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**5TH EDITION**

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# **GLOSSARY OF TERMS**

Terminology for the Vascular  
Ultrasound Technologist/  
Sonographer



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The VOICE for the Vascular Ultrasound Profession





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Vascular Ultrasound  
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# Acknowledgements

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## A

**A-C coupling (Alternating Current):** Type of output signal to graphic display connection which responds to changes faster than 0.5Hz. This reduces baseline shifts and results in a stable graphic tracing.

**A-mode:** A mode of operation in which the display plots time along a horizontal axis and echo amplitude along a vertical axis. In ultrasound, this is referred to as the amplitude mode.

**Abdominal aorta:** The abdominal aorta is a portion of the descending aorta and is located at the level of the diaphragm and extends to its bifurcation (the common iliac arteries).

**Abdominal Aortic Aneurysm (AAA):** A focal dilation of the aorta. Most common location is infrarenal.

**Abduction:** Drawing away from the midline, opposite of adduction.

**Abscess:** A localized collection of pus surrounded by inflamed tissue.

**Absorption:** A process of conversion of acoustic energy to heat, resulting in a loss of energy. Absorption is a factor in attenuation.

**Acceleration Index (AI):** This is the systolic acceleration of the Doppler spectral waveform determined by the change in distance between the onset of systolic flow and the peak systolic velocity (cm/sec), divided by the acceleration time (AT). The acceleration index (AI) is reported in frequency units as KHz/sec/MHz or velocity units as cm/sec<sup>2</sup>

**Acceleration Time (AT):** This is the time interval from the onset of flow to the initial peak--not peak systole

**Achrocyanosis:** Coldness and blueness of an extremity; a vasospastic condition. Symptoms include a symmetrical, mottled cyanosis of the hands and feet, cold

seat on the digits. Cold accentuates, warmth relieves the symptoms.

**Acoustic:** Having to do with sound.

**Acoustic field:** The distribution pattern of sound energy in space and time.

**Acoustic impedance:** Property of a medium equal to the product of density and propagation speed. The intensity of reflection (echo production) is related to the ratio of difference in acoustic impedance at an interface. The greater the difference in impedance the greater the intensity of reflection.

**Acoustic shadow:** Loss of acoustic properties of targets lying behind an attenuating structure. In the arteries, the most common cause of acoustic shadowing is calcified plaque (*see calcification*).

**Acoustic variables:** Pressure, density, temperature, and particle motion. Sound is identified as the rhythmic cycling of acoustic variables.

**Acute:** Short, severe symptoms of sudden onset or short duration; i.e., not chronic.

**Adduction:** Drawing toward the midline.

**Adventitia:** The outermost layer of an artery.

**Aliasing:** A phenomenon associated with pulsed Doppler; a misrepresentation of the Doppler shift in a negative direction occurs when the Doppler shift exceeds half the pulse repetition frequency.

**Allen test:** A test performed to check the continuity of the palmar arch normally supplied by both the radial and ulnar arteries. The test may be performed using a Doppler, a PPG, or Strain Gauge Plethysmograph.

**Amaurosis fugax:** Temporary blindness (partial or total) resulting from transient ischemia of the retinal arteries secondary to cerebral arterial disease. The most likely etiology is embolic.

**Ampere:** A unit of electromotive force; one volt acting against the resistance of one ohm (*see Ohm's law*).

**Amplifier:** An electronic device for increasing the amplitude of a signal.

**Amplitude:** The maximum variation in an acoustic variable. It is the difference between the average value and the maximum value of an acoustic variable. Units used with amplitude coincide with the acoustic variable used.

**Amputation:** The cutting off (traumatic or surgical) of all or part of an appendage. AK amputation: above the knee, BK amputation: below the knee, Syme's amputation: foot amputation with heel pad intact, Transmetatarsal amputation: toe amputation (across the metatarsals).

**Amputee:** One who has had an amputation.

**Analgesia:** Loss of painful sensation.

**Analogue signal:** A signal which is measured along a scale rather than by numerical values. The Doppler waveform derived from a chart recorder is a type of analogue signal (*see digital signal*).

**Anastomosis:** The natural or surgically-created communication between blood vessels or prosthetic graft and blood vessel as in a bypass graft. Anastomosis can then be referred to as proximal or distal.

**Anechoic:** Describes the property of being echo-free or without echoes (i.e., fluid-filled cyst).

**Anesthesia:** Loss of sensation.

**Aneurysm:** Dilation of a blood vessel, as a result of degeneration and weakening of the vessel wall. The most common cause of aneurysm formation is atherosclerosis.

**Aneurysm, dissecting:** Rupture of the intima allows blood between layers of the vessel wall, expanding the

vessel while separating the layers. Extensive extravasation can occlude the lumen.

**Aneurysm, pseudo:** An encapsulated hematoma occurring at the site of an anastomosis, or a ruptured artery, or following an iatrogenic procedure. The pulsing mass resembles an aneurysm, i.e., it is a “false” aneurysm.

**Angiectasis:** Abnormal dilation of blood vessels.

**Angiogram:** A series of x-rays taken of a blood vessel following the injection of a radiopaque substance into the vessel (arteriogram).

**Angioplasty:** Dilation of an artery by a balloon tipped catheter. Often referred to as percutaneous transluminal angioplasty (PTA).

**Angle of incidence:** The angle at which an ultrasound beam strikes an interface (with respect to the normal or perpendicular angle). In reference to Doppler, it is the angle of the beam with respect to the flow axis.

**Ankle-arm pressure index:** The ratio of ankle systolic pressure to highest arm systolic pressure. The numerical index serves as an indicator of arterial insufficiency. Normal value is 1.0 or greater; the ratio decreases as arterial insufficiency increases. Usually referred to as ABI.

**Annular array:** Array made up of ring-shaped elements arranged concentrically.

**Anomaly:** A marked deviation from the normal standard.

**Anoxia:** Absence of oxygen to the tissues.

**Antecubital fossa:** A triangular area located at the bend of the elbow that contains the cephalic, median cubital and basilic veins.

**Antegrade:** Proceeding toward.

**Antegrade flow:** Proceeding towards or forward. Opposite of retrograde or reversed.

**Anterior:** Situated in the frontal plane, in the front of.

**Anterior tibial artery (ATA):** A terminal branch of the popliteal artery located along the lateral surface of the tibia and continues onto the dorsum of the foot as the dorsalis pedis artery.

**Anticoagulant:** Substances which prohibit or delay the normal blood clotting mechanism, e.g., Coumadin and heparin.

**Aorta:** The main trunk of the arterial system with its origin off the surface of the left ventricle. It is usually described in several portions, the ascending aorta, the aortic arch, and the descending aorta (thoracic and abdominal).

**Aphasia:** Impairment of speech due to cerebral dysfunction. Sensory aphasia: inability to recognize written or spoken words. Motor aphasia: Loss of ability to articulate language.

**Arcus senilis:** An opaque ring around the cornea, seen in the elderly.

**Array:** Transducer array.

**Arrhythmia:** Abnormal heart rhythm.

**Arterial compliance:** The expansile and contractile properties of an artery.

**Arterial inflow:** Pertaining to blood flow into the lower extremities proximal to the level of the common femoral arteries.

**Arterial insufficiency:** Reduction in blood flow within the arterial system. Inadequate blood flow results in hypoxia; the symptoms produced by arterial insufficiency vary with the end organ site.

**Arterial occlusion:** Complete blockage of an artery.

**Arterial outflow:** Normally pertaining to the medium size blood vessels, common femoral through the popliteal artery. Outflow could also pertain to the vessels carrying blood away from a bypass graft.

**Arterial runoff:** The infra-popliteal vessels (tibial and distal vessels).

**Arterial ulceration:** A local defect or excavation which is produced by sloughing of inflammatory necrotic tissue.

**Arteriography:** A radiologic procedure in which an opaque substance is injected into an artery and subsequent x-ray films are taken in order to visualize the arterial system. Arteriography is an invasive procedure with a small but definite associated morbidity and mortality.

**Arteriole:** A minute artery whose distal end leads to a capillary.

**Arteriosclerosis:** Degenerative changes in the artery associated with aging.

**Arteriectomy:** Incision into an artery.

**Arteriovenous malformation:** congenital anomalies resulting from faulty development of arterial, capillary, venous or lymphatic structures or any combination thereof. These lesions are thought to be present from birth and do not represent neoplasms.

**Arteritis:** A disease characterized by inflammation of the walls of the blood vessels (vasculitis). The vessels affected are the arteries (hence the name "arteritis") This usually affects patients over 50 years of age. Cranial arteritis is also known as temporal arteritis or giant cell arteritis. It can lead to blindness and/or stroke.

**Artery:** Any of the blood vessels which carry blood from the heart to the other parts of the body. With the exception of the pulmonary and umbilical arteries, arteries transport oxygenated blood. Arteries are composed of three layers: the intima, media, and adventitia.

**Artifact:** In ultrasound usage, refers to an echo which does not correspond to a real target. In general, refers to any artificial finding which may resemble the expected findings. Artifacts may be intrinsic, e.g., reverberation or extrinsic, e.g., probe or limb movement during an examination. Cuff artifact refers to abnormally high pressures associated with the use of cuffs which are proportionately too narrow for the limb they are encircling.

**Ascites:** Accumulation of serous fluid in spaces between tissues and organs in the abdominal cavity.

**Atheroma:** Fatty degeneration or thickening of the arterial intima.

**Atherosclerosis:** Disease of the arterial intima, characterized by intimal proliferation (hyperplasia), deposition of fatty substances and luminal reduction.

**Atrophy:** Diminution in size or function, wasting.

**Attenuation:** Reduction in amplitude and intensity as a sound wave passes through a medium. Factors contributing to attenuation include: absorption, reflection, refraction, and scattering.

**Augmentation:** To cause to augment or increase. When used in conjunction with Doppler examinations of the venous or cerebral systems, refer to the increased flow velocity which is noted after one or more compression/release maneuvers.

**Auscultation:** Listening to body sounds with a stethoscope.

**Autologous vein graft:** Self generation vein specimen (your own vein), used for bypass conduit, same as autogenous.

**Axilla:** Pertains to the armpit.

**Axillary artery:** A continuation of the subclavian artery that begins at the outer border of the first rib and terminates at the lower border of the teres major muscle and becomes the brachial artery.

**Axial resolution:** Separation required to distinguish two reflectors along the same longitudinal plane, i.e., parallel to the beam axis. Axial resolution is equal to one-half the spatial pulse length.

## B

**B-Mode:** A method of operation in which the intensity of the returning echo is displayed as a spot, brightening for each pulse; brightness mode.

**Bandwidth:** The range of frequency components within a signal. When referring to a device or system, bandwidth is the range of the frequencies that the system is capable of processing.

**Basilic vein:** Large vein on the inner side of the arm (medial), near the brachial veins, a superficial vein.

**Beam:** The acoustic field produced by a transducer.

**Bernoulli effect:** The reduction in pressure which accompanies an increase in velocity of fluid flow.

**Bernoulli equation:** The equation which states that the *total fluid* energy along a streamline of fluid flow is constant. This is a form of the more general law of conservation of energy.

**Bi-Directional Doppler:** A Doppler instrument capable of determining whether the frequency of the Doppler shift is above or below the transmission frequency, permitting determination of blood flow towards or away from the probe.

**Bifurcation:** That location where a vessel branches; a frequent site of atherosclerosis.

**Bilateral:** On both sides.

**Biphasic:** Having two phases or variations having a forward and reverse component.

**Blood pressure (BP):** Pressure within the arterial system, quantified in millimeters of mercury (mm Hg); includes systolic pressure (during heart contraction), diastolic pressure (during cardiac relaxation) or mean blood pressure. Blood pressure is usually expressed as systolic over diastolic pressure.

**Blood urea nitrogen (BUN):** Waste product that accumulates in the blood stream when the kidneys are not working properly. Levels above 25 are abnormal.

**Boundary layer:** A thin layer of stationary fluid that is in contact with the vessel walls.

**Brachial artery:** Main artery of the arm, continuation of the axillary artery, on the inside of the arm, used to take the blood pressure.

**Brachial veins:** A paired set of veins which accompany the brachial artery. They are formed at the elbow by the union of the radial and ulnar veins. They drain the same area that the brachial artery supplies.

**Brachiocephalic (Innominate):** Right artery arising from the arch of the aorta, dividing into the right subclavian and right common carotid arteries.

**Bradycardia:** Abnormally low heart rate, generally less than 60 beats per minute.

**Bruit:** Auscultory sound produced by turbulent or disturbed blood flow.

**Budd-Chiari syndrome:** Venous outflow obstruction or occlusion, located at any level from the hepatic venules to the inferior vena cava (IVC), associated with ascites and liver failure.

**Buerger's disease:** Inflammatory disease of the arteries and veins, also called thromboangiitis obliterans. Symptoms produced are those of arterial insufficiency which can ultimately progress to gangrene. Young males are the most commonly affected. Smoking is a very definite factor in the development of this disease.

**Bypass:** An alternate route, a surgically created pathway within the arterial or venous system used to avoid an obstruction.

## C

**Calcification:** Deposition of calcium salts within an organic substance causing hardening; a normal process in bone but pathological in the arteries. Medial calcification is known as Monckeberg's sclerosis. Arterial calcification hampers Doppler ultrasonic evaluation of blood flow because of the high reflectivity of calcium. In ultrasound, acoustic shadowing occurs distal to a calcified plaque because most of the ultrasound is reflected back to the transducer. Calcified structures have a higher acoustic impedance than the surrounding tissues.

**Calf:** The fleshy mass formed by the gastrocnemius muscle at the back of the leg below the knee.

**Callosity or Callus:** A thickening of the skin, due to friction, pressure or other irritation.

**Capillary:** A minute vessel that connects the arterioles and venules forming a network, in all parts of the body.

**Cardiac:** Pertaining to the heart.

**Cardiovascular:** Pertaining to the heart and blood vessels.

**Carotid body:** An oval mass of cells within the carotid sinus. This area acts as a chemoreceptor site and responds to changes in oxygen and carbon dioxide concentrations within the blood.

**Carotid phonoangiography:** A process of recording bruits and analyzing their frequency components. The device consists of a sensitive microphone and a storage oscilloscope commonly called CPA.

**Carotid sinus:** A slight dilation of the carotid bifurcation area which contains pressure receptors (baroreceptors) that respond to changes in blood pressure by altering the heart rate.

**Catheterization:** Passage of a small catheter into the artery or vein to obtain blood samples, used with interventional and diagnostic procedures on the arteries in the heart or the body.

**Catheter:** A tube passed through the body for evacuating fluid or injecting them into the body cavities. Typically made of elastic, elastic web, rubber, glass, metal, or plastic.

**Cathode Ray Tube (CRT):** A television, or a large vacuum tube. The inner surface of the CRT screen is coated with phosphors that glow when struck with electrodes.

**Caval:** Pertaining to the vena cava.

**Cavity:** A hollow space.

**Caudad:** In a direction toward the feet (or tail), the opposite of cephalad.

**Caudate lobe:** The lobe of the liver that lies anterior to the inferior vena cava and posterior to the left lobe.

**Causalgia:** Severe neuralgic pain; also called reflex sympathetic dystrophy.

**Celiac artery:** First branch of the abdominal aorta. The branches of the celiac artery (left gastric, hepatic, and splenic arteries) supply blood to the stomach, liver, spleen, duodenum, and pancreas.

**Cellulitis:** Inflammation of cellular or connective tissue. An infection in or close to the skin is usually localized by the body defense mechanisms.

**Centimeter:** One hundredth of a meter.

**Cephalad:** Toward the head.

**Cephalic:** Cranial; superior in position.

**Cephalic vein:** A superficial vein that ascends from the dorsal aspect of the radial border of the forearm, to the anterior surface and subcutaneously up the arm and ends in the axillary vein near the clavicle. Frequently used for arteriovenous fistula formation for dialysis access.

**Cerebral:** Pertaining to the brain.

**Cerebrovascular:** Pertaining to the blood supply and blood vessels to the brain.

**Cerebrovascular accident (CVA):** Catastrophic event in which cerebral ischemia results in a neurologic deficit (lasting longer than 48 hours). The type of symptoms depends upon the cerebral hemisphere and territory involved. The etiology of CVA can be thrombotic, hemorrhagic, or embolic.

**Cervical rib:** An extra rib in the cervical region; may cause symptoms by compression of the brachial plexus (*see thoracic outlet syndrome*).

**Cholesterol:** Ammohydric alcohol; a sterol widely distributed in animal tissues and occurring in egg yolks, various oils, fats, the nerve tissue of the brain and spinal cord, the liver, kidneys and adrenal glands.

**Chronic:** Of long duration, or occurring with repeated frequency; opposite of acute. Occurring over a long period of time, old versus new.

**Circle of Willis:** Arterial circle of the cerebrum composed of left and right internal, anterior, posterior, and middle cerebral arteries as well as anterior and posterior communicating arteries. This important anastomosis connects the bilateral carotid circulation with the vertebral circulation and may be a source of collateralization in internal carotid occlusive disease.

**Circulation:** The continuous passage of blood throughout the arterial and venous systems.

**Cirrhosis:** A chronic disease of the liver; dense connective tissue forms, liver cells cease to function.

**Claudication:** Literally, “to limp” symptoms associated with arterial insufficiency of the extremity; intermittent leg pain (ache, cramp, etc.) brought on by exercise and relieved by rest.

**Coagulate:** To become clotted or congealed.

**Coagulation:** To change from a fluid to a semi solid mass.

**Coapt:** To meet or join. When performing a venous duplex exam, with light probe pressure, the walls of normal veins collapse and come together (compression).

**Coarctation:** A stricture or narrowing of a vessel, usually of a congenital nature.

**Collagen disease:** Any of various clinical syndromes characterized by widespread alterations of connective tissue including inflammation and degeneration. Included are polyarteritis, systemic lupus erythematosus, Marfan’s syndrome.

**Collateral circulation:** An alternate, natural circulatory pathway. When there is interference in the arterial supply because of obstruction, communicating channels develop to accommodate blood flow. The peripheral resistance of the collateral vessels is higher because of the smaller diameter of the vessels.

**Colon:** The large intestine from the terminal ileum to the rectum; divided into ascending, transverse, descending, and sigmoid colon.

**Common bile duct (CBD):** Passes very obliquely through the muscular wall of the duodenum and joins with the pancreatic duct to form the ampulla of Vater; carries bile to the duodenum and after receiving it from the cystic duct of the gall bladder and the hepatic ducts from the liver.

**Common Carotid Artery:** The common carotid artery (CCA) is the main artery that supplies the head and neck. It arises from the innominate (brachiocephalic) artery on the right and from the aorta on the left CCA.

Each CCA branches into the internal and external carotid arteries.

**Compartment syndrome:** This syndrome occurs when increased pressure in the noncompliant fascia compromises circulation and neuromuscular function in that anatomic space.

**Competence:** In the normal vein no retrograde flow is detected, either with Valsalva maneuver, with proximal compression, or with the release of distal compression. Absence of retrograde flow confirms adequate venous valve closure.

**Composite bypass:** An arterial bypass graft constructed by using composites of autogenous vein and dacron or synthetic graft material interchangeably.

**Compression:** The act of pressing or squeezing; the condition of being pressed together.

**Conduction:** The transmission of waves (light or sound) through a medium.

**Congenital:** Present at birth.

**Congested:** Containing an abnormal amount of blood in the tissue.

**Congestive heart failure (CHF):** A chronic cardiac condition in which the heart is unable to maintain adequate output of blood resulting in congestion of blood in the veins and other organs of the body.

**Constriction:** The narrowing of a vessel opening.

**Continuous flow:** In abnormal veins the respiratory phasicity is lost, resulting in a steady flow signal. When coupled with very low velocity, continuous flow indicates proximal (except in the Portal system) obstruction that is preventing the normal fluctuations in flow that occurs during respiration. It is not always possible to distinguish between extrinsic vein compression and intrinsic obstruction (DVT), most especially in the iliac segments.

**Continuous wave:** A wave in which cycles repeat indefinitely.

**Continuous wave Doppler (CW):** A Doppler which uses separate transmitting and receiving piezoelectric crystals, each operating without interruption. The reflected sound waves are processed continuously.

**Contralateral:** On the opposite side.

**Contrast medium:** The use of a foreign substance to provide a difference in density (contrast) so that the tissue or organ can be better visualized.

**Cord:** A string like structure. A firm elongated structure consistent with a thrombosed vein.

**Coronary artery bypass surgery:** Surgical establishment of a shunt that permits blood to travel from the aorta to a branch of the coronary artery at a point past an obstruction.

**Coronary Artery Disease (CAD):** Narrowing of the arteries sufficient to prevent adequate blood supply to the myocardium.

**Cortex:** The outer layer of an organ as distinguished from the inner medulla, as in the kidney, ovary, lymph nodes, etc.

**Costoclavicular:** Pertains to the ribs and the clavicle.

**Costotomy:** Incision or division of a rib or part of one.

**Coumadin anticoagulant:** One of a group of natural and synthetic compounds that antagonize the biosynthesis of vitamin K dependent on coagulation factors in the liver.

**Coupling medium:** Normally an aqueous based gel. Used due to its high impedance match with tissue which allows for rapid passage of the sound beam into the tissue, with very little refraction.

**Cramp:** Spasmodic muscle contraction; term often used by patients to describe claudication pain.

**Creatine:** The decomposition product of the metabolism of phosphocreatine, a source of energy for muscle contraction. Increased quantities of it are found in advanced stages of renal disease.

**Credentialing:** Recognition by licensure and/or certification that an individual has met a certain criteria.

**Crescendo TIAs:** TIAs that are increasing in frequency over a given period of time.

**Critical stenosis:** A stenosis of sufficient diameter reduction that flow rate and pressure are significantly affected. Sometimes called “hemodynamically significant” stenosis.

**Crosstalk:** Occurs when a strong Doppler signal in one direction channel passes into the other channel. This can produce the Doppler mirror-image artifact.

**Cuff artifact:** Consistently high segmental blood pressure in the lower extremity resulting from the use of narrow segmental cuffs which may not completely transmit cuff pressure to the vessels in the central part of the limb (i.e., femoral artery). This effect is most pronounced in the upper thigh. Cuff artifact must be considered to avoid false negative examinations.

**Cyanosis:** A slight bluish, grayish, slate like or dark purple discoloration of the skin caused by reduced amounts of hemoglobin in the blood. Etiology: a deficiency of oxygen.

**Cycle:** A complete variation of an acoustic variable.

**Cyst:** A closed sac or pouch, with a definite wall, contains fluid, semi fluid, or solid material. A simple cyst is usually spherical, with echo enhancement posterior to cyst. Complex cysts can have internal debris and septations.

## D

**D-C coupled (Direct Current):** Type of output signal to graphic display connection which responds to steady state conditions; results in baseline shifts.

**Damping:** A technique used to reduce the amplitude of an ultrasound pulse at its point of origin in the transducer or upon its return to the transducer.

**Damping factor:** The ratio of proximal and distal pulsatility indices (Gosling).

$$DF = \frac{\text{Proximal PI}}{\text{Distal PI}}$$

**Damping material (backing material):** A material that is bonded to the backside of the active element and acts to limit the “ringing” of the crystal.

**D-Dimer:** D-Dimer is formed as fibrin is broken down. Lab testing can reveal its presence in the blood. Positive levels are suggestive of a thrombotic event such as deep vein thrombosis or pulmonary embolism. Negative levels can virtually rule out the presence of DVT or PE, sparing the patient further expensive, uncomfortable and/or invasive testing

**Dead zone:** The region close to the transducer that cannot be imaged accurately.

**Deceleration:** A decrease in velocity.

**Decibel (dB):** The unit for expressing logarithmically the pressure or power (intensity or loudness) of sound.

**Decubitus, lateral:** Refers to a patient lying on their side.

**Deep vein thrombosis (DVT):** Obstruction of the deep veins by blood clot. At one time referred to as phlebothrombosis; DVT is a non-inflammatory process. The possibility of the loosely attached thrombus dislodging is always present. DVT can lead to valvular destruction, post-phlebitic syndrome, and pulmonary embolism.

**Demarcation:** A distinct dividing line that is visually noted, separating living and necrotic tissue.

**Dependent rubor:** Abnormal redness noted of the toes (filling of the small vessels) and forefoot when the leg is in the dependent position. This is usually noted in patients with severe occlusive disease.

**Depth of penetration:** That depth wherein echoes are no longer detectable; a function of the operating frequency of the transducer.

**Dermatitis:** Inflammation of skin evidenced by itching, redness, and various skin lesions.

**Diabetes mellitus:** A chronic disease characterized by hyperglycemia secondary to inadequate production or reduced effectiveness of insulin. Juvenile onset diabetes develops before the age of 40 and is associated with lack of insulin. Adult-onset diabetes occurs later in life, primarily in the obese; these patients have inadequate insulin supply but can usually be managed by dietary treatment or oral hypoglycemic agents. Diabetes accelerates the atherosclerotic process and in its later stages results in a variety of vascular complications. Medial-wall calcification is commonly found in diabetic patients.

**Diagnosis:** The art of identifying a disease.

**Diaphragm:** A musculomembranous wall separating the abdomen from the thoracic cavity. It contracts and expands with respiration.

**Diastole:** Relaxation period of the cardiac cycle.

**Diastolic bruit:** A bruit which extends into diastole. This is indicative of a very severe stenosis.

**Diastolic pressure:** The period of least pressure in the arterial vascular system.

**Dicrotic notch:** A brief, abrupt upswing in pressure during the deceleration phase of systole, forming a “notch” in the pressure and velocity waveforms. This

marks the closure of the semilunar valves, sometimes used as a marker for the end of systole.

**Digit:** A toe or finger.

**Digital signal:** A signal which occurs in discrete steps over time and in sequence; signals converted into numerical values or multiples of the numerical. Digital data information is then translated (e.g., through a digital scan converter) for display purposes.

**Digital subtraction angiography (DSA):** An invasive computerized radiologic procedure performed to visualize major vessels, the bone and soft tissue is subtracted electronically to enhance the images. This procedure can be intra-arterial or intravenous.

**Dilatation:** A vessel is stretched beyond normal dimensions.

**Dissecting aneurysm:** Splitting or dissection of an arterial wall by blood entering through an intimal tear or interwall hemorrhage. Usually in aortic arch and thoracic aorta.

**Dissection:** Separation of tissues; usually surgically (*see aneurysm, dissecting*).

**Disseminated intravascular coagulation (DIC):** A pathological form of coagulation that is diffuse rather than localized, as would be the case of normal coagulation. The process damages rather than protects the area involved, and several clotting factors are consumed to such extent that generalized bleeding may occur.

**Distal:** Farthest from the center from medial line, or from the trunk; opposite of proximal.

**Distance:** The space between two objects.

**Distortion:** Variation in amplitude or frequency of a signal that may be caused by overdriving the amplifier in the circuit.

**Divergence:** The spreading out of a beam that results from a source of small physical dimensions or diffraction's or scattering. Divergence degrades the ultrasound image by creating loss of beam intensity.

**Doppler:** A diagnostic instrument which emits an ultrasonic beam into the body. This ultrasound is reflected back from moving structures within the body at a frequency higher or lower than this transmitted frequency (Doppler shift). This shift is amplified and presented as a sound or graphic (chart) display.

**Doppler angle:** The angle between the direction of propagation of the ultrasound and the direction of flow. As an approximation, the angle between the axis of the ultrasound beam and the axis of the vessel lumen is generally used.

**Doppler effect:** Observed frequency change of reflected sound due to reflector movement to the source or the observer.

**Doppler scanning:** A scanning technique based on the Doppler effect to indicate the presence or absence of motion.

**Doppler shift:** The frequency shift created between the transmitted frequency and received frequency by an interface moving with velocity at an angle to the sound source.

**Doppler shift formula:**

$$F = \frac{2 f_t V (\cos \theta)}{C}$$

F = Frequency shift

f<sub>t</sub> = transmitting frequency

V = velocity of target

θ = angle of incidence

C = velocity of sound in tissue.

**Doppler shifted frequency:** The change in frequency equal to reflected frequency minus incident frequency.

**Doppler waveform:** The time display of the spectrum of the Doppler signal.

**Dorsal:** Indicating a position toward the rear part, pertaining to the back: opposed to ventral.

**Dorsalis pedis artery:** The extension of the anterior tibial artery, distal to the ankle joint, along the dorsum of the foot.

**Drop attacks:** A symptom of vertebrobasilar insufficiency manifested by loss of postural control resulting in sudden periodic falling, not associated with vertigo or unconsciousness.

**Duct:** A narrow or tubular vessel or channel, especially one that conveys secretions from a gland.

**Duodenum:** The first part of the small intestine, connecting with the pylorus of the stomach and extending to the jejunum.

**Duplex scan:** An ultrasound technology which combines two-dimensional B-Mode imaging with time-velocity spectral analysis.

**Duplex scanner:** Instrument that combines static B-mode or real-time imaging with Doppler flow detection.

**Duty factor:** Amount of time that the ultrasound system is on.

**Dynamic range:** The ratio of the largest and smallest signals that a system can handle simultaneously; expressed in decibels.

**Dysarthria:** A speech disorder in which the pronunciation is unclear although the linguistic content and meaning are normal.

**Dysesthesia:** Abnormal sensations on the skin, such as feelings of numbness, tingling, prickling, or a burning or cutting pain.

**Dysfunction:** Abnormal, inadequate, or impaired action of an organ or part.

**Dyskinesia:** A defect in the ability to perform voluntary movement.

**Dysphagia:** A condition in which the action of swallowing is either difficult to perform, painful, or in which swallowed material seems to be held up in passage to the stomach.

**Dysphasia:** Lack of coordination of speech, and failure to arrange words in an understandable way; related to cortical damage.

## E

**Echymosis:** A skin discoloration consisting of large irregularity formed hemorrhagic areas.

**Echo:** Reflection of acoustic energy.

**Echogenic:** The acoustic property of a medium which renders it capable of producing echoes.

**Echoic:** The area of an ultrasound image that depicts strong echoes created by strong interfaces.

**Ectatic:** Distended or stretched.

**Ectopic:** In an abnormal position. Originating in an area of the heart other than the sinoatrial node causing an ectopic heart beat.

**Edema:** A local or generalized condition in which the body tissues contain an excessive amount of tissue fluid.

**Elasticity:** Willingness of a medium to distort from its original size and shape and restore to its original form after the external influence is removed.

**Elevation pallor:** Pallor induced by elevation of the limb.

**Embolectomy:** Removal of an embolus from a vessel.

**Embolism:** An obstruction in a vessel from a foreign substance or blood clot.

**Embolus:** A mass of undissolved matter present in a blood or lymphatic vessel and carried there by the blood or lymph current.

**Endarterectomy:** Surgical removal of atherosclerotic material and intimal lining from within an artery.

**Endarteritis:** Inflammation of the innermost layer (intima) of an artery.

**Endograft:** A graft placed within a vessel.

**Endoleak:** Endoleak is a term that describes the presence of persistent flow of blood into the aneurysm sac after device placement. There are 4 types of endoleaks dependent on their etiology

**Endoleak, attachment (Type I):** A type I endoleak, is due to an incompetent seal at either the proximal or distal attachment site.

**Endoleak, branch (Type II):** Type II endoleaks are the most prevalent type and describe flow into and out of the aneurysm sac from patent branch vessels. They are most often identified on the post procedural CT, appearing as collections of contrast outside of the endograft, but within the aneurysm sac. The most frequent sources of type II endoleaks are collateral back flow through patent lumbar arteries and a patent inferior mesenteric artery. Because the sac fills through a collateral network, the endoleak may not be visualized on the arterial phase of CT scanning; thus, delayed imaging is required.

**Endoleak (Type III):** These endoleaks are less common and represent flow into the aneurysm sac from separation between components of a modular system, or tears in the endograft fabric.

**Endoleak (Type IV):** These endoleaks are due to egress of blood through the pores in the fabric.

**Endotension:** An enlarging of the aneurismal sac without a visible endoleak.

**Endothelium:** A form of squamous epithelium consisting of flat cells that line the blood and lymphatic vessels.

**Endovascular:** A catheter-based, imaging-guided procedure that allows one to work within a vessel

**Enhancement:** An image artifact created behind a low attenuating medium.

**Erythema:** Reddening of the skin.

**Erythrocyte:** A mature red blood cell (RBC) or corpuscle.

**Esophageal varices:** Varicosities of the branches of the azygos vein that anastomose with the tributaries of the portal vein in the lower esophagus; occurs in patients with portal hypertension.

**Ethics:** A code of moral principles, individually or collectively defined; derived from a set of values or beliefs.

**Etiology:** Study of the causation of disease.

**Eversion:** To turn inside out.

**Exogenous:** Originating outside an organ or part.

**External carotid artery (ECA):** The vessel which arise from the common carotid artery at the carotid bulb and course anteromedially, supplying the exterior of the head, the face, and the greater part of the neck (normally has eight branches).

**External iliac artery:** The branch of the iliac bifurcation that arises from the common iliac artery that supplies the pelvic and genital organs. This artery is also known as the hypogastric artery.

**Extracranial:** Outside of the skull, usually used in reference to vessels or structures outside of the cranium.

**Extravasation:** Discharge or escape, as of blood or other substance from within a vessel into the tissue.

**Extrinsic:** Originating from without, opposite of intrinsic.

## F

**Faint:** A state of temporary unconsciousness.

**Falciform ligament:** A wide, sickle-shaped extension of the peritoneum that serves as the principal attachment of the liver to the diaphragm and separates the right from the left lobes of the liver.

**False aneurysm:** See aneurysm, pseudo.

**False negative rate:** Rate at which a diagnostic test produces negative results when disease is actually present.

$$\text{False Neg. Rate} = \frac{\text{FN}}{\text{TP} + \text{FN}} \times 100 = \%$$

FN = false negative, TP = true positive

**False positive rate:** Rate at which a diagnostic test produces positive results when disease is not present.

$$\text{False Pos. Rate} = \frac{\text{FP}}{\text{TN} + \text{FP}} \times 100 = \%$$

TN = true negative, FP = false positive

**Far zone (far field, Fraunhofer):** Distance from a focused transducer to the center of the focal region; in an unfocused transducer, that area where the beam begins to diverge.

**Fasciotomy:** A surgical procedure which involves the incision and division of the fascia in order to relieve pressure within the muscle compartments (compartment syndrome).

**Fast Fourier transformation:** A mathematical formula used to analyze amplitude frequency profile.

**Fibromuscular dysplasia:** An abnormal development of tissue composed of fibrous and muscular tissue (usually found, distal internal carotid and mid to distal renal arteries).

**Field:** That region propagated by an ultrasonic wave.

**Field of view:** That plane seen by specific ultrasound transducer.

**Filter:** An electronic circuit designed to allow signals of certain frequencies to pass and to stop signals of other frequencies.

**Fistula, arteriovenous:** Communication between an artery and a vein. It may be congenital, traumatic, or surgically created for dialysis access.

**Focal length:** The distance from the focused transducer to the center of the focal region.

**Focal region:** That region where beam diameter and area are minimum.

**Frame rate:** Number of television frames displayed by a system per second. Standard television format is 30 frames per seconds. The field rate is 60 frames per second (2 fields make up 1 frame).

**Frame:** The display produced by one scan of an ultrasound beam.

**Frequency:** Number of cycles per unit of time (usually seconds); expressed in Hertz (Hz): 1 Hz = 1 cycle per second, Kilohertz (KHz): 1 KHz = 1,000 Hz, or Megahertz (MHz): 1 MHz = 1,000,000 Hz or 1,000,000 cycles per second.

**Friable:** Easily crumpled; term is occasionally used to describe atherosclerotic plaque.

**Fusiform:** uniform circumferential dilatation; spindle shaped.

## G

**Gain:** The ratio of output to input in an amplifying system.

**Gaiter area zone:** The region of the medial lower leg just above the ankle. It is this area where signs of venous stasis are most evident.

**Gallbladder:** A pear shaped sac on the underside of the right lobe of the liver; it stores bile from the liver, concentrates the bile by removing water from it, and discharges the bile through the cystic duct.

**Gangrene:** Tissue death, usually as a result of inadequate blood supply; occasionally due to infection. Lack of blood supply may be due to atherosclerosis, embolism, spasm, frostbite, tourniquets, etc.

**Gastric:** Pertaining to the stomach.

**Gastric artery:** Arises from the celiac axis; usually the first branch; divides into right and left; supplies blood to the stomach.

**Gastro-duodenal artery:** Arises from the common hepatic trunk and supplies the stomach and duodenum.

**Gastrointestinal (GI):** Pertaining to the stomach and intestine.

**Gastrocnemius:** That large muscle of the posterior portion of the lower leg that propels venous blood up the leg as it contracts. Commonly referred to as the calf muscle pump, this superficial muscle extends the foot and helps to flex the knee.

**Gate:** Electronically controlled device which controls transmission or reception of a signal.

**Glaucoma:** An ocular disease characterized by increased intraocular pressure. Presence of this disease should be noted prior to performing OPG or OPG-G testing.

**Glomerulonephritis:** A variety of nephritis characterized by inflammation of the capillary loops in the glomeruli of the kidney. It occurs in acute, subacute, and chronic forms and is usually secondary to an infection, especially with the hemolytic streptococcus.

**Graft:** The material used, either organic or inorganic, that is surgically inserted to replace a defect in the body.

**Gravitational:** Pertaining to the force of gravity.

**Gray scale:** A display format in which the intensity information is recorded as changes in brightness. Also known as B-mode.

**Greater saphenous vein (GSV):** One of the two major superficial veins of the lower limb. It originates on the dorsum of the foot, ascends medially along the calf and thigh, and drains into the common femoral vein. It is the longest vein in the body and is the vessel of choice for lower extremity bypass procedures and is also used for coronary artery bypass.

## H

**Hard copy:** A method of preserving or recording observed data, e.g., Polaroid pictures of images, analog tracings of Doppler shifted signals and digital images.

**Heat:** Energy resulting from thermal molecular motion.

**Hemangioma:** A tumor, growth, or abnormal mass composed of blood vessels.

**Hematoma:** A blood-filled swelling.

**Hemianopia:** Blindness in one-half of the visual field; may affect one or both eyes.

**Hemiparesis:** Muscular weakness affecting one side of the body.

**Hemiparalysis:** Paralysis of one side of the body; may be permanent (stroke) or temporary (TIA).

**Hemiplegia:** Paralysis of one side of the body.

**Hemispheric:** Pertaining to one side of the brain. Stroke is referred to as being right or left hemispheric; this is in relation to the side of the brain that is affected, not the side of the body that is afflicted.

**Hemodynamics:** Pertaining to the physical principles governing blood flow (i.e., blood pressure, blood flow, vascular volumes, heart rate, ventricular function).

**Hemoglobin:** The iron containing pigment of the red blood cells. Its function is to carry oxygen from the lungs to the tissues. The amount of hemoglobin in the blood averages 14-16 grams per 100ml.

**Hemorrhage:** Escape of blood from a vessel (arterial or venous). Abnormal bleeding.

**Heparin:** Substance used to inhibit coagulation of blood; frequently used in the treatment of deep venous thrombosis.

**Hepatic artery (common):** Arises from the celiac trunk and supplies the stomach, pancreas, duodenum, liver, gallbladder, and greater omentum. Divides into proper hepatic and gastroduodenal arteries.

**Hepatic artery (proper):** Arises from the common hepatic artery and supplies the liver and gallbladder.

**Hepatic veins:** Drain blood flow from the liver into the inferior vena cava. There are three main veins, the left, middle and the right.

**Hepatofugal flow:** Directed or flowing away from the liver.

**Hepatopetal flow:** Directed or flowing toward the liver.

**Hertz (Hz):** The basic unit of frequency, equal to one cycle per second.

**Heterogeneous:** Of different kind or species; used in ultrasound to describe sonographic characteristics of atherosclerotic plaque; opposite of homogeneous.

**Hilum:** A depression or pit at that portion of an organ where vessels, ducts, and nerves enter. The indented part of the kidney.

**Histogram:** A graphic representation of a frequency distribution.

**Holosystolic:** Throughout systole, used interchangeably with pansystolic.

**Holosystolic bruit:** A bruit which extends throughout the period of systole from the first to the second heart sound; consistent with a severe stenosis.

**Homan's sign:** Pain in the calf muscle resulting from passive dorsiflexion of the foot. Is sometimes indicative of deep venous thrombosis; of limited accuracy.

**Homogeneous:** Uniform in structure, of the same composition.

**Homologous vein graft:** A graft which is similar in structure and origin to the native vessel and is donated from another human being or specimen (Bovine).

**Homonymous:** Of corresponding halves; see hemianopia.

**Homonymous hemianopia:** Blindness in the same visual fields in both eyes (*see hemianopia*).

**Horseshoe kidney:** A congenital abnormality in which both kidneys are joined at their lower poles.

**Hunter's canal:** A triangular space lying in the distal thigh beneath the sartorius muscle and between the adductor longus and the vastus medialis muscle. It is at this location that the femoral vessels and the saphenous nerve are transmitted. This change in the course of the superficial femoral vein may cause difficulty in evaluating the compressibility of that vessel during a venous imaging procedure.

**Hydronephrosis:** Obstruction of the outflow from the kidney somewhere in the ureter, bladder, or urethra, causing dilation of the kidney's collecting system.

**Hydrostatic pressure:** A pressure created in a fluid system, such as the circulatory system.

**Hypercholesterolemia:** Excessive cholesterol in the blood.

**Hyperchromic:** Excessive pigmentation or coloration; term may be used to describe venous stasis changes.

**Hyperechoic:** Producing echoes of higher amplitude than normal for the surrounding medium.

**Hyperemia:** Increased blood in an area. May be active, i.e., caused by increased flow or passive, i.e., increased flow that occurs in response to a previous restriction of flow (*see reactive hyperemia*).

**Hyperlipemia:** Excessive fat in the blood.

**Hyperplasia:** Excessive cell formation.

**Hypertension:** Abnormally elevated blood pressure: may be essential (etiology unknown) or secondary to another condition (e.g., renal disease, pregnancy). Although there is no universal agreement, 140 systolic and 90 diastolic are considered the upper limits of normal. Hypertension is a major risk factor in the development of atherosclerosis. Control of hypertension is an important consideration; some sequelae of hypertension include stroke, small vessel damage, and congestive heart failure.

**Hypertrophy:** Abnormal tissue or structural size.

**Hypervolemia:** Excessive blood volume.

**Hypoechoic:** Producing echoes of lower amplitude than normal for the surrounding medium.

**Hypoesthesia:** Diminished sensation.

**Hypogastric artery:** Another name for the internal iliac artery, which supplies the pelvic viscera and musculature.

**Hypoplastic:** Incomplete development or underdeveloped (artery or organ).

**Hypotension:** Abnormally low blood pressure; may be primary, secondary, or postural.

**Hypovolemia:** Decreased blood volume.

**Hypoxia:** Diminished oxygen content in the tissues.

**Iatrogenic:** Refers to any condition which arises from the treatment of another condition by a physician or surgeon, e.g., damage to the artery during an arteriographic procedure.

**Iliac artery:** Originates at the terminal bifurcation of the abdominal aorta forming the right and left iliac arteries. The common iliac branches into the external and internal iliac arteries.

**Iliac vein:** Formed by the union of the internal iliac vein which drains the pelvis and the external iliac vein which is a continuation of the common femoral vein. The right and left common iliac veins unite to form the inferior vena cava.

**Image update:** The ability of a duplex scanner to alternate between the two functions of imaging and Doppler.

**Impedance:** Electrical resistance; changes in impedance (or resistance) are measured by impedance plethysmography (IPG) and strain gauge plethysmography (SPG) (*see acoustic impedance for ultrasound usage*).

**Impedance plethysmography:** A noninvasive diagnostic technique used in the diagnosis of deep venous thrombosis. Four electrodes are placed around the

calf and a small electrical current is sent through the underlying tissues. A recording is made of changes in venous capacitance occurring during a period of obstruction to venous outflow (via an occluding thigh cuff). Since the current is held constant any changes in resistance (or impedance) detected by the skin electrodes are associated with volume changes in the calf. By plotting venous filling (capacitance) and venous emptying (outflow) on a graph, conclusions can be drawn about the patency of the venous system (*see Ohm's law*).

**Impotence:** In the male, inability to achieve penile erection. The etiology can be neurogenic, metabolic, vasculogenic, or psychogenic. Identification of the primary etiology is complex and involves serum hormonal studies, nocturnal tumescence study, and noninvasive vascular examination (*see penile-brachial index*).

**In situ:** In position. Used to describe a vascular surgery procedure where the greater saphenous vein remains in its anatomical position as the vessel is transformed into an arterial conduit. The valves are surgically removed and the branches are ligated before the proximal and distal anastomoses are made.

**Incidence angle:** Angle between propagated sound beam direction and line perpendicular to media boundary.

**Incompetent:** Unable to perform natural function. Used to refer to venous valves which no longer close completely, permitting blood to flow in a backward direction.

**Incompressible vessel:** Inability to eliminate the arterial flow signal with maximal cuff pressures most likely due to medial calcification of the arterial wall and resulting in falsely high pressures.

**Inertia:** Resistance to acceleration.

**Infarct:** A localized area of ischemic tissue necrosis due to inadequate arterial blood supply.

**Infarction:** An event occurring when there is an arterial occlusion or stenosis to the point of insufficient blood flow to an organ.

**Inflow obstruction:** Arterial blood flow is severely restricted due to a proximal obstructing lesion.

**Inferior:** Lower than, beneath.

**Inferior mesenteric artery (IMA):** Originates from the distal aorta and supplies the left portion of the transverse colon, the descending colon, the sigmoid colon, and part of the rectum.

**Inferior mesenteric vein (IMV):** Is usually small in size and runs to the left of the superior mesenteric vein to join the splenic vein.

**Inferior vena cava (IVC):** Originates from the union of the right and left iliac veins terminating in the right atrium of the heart.

**Infrapopliteal:** Located below the popliteal artery or popliteal space.

**Infrarenal:** Located below the renal artery.

**Inguinal ligament:** A fibrous band extending from the anterior superficial iliac spine to the pubis tubercle in the groin.

**Innominate artery:** Arising from the arch of the aorta, dividing into the right subclavian and right common carotid arteries.

**Innominate vein:** Formed by the union of the internal jugular with the subclavian vein.

**Insonate:** To expose to ultrasound waves, to examine utilizing sound waves.

**Insulin:** Pancreatic hormone required for carbohydrate metabolism (*see diabetes*).

**Intensity:** Total energy in an acoustic wave as it travels through a space per unit time; equal to the power

in the wave divided by the area over which the power is spread.

$$\text{Intensity} = \frac{\text{power (watts)}}{\text{area (CM}_2\text{)}}$$

**Interface:** Surface forming the boundary between two media having different properties/densities (i.e., acoustic impedance).

**Intermittent:** Occurring at intervals, not constant. Used when describing claudication.

**Internal:** Inside, opposite of external.

**Internal carotid artery (ICA):** The internal carotid artery arises from the common carotid artery at the carotid bulb, and courses posterolaterally to the base of the skull where it gives rise to vessels which feed the brain, nose, orbit, internal ear, and forehead. It is divided into four parts: cervical, petrous, cavernous, and cerebral.

**Interosseous artery:** A branch of the ulnar artery, which in some individuals continues to the wrist.

**Intima:** Innermost layer of an artery; comprised of an endothelial lining, a thin layer of connective tissue, and an internal elastic membrane.

**Intima media thickness (IMT):** A statistical measurement/ parameter used to define the extent of atherosclerosis in its early phase (discrimination threshold in the resolution area of ultrasound equipment: > 100um).

**Intimal flap:** A loosened portion of the innermost wall of the artery.

**Intracranial:** Within the skull; used to refer to those structures and blood vessels within the cranium. Opposite of extracranial.

**Intraluminal thrombus:** Soft clot (usually poorly echogenic), which is contained within the walls of a blood vessel.

**Intravascular sonography:** The introduction of suitable transducers into the blood vessel.

**Intrinsic:** From within, inside. Opposite of extrinsic.

**Invasive:** Penetrating into the body tissues; e.g., an invasive procedure is one in which a substance or an instrument enters the body.

**Iodine-125 fibrinogen uptake:** Radio labeled fibrinogen is injected into the blood stream and is “taken up” or incorporated into any active clot formation.

**Ipsilateral:** On the same side, opposite of contralateral.

**Ischemia:** Deficient local blood supply to body tissues; due to obstruction of arterial inflow. Symptoms of ischemia include coldness, pallor, pain, impairment of function and ultimately tissue necrosis (gangrene).

## J

**Jugular vein:** Major neck vein subdivided into anterior, external, and internal jugular veins bilaterally.

**Jugular vein anterior:** Originates from the veins draining the lower jaw, descends anteriorly, and terminates in the external jugular vein.

**Jugular vein external:** Drains the exterior of the cranium and deep parts of the face, runs perpendicularly in the neck to empty into the subclavian, internal jugular, or brachiocephalic vein.

**Jugular vein internal:** Continues from the transverse sinus at the base of the skull, runs vertically in the neck to unite with the subclavian vein to form the brachiocephalic vein.

**Juxtarenal:** Adjacent to, side by side, or in close proximity to the renal structures.

## K

**Kilohertz (KHz):** 1,000 Hertz or cycles per second (see *Hertz, frequency*).

**Kinetic:** Pertaining to motion; e.g., kinetic energy is that energy associated with movement.

## L

**Lacunar infarct/Lacunae:** Important, but poorly understood, irregularly/jagged cavities in the brain (0.5 to 15 mm in size) believed to be small, deep cerebral infarcts.

**Lamina:** A thin layer.

**Laminar flow:** Blood flowing in thin layers in a streamline direction parallel to the vessel wall. The highest velocities are at center stream; slowest along the wall. In laminar flow, red blood cells tend to migrate toward center stream, leaving the less viscous plasma along the wall.

**Lateral:** Away from the mid-line, to the side.

**Lateral resolution:** That separation required to distinguish two reflectors along a path perpendicular to the sound beam path; a function of beam width.

**Left gastric artery:** Originates from the celiac artery and supplies the stomach.

**Lens, acoustic:** A transparent material placed in front of a transducer used to focus an ultrasound beam.

**Lesion:** Any pathological change in a body tissue, e.g., a venous ulcer is a lesion, atherosclerotic plaque may be referred to as a lesion.

**Lesser saphenous vein (LSV):** One of two major superficial veins of the lower limb. Originating on the lateral side of the foot, it extends along the posterior

aspect of the calf. The termination of the LSV varies; terminations include the popliteal 2-4 cms near knee crease, distal SFV, or GSV (either directly or via a perforating vein).

**Ligamentum teres:** Echogenic structure in the left lobe of the liver (a remnant of the ductus venosum) in which the umbilical vein runs.

**Ligate:** To tie off, e.g., to tie off a blood vessel at surgery.

**Light reflection rheography (LRR):** An instrument, similar to the photoplethysmograph, which measures, by means of three infrared lights and a receiving diode, changes in skin blood perfusion. This instrument is used to assess venous disease (i.e., venous reflux, obstruction).

**Linear:** Relating to, consisting of, or resembling a line. Linear transducer; multiple elements arranged in a line.

**Linear array:** An electronically steered real time transducer composed of multiple transducer elements, each element can be fired independently or in combination.

**Linear phased array:** Is operated by applying voltage pulses to all elements with small time variants. This allows the beam to be shaped and steered.

**Linear switched array:** Operated by applying voltage pulses to groups of elements in succession.

**Lipid:** Generic term used to describe any of the water soluble fats.

**Lobe:** A well-defined portion of any organ, usually a lobe is demarcated in some way.

**Longitudinal:** Along the path of a sound beam; or along a lengthwise course, as in a longitudinal scan.

**Longitudinal resolution:** Same as axial resolution.

**Lumen:** The space inside a tube, blood vessel, or duct.

**Lymph:** Transparent fluid, comprised of white blood cells (lymphocytes), conveyed in the lymphatic vessels.

**Lymphangitis:** Inflammation of a lymph vessel.

**Lymphedema:** Fluid retention in the tissues as a result of obstruction in the lymphatic system. Can present symptoms similar to deep venous thrombosis.

**Lymphoceles:** Fluid collections, which result from lymphatic leakage from, disrupted channels along the iliac vessels.

## M

**M-Mode:** Method of display in which a brightening spot for each pulse produces a one-dimensional time display of reflector position; motion mode.

**Manometer:** An instrument for measuring pressure.

**Matching layer:** The material placed in front of the front face of the transducer element to reduce the reflection at the transducer element face.

**Maximum venous outflow:** Describes the maximum rate of venous emptying which occurs in a limb following rapid cuff deflation post venous occlusion.

**Mean:** Midway between two points or measurements; the arithmetic average.

**Mechanical scanners:** A single transducer or several transducers are oscillated within the scan head steering the sound beam over the region of interest.

**Media:** Middle layer of an artery.

**Medial:** Toward the midline, opposite of lateral.

**Median:** The middle number in a distribution, half of the numbers will be above and half of the numbers will be below it.

**Median cubital vein:** Located in the antecubital fossa and crosses from the medial to the lateral side of the fossa and connects the basilic and cephalic veins.

**Medium:** Substance through which a sound wave travels.

**Medulla:** The inner part of the kidney containing the renal pyramids which appear hyperechoic on ultrasound.

**Megahertz (MHz):** 1,000,000 Hertz or cycles per second (*see Hertz, frequency*). Most clinical Doppler instruments operate between 2-20 MHz.

**Membrane:** A thin lining or covering.

**Memory:** A collection of integrated circuits in which data is stored. Binary data is stored as electrical signals.

**Menu:** A list of all the programs that can be used with the system or a listing of all the functions within a program. The menu lists the options available to the operator; options are selected by pressing a key.

**Mesenteric artery, superior (SMA):** The SMA arises from the abdominal aorta, approximately 1 cm below the celiac trunk. The SMA and its branches (inferior pancreatic, duodenal, colic, ileocolic and intestinal arteries) supply blood to the small intestines and to the proximal half of the colon.

**Mesenteric artery, inferior (IMA):** The IMA arises from the abdominal aorta approximately at the level of the 3<sup>rd</sup> and 4<sup>th</sup> vertebra. The IMA and its branches (left colic, sigmoid and superior rectus arteries) supply blood to the descending colon, sigmoid colon and rectum.

**Microprocessor:** An integrated circuit that performs basic data processing operations; i.e., the processing of electronic signals.

**Migraine:** Periodic, throbbing headache, often unilateral.

**Mirror image artifact:** Identical representation of an object on the other side of a strong reflector (sonography). Identical representation of the spectrum on the other side of the baseline (Doppler).

**Mode frequency:** Indicates the frequency with the highest amplitude and is the value that can be measured most reliably.

**Monckeberg's sclerosis:** Degenerative arteriosclerotic change in which calcium is deposited in the media of small and middle-sized arteries. Medial calcification results in a rigid artery which does not compress under ordinary pressure. In such cases, abnormally higher pressure must be exerted with a blood pressure cuff in order to obliterate the arterial signal. Pressures measured in this way are artifactually elevated.

**Monocular:** Pertaining to one eye; e.g., amaurosis fugax may produce monocular symptoms.

**Monophasic:** A monophasic pattern as a readily distinguishable systolic pulse but a lack of oscillatory activity during diastole. Such patterns demonstrate diminished arterial compliance. They may indicate a stenosis proximal to the examination site and low resistance in distal vessels.

**Morbidity:** The ratio of unhealthy individuals to the total population of a given group; a state of being sick/diseased.

**Mortality:** The ratio or total number of deaths to the total number of a given group.

**Motor:** Pertaining to motion, action.

**Mottling:** A condition that is marked by discolored areas.

**Mural:** Refers to the wall of a cavity, organ, or vessel.

**Murmur:** Abnormal sound heard on auscultation of the heart, associated with turbulent blood flow. Synonymous with bruit, but is limited to the heart.

**Muscle pump:** A mechanism to direct blood from the lower extremities towards the heart. The contracting muscles of the leg, especially the calf, act as a power source to propel the venous drainage collected in the soleal sinusoids. Competent valves prevent the reflux of blood. When the muscles relax, the space created in the now-emptied deep veins draws blood from the superficial veins into the deep system via the perforators.

**Myocardial infarction (MI):** Damage or death to an area of heart muscle resulting from reduction of blood supply; a heart attack.

## N

**Near zone (near field, Fresnel zone):** The region of a sound beam in which the beam diameter decreases as the distance from the transducer increases.

**Necrosis:** Localized tissue death; when due to arterial insufficiency is called ischemic necrosis; often used interchangeably with the term gangrene.

**Negative predicted value:** The likelihood that a negative test result actually implies the absence of disease.

**Negative predictive value:** The ability of a test to anticipate (predict) normal findings.

$$\text{Neg. Pred. Value} = \frac{\text{TN}}{\text{TN} + \text{FN}} \times 100 = \quad \%$$

TN = true negative, FN = false negative

**Neointimal hyperplasia:** The narrowing of an endarterectomized artery by smooth muscle and fibrous overgrowth of the tissue layer that replaces the intima after surgery.

**Nephrology:** Science of the structure and function of the kidney.

**Neurogenic:** Originating within the nervous system, may be used to describe claudication or impotence when the etiology is nervous rather than vascular.

**Neuropathy:** A functional disturbance or pathological change in the nervous system. Can be related to peripheral vascular disease in the diabetic patient, sensory, motor, autonomic, and mixed varieties.

**Nocturnal:** Occurring during the night. May be used to describe rest pain which causes awakening from sleep.

**Noise:** Any signal that conveys unwanted information; may refer to unwanted echoes that are due to reverberation. Electronic noise may originate in the transducer and the electrical components of a system.

**Nondirectional:** A Doppler instrument which assesses flow, via frequency shift, without regard for direction of blood flow.

**Noninvasive:** Refers to any procedure or examination in which the body is not penetrated by a substance or instrument. Plethysmographic and ultrasonic examinations are examples of noninvasive examinations. Venography or arteriography are examples of invasive examinations.

**Nonocclusive:** Not totally obstructed.

**Normotensive:** Of normal pressure.

**North America Symptomatic Carotid Endarterectomy Trial (NASCET):** A technique for measuring a carotid stenosis using the smallest residual internal carotid artery diameter in the stenosis (a) divided by the normal ICA diameter beyond the stenosis (b). Percent stenosis =  $a/b \times 100$ .

**Nyquist limit:** The highest frequency in a sampled signal that can be represented unambiguously; equal to one-half the pulse repetition frequency.

**Nystagmus:** Involuntary, repetitive, jerky movements of the eye.

**Objective:** Pertains to things or events that are external to one's self. Objective tests are those in which the results can be observed by individuals other than the examiner. Objective signs are those which can be noted by an observer, as opposed to those signs (such as pain) which are described by a patient. Opposite of subjective.

**Obstructive Raynaud's syndrome:** Episodic attacks of vasospasm resulting in the closure of small arteries and arterioles of the distal extremities in response to cold or stress with obstruction of the palmar and digital arteries.

**Occlusion:** The complete closure of an opening, duct or vessel.

**Ocular:** Pertaining to the eye.

**Oculoplethysmography:** A noninvasive diagnostic procedure designed to detect flow reducing lesions of the internal carotid artery. Changes in ocular volume are related to changes in arterial blood flow. These changes in volume are detected (via small corneal eye cups attached to a transducer) and recorded (ocular pulse recordings). A delay in ocular pulse arrival time is associated with a hemodynamic stenosis. This is an indirect measurement of internal carotid artery status.

**Oculopneumoplethysmography:** A noninvasive diagnostic procedure designed to detect flow reducing lesions of the internal carotid artery. Intraocular pressure is measured by placing small cups (which are attached to a transducer) on the sclera. A negative vacuum is applied to obliterate arterial inflow. The degree of vacuum corresponds to a specific intraocular pressure. As the vacuum is released, ocular pulsations return and the intraocular pressure is recorded. Differences in intraocular pressure between the eyes is associated with a hemodynamic stenosis. Like the OPG, this is an indirect measurement of internal carotid artery status.

**Ohm:** Unit of electrical resistance; one ohm is the resistance which permits one ampere of current to flow under an electromotive force of one volt.

**Ohm's law:** States that voltage equals current multiplied by resistance (impedance).

$$\text{Voltage} = \text{Current} \times \text{Resistance}$$

This is the basis for strain gauge and impedance plethysmographic testing. When voltage and current are held constant, the changes in resistance can only be due to changes in limb volume.

**Ophthalmic:** Pertaining to the eye.

**Ophthalmic artery:** Arises from the internal carotid artery, just as that vessel is emerging from the cavernous sinus, on the inner side of the anterior clinoid process, and enters the orbit through the optic foramen, below and on the outer side of the optic nerve.

**Ophthalmoscope:** An illuminating instrument used to examine the interior of the eye.

**Origin:** The source or starting point; i.e., the point where an artery begins.

**Orthostatic hypotension:** A fall in blood pressure that is associated with standing upright.

**Orthotic:** Any device (including prostheses) applied to the body in the management of disability or impairment. For example, the special implements used to facilitate eating in the stroke patient are orthotic devices.

**Oscillation:** Vibration.

**Overall accuracy:** Sum of true positive tests and true negative tests divided by the total number of tests performed.

## P

**Pallor:** Abnormal paleness or lack of color in the skin.

**Palmar:** Pertaining to the palm of the hand, as in palmar arch. The **palmar arch** is formed by the anastomoses of ulnar and radial arteries, both superficial and deep.

**Palpation:** The act of examining by touch, manually. To assess skin temperature or pulses by touch is to palpate.

**Pancreas:** A large elongated gland, located behind the stomach, it stretches transversely between the spleen and duodenum. Produces digestive enzymes and insulin.

**Pansystolic:** Extending throughout systole, as in pansystolic bruit. Used interchangeably with holosystolic.

**Papaverine:** A vasodilating agent used in patients with suspected vasculogenic impotence. The intracavernosal injection bypasses the psychoerotic and neurologic pathways that normally induce an erection.

**Papilledema:** Edema of the optic disc (choked disc); indicates increased intracranial pressure.

**Paralysis:** Complete or incomplete loss of nervous function to the body or body part, may be motor or sensory or both. Stroke is only one of the many causes of paralysis.

**Paraplegia:** Paralysis of the lower extremities, may include bowel and bladder paralysis also.

**Parasympathetic:** A division of the autonomic nervous system involved primarily with restorative functions. The parasympathetic nerves are derived from intracranial and sacral nerves and travel via the vagus nerves. The vagi participate in visceral reflexes including pressures and chemical receptors located in the aortic arch. Parasympathetic activity is mediated by acetylcholine.

**Parenchyma:** The essential elements of an organ; used in anatomical nomenclature as a general term to designate the functional elements of an organ as distinguished from its framework.

**Paresis:** Partial or incomplete paralysis.

**Paresthesia:** Abnormal sensation without objective cause, such as numbness, prickling and tingling ---a heightened sensitivity. Experienced in central and peripheral nerve lesions and in locomotor ataxia.

**Patency:** The state of being open. A venous characteristic assessed in the venous Doppler examination.

**Patent:** Open, not occluded.

**Pathogenesis:** The origin and development of a disease.

**Pathology:** The study of the essential nature of disease, especially of the structural and functional changes in tissues and organs of the body which cause or are caused by disease, the structural and functional manifestations of disease.

**Pedal:** Pertaining to the foot as in pedal pulses, the pulses of the foot.

**Penile brachial index (PBI):** An index derived by dividing the penile blood pressure by the brachial blood pressure. An abnormal pressure ratio suggests a decreased blood flow which may explain urologic symptoms.

**Penile implant:** A semi rigid rod or inflatable device implanted in the penis to provide an erection in men with organic impotence.

**Percent window:** A measure of spectral broadening, integrated over systole. The measure is normalized so that 100% indicates no spectral broadening or a "clear" window.

**Percutaneous:** Effected through the skin, as in injection, or to inject through the skin.

**Perforating veins (communicating veins):** Veins that link the superficial veins of the leg to the deep venous system.

**Perfusion:** The passage of blood through the vessels of a specific organ.

**Periarteritis:** Inflammation of the outer lining of an artery and the surrounding tissues.

**Perigraft fluid:** An accumulation of fluid adjacent to an allograft in the postoperative period. Possibilities include serous fluid (seroma), blood (hematoma), pus (abscess), urine (urinoma) and lymph (lymphocele.)

**Periorbital:** Surrounding the eye (orbit).

**Periorbital Doppler examination:** The terminal branches of the ophthalmic artery (derived from the internal carotid artery) are assessed via a directional Doppler probe. Normal flow is antegrade out of the orbit of the eye and can be obliterated with ipsilateral common carotid artery compression. In the presence of a flow reducing lesion, flow may be retrograde into the orbit of the eye (the source of flow derived from the external carotid artery), or normal in direction but not obliterated with ipsilateral common carotid artery compression.

**Peripheral vascular resistance:** That resistance (or impedance) to blood flow in the systemic arterial system. Resistance to blood flow is determined primarily by the caliber of small arterioles, i.e., the smaller the vessel the greater the resistance. Other factors affecting resistance include the length of the vessel and viscosity. It is vascular resistance which contributes to the brief period of flow reversal in the peripheral vessels.

**Peripheral:** Pertaining to the outer boundaries, away from the center. Peripheral vascular refers to those vessels away from the center, i.e., excluding the heart.

**Perivascular:** Surrounding a blood vessel.

**Peroneal artery:** Arising about 2.5 cm below the bifurcation of the popliteal artery, it is the largest branch

of the posterior tibial artery. It follows the medial edge of the fibula and remains in close relation with the posterior aspect of the bone and with the interosseous membrane throughout the rest of its course.

**Perm Cath catheter:** Used for acute dialysis access. These catheters may be used immediately. Their softer material is better tolerated by patients and allows the catheter to remain in place for prolonged periods.

**Petechia:** A very small hemorrhagic spot.

**Pevronie's disease:** A condition when scarring thickens and may even calcify the tunica albuginea that surrounds the corpora cavernosa. Symptoms include painless curvature with erection or sometimes enough pain with erection that detumescence results.

**Phantom:** Materials used with similar characteristics of normal tissue (e.g., scattering or attenuation).

**Phased array:** A type of electronically steered transducer in which there are multiple transducer elements. The ultrasound energy from a phased array is steered by pulsing all of the elements as a group but with a small time (or phase) difference between the elements. A phased array produces a sector B-scan.

**Phasicity:** Normal venous flow increases and decreases in response to respiration. In a normal lower extremity, flow will diminish or cease with respiration. Phasicity is reversed in the upper extremity veins.

**Phlebitis:** Inflammation of a vein.

**Phlebography:** Radiologic procedure in which an opaque substance is injected into a vein; subsequent x-ray pictures are taken in order to visualize the venous system. Synonymous with venography.

**Phleborheography (PRG):** A noninvasive diagnostic technique used to identify the presence of deep venous thrombosis. This is a plethysmographic technique in which air-filled cuffs are placed on the extremity and the volume changes associated with the respiratory variability of venous blood flow are recorded. In

the absence of venous obstruction, respiratory waves are present in the limb. Compression of the limb distal to the recording cuffs should produce no change in the baseline recordings.

**Phlebothrombosis:** Term used to describe occlusion of vein by clot in the absence of an inflammatory process (see deep venous thrombosis).

**Phlegmasia Cerulea Dolens:** When DVT involves the major veins proximal to the inguinal ligament. Commonly referred to as iliofemoral thrombosis.

**Phonoangiography:** See carotid phonoangiography (CPA).

**Photoplethysmograph (PPG):** A device (transducer) which assesses minute changes in skin blood perfusion. Infrared light is emitted from a transmitting diode and reflected back to a receiving diode; changes in red blood cell density associated with arterial pulsation are detected by the transducer. Thus, PPG detects changes in red blood cell volume; the signal output is in the form of a pulse wave form. PPG is used in a number of noninvasive diagnostic examinations; venous reflux plethysmography, supraorbital plethysmography, digital pressures, Allen's test, and thoracic outlet maneuvers to name a few.

**Piezoelectric (from the Greek *piezo*, meaning pressure):** The property of certain crystals cause them to emit electricity when deformed or squeezed. When electricity is applied to the crystal, the crystal changes its shape and the crystal vibrates; this is the source of the ultrasound wave.

**Piezoelectric effect:** Changing of mechanical to electrical energy and vice versa.

**Pignoli's double line measurement:** Characteristic double lines on images that represent the combined thickness of the intima and media of the arterial wall.

**Pixel:** The individual picture cell on a television screen. A screen is divided into many horizontal scan

lines, which are in turn divided into pixels. The result is a grid made of many, many pixels.

**Plantar:** Pertaining to the sole of the foot.

**Plaque:** Generic term used to describe an atherosclerotic lesion. It can consist of platelets, fibrin, lipids, and calcium.

**Plasma:** Fluid portion of the blood.

**Platelet:** A round or oval disk, 1/3 to 1/2 the size of an erythrocyte found in the blood. Platelets number from 150,000 to 450,000 per cc. Function: Platelets play an important role in blood coagulation, hemostasis and blood thrombus formation. When a vessel is injured, platelets adhere to each other and the edges of the injury and form a plug which covers the area. The plug or blood clot formed soon retract and stops the loss of blood.

**Plethysmograph (from the Greek plethys, meaning volume):** Any device, instrument, or transducer which measures volume changes in size or amount. Air plethysmographs include: phleborheography, volume pulse recordings, and ocular pulse recordings. Water plethysmography is typified by the OPG. Impedance plethysmography and strain gauge are similar in concept and detect changes in calf size associated with venous filling of a limb. Photoplethysmography detects the volume of red blood cells in the skin.

**Poiseuille's law:** Formula describing the relationship between flow, pressure, and resistance in a laminar flow system. The following formula is an abbreviated version the pressure/volume flow relationship.

$$Q = \frac{P}{R}$$

Q = Flow, P = Pressure, R = Resistance

**Polycystic disease:** Multiple cysts of varying sizes found in the kidneys and the liver.

**Polytetrafluoroethylene (PTFE):** A synthetic or prosthetic graft or material used for bypass or patching arteries.

**Popliteal artery:** Originates as a continuation of the femoral artery in the popliteal space, bifurcating at the lower border of the popliteus muscle into the anterior and posterior tibials. Its branches also include the lateral and medial superior geniculars, middle genicular, the lateral and medial inferior genicular, and sural arteries.

**Portacaval shunt:** The surgical creation of an anastomosis between the portal vein and vena cava.

**Porta hepatis:** The transverse fissure on the visceral surface of the liver where the common bile duct exits the liver and the hepatic artery and portal vein enter the liver.

**Portal hypertension:** Increased portal venous pressure, usually due to liver disease. Can cause the dilatation or thrombosis of the portal vein, superior mesenteric vein, splenic vein, and the formation of varices.

**Portal system:** Consists of the portal vein, splenic vein, and inferior and superior mesenteric veins.

**Portal vein (PV):** Collects blood from the digestive tract and empties into the liver to be detoxified. Formed by the junction of the splenic vein and the superior mesenteric vein.

**Portosystemic Shunt:** An expandable metallic stent between the right hepatic vein and right portal vein for the treatment of portal hypertension, variceal bleeding, and refractory ascites.

**Positive predictive value:** The ability of a test to anticipate (predict) abnormal findings.

$$\text{Pos. Pred. Value} = \frac{P}{TP + FP} \times 100 = \%$$

TP = true positive, FP = False positive

**Posterior:** Refers to the back; or dorsal side of the body; opposite of anterior.

**Posterior tibial artery (PTA):** The larger and more directly continuous of the two terminal branches of the popliteal artery. Its branches are the peroneal, nutrient of the fibula, lateral and medial posterior malleolar, nutrient of the tibia, and the lateral and medial plantar.

**Postphlebotic syndrome:** Chronic venous insufficiency secondary to previous deep venous thrombosis. Venous thrombosis damages the valves and renders them incompetent. The physical signs include edema, stasis pigmentation changes, pain, and ulceration.

**Potential energy:** Capable of doing or being although not yet doing or being; possible but not actual. Latent energy, energy of position, the energy existing in a body by virtue of its state of existence, which is not exerted at the time.

**Pourcelot index (resistance index):** An index of pulsatility of blood flow. The difference between the maximum and minimum Doppler frequency shifts, divided by the maximum Doppler frequency shift, represents the Pourcelot index.

**Power:** Rate of flow of energy in the direction of propagation; expressed in watt units. Power is proportional to the square of amplitude.

**Precursor:** Forerunner.

**Profunda femoris artery (deep femoral artery):** Deep artery of the thigh which originates from the common femoral artery. Its branches include the lateral circumflex femoral and the median circumflex femoral. It terminates in three or four perforating branches in the mid-thigh (major source of collateral flow in the presence of an occluded superficial femoral artery).

**Profundoplasty:** Reconstruction of the occluded or stenosed deep femoral artery.

**Proliferate:** To increase by cell division, e.g., the early lesions of atherosclerosis are marked by intimal proliferation.

**Prone:** Lying on the abdomen with the face downward, opposite of supine.

**Propagation speed:** Velocity of an acoustic wave; equal to the product of frequency and wavelength.

**Prophylaxis:** Pertaining to any measures designed to prevent disease development.

**Prosthesis:** An artificial part or device used as a substitute for one that is missing; e.g., after a limb amputation, a prosthesis is fitted to the stump.

**Proximal:** Nearest to a point of reference. Opposite of distal.

**Pseudoaneurysm:** See aneurysm, pseudo.

**Pseudoclaudication:** Term used to describe a syndrome of symptoms resembling claudication but not of a vascular origin. The most common etiology is neurogenic. Pseudoclaudication can be differentiated from true claudication by the nature of the presenting symptoms. The exercise-pain-rest-relief cycle is not present in pseudoclaudication.

**Psychogenic:** Arising from the psyche or the mind; i.e., not organic in nature.

**Pulmonary embolus:** Embolus (blood clot, air, fat) which is carried through the venous system ultimately lodging in the pulmonary vasculature. PE is a serious and occasionally fatal complication of deep venous thrombosis.

**Pulsatility index (PI):** A parameter used to convey the pulsatility of a time varying waveform such as the maximum Doppler shift frequency of the signal from an artery. Indices of pulsatility are usually ratios of Doppler shift frequencies and are hence independent of *Doppler angle*. The most common definition of pulsatility index (PI) of a waveform such as that defined

by the maximum Doppler shift frequency, is the difference between the maximum and minimum value, divided by the mean value of the waveform over the cardiac cycle.

$$PI = \frac{\text{Peak to Peak Velocity}}{\text{Mean}}$$

**Pulse:** The regular, palpable wave of distention or volume change transmitted to the arteries. This is due to blood ejected from the heart during ventricular contraction.

**Pulse pressure:** The difference between the peak systolic and minimum diastolic pressure in the cardiac cycle.

**Pulse reappearance time:** An index of arterial insufficiency defined by Fronek; the time period required for the return of toe pulse waves (via strain gauge or PPG) after four minutes of arterial occlusion by cuff.

**Pulse repetition frequency (pulse repetition rate):** The rate of repetition of pulses per unit time; in a pulsed system, the number of pulses generated every second. Not to be confused with frequency, PRF is the rate of pulse repetition.

**Pulse volume recorder (PVR):** Plethysmographic technique in which air filled cuffs are placed segmentally on an extremity; changes in limb volume associated with arterial pulsation are translated in pulse waveforms. Alterations in the shape of the waveform at each level are associated with obstruction proximal to the cuff.

**Pulse wave Doppler (PW):** Timed bursts of ultrasound (pulses); a single transducer alternately transmits and receives impulses. Permits more discrete sampling from a select depth and volume. Sample volume is selected through the process of range gating, i.e., receiving reflections after a defined time period has elapsed (*see gate, sample volume*).

**Pulsed wave:** Refers to an intermittent wave of sound (frequency) produced by applying short bursts of electrical impulses to an ultrasound transducer.

**Pulseless Disease:** Takayasu's disease; progressive obliterative arteritis.

**Pulsus tardus/pulsus parvus:** Terms used to describe dampened, post obstructive waveforms. Tardus refers to delayed arrival of the systolic peak, and parvus refers to overall low velocity.

**Pyelonephritis (chronic):** Repeated infections of the kidneys that cause scarring in some areas of the parenchyma.

**Pyramids:** Conical structures within the medulla of the kidney where blood is filtered and absorbed, leaving urine behind.

## Q

**Q's law:** Quality before quantity.

**Quadriplegia:** Paralysis of all four limbs.

**Qualitative:** A non-objective measurement relating to quality; descriptive assessment of attributes, traits, or characteristics. Measurements in which an exact numerical value cannot be assigned; scales or grades can be used.

**Quantitative:** An observable quantity which can be described in objective, measurable terms, i.e., numbers.

## R

**Radial artery:** It begins at the division of the brachial artery below the bend of the elbow, and passes along the radial side of the forearm to the wrist where the pulse is readily palpated.

**Radiography:** Generic terms referring to any type of x-ray procedure; venography, arteriography are two types of radiographic techniques.

**Range:** The distance between the reflector (target) and the transducer; equal to one half of the total ultrasound path length.

**Range ambiguity:** Occurs when the pulse repetition frequency is too high, causing misrepresentation of echoes ranges.

**Range gating:** With range gating the transducer will only accept echoes from a selected depth based on echo arrival times.

**Raster:** On a cathode ray tube, the pattern of horizontal lines beginning at the top of the screen and progressing from left to right. Each line is made of many pixels.

**Raynaud's disease:** Vasospastic disease characterized by intermittent pallor, cyanosis and rubor of the digits; rarely results in tissue necrosis. Symptoms are induced by exposure to cold or emotional upset. Raynaud's disease is a primary condition and exists in the absence of arterial obstruction and has no clear-cut association with any other systemic disease. Syndromes with similar symptoms, but with secondary etiology, are referred to as Raynaud's phenomenon.

**Raynaud's phenomenon:** Describes any number of conditions which present symptoms suggestive of digital arterial vasospasm (see Raynaud's disease). The phenomenon follows the color sequence of pallor, cyanosis, rubor. Pain may be present and occasionally there may be gangrene of the digital tips. The underlying etiology may include; collagen vascular disease, nerve compressions, occupational trauma, and arterial obstruction.

**Reactive hyperemia:** Response to ischemia characterized by rapid increase in blood flow following cessation of a period of induced ischemia. A technique to assess the degree of functional arterial impairment. Resting ankle pressures are recorded prior to the ap-

plication of an occlusive cuff to the thigh. Following a period of ischemia, the cuff is deflated and ankle pressures are measured. The degree of drop in ankle pressure immediately following release is indicative of the degree of impairment. This technique is sometimes used in lieu of exercise/treadmill testing.

**Real-Time display:** Display system in which an image is continuously up-dated and reviewed as the target changes or moves.

**Recanalization:** The formation of a new canal or channel of blood flow through an obstruction, such as blood clot or thrombus (deep vein thrombosis).

**Reconstitution:** When a main artery is again patent distal to a segment of occlusion (SFA/POP) due to collateral flow.

**Reflection:** The acoustic energy returned (reflected) back to the transducer from a structure (target). The intensity of the reflection is dependent upon the acoustic impedance ratio at the tissue interface. The greater the impedance ratio the greater the reflection.

**Reflex sympathetic dystrophy (RSD):** A condition characterized by diffuse pain, swelling, and limitation of movement that follows an injury such as a fracture in an arm or leg. The symptoms are way out of proportion to the injury and may linger long after the injury has healed.

**Reflux:** Backward flow. A characteristic noted on the venous Doppler examination during proximal limb compression; indicative of valvular dysfunction.

**Refraction:** The change in direction of an acoustic wave at an interface; the bending of an acoustic wave; refraction occurs when the angle of incidence is not normal (perpendicular) or as the wave passes through media of different densities (acoustic impedances).

**Regeneration:** The natural renewal of a structure, tissue, organ, or part.

**Rehabilitation:** A planned program of therapy designed to restore a patient who is disabled to maximum physical and psychological functioning.

**Rejection:** The body's immune response against foreign bodies, or grafted tissue, that results in the failure of the grafted tissue or organ to survive.

**Renal arteries:** Originates off the aorta just below the level of the superior mesenteric artery. They supply the kidneys, adrenals, and the ureters.

**Renal veins:** Drain the kidney and empty into the inferior vena cava. The left renal vein is longer than the right renal vein.

**Renovascular hypertension:** High blood pressure pertaining to or affecting blood vessels of the kidney, or hypertension produced by renal artery flow reducing stenosis or occlusion.

**Resistance:** The opposition to blood flow occurring in the vascular system (see peripheral vascular resistance). The opposition to flow of current in an electrical circuit (see *impedance*, *Ohm's law*).

**Resistance index (RI):** (see *Pourcelot index*).

**Rest pain:** A sign of severe arterial obstruction resulting in pronounced ischemia of an extremity. Arterial compromise is such that pain occurs at rest; often causing night-time wakefulness (due to recumbency and the reduced cardiac output of sleep). The pain is confined to the digit and dorsum of the foot and symptoms are relieved, in part, by dependency of the limb. Generally two or more segments of the arterial tree are involved and ABI values are below 0.5. If left untreated, rest pain will progress to gangrene.

**Retrograde:** Proceeding away from or backward; opposite of antegrade or forward.

**Retrograde flow:** Blood flowing moving backwards or against the usual direction of flow.

**Reverberation:** Multiple reflections within a confined space or from the same target; a source of false echo information in real time imaging (*see artifact*).

**Reynolds number:** Predicts the onset of turbulence based on flow speed and viscosity.

**RIND:** Refers to Reversible (or resolving) Ischemic Neurologic Deficit.

**Rubor:** Redness; term used to describe inflammation. **Dependent rubor:** Describes the classic redness which occurs in an ischemic limb on dependency following a period of elevation.

**Rupture:** Tearing apart; bursting.

## S

**Saccular:** Having the shape of or resembling a sac, an out pouching.

**Sagittal:** In the anterior-posterior plane of the body.

**Sample volume:** With a pulsed Doppler system, describes the site of flow detection; size of the sample volume is determined by beam diameter and length of the ultrasound pulse (*see pulsed Doppler, gate*).

**Saphenous vein:** There are two veins that serve as the principal superficial venous outflow, the greater saphenous and lesser saphenous. The greater (long) saphenous vein runs from the foot to the groin where it conflues with the common femoral vein. The lesser saphenous vein (short) runs from the posterior lateral malleolus (lateral to the Achilles' tendon, near ankle) along the posterior leg and usually joins the popliteal vein in the space behind the knee.

**Scattering:** Diffuse reflection and refraction of an acoustic wave in many directions; caused by irregular interfaces, heterogeneous media, or particle suspensions (blood).

**Scleroderma:** A disease of the connective tissue in which the skin forms scar tissue (fibrous tissue). This may also occur in other organs of the body.

**Sclerosis:** Generic term used to describe an abnormal hardening or fibrosis of an artery (*see atherosclerosis, Monckeberg's sclerosis, calcification, diabetes*).

**Segmental blood pressures:** Obtaining blood pressure measurements at different levels of the upper or lower extremities, the comparison of pressure change across each segment of the limb in order to determine the level of occlusive disease.

**Sensitivity:** The ability of a diagnostic technique to identify the presence of disease when disease is actually present.

$$\text{Sens.} = \frac{\text{TP}}{\text{TP} + \text{FN}} \times 100 = \%$$

TP = true positive, FN = false negative

**Sequential bypass:** Arterial bypasses in series; a continuation and/or additional bypass performed to maintain patency of previous surgery.

**Serum creatinine:** When the kidneys do not work properly this waste product accumulates in the blood. Levels above 1.0 are considered to be elevated and abnormal in a female. Levels above 1.3 are considered elevated and abnormal in a male.

**Shadowing:** Reduction in reflection amplitude from reflectors that lie behind a strongly reflecting or attenuating structure.

**Shunt:** Term used to describe a pathway other than the usual to divert blood from one point to another; may be a natural channel, i.e., an arteriovenous fistula or a surgically created channel, i.e., a bypass graft. In carotid endarterectomy a shunt is often used to divert blood from the common carotid artery to the internal system during the procedure. Shunt is synonymous with bypass.

**Side effect:** Any physiological change (other than the expected one) which occurs as a result of a prescribed treatment or procedure.

**Sinus:** The renal sinus contains the collecting system, renal arteries and veins, lymphatics, fat and fibrous tissue. The renal sinus has an ultrasound appearance that is highly echodense.

**Snell's law (simplified):** In ultrasound, states that the angle of reflection is equal to the angle of incidence.

**Spatial pulse length:** Distance traveled by an ultrasound pulse; equal to the product of wavelength and the number of cycles in a pulse.

**Specificity:** The ability of a diagnostic technique to identify the absence of disease (normalcy) when no disease is actually present.

$$\text{Spec.} = \frac{\text{TN}}{\text{TN} + \text{FP}} \times 100 = \%$$

TN = true negative, FP = false positive

**Spectral analysis:** A method of analyzing and/or displaying the Doppler signal output. The Doppler shifted signal is made up of a range of frequencies. Spectral analysis, using a microprocessor, is capable of analyzing and displaying the complete range of frequencies in each waveform. This technique may be used with pulsed or continuous wave Doppler systems. Time is displayed on the horizontal axis, frequency on the vertical axis and amplitude of the signal by the intensity of the gray scale. Spectral analysis provides the most complete assessment of the Doppler waveform and is a useful technique for quantifying degree of arterial stenosis.

**Spectral broadening:** The width of the Doppler spectrum on a sonogram display corresponds to the range of Doppler shift frequencies present at a given time. Spectral broadening will be seen when this range is increased; an example is the Doppler signal obtained when laminar flow with a blunt flow profile becomes disturbed.

**Spindle:** Hour glass shaped.

**Spleen:** A large, glandlike and ductless organ; situated in the upper abdomen; disintegrates red blood cells and sets free hemoglobin which the liver transforms to bilirubin; creates red blood cells in the fetus and in the newborn; produces lymphocytes and plasma, etc.

**Splenic artery:** Originates from the celiac artery and supplies the pancreas, spleen, stomach, and greater omentum.

**Splenic vein:** Collects blood from the spleen and part of the stomach and joins with the superior mesenteric vein to form the portal vein.

**Spontaneity:** In normal veins flow occurs passively. It should be detectable in all major veins.

**Stasis:** Refers to the stagnation of blood; cessation of normal blood flow. In the venous system of the lower extremity, stagnant blood flow as the result of immobility contributes to venous thrombosis. Stagnation of venous blood in the extremity because of valvular dysfunction (or post-phlebitic syndrome) results in pigmentation changes and ulceration.

**Stenosis:** The narrowing or constriction of a tube, specifically the lumen of an arterial blood vessel. Plural, stenoses. A stenosis of sufficient caliber to reduce blood flow is termed a hemodynamically significant stenosis. This is equal to a 75% area reduction or a 50% diameter reduction.

**Stent:** A tube made of metal or plastic that is inserted into a vessel or passage to keep it open and prevent closure due to a stricture or external compression.

**Stent Graft:** A stent-graft is an intraluminal device that consists of a supporting framework (currently made of metal such as stainless steel or nitinol) and a synthetic graft material. Stent-grafts can be either self-expanding or balloon-expandable, depending on the type of metal in the stent. The stent may be located inside, outside, or within the graft material, and it may be along the entire length of the graft or restricted to the

ends. To deliver the stent-graft through a small vascular access, the device is compacted onto a catheter or compressed into a sheath. With the use of imaging guidance, the device is advanced into an appropriate location in the aorta from a remote access site and deployed.

**Stethoscope:** An instrument used to listen to body sounds; an auscultatory device. Most stethoscopes have dual components, a diaphragm and a bell. Bruits are best assessed with the bell of the stethoscope.

**Stokes-Adams syndrome:** Syncope of cardiac origin occurring most often in patients with a pulse rate of less than 40 beats/minute and complete atrioventricular heart block.

**Strain gauge plethysmography (SPG):** A noninvasive diagnostic technique used primarily for the detection of deep venous thrombosis. The strain gauge consists of an electroconductive material enclosed in a thin elastic tubing. The strain gauge is placed around an extremity and limb volume changes are detected by measuring changes in impedance. Strain gauge is most often used to record maximum venous capacitance/outflow ratios as in impedance plethysmography but may also be used for venous reflux plethysmography and digital arterial waveforms (*see Ohm's law, impedance plethysmography*).

**Streptokinase:** A protein produced B-hemolytic streptococci. It is used as a thrombolytic agent; used topically on surface lesions or by instillation in closed body cavities to remove clotted blood.

**Stricture:** A narrowing of a tube, usually due to scar tissue formation.

**Stroke:** Popular term for cerebrovascular accident.

**Subclavian artery:** Originates on the right from the brachiocephalic (innominate) artery and on the left from the aortic arch. As it continues under the scapula, it continues as the axillary artery at the lateral border of the first rib. The major branches are the vertebral,

thyrocervical, internal thoracic and costocervical arteries.

**Subclavian vein:** The direct continuation of the axillary vein at the lateral border of the first rib, it passes medially to join the internal jugular vein and form the brachiocephalic veins bilaterally.

**Subjective:** Pertains to things or events which are internal, not observable by others. **Subjective tests** are those in which the results can only be observed by the examiner, e.g., the venous Doppler exam. Opposite of objective. Symptoms are subjective, physical signs are objective.

**Superior mesenteric artery (SMA):** Originates off the aorta just below the level of the celiac artery. This artery supplies the small bowel, cecum, ascending colon, and part of the transverse colon.

**Superior mesenteric vein (SMV):** Drains the cecum, transverse and sigmoid colon, and small bowel.

**Superficial femoral artery (SFA):** It originates from the common femoral artery at its bifurcation with the deep femoral artery (1-2" below the inguinal ligament), and continues through the thigh and Hunter's canal (adductor canal) to then become the popliteal artery.

**Superior vena cava (SVC):** Returns blood from the head and neck, upper limbs and thorax, and is formed by the union of the two brachiocephalic veins (innominate veins).

**Supine:** Lying on the back with face upwards, opposite of prone.

**Supraorbital:** Above the orbit of the eye; term is not synonymous with periorbital.

**Supraorbital plethysmography:** A noninvasive diagnostic technique used in the assessment of carotid occlusive disease. PPG transducers are placed on the supraorbital region, waveforms are recorded, and the response to compression of the external branch arteries and common carotid arteries are noted. The physi-

ological basis for this technique is similar to the cerebrovascular Doppler exam.

**Suprarenal:** Located above the level of the renal artery.

**Suprasystolic:** Above systolic pressure.

**Symes amputation:** Amputation of the foot at the ankle joint with removal of both malleoli, and creating a flap with the soft parts of the heel.

**Sympathectomy:** Surgical interruption (excision) or chemical block of part of the sympathetic nervous system. Sympathectomy is used in the treatment of severe arterial occlusive disease (where vasoconstriction is a factor) to produce vasodilation and thereby enhance blood flow to an extremity.

**Sympathetic:** A division of the autonomic nervous system involved primarily with emergency responses and muscular activity. It is the sympathetic system which mediates homeostasis and vascular smooth muscle response, i.e., vasodilation and vasoconstriction.

**Symptom:** A subjective manifestation of disease, e.g., pain.

**Syncope:** A brief loss of consciousness; caused by reduction in cerebral blood flow; etiology may be due to extreme vasodilation brought on by emotions or secondary to hypotension, heart block, or arrhythmia.

**Syndrome:** A group of signs and/or symptoms, which when occurring together characterize a disease.

**Systole:** The contraction phase of the cardiac cycle.

## T

**Tachycardia:** Excessively rapid heart rate, usually over 100 beats per minute.

**Takayasu's arteritis:** Progressive obliteration of the brachiocephalic trunk and the subclavian and common carotid arteries above their origins in the aortic arch; leading to loss of pulse in both arms and carotids and to one or more symptoms associated with ischemia of the brain, eyes, and kidneys.

**Temporal arteritis:** Also called giant cell arteritis or cranial arteritis. (See arteritis)

**Test object:** Device used to measure some characteristics of an imaging system without having tissue-like properties.

**Testicular torsion:** A condition in which the testicle is twisted on its mesentery, impairing blood supply and causing pain.

**Thermal biofeedback:** A technique used in the treatment of Raynaud's phenomenon; used when symptoms are related to stress or anxiety; patients are taught to increase skin temperature through biofeedback techniques.

**Thermocouple:** A device that converts temperature to a voltage.

**Thermography:** Diagnostic technique in which body temperature differences are recorded on photographic paper; temperature differences associated with reduced blood flow can be documented in this manner.

**Thoracic outlet syndrome (TOS):** A symptom complex associated with compression of the arteries, veins, or nerves of the upper extremity at the outlet from the thoracic cavity. Symptoms include numbness or pain of the arm associated with activity, elevation, or hyperabduction. The cause is usually related to brachial nerve plexus compression rather than arterial compression. To identify or rule out arterial compression, Doppler, or PPG may be used to document obliteration of flow during specific arm movements.

**Thrombectomy:** Surgical removal of a blood clot from a vessel.

**Thromboangiitis:** Clot formation within an inflamed vessel; Buerger's disease was referred to as thromboangiitis obliterans.

**Thromboendarterectomy:** Surgical removal of a blood clot from within an artery.

**Thrombogenic:** Capable of causing blood clotting.

**Thrombolysis:** The breaking up of thrombus.

**Thrombolytic:** Capable of disintegrating a blood clot. TPA, Streptokinase and Urokinase are used to dissolve clots. This agent acts by stimulating the conversion of plasminogen to plasmin (an enzyme which breaks down fibrin). **Thrombolytic therapy** is used successfully in the treatment of deep venous thrombosis, for acute arterial thrombosis, and graft occlusion.

**Thrombophlebitis:** Inflammation of a vein with secondary thrombosis in the involved segment.

**Thrombosis:** The formation of an intravascular blood clot formation.

**Thrombus:** An intravascular blood clot; plural, thrombi.

**Time gain compensation:** Selective gain amplification over time used in real-time imaging to compensate for loss in echo intensity due to attenuation; permits echoes from greater depths to have the same intensity as those from shallow sites. Increases the gain in the far field without saturating the echoes in the near field.

**Tortuous:** Twisting or turning of the vessel. Sometimes making it difficult to interrogate throughout its length with Doppler.

**Tourniquet:** An apparatus which encircles a limb for the purpose of compressing blood vessels to occlude flow. May be a simple rubber strip or a pneumatic cuff.

**Tissue plasminogen activator (TPA):** A generic term for a group of substances that have the ability to cleave

to plasminogen and convert it to plasmin in its active form; it is used for therapeutic thrombolysis.

**Transcranial Doppler (TCD):** Doppler evaluation of the major intracerebral arteries via a cranial “window” (transorbital, transtemporal, suboccipital). The method utilizes a pulsed Doppler combined with spectral analysis to obtain velocities of the major vessels.

**Transcutaneous:** Transdermal, entering through skin as in the administration of a drug applied to the skin in ointment or patch form.

**Transducer:** Any device which converts one form of energy to another, e.g., pressure to electrical, acoustic to electrical, electrical to acoustic.

**Transient ischemic attack (TIA):** Fleeting neurological dysfunction without residual symptoms lasts less than 24 hours, more typically 15-30 minutes. Depending on the cerebral territory involved, symptoms may include: sensory/motor dysfunction of an arm/leg, speech impairment (aphasia), and visual disturbances (amaurosis fugax); etiology is usually embolic. TIA is often the precursor of a cerebrovascular accident.

**Transluminal angioplasty:** Dilatation of a blood vessel by means of a balloon catheter inserted through the skin and through the lumen of the vessel to the site of narrowing, where the balloon is inflated to compress plaque against the arterial wall.

**Transmetatarsal amputation:** Removal of one or all of the toes across the end of the metatarsal heads.

**Transplant:** To transfer tissue or organs from one part of the body to another or from one body to another.

**Transposition:** the state of being transposed, or being on the wrong side of the body.

**Transverse:** Cross-sectional.

**Trifurcation:** The site of separation into three branches.

**Triphasic:** Having three phases or variations; forward flow in systole, brief reverse flow, and a third forward flow component (multiphasic).

**Trophic:** Pertaining to nutrition; **trophic changes** on an extremity (e.g., nail thickening, atrophied skin) are the results of ischemia or lack of nutrition to the skin.

**Tumor:** A growth of tissue in which the multiplication of cells is uncontrolled and progressive; can be neoplasm.

**Tunica:** A coat; lining membrane, as in tunica intima, tunica media, tunica adventitia.

**Turbulence:** The disruption of the normal laminar flow within a tube or vessel; disturbed blood flow in which whirls and eddies occur; usually due to obstruction to blood flow; a source of bruits.

## U

**Ulcer:** An open sore or lesion on a body surface. The etiology of lower extremity ulceration may be arterial (ischemic or necrotic ulcer), venous (varicose ulcer or secondary to post-phlebitic syndrome), or neurogenic (as in diabetes). An ulcer in an atherosclerotic plaque may range from a slight irregular and roughened surface to a pronounced lesion within the atheroma. Ulcerative plaques have the potential to produce embolic material.

**Ulnar artery:** Artery that originates at the division of the brachial artery below the bend of the elbow and travels along the ulnar aspect of the forearm to the wrist.

**Ultrasonography:** Production of images or audio display for diagnostic purposes through the use of ultrasound.

**Ultrasound:** Sound above the range of human hearing, greater than 20 KHz. Clinical ultrasound ranges from 2-20MHz.

**Umbilical vein:** Not usually visualized but may dilate in portal hypertension.

**Uniform insonation method:** An ultrasonic method for the estimation of volume flow rate in single vessels. The average value of the product of the spatial mean velocity and the cross-sectional area is calculated over several cardiac cycles.

**Unilateral:** Pertaining to one side.

**Ureter:** The tube that conducts urine from the kidney to the bladder. It begins in the pelvis of the kidney as a widened area that looks like a funnel; it empties into the bladder and is approximately 16-18 inches long.

## V

**Valsalva maneuver:** Forced expiration against the closed glottis impeding blood flow through the pulmonary capillary bed and increasing intrathoracic pressure. This maneuver impedes venous return and is used in the venous Doppler examination to assess venous flow and valvular competency.

**Valve:** A membrane within a tube or vessel allowing flow to move in one direction only. The venous valves are bicuspid and open towards the heart to prevent reflux. Damaged or incompetent valves allow retrograde venous flow.

**Varices:** Enlarged tortuous vessel; the vessels can be veins or lymphatic vessels.

**Varicocele:** Varicosity of the veins of the spermatic cord. A common cause of infertility in the male. Diagnosis can be made by palpation or (in subclinical presentation) by Doppler ultrasound. Venous reflux during Valsalva maneuver is found in the presence of varicocele.

**Varicose veins:** Veins that are distended, lengthened, and tortuous. The superficial veins (saphenous veins) of the legs are most commonly affected. There is an

inherited tendency to varicose veins (primary) but obstruction to blood flow or incompetent valves, which permit backflow of venous blood (secondary), also may be responsible. Treatment may include elastic support stockings, elevation, sclerotherapy, or vein stripping.

**Vascular:** Pertaining to the blood vessels.

**Vascular steal:** Diversion of blood via alternate routes or reversed flow from the vascularized tissue to one deprived by proximal arterial obstruction.

**Vasculogenic:** Of a vascular origin.

**Vasoconstriction:** Narrowing of the vessel lumen caused by contraction of the muscular vessel wall.

**Vasodilation:** Enlarging of the vessel wall caused by relaxation of the muscular vessel wall.

**Vasospasm:** Spasmodic constricting of a vessel wall.

**Vein:** A blood vessel which conveys blood from the capillaries back to the heart. Veins are composed of three layers, intima, media, and adventitia. The media of the vein is less muscular than an artery. Veins are more compliant than arteries and are equipped with one-way valves to prevent reflux of blood.

**Velocity:** Speed of an acoustic wave per unit time in a specific direction.

**Velocity:** The rate at which an object moves in a specified direction.

**Velocity detector:** An ultrasound Doppler instrument which detects the velocity of blood flow transcutaneously.

**Vena cava filter:** A device placed in the IVC to catch emboli and prevent them from getting to the lungs.

**Venography:** A radiographic procedure in which an opaque substance is injected into the veins. Subse-

quent x-ray pictures are taken for the purpose of visualizing the venous system (*see phlebography*).

**Venous:** Pertaining to the veins.

**Venous air embolism:** An air bubble which may enter the venous system during any surgical procedure in which the surgical site is above the level of the right atrium. Doppler ultrasound is the most sensitive method of detection of air emboli in the right atrium.

**Venous insufficiency:** Condition in which faulty or damaged venous valves permit retrograde or backward flow of blood. Stagnant venous blood in the lower extremity may result in pigmentation changes, edema, pain, and ulceration (*see post phlebitic syndrome*).

**Venule:** A small vein.

**Vertebral artery:** First branch arising from the subclavian artery, coursing through the posterior neck and terminating in the basilar artery. Along with the internal carotid arteries, the vertebral arteries are the source of blood supply to the brain.

**Vertigo:** Dizziness or giddiness; feeling of spinning.

**Vessel:** A tube, duct, or canal which holds or conveys a fluid.

**Virchow's triad:** The three mechanisms of thrombosis--injury to the vessel wall, decrease in blood flow (stasis), and blood hypercoagulability.

**Viscosity:** Resistance of a fluid to flow when a pressure is applied.

**Volt:** A unit of electrical force.

**Vortices:** Areas of circular flow which are present in turbulence.

## W

**Wallfilter:** An electrical filter that removes strong low frequency Doppler shifts (e.g., pulsating heart or vessel walls) while allowing frequencies above a certain level to pass.

**Waveform:** A curve or undulation traced by a recording device and reflecting alterations in electrical activity; the shape of a wave on a graph (*see triphasic*).

**Wavelength:** Distance required for a complete cycle.

**Wrap around:** An incorrect shift of Doppler information to the other side of base line (caused by aliasing).

## XYZ

**Xanthaloma:** Cholesterol deposition under the skin producing a yellowish lesion.

**Xiphoid process:** The pointed part of cartilage located at the lower end of the sternum.

**Zero-Crossing device:** A method of processing a Doppler signal whereby the incoming signal passes through a zero point and produces an output proportional to the average frequency at which the crossing occurs. The output information is both antegrade and retrograde (above or below the zero point); however, the output is an average of the frequencies at any given point in time and therefore not as accurate as spectral analysis.

# Prefixes

<b>Prefix</b>	<b>Meaning</b>	<b>Example</b>
a-	without, not	anoxia
ab-	away from	abduct
amb-	on both sides	ambidextrous
angi-	blood vessel	angioplasty
ant-/anti-	against	anticoagulant
ante-/antero-	before	antegrade
bi-	two	bidirectional
brady-	slow	bradycardia
cardio-	heart	cardiology
cephal-	head	cephalometry
cerebro-	brain	cerebrovascular
circum-	around	circumference
co-/con-	together	congenital
contra-	against	contralateral
de-	away from	decerebrate
dextro-	to the right	dextrocardia
dis-	separation	disarticulation
dys-	difficult, abnormal	dysphasia
en-/end-/ endo-	in, within	endothelium
ent-/ex-	away from	exsanguination
exo-/extra-	outside	extracranial
hemi-	half	hemisphere
hetero-	unlike	heterogeneous
homo-	same	homogeneous
hyper-	above	hypertension
hypo-	below	hypoxia
infra-	below	infraorbital
inter-	between	interface
intra-	within	intracranial
medi-	middle	medial
meta-	between	metatarsal
mono-	one, single	monophasic
multi-	many	multiphasic
neo-	new	neointima
normo-	normal	normotensive
oculo-	eye	oculoplethysmography
pan-	all	pansystolic
para-	beside	parasympathetic
peri-	around	periorbital
phlebo-	vein	phleborheography

<b>Prefix</b>	<b>Meaning</b>	<b>Example</b>
photo-	light	photoplethysmography
plethys-	volume	plethysmography
post-	after	post phlebitic
pre-/pro-	before	precursor
pseudo-	false	pseudoaneurysm
quadri-	four	quadriphonic
radio-	radiation	radiography
retro-	backward	retrograde
sclero-	hard	sclerosis
sub-	below	subacute
supra-	above	supraorbital
tachy-	rapid	tachycardia
thermo-	temperature	thermography
thrombo-	blood clot	thrombophlebitis
trans-	across	transverse
ultra-	from beyond to above	ultrasound
uni-	one	unidirectional
vaso-	vessel	vasospasm

## Suffixes

<b>Suffix</b>	<b>Meaning</b>	<b>Example</b>
-algia	pain	causalgia
-ectomy	removal of	thrombectomy
-emia	blood	anemia
-esthesia	sensation	parasthesia
-genesis	origin	thrombogenesis
-genic	causation	vasculogenic
-graphy	writing	plethysmography
-itis	inflammation	arteritis
-logy	study of	physiology
-meter	measure	manometer
-otomy	opening	arteriotomy
-ous	like	atheromatous
-pathy	disease	cardiopathy
-penia	lack of	thrombocytopenia
-phagia	swallowing	dysphasia
-phasia	speech	aphasia
-plegia	paralysis	paraplegia
-rhage	burst forth	hemorrhage
-sonic	sound	ultrasonic
-stasis	stagnation	hemostasis

# Acronyms

## A

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AAA	Abdominal Aortic Aneurysm
ABI	Ankle-Brachial Index
ACAS	Asymptomatic Carotid Atherosclerosis Study
ACC	American College of Cardiology
ACR	American College of Radiology
AEUS	American Emergency Ultrasonographic Society
AHA	American Hospital Association
AI	Acceleration Index
AIUM	American Institute of Ultrasound in Medicine
AMA	American Medical Association
ARDMS	American Registry of Diagnostic Medical Sonography
ARRT	American Registry of Radiologic Technologists
ASE	American Society of Echocardiography
ASN	American Society of Neuroimaging
ASRT	American Society of Radiologic Technologists
AT	Acceleration Time
ATA	Anterior Tibial Artery
ATV	Anterior Tibial Vein
AVA	American Vascular Association
AVIR	Association of Vascular and Interventional Radiographers

## B

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BUN	Blood Urea Nitrogen
BP	Blood Pressure

## C

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CAAHEP	Commission on Accreditation of Allied Health Education Programs
CABG	Coronary Artery Bypass Graft
CAC	Carrier Advisory Committee
CAD	Coronary Artery Disease
CBD	Common Bile Duct
CCA	Common Carotid Artery
CCI	Cardiovascular Credentialing International
CFA	Common Femoral Artery
CFV	Common Femoral Vein
CHF	Congestive Heart Failure
CIA	Common Iliac Artery
CMD	Carrier Medical Director
CME	Continuing Medical Education units
CMS	Centers for Medicare and Medicaid Services
CQU	Coalition for Quality in Ultrasound
CVA	Cerebrovascular Accident

## D

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DHHS	Dept. of Health and Human Services
DBI	Digit-Brachial Index
DIC	Disseminated Intravascular Coagulation
DOL	Dept. of Labor
DVT	Deep Vein Thrombosis

## E

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ECA	External Carotid Artery
EIA	External Iliac Artery

## G

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GSV	Greater Saphenous Vein
GI	Gastrointestinal

## H

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HBP	High Blood Pressure
HCT	Hematocrit
HGB	Hemoglobin
HIPAA	Health Insurance Portability and Accountability Act of 1996

## I

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ICA	Internal Carotid Artery
ICAEL	Intersocietal Commission for the Accreditation of Echocardiography Laboratories
ICAVL	Intersocietal Commission for the Accreditation of Vascular Laboratories
IDTF	Independent Diagnostic Testing Facility
IMA	Inferior Mesenteric Artery
IMT	Intimal Medial Thickness
IVC	Inferior Vena Cava
IVUS	Intravascular Ultrasound

## J

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JDMS	Journal of Diagnostic Medical Sonography
JRC-CVT	Joint Review Committee on Education in Cardiovascular Technology
JRC-DMS	Joint Review Committee on Education in Diagnostic Medical Sonography
JVU	<i>Journal for Vascular Ultrasound</i>

## K

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KHz	Kilohertz
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## L

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LCD	Local Coverage Determination
LMRP	Local Medical Review Policy
LSV	Lesser Saphenous Vein

## M

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MedPAC	Medicare Payment Advisory Commission
MHz	Megahertz
MI	Myocardial Infarction

## N

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NAA	National Aneurysm Alliance
NASCET	North American Symptomatic Carotid Endarterectomy Trial

## O

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OSHA	Occupational Safety & Health Administration
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## P

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PAD	Peripheral Arterial Disease
PBI	Penile Brachial Index
PE	Pulmonary Embolus
PI	Pulsatility Index
POP	Popliteal
PPG	Photoplethysmography
PRG	Phleborheography
PTA	Posterior Tibial Artery
PTFE	Polytetrafluoroethylene
PTV	Posterior Tibial Vein
PV	Portal Vein
PVD	Peripheral Vascular Disease
PVR	Pulse Volume Recording

## R

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RA	Renal Artery
RAR	Renal Aortic Ratio
RDCS	Registered Diagnostic Cardiac Sonographer
RDMS	Registered Diagnostic Medical Sonographer
RI	Resistive Index
RIND	Reversible Ischemic Neurological Deficit
RSD	Reflex Sympathetic Dystrophy

RV	Renal Vein
RVS	Registered Vascular Specialist
RVT	Registered Vascular Technologist
ROUB	Registered Ophthalmic Ultrasound Biometrics

## S

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SDMS	Society of Diagnostic Medical Sonography
SFV	Superficial Femoral Vein
SIR	Society of Interventional Radiology
SMA	Superior Mesenteric Artery
SMV	Superior Mesenteric Vein
SVMB	Society for Vascular Medicine and Biology
SVN	Society for Vascular Nursing
SVS	Society for Vascular Surgery
SVU	Society for Vascular Ultrasound

## T

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TBI	Toe-Brachial Index
TCD	Transcranial Doppler
TCPO <sub>2</sub>	Transcutaneous Pulse Oximetry
TIA	Transient Ischemic Attack
TOS	Thoracic Outlet Syndrome
TPA	Tissue Plasminogen Activator

## U

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USPSTF	United States Preventative Services Task Force
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## V

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VDF	Vascular Disease Foundation
VPR	Volume Pulse Recording







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