suggest that venous plethysmography be used selectively for the noninvasive evaluation of the venous system in patients with simple varicose veins (CEAP class C2). 2 C</p> <p>3.2 We recommend that venous plethysmography be used for the noninvasive evaluation of the venous system in patients with advanced chronic venous disease if duplex scanning does not provide definitive information on pathophysiology (CEAP class C3 -C6). 1 B</p>
69.	<ul style="list-style-type: none"> Varicose veins with lower extremity pain or heaviness 	
70.	<ul style="list-style-type: none"> Varicose veins with chronic lower extremity swelling or skin changes of chronic venous insufficiency (e.g., hyperpigmentation or lipodermatosclerosis) 	
71.	<ul style="list-style-type: none"> Skin changes of chronic venous insufficiency without visible varicose veins (e.g., hyperpigmentation or lipodermatosclerosis) 	
72.	<ul style="list-style-type: none"> Lower extremity pain or heaviness without signs of venous disease 	
73.	<ul style="list-style-type: none"> Limb swelling: unilateral – acute Suspected acute venous thrombosis 	
Shortness of Breath		
74.	<ul style="list-style-type: none"> Suspected pulmonary embolus 	None

References:

Gloviczki P, Comerota AJ, Dalsing MC, et al. The care of patients with varicose veins and associated chronic venous diseases: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. J Vasc Surg. 2011 May;53(5 Suppl):2S-48S.

Duplex Evaluation of the Inferior Vena Cava (IVC) and Iliac Veins

Table 5. Duplex of the IVC and Iliac Veins for Patency and Thrombosis

Indication	Appropriate Use Rating
Prior to IVC Filter Placement	

75.	<ul style="list-style-type: none"> • Prior to IVC filter placement • For procedural access planning 	None
Evaluation for Suspected Deep Vein Thrombosis		
76.	<ul style="list-style-type: none"> • Lower extremity swelling - unilateral or bilateral – as a “stand alone test” without a venous duplex of the lower extremities 	None
77.	<ul style="list-style-type: none"> • Lower extremity swelling – unilateral or bilateral – combined routinely with a venous duplex of the lower extremities 	None
78.	<ul style="list-style-type: none"> • Lower extremity swelling – unilateral or bilateral –performed selectively – when the lower extremity venous duplex is normal 	None
79.	<ul style="list-style-type: none"> • Lower extremity swelling – unilateral or bilateral –performed selectively – when the lower extremity venous duplex is positive for acute proximal DVT 	None
80.	<ul style="list-style-type: none"> • Selectively - When the flow pattern in one or both common femoral veins is abnormal 	None
Evaluation for Suspected Pulmonary Embolus		
81.	<ul style="list-style-type: none"> • Pulmonary symptoms (suspected pulmonary embolus) - as a “stand alone test” without a venous duplex of the lower extremities 	None
82.	<ul style="list-style-type: none"> • Pulmonary symptoms (suspected pulmonary embolus) – combined routinely with a venous duplex of the lower extremities 	None
Evaluation of Other Symptoms or Signs of Abdominal Vascular Disease		
83.	<ul style="list-style-type: none"> • Abdominal pain 	None
84.	<ul style="list-style-type: none"> • Abdominal bruit 	None
85.	<ul style="list-style-type: none"> • Fever of unknown origin 	None

Hepatoportal and Renal Venous Evaluation

Table 6. Duplex of the Hepatoportal System (portal vein, hepatic veins, splenic vein, superior mesenteric vein, inferior vena cava) for patency, thrombosis, and flow direction †

Indication		Appropriate Use Rating
Evaluation of Hepatic Dysfunction or Portal Hypertension		
86.	<ul style="list-style-type: none"> Abnormal liver function tests No alternative diagnosis identified (e.g., medication related or infectious hepatitis) 	None
87.	<ul style="list-style-type: none"> Cirrhosis with or without ascites 	None
88.	<ul style="list-style-type: none"> Jaundice As an initial diagnostic test 	None
89.	<ul style="list-style-type: none"> Jaundice No alternative diagnosis identified after initial evaluation (e.g., no biliary obstruction) 	None
90.	<ul style="list-style-type: none"> Hepatomegaly and/or splenomegaly 	None
91.	<ul style="list-style-type: none"> Portal hypertension 	None
Surveillance following Portal Decompression Procedure		
92.	<ul style="list-style-type: none"> Follow-up of a TIPS 	American Association for the Study of Liver Diseases Practice Guidelines: the role of transjugular intrahepatic portosystemic shunt creation in the management of portal hypertension. J Vasc Interv Radiol. 2005 May;16(5):615-29. Recommendation 9: Each center performing TIPS should have an established program of TIPS surveillance and although there are no established guidelines, Doppler ultrasound should be performed before the patient is

		<p>discharged from the hospital and at specified intervals following the procedure and the yearly anniversary of the TIPS thereafter (evidence: grade II-1).</p> <p>Recommendation 11: TIPS stenosis is common, especially in the first year, and Doppler ultrasound lacks the sensitivity and specificity needed to identify many of these patients. Therefore, repeat catheterization of the TIPS or upper endoscopy should be performed at the 1-year anniversary of placement, especially in those patients who bled from varices (evidence: grade II-3).</p> <p>American Association for the Study of Liver Diseases Practice Guidelines: the role of transjugular intrahepatic portosystemic shunt creation in the management of portal hypertension. J Vasc Interv Radiol. 2005 May;16(5):615-29.</p> <p>Recommendation 10: Ultrasonographic findings suggesting TIPS dysfunction or recurrence of the complication of portal hypertension that lead to the initial TIPS should lead to venography and intervention, as indicated. The recurrence of symptoms in the face of a “normal” ultrasound does not eliminate the need for TIPS venography (evidence: grade II-2).</p>
Evaluation of Other Symptoms or Signs of Abdominal Vascular Disease		
93.	<ul style="list-style-type: none"> Abdominal pain 	None
94.	<ul style="list-style-type: none"> Fever of unknown origin 	None
Evaluation of Cardiac and/or Pulmonary Symptoms		
95.	<ul style="list-style-type: none"> Pulmonary symptoms (suspected pulmonary embolus) 	None
96.	<ul style="list-style-type: none"> Cor pulmonale 	None

†Testing indications refer to evaluation of native hepatoportal venous system only (i.e. hepatic transplant sites and arterial system excluded).

References:

Boyer TD, Haskal ZJ. American Association for the Study of Liver Diseases Practice Guidelines: the role of transjugular intrahepatic portosystemic shunt creation in the management of portal hypertension. J Vasc Interv Radiol. 2005 May;16(5):615-29.

Table 7. Duplex of the Renal Veins for Patency and Thrombosis †

Indication		Appropriate Use Rating
Evaluation for Suspected Renal Vein Thrombosis – Potential Signs and/or Symptoms		
97.	• Gross hematuria	None
98.	• Acute renal failure	None
99.	• Acute flank pain	None
Evaluation of Cardiac and/or Pulmonary Symptoms		
100.	• Pulmonary symptoms (suspected pulmonary embolus)	None
Evaluation of Other Symptoms or Signs of Abdominal Vascular Disease		
101.	• Drug-resistant hypertension (suspected renal artery stenosis)	None
102.	• Microscopic hematuria (prior to urological evaluation)	None
103.	• Fever of unknown origin	None
104.	• Epigastric bruit	None

†Testing indications refer to evaluation of native renal veins only for patency (i.e. renal transplant sites and renal arteries excluded).

Hemodialysis Vascular Access Duplex Ultrasound

Table 8. Preoperative Planning and Postoperative Assessment of a Vascular Access Site*

Indication	Appropriate Use Rating
Assessment Prior to Access Site Placement*	
105. <ul style="list-style-type: none"> Preoperative Mapping Study (Upper extremity arterial and venous duplex) ≥ 3 months prior to access placement 	<p>K/DOQI Clinical Practice Recommendations for Vascular Access; 2001, updated 2006.</p> <p>1.4. Evaluation that should be performed before placement of a permanent hemodialysis access include:</p> <p>1.4.1 History and physical examination (B)</p> <p>1.4.2 Duplex ultrasound of the upper extremity arteries and veins (B)</p> <p>1.4.3 Central vein evaluation in the appropriate patient known to have a previous catheter or pacemaker (A)</p> <p>2006 update:</p> <p>1.4 Alternative imaging studies for the central veins include DDU (sic: duplex ultrasound) and magnetic resonance imaging/MRA.</p> <p>American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound Practice Guideline for the Performance of Ultrasound Vascular Mapping for Preoperative Planning of Dialysis Access. Revised 2011.</p> <p>II. Indications for vascular mapping for preoperative planning of dialysis access include planning of vascular access for hemodialysis. There are no absolute</p>

		contraindications for this examination.
106.	<ul style="list-style-type: none"> Preoperative Mapping Study (Upper extremity arterial and venous duplex) <3 months prior to access placement 	
“Failure to Mature”		
107.	<ul style="list-style-type: none"> “Failure to Mature” on basis of physical examination 0-6 weeks after placement 	K/DOQI Clinical Practice Recommendations for Vascular Access; 2001, updated 2006.
108.	<ul style="list-style-type: none"> “Failure to Mature” on basis of physical examination > 6 weeks after placement 	<p>3.2.4 If a fistula fails to mature by 6 weeks, a fistulogram or other imaging study should be obtained to determine the cause of the problem (B)</p> <p>American College of Radiology/American Institute of Ultrasound in Medicine Practice Guideline for the Performance of Vascular Ultrasound for Postoperative Assessment of Dialysis Access. Published 2007.</p> <p>II. Indications for dialysis access ultrasound include, but are not limited to:</p> <ol style="list-style-type: none"> Patients with decreased flow rates during hemodialysis Patients with development of arm swelling or discomfort after access placement surgery or a hemodialysis session Patients with prolonged immaturity of a surgically created AVF Patients suspected of having a pseudoaneurysm, AVF or graft stenosis, or adjacent fluid collection
Symptoms and Signs of Disease†		
109.	<ul style="list-style-type: none"> Signs of access site malfunction during dialysis (e.g., low blood flows, kt/V, recirculation times or increased venous pressure) 	The Society for Vascular Surgery: clinical practice guidelines for the surgical placement and maintenance of arteriovenous hemodialysis access. J Vasc Surg 2008 November;48(5 Suppl):2S-25S. Recommendation 5.A. We recommend regular clinical

		<p>monitoring (inspection, palpation, auscultation, and monitoring for prolonged bleeding after needle withdrawal) to detect access dysfunction (Grade 1, very low-quality evidence).</p> <p>Recommendation 5.B. We suggest access flow monitoring or static dialysis venous pressures for routine surveillance (Grade 2, very low quality evidence).</p> <p>Recommendation 5.C. We suggest performing a Duplex ultrasound (DU) study or contrast imaging study in accesses that display clinical signs of dysfunction or abnormal routine surveillance (Grade 2, very low-quality evidence)</p> <p>K/DOQI Clinical Practice Recommendations for Vascular Access; 2001, updated 2006.</p> <p>4.2 Techniques, not mutually exclusive, that may be used in surveillance for stenosis in grafts include:</p> <p>4.2.1 Preferred</p> <p>4.2.1.1 Intra-access flow by using 1 of several methods(A)</p> <p>4.2.1.2 Directly measured or derived status venous dialysis pressure by 1 of several methods (A)</p> <p>4.2.1.3 Duplex ultrasound (A)</p> <p>4.3 Techniques, not mutually exclusive, that may be used in surveillance for stenosis in AVFs include:</p> <p>4.3.1 Preferred</p> <p>4.3.1.1 Direct flow measurements (A)</p> <p>4.3.1.2 Physical findings of persistent swelling of the arm, presence of collateral veins, prolonged bleeding after needle withdrawal, or altered characteristics of pulse or thrill in the outflow vein (A)</p>
--	--	--

		<p>4.3.1.3 Duplex ultrasound</p> <p>American College of Radiology/American Institute of Ultrasound in Medicine Practice Guideline for the Performance of Vascular Ultrasound for Postoperative Assessment of Dialysis Access. Published 2007.</p> <p>II. Indications for dialysis access ultrasound include, but are not limited to:</p> <ol style="list-style-type: none"> 5. Patients with decreased flow rates during hemodialysis 6. Patients with development of arm swelling or discomfort after access placement surgery or a hemodialysis session 7. Patients with prolonged immaturity of a surgically created AVF 8. Patients suspected of having a pseudoaneurysm, AVF or graft stenosis, or adjacent fluid collection
110.	<ul style="list-style-type: none"> • Mass associated with an AVF/AVG 	None
111.	<ul style="list-style-type: none"> • Loss of palpable thrill of AVF/AVG 	None
112.	<ul style="list-style-type: none"> • Arm swelling 	None
113.	<ul style="list-style-type: none"> • Hand pain, pallor, and/or digital ulceration (i.e., evaluation for suspected arterial steal syndrome) 	None
114.	<ul style="list-style-type: none"> • Cool extremity • Without pain, pallor, or ulceration 	None
115.	<ul style="list-style-type: none"> • Difficult cannulation by multiple personnel on multiple attempts 	None
Asymptomatic†		
116.	<ul style="list-style-type: none"> • Routine surveillance of a functioning AVF or AVG 	<p>The Society for Vascular Surgery: clinical practice guidelines for the surgical placement and maintenance of arteriovenous hemodialysis access. J Vasc Surg 2008 November;48(5 Suppl):2S-25S.</p> <p>Recommendation 5.A. We recommend regular clinical monitoring (inspection, palpation, auscultation, and</p>

		<p>monitoring for prolonged bleeding after needle withdrawal) to detect access dysfunction (Grade 1, very low-quality evidence).</p> <p>Recommendation 5.B. We suggest access flow monitoring or static dialysis venous pressures for routine surveillance (Grade 2, very low quality evidence).</p> <p>Recommendation 5.C. We suggest performing a Duplex ultrasound (DU) study or contrast imaging study in accesses that display clinical signs of dysfunction or abnormal routine surveillance (Grade 2, very low-quality evidence)</p> <p>K/DOQI Clinical Practice Recommendations for Vascular Access; 2001, updated 2006.</p> <p>4.2 Techniques, not mutually exclusive, that may be used in surveillance for stenosis in grafts include:</p> <p>4.2.1 Preferred</p> <p>4.2.1.1 Intra-access flow by using 1 of several methods(A)</p> <p>4.2.1.2 Directly measured or derived status venous dialysis pressure by 1 of several methods (A)</p> <p>4.2.1.3 Duplex ultrasound (A)</p> <p>4.3 Techniques, not mutually exclusive, that may be used in surveillance for stenosis in AVFs include:</p> <p>4.3.1 Preferred</p> <p>4.3.1.1 Direct flow measurements (A)</p> <p>4.3.1.2 Physical findings of persistent swelling of the arm, presence of collateral veins, prolonged bleeding after needle withdrawal, or altered characteristics of pulse or thrill in the outflow vein (A)</p> <p>4.3.1.3 Duplex ultrasound</p>
--	--	--

*Ultrasound assessment prior to creation of dialysis access (AVF or AVG) typically includes a combined arterial and venous duplex examination that is performed to determine the adequacy of superficial veins (patency, size, and length of conduit), patency of central venous outflow, and adequacy of adequate arterial inflow. Determination of central venous patency is particularly important for patients with a history of prior central venous catheter(s).

†In a mature AVF or AVG that is being accessed for hemodialysis

References:

American College of Radiology/American Institute of Ultrasound in Medicine/Society for Radiologists in Ultrasound Practice Guideline for the Performance of Ultrasound Vascular Mapping for Preoperative Planning of Dialysis Access. Revised 2011.

American College of Radiology/American Institute of Ultrasound in Medicine Practice Guideline for the Performance of Vascular Ultrasound for Postoperative Assessment of Dialysis Access. Published 2007.

Casey ET, Murad MH, Rizvi AZ, et al. Surveillance of Arteriovenous Hemodialysis Access: a Systematic Review and Meta-analysis. *J Vasc Surg*. 2008 Nov;48(5 Suppl):48S-54S.

National Kidney Foundation – K/DOQI Clinical Practice Recommendations for Vascular Access; 2001, updated 2006. Available at: http://www.kidney.org/professionals/KDOQI/guideline_upHD_PD_VA/index.htm

Sidawy AN, Spergel LM, Besarab A et al. The Society for Vascular Surgery: Clinical Practice Guidelines for the Surgical Placement and Maintenance of Arteriovenous Hemodialysis Access. *J Vasc Surg* 2008 November;48(5 Suppl):2S-25S.

Umphrey HR, Lockhart ME, Abts CA, Robbin ML. Dialysis Grafts and Fistulae: Planning and Assessment. *Ultrasound Clin* 2011;6(4): 477-490.

Robbin ML, Chamberlain NE, Lockhart ME, Gallichio MH, Young CJ, Deierhoi MH, Allon MA. Hemodialysis Arteriovenous Fistula Maturity: US Evaluation. *Radiology* 2002;225(1):59-64.

Singh P, Robbin ML, Lockhart ME, Allon M. Clinically Immature Arteriovenous Hemodialysis Fistulas: Effect of US on Salvage. *Radiology* 2008;246(1):299-305.