



**Department of Rehabilitation Services
Physical Therapy**

**Standard of Care: Physical Therapy Management of the Patient with
Peripheral Vascular Disease**

Case Type / Diagnosis: Vascular Diseases

Practice Patterns Include:

- 4J Impaired Motor Function, Muscle Performance, Range of Motion, Gait, Locomotion, and Balance Associated with Amputation
- 6B Impaired Aerobic Capacity/Endurance Associated with Deconditioning
- 7A Primary Prevention/Risk Reduction for Integumentary Disorders
- 7B Impaired Integumentary Integrity Associated with Superficial Skin Involvement

ICD 10 Codes Include:

- E08.51 to E13.59 Diabetes Mellitus
- I70.0 to I70.91 Atherosclerosis
- I83.001 Varicose veins, varices, post-thrombotic syndrome
- I70.92 to I82.C29 and I96 to T81.72XA Other disorders of the circulatory system
- I87.2 to I87.399 Venous Insufficiency NOS

Introduction:

This standard of care provides guidelines for the management of individuals with vascular disease and its many symptoms and sequelae. Vascular disease is separated into two general categories, Arterial and Venous. Both types of vascular disease may impact all organ systems and affect function and quality of life.

Peripheral Artery Disease (Peripheral Arterial Occlusive Disease)

Peripheral arterial disease (PAD) most commonly occurs when atherosclerotic plaques produce localized stenosis of the arterial lumen. The atherosclerotic plaque is comprised of fibrous tissue, smooth muscle cells, cholesterol, macrophages, and platelets. Atherosclerotic plaque lesions can vary in structure and progression, resulting in variability in symptom presentation.²

The high prevalence of peripheral vascular disease (PVD) has important implications for mobility and physical therapy as PAD has been linked to increased fall risk.¹³ In addition,

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individuals with PAD often experience vascular involvement in other organ systems such as the heart. e.g. coronary artery disease, and the brain, e.g. cerebrovascular disease, leading to increased risk of myocardial infarction and stroke. Predisposing risk factors for PAD include smoking, diabetes, hypertension, hypercholesterolemia and male gender. The most common symptom of mild to moderate PAD is intermittent claudication, defined as “walking-induced pain, cramping, aching, tiredness, heaviness in one or both legs especially calves, that does not go away with continued walking and is relieved with rest”.¹⁰

Early detection of PAD is a crucial step in avoiding the need for surgical intervention. Early PAD is often diagnosed using the ankle-brachial index (ABI). This is a non-invasive test that compares the systolic blood pressure (SBP) at the ankle to the brachial SBP (ankle SBP/brachial SBP = ABI). An ABI less than 0.96 is suggestive of PAD.

Non-surgical management includes exercise, medication, and changes in lifestyle to minimize risk factors.^{11,17} Smoking cessation has the most significant impact, as evidence has shown it can stop PAD progression and improve circulation. In addition, many studies show that regular exercise, including active and resistive range of motion exercises and walking, leads to quantifiable improvements in quality of life, community-based functional capacity and walking distance.^{9,11} Exercise and ambulation may prevent or slow the progression of PAD. Unfortunately, individuals with PAD and resulting claudication often have a decrease in activity in response to discomfort. They also may have the incorrect belief that walking can cause them injury. This decrease in activity causes faster progression of PAD.¹⁶

The goal of surgery is to regain adequate blood flow thus relieving pain, improving function and quality of life and prolonging patient survival.⁴ Unfortunately, most patients with lower limb ischemia have a heavy disease burden related to their comorbidities. The 5-year survival rate is poor.⁴ The present medical outcomes are seen in those with PAD involving the calf or foot in conjunction with diabetes, often requiring surgical intervention.⁸

Venous Disease

Venous insufficiency occurs when the venous system is unable to provide adequate antegrade blood flow back to the heart, i.e. venous return, and fails to prevent retrograde flow into the extremities, leading to peripheral edema.⁵

Venous disease can manifest in changes to vasculature, including superficial varicose veins and chronic venous stasis which affects the deeper veins. Deep vein thrombosis (DVT) most commonly result in changes to the deep vein tissue. Reflux disease due to venous valvular incompetence accounts for the majority of chronic venous insufficiency (CVI). The venous valve leaflets can become thickened, shortened or embedded in scarred vein wall during the process of phlebotic inflammation. This process leads to the vein becoming rigid and thickened with fibrous material crossing the lumen.⁸

Venous disease can be congenital or of unknown etiology. Risk factors for venous disease include pregnancy and hormone therapy.⁵ Physical symptoms of venous disease include

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dependent ankle edema, subcutaneous fibrosis, brown skin discoloration known as hemosiderin staining, eczema, and dilation of subcutaneous veins. Arterial pulses are usually present. Disease which occurs below the knee appears more commonly in the more severe cases of venous insufficiency. Severe CVI often includes the development of chronic, difficult to heal, weeping ulcers.⁵

Typically, the symptoms of CVI can be managed nonsurgically. Treatment focuses on leg elevation and compression to decrease edema, the management of infected ulcers with local wound care such as debridement using pulsatile lavage or topical enzymatics, and antibiotics. The ultimate goals are to heal and/or prevent ulcers and preserve a functional lifestyle. Surgical intervention is mostly focused on management of venous stasis ulcers with irrigation/debridement and skin grafting.

The systemic nature of vascular disease makes any part of the body susceptible to insult, including the upper extremities. Individuals with renal disease requiring dialysis are at the highest risk for upper extremity involvement as their dialysis access is most commonly located in their arms. These grafts, most often a polytetrafluorethylene or PTFE graft, are at high risk for clotting and infection, due to the synthetic material used and because of the dialysis patients' comorbidities. These thrombi often require surgery such as thrombectomy or dialysis access revision. Less frequently, upper extremities can require the same interventions as lower extremities, such as bypass grafts or wound management.

Venous disease can manifest as deep vein thrombosis, which is the most common cause of secondary venous disease. Conversely venous stasis can cause DVTs as it decreases the clearing of activated coagulation factors which leads to clot formation.¹⁴ Symptoms of DVTs include skin that is warm to the touch, blue, brown, or red skin discoloration, dependent edema, and pain with palpation. There are several types of DVT. Deep calf thrombi are generally small and asymptomatic but can extend into proximal veins within 1-2 weeks.⁵ There is a low risk of pulmonary embolus (PE) and the best treatment is early mobilization. Proximal DVT including popliteal or above, tend to be more symptomatic and have a increased risk of PE.⁵

The most common treatment of DVT is anticoagulant medication, including Heparin, Lovenox, Coumadin, Fragmin, Bivalirudin, or Argatroban.¹ Use of anticoagulation medications is highly effective in preventing DVT extension, embolization and recurrence.¹⁵ In cases where heparin is used there is a 5% risk of major bleeding and a 1% risk of inducing thrombocytopenia.¹⁵ It is important to note that anticoagulation does not eliminate an existing DVT as it can take the body months to absorb the clot.

There are several factors that can reduce the risk of DVT. Activity, especially walking and exercises, causes skeletal muscle contraction which decreases venous stasis. Effective hydration and anticoagulation are also important. Compression that assists with venous return such as use of graduated compression stockings or pneumatic compression devices can also be effective.¹⁵

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Common Surgical Procedures for the management of Peripheral Vascular Disease

1. Carotid Endarterectomy (CEA)
2. Abdominal Aortic Aneurysm Repair—open (AAA) or endovascular (EVAR)
3. Thoracic Aortic Aneurysm Repair, open (TAA) or endovascular (TEVAR)
4. Aorto-bifemoral bypass graft
5. Axillo-femoral bypass graft
6. Femoral-popliteal bypass graft [above knee (AK) or below knee (BK)]
7. Femoral-anterior tibial bypass graft
8. Popliteal-dorsalis pedis bypass graft
9. Tibial-dorsalis pedis bypass graft
10. Amputations [above knee (AKA), below knee (BKA), transmetatarsal (TMA), toe amputations]. (See Amputation Standard of Care for additional information about the management of patients following an amputation)
11. Debridement and skin grafting of decubitus ulcers due to PAD or venous stasis/insufficiency (See Wound Care Standard of Care for additional information about patients with integument issues)

Indications for Treatment: Patients with impaired peripheral vascular systems may present with impaired skin integrity, pain, and decreased endurance leading to a decline in overall functional mobility. Decreased activity due to these impairments and pain often results in generalized weakness, joint contractures, impaired aerobic capacity, and edema. These impairments may then lead to further decreased function and increased pain. Patients may require education on weight-bearing restrictions, wound healing, skin protection, safety awareness, and the importance of activity progression.

Claudication Scale: Per the American Heart Association and American College of Cardiology, patients that experience claudication pain should be encouraged to mobilize at an activity level that elicits moderate pain within 3-5 minutes, then to rest until improved, and then return to exercise until moderate pain level achieved again. This is completed with exercise/rest cycle for 35 minutes initially progressed to 50 minutes per session, 3-5 times per week, for a minimum of 12 weeks. This has been shown to increase pain-free and maximal time and distance ambulated as compared to placebo.⁷ Refer to Appendix 2 for scale.

Contraindications / Precautions for Treatment:

Contraindications:

- Orders for strict bedrest which may be initiated due to excessive bleeding, critical ischemia of an extremity, recent distal LE revascularization, new skin graft
- Femoral lines depending on whether flexible or rigid, purpose, physician and team preference, not a strict contraindication but must obtain clearance
- Unstable heart rate or rhythm, blood pressure and/or high fever

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Precautions:

- The following are commonly ordered precautions for vascular surgery, however individual physician preference or individual cases may differ.
 - Closed amputations of the foot: NWB or heel weight-bearing to avoid pressure on suture line and possible dehiscence
 - Open amputations of the foot: Usually weight-bearing as tolerated, sometimes partial weight-bearing.
 - Peripheral artery revascularization: Weight-bearing as tolerated
 - Aortic aneurysm repairs: Avoid lifting/pulling/pushing more than 10lbs, avoid sit-ups and excessive twisting of trunk to avoid increased intra-abdominal pressure and tension on the repair. Log roll technique for bed mobility to minimize tension on the repair.
 - Skin breakdown and chronic ulcers: Activity precautions vary depending on location and treatment, such as weight-bearing restrictions if the area of breakdown is on the plantar surface of the foot.
 - Venous Stasis: Lower extremities elevated above the level of the heart to facilitate venous return and edema control. Ambulation encouraged as pumping action of muscles assists with venous return.
 - Amputations: Often two surgeries, first phase to remove diseased or ischemic limb, left open, may be seen. Second phase to trim and close limb in sterile environment.
 - Caution required if $INR > 3$, exercise may be contraindicated if $INR > 6$
- *Consideration:* Patients on dialysis may experience significant fatigue and hypotension after dialysis which decreases their tolerance for activity. Therapist should attempt to schedule treatments before dialysis or on non-dialysis days, with consideration of pre-dialysis lab values such as elevated potassium.

Evaluation:Chart Review

Medical History: Pertinent past and ongoing medical issues that may impact physiological response to treatment such as diabetes and its sequelae, prior vascular surgeries, and use of tobacco or alcohol

History of Present Illness:**Hospital Course:**

- Pertinent lab values including international normalized ratio (INR), prothrombin time (PT), partial thromboplastin time (PTT), hematocrit, platelets, white blood cells
- Lab values related to comorbidities including but not limited to creatinine, blood urea nitrogen, blood glucose levels
- ABI value in those with PAD

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- Ultrasounds to rule out DVTs
- Angiogram results

Social History:

- Specifics about home environment including architectural barriers, stairs, handrails
- Support available upon discharge
- Ability of patient to comply with precautions in the past
- Adaptive equipment used currently and previously
- Psychosocial issues and substance abuse issues

Examination

Cardiopulmonary

- Assess patient's cardiopulmonary status during activity by monitoring vital signs to assess for appropriate hemodynamic response.
 - Surgery may exacerbate existing cardiac and pulmonary problems. It may also result in an acute decrease in cardiopulmonary status due to depressed respiration rate due to anesthesia and as well as fluid overload from IV administration resulting in impaired oxygen saturation. In addition to objective values, patient response to activity should be measured using the Borg Scale to indicate how hard a patient feels they are working during activity.

Integument

- Observe surgical incisions for presence of drains, integrity of sutures or staples, amount and quality of drainage, type of dressing being used. Note presence of open areas (e.g. open toe amputations or incisions that have been left open due to edema).
- Check skin integrity including color, trophic changes (thickness, hairlessness, flaking).
- Note presence of open wounds, size (length, width, and depth), type of tissue present and amount of each. Refer to Wound Care Standard of Care for a detailed wound assessment screening chart.
- Examine extremities for edema and make circumferential measurements as necessary for assessment of acute or chronic edema.

Musculoskeletal

- Range of motion: Goniometric measurements of visibly contracted joints should be measured. Incisions that cross the joint line increase risk of contracture due to pain, edema and resultant disuse.
- Strength: Manual muscle test (MMT) is ideal but if patient unable to participate may note gross observations of 3/5 or less.

Neuromuscular

- Pain: Visual Analog Scale (VAS 0-10)
 - Pre-medication as appropriate, deep breathing and relaxation techniques
- Light touch: If impaired, assess sharp-dull and deep pressure sensation.

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- Proprioception: Often impaired for those with PAD and peripheral neuropathy.
- Balance:
 - Berg Balance Assessment, Dynamic Gait Index, Function in Sitting

Functional Capacity

- Functional mobility including use of ambulatory devices, including quality, speed of movement

Mental Status and Cognition

- Safety awareness
- Ability to follow direction and comply with restrictions especially regarding level of activity and weight-bearing status

Psychological Considerations

- Learning style
- Patient's goals for recovery
- Impact of psychiatric disorders on participation and recovery

Assessment:

Problem List

- Impaired range of motion of involved extremities
- Edema
- Presence of/risk for skin breakdown
- Impaired mobility
- Impaired endurance
- Impaired respiratory status
- Impaired balance
- Impaired strength
- Knowledge deficit regarding precautions, activity progression, healing process
- Pain
- Sensation deficits

Prognosis:

Symptomatic vascular disease can impact an individual's functional level in a variety of ways. Claudication pain, skin breakdown and weightbearing restrictions can all limit activity and affect quality of life.² Many studies have detailed the benefits of various types of exercise. McDermott et. al. showed that group participation in a supervised treadmill program and lower extremity resistance training improved 6 minute walk performance, brachial artery flow-mediated dilation, stair climbing ability and quality of life.³ Studies document that exercise increases quality of life and activity level even without improvement in brachial artery flow.^{2,10} These findings show that a progressive walking program and exercises can be beneficial in any person with vascular disease admitted to the hospital and improve their functional and vascular prognosis.

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- Custom-made footwear may be needed in isolated cases
- Range of Motion, Stretching and Strengthening
 - Active, active assisted, passive ROM and stretching as tolerated to preserve and increase flexibility and strength. Ideally the incision site should be visible during stretching for visual feedback on stress on wound. Resistive exercises as tolerated can increase strength but also improve circulation and decrease claudication.^{6, 15}
- Endurance
 - An activity program that includes progressive ambulation and exercises performed in increasing repetition and frequency can increase a patient's activity tolerance. A stationary bike, treadmill, elliptical may also be used.

Frequency & Duration

These patients are typically seen 3-5 times per week but may be seen less frequently if appropriate. Medical issues that arise can impact length of stay and the patient's ability to progress toward goals. Length of stay can vary widely in this group of individuals depending on complexity of the surgery and the severity of the disease, from days to months.

Patient / Family / Caregiver education

Discussion with patient and family/caregivers regarding physical therapy involvement with patient and expected progression should include:

- Detailed explanation of weight-bearing restrictions and discussion of importance of compliance for optimal healing
- Discussion of importance of moving affected extremity within precaution parameters to prevent joint contractures, particularly at the ankle and knee
- Instruction of patient and family/caregivers in appropriate exercises and activities to improve strength, flexibility and endurance
- Instruction on skincare regimen including daily check of areas at especially for those with impaired sensation such as from diabetic neuropathy. Shoes should be assessed for proper fit and modified by an orthotist or podiatrist. Patients should be encouraged to contact their physicians quickly if any skin or wound changes occur.

Recommendations and referrals to other providers

- Social Work
- Occupational Therapy
- Psychiatry
- Orthopedic Technician
- Prosthetist/Orthotist

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Re-evaluation

Standard Time Frame for plan of care (progress note required): 7-10 days or sooner as appropriate

Other Possible Triggers: A significant change in medical status, surgical procedure resulting in new mobility impairments

Discharge Planning

Commonly expected outcomes at discharge:

- Patient functioning at baseline or close to baseline functional levels with or without assistive device or is at the level at which home supports allow
- Patient is independent with walking program and/or exercise program, or has adequate support for assist levels required
- Patient or family are independent with skin inspection, use of durable medical equipment

Patient's discharge instructions

- Progressive ambulation program including activity log if necessary
- Weight-bearing restrictions
- ROM and strengthening exercise program
- Proper management of positioning devices and splints including wearing schedule, don/doff procedure

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APPENDIX 1

Comparison of Arterial and Venous Disease Symptoms¹⁴

	Arterial	Venous
Pain	Intermittent claudication, may progress to pain at rest	Chronic, dull aching pain which progresses throughout the day
Color	Pale to dependent rubor, dull to bright reddish color	Normal to cyanotic
Skin temperature	Takes on environmental temperature, cool	Normal
Pulses	Diminished to absent	Normal but difficult to palpate due to edema
Edema	Not present with isolated PAD	Present, can be pitting. Can have weeping of serous fluid
Tissue changes	Skin is shiny with hair loss. Trophic changes in nails, muscle wasting	Stasis dermatitis with flaky dry and scaly skin. Can have brownish discoloration. Fibrosis with narrowing of the lower legs (“bottle legs”)
Wounds	Occur distally especially at toes and web spaces. May develop gangrene and tissue loss	Shallow ulcers on the foot and ankle, usually medially

From Sussman C. Bates-Jensen B. Wound Care: A Collaborative Practice Manual for Physical Therapists and Nurses. Aspen Publishers, Inc. 2001, page 179.

APPENDIX 2

Intermittent Claudication Rating Scale

Rating	Pain	Description
0	None	During rest or early exercise
1	Mild	1 st feeling of any pain
2	Moderate	Level at which an exercise training bout should cease
3	Intense	Nearly maximal pain
4	Unbearable	Maximal, equivalent to most severe pain experienced

From Ehrman J, Lui K, Treat-Jacobson D. Supervised Exercise Training for Symptomatic Peripheral Artery Disease. *Journal of Clinical Exercise Physiology*. Volume 6. 2017.

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