

Vascular Ultrasound Vocabulary Reference

Part 2: Cerebrovascular | Chapters 4–7

Kupinski, *Diagnostic Medical Sonography: The Vascular System*, 3rd Ed.

An In-Depth Review by Dr. Alice Matthews

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Chapter 4: The Extracranial Duplex Ultrasound Examination

Term	Definition	Analogy / Example
Acoustic Shadowing	A dark area on the ultrasound image deep to a calcified structure, caused by attenuation of the sound beam by calcium.	Like a shadow cast by a rock in a flashlight beam--calcium blocks the sound waves, creating a dark "shadow" behind it.
Alternating (Bidirectional) Flow	A steal waveform where part of the cardiac cycle shows antegrade flow and part shows retrograde flow.	Like a tug-of-war where each side wins part of the time--blood flows forward during one part of the heartbeat and backward during another.
Amaurosis Fugax	Temporary monocular blindness caused by embolism to the ophthalmic artery from carotid plaque. Often described as a "shade coming down" over one eye.	Like a window shade being pulled down--the eye temporarily goes dark due to a small clot blocking its blood supply.
Arterial Dissection	Separation of the vessel wall layers (intima from media) creating a false lumen alongside the true lumen. Can be spontaneous or traumatic.	Like wallpaper peeling away from a wall--blood forces its way between the layers of the vessel wall, creating two channels.
Arteriovenous Fistula	An abnormal connection between an artery and vein, often caused by traumatic puncture. Shows high-velocity, low-resistance arterial flow and pulsatile venous flow.	Like a shortcut between two highways--blood bypasses the normal capillary route, flowing directly from artery to vein.
Carotid Bruit	An abnormal "swishing" sound heard with a stethoscope over a stenotic carotid artery, caused by turbulent flow.	Like the sound of water rushing through a kinked hose--the turbulence creates an audible noise.
Carotid Thrombosis	Complete occlusion of the carotid artery by a blood clot, often associated with underlying atherosclerotic plaque.	Like a clogged drain--blood has clotted and blocked all flow through the vessel.
Choke Lesion	A severe distal common carotid artery stenosis that creates a pressure gradient, potentially causing flow reversal in the ECA to supply the ICA.	Like a bottleneck that creates a traffic jam--the severe narrowing changes pressure relationships, causing collateral flow patterns.
Color Aliasing	A color Doppler artifact where high-velocity flow appears as the wrong color (typically red appearing blue or vice versa) due to exceeding the Nyquist limit.	Like a car wheel appearing to spin backward in videos--when flow is too fast for the settings, colors wrap around incorrectly.
Complete Steal	Total retrograde flow in the vertebral artery throughout the cardiac cycle due to severe proximal subclavian stenosis.	Like a one-way street that has been reversed--blood flows entirely backward, from brain to arm, throughout the entire heartbeat.
Duplex Ultrasound	An ultrasound technique that combines B-mode (grayscale) imaging with Doppler spectral analysis to provide both anatomic and physiologic information about blood vessels.	Like having both a camera and a speed detector in one device--you can see the road (vessel) and measure how fast cars (blood) are traveling at the same time.

Term	Definition	Analogy / Example
End Diastolic Velocity (EDV)	The velocity measured at the end of diastole, just before the next systole. Elevated EDV (>140 cm/s) suggests severe ICA stenosis (80-99%).	Like the minimum speed a car maintains before accelerating again--the velocity at the lowest point of the cardiac cycle.
False Lumen	The channel created within the vessel wall by a dissection, often showing slower, delayed, or reversed flow compared to the true lumen.	Like an emergency lane created when the road split--the new channel formed by blood forcing between wall layers.
Fibrous Cap	A layer of connective tissue between the plaque and the arterial lumen. A smooth, intact fibrous cap suggests stable plaque.	Like the crust on a pie--the covering layer that keeps the filling (plaque contents) contained. If it ruptures, the contents spill out.
Flow Separation (Boundary Layer Separation)	A normal finding in the carotid bulb where blood flow creates a zone of reversed, swirling flow along the outer wall opposite the flow divider. It disappears as plaque fills the bulb.	Like water swirling in eddies along the banks of a widening river--when the vessel widens at the bulb, some blood swirls backward along the outer edge.
Hesitant Waveform	A vertebral artery waveform with a deep flow reversal notch where flow pauses before continuing forward. It indicates impending subclavian steal.	Like a river that hesitates at a bend--flow momentarily reverses before continuing in the original direction.
Heterogeneous Plaque	Plaque with mixed echogenicity containing both echolucent and echogenic areas, often with calcification and acoustic shadowing.	Like a chunky soup with different ingredients--mix of fatty, fibrous, and calcified components visible as different brightness levels.
Homogenous Plaque	Plaque with uniform echogenicity, typically low-level echoes, often associated with fibrofatty tissue and a smoother surface.	Like a smooth, uniform blob of butter--consistent in appearance throughout, suggesting a more stable plaque composition.
Iatrogenic Injury	An injury caused inadvertently by medical treatment or diagnostic procedures, such as pseudoaneurysm from catheter placement.	Like accidentally dinging a car door while parking--unintended damage caused during a medical procedure.
ICA/CCA Ratio	The ratio of peak systolic velocity in the internal carotid artery to the peak systolic velocity in the common carotid artery. A ratio ≥ 4.0 suggests $\geq 70\%$ ICA stenosis.	Like comparing highway speeds to city street speeds--if the ICA is going much faster than the CCA (4x or more), there's likely a significant narrowing ahead.
Intimal Flap	The separated intimal layer visible within the vessel lumen in dissection, appearing as a linear echo moving with the cardiac cycle.	Like a curtain blowing in the wind--the peeled-back inner layer moves with each heartbeat.
Intimal-Medial Thickness (IMT)	The combined thickness of the tunica intima and tunica media layers, measured as a marker of early atherosclerosis.	Like measuring the thickness of a wall lining--increased IMT suggests early vessel wall changes before actual plaque forms.
Intra-aortic Balloon Pump (IABP)	A cardiac assist device that inflates during diastole and deflates during systole, creating distinctive waveforms.	Like a balloon inflating and deflating with each heartbeat--changes the normal arterial pressure pattern dramatically.
Intraplaque Hemorrhage	Bleeding within a plaque beneath the fibrous cap, which can cause plaque expansion and instability, increasing stroke risk.	Like a bruise forming under the skin--blood leaks into the plaque, making it swell and potentially rupture.
Latent Steal	An early stage of subclavian steal where flow begins to show signs of reversal but is not yet completely retrograde.	Like a door starting to swing the wrong way--the pressure gradient is changing, but flow hasn't fully reversed yet.

Term	Definition	Analogy / Example
Mosaic Color Pattern	A turbulent flow appearance on color Doppler showing mixed colors (red, blue, yellow, green) indicating disturbed flow.	Like a mosaic tile artwork with mixed colors--the jumble of colors shows flow going in multiple directions due to turbulence.
NASCET Method	The North American Symptomatic Carotid Endarterectomy Trial method for calculating stenosis: comparing the minimal residual lumen diameter to the normal distal ICA diameter.	Like measuring how narrow a road gets compared to the normal highway width downstream--gives a standardized way to report stenosis severity.
Near Occlusion (Preocclusive)	A severely stenotic lesion with a very narrow residual lumen. Velocity criteria may not apply; diagnosis is made by demonstrating a markedly narrowed lumen.	Like a nearly closed valve--so tight that flow patterns become unpredictable, sometimes high velocity, sometimes low.
Peak Systolic Velocity (PSV)	The maximum velocity measured during systole, the primary parameter used to classify carotid stenosis severity.	Like the top speed a car reaches on a straightaway--the highest point on the velocity waveform during the heart's contraction.
Poststenotic Turbulence	Disordered, chaotic flow patterns occurring immediately distal to a significant stenosis, visible as spectral broadening and mosaic color patterns.	Like water churning after going through rapids--the flow gets all mixed up after squeezing through a narrow spot.
Power Doppler	A Doppler mode that displays the amplitude (power) of the Doppler signal rather than velocity, useful for detecting slow flow and distinguishing near-occlusion from occlusion.	Like a volume meter instead of a speedometer--shows how much blood is present rather than how fast it's moving, great for finding very slow flow.
Pseudoaneurysm (False Aneurysm)	A hematoma that forms outside the arterial wall due to vessel injury, with flow communication through a "neck" to the artery. Shows characteristic "to-and-fro" flow pattern.	Like a balloon attached to the side of a pipe--blood squirts out through a hole, pools in a sac outside the vessel, then flows back in with each heartbeat.
Pulsus Bisferiens	A waveform with two systolic peaks separated by a systolic retraction, seen in patients with aortic valvular disease or hypertrophic cardiomyopathy.	Like a camel with two humps--the waveform has two peaks instead of one due to heart valve problems.
Spectral Broadening	An increase in the width of the Doppler frequency spectrum, indicating turbulent flow. It appears as "filling in" of the clear window under the systolic peak.	Like a chorus singing in unison versus everyone singing different notes--normal laminar flow has a narrow "clean" spectrum, while turbulent flow shows a broad, "messy" spectrum.
Spectral Window	The clear (echo-free) area under the systolic peak in a normal laminar flow waveform. Loss of this window indicates turbulence.	Like the empty space under a curve--normal flow has a "window" of silence; turbulence fills it in.
String Sign	A preocclusive waveform pattern characterized by blunted, low-velocity flow with minimal diastolic component. It indicates a nearly occluded vessel with only a tiny residual lumen.	Like water trickling through an almost-clogged pipe--just a thin "string" of flow remains before complete blockage.
Subclavian Steal Phenomenon	Retrograde (reversed) flow in the vertebral artery caused by a proximal subclavian artery stenosis. Blood is "stolen" from the brain to supply the arm.	Like siphoning gas from a neighbor's tank--blood meant for the brain gets diverted backward through the vertebral artery to supply the arm because of a blockage in the subclavian.
Tardus-Parvus Waveform	An abnormal waveform pattern found distal to a significant stenosis, characterized by delayed systolic acceleration (tardus = late) and decreased peak velocity (parvus = small).	Like water coming out of a kinked hose--after squeezing through a narrow spot, the flow arrives late and weak instead of quick and strong.

Term	Definition	Analogy / Example
Temporal Tap Maneuver	A technique used to differentiate the external carotid artery (ECA) from the internal carotid artery (ICA) by tapping on the superficial temporal artery and observing oscillations in the ECA Doppler waveform.	Like tapping on a garden hose and watching the ripples--if you tap the temporal artery near the ear, the vibrations show up in the ECA but not the ICA, helping you tell them apart.
To-and-Fro Flow	The characteristic Doppler pattern of a pseudoaneurysm neck, showing flow into the sac during systole and out during diastole.	Like a swing going back and forth--blood flows into the pseudoaneurysm during the heart's push, then flows back out during relaxation.
Transient Ischemic Attack (TIA)	A brief episode of stroke-like symptoms lasting less than 24 hours, caused by temporary interruption of blood supply to the brain.	Like a warning shot--a mini-stroke that resolves but warns of higher stroke risk.
True Lumen	The original arterial channel in a dissection, typically showing normal or stenotic flow patterns.	Like the original lane on a highway--the original path blood traveled before the dissection created an alternate route.
Ventricular Assist Device (VAD)	A mechanical pump that supports heart function in patients with severe heart failure, creating unusual arterial waveforms.	Like having a second heart--the device creates continuous or pulsatile flow patterns that look different from normal cardiac output.

Chapter 5: Uncommon Pathology of the Carotid System

Term	Definition	Analogy / Example
Carotid Aneurysm	An abnormal dilation of the carotid artery to more than 1.5 times its normal diameter, which can contain thrombus.	Like a bulging weak spot in a tire--the artery wall balloons outward, potentially containing clotted blood.
Carotid Body Tumor (Paraganglioma)	A vascular tumor arising from the carotid body at the bifurcation, causing splaying (widening) of the ICA and ECA.	Like a ball wedged between two branches--a tumor grows at the fork, pushing the two arteries apart.
Carotid Coil	A corkscrew or S-shaped elongation and twisting of the carotid artery, often congenital or due to vessel elongation with age.	Like a winding mountain road--the artery twists and turns in loops instead of taking a straight path.
Carotid Kink	An acute bend or angulation in the carotid artery that can cause turbulent flow and mimic stenosis on color Doppler.	Like a sharp bend in a highway--the road curves so abruptly it can cause traffic problems (turbulence) without actual narrowing.
ECA Collateralization	Development of collateral pathways through the external carotid artery branches when the ICA is occluded, which can complicate the temporal tap maneuver.	Like traffic being diverted through side streets--when the main route (ICA) is blocked, blood finds alternate paths through ECA branches.
Fibromuscular Dysplasia (FMD)	A non-atherosclerotic arterial disease causing alternating areas of stenosis and dilation, giving a "string of beads" appearance. Most common in young to middle-aged women.	Like a string of beads--the artery has bulges and narrow spots alternating, not from plaque but from abnormal wall development.
Pulsatile Neck Mass	A palpable mass in the neck with a detectable pulse, which could be an aneurysm, carotid body tumor, or tortuous vessel.	Like feeling your heartbeat through a lump--any mass in the neck that pulses needs evaluation.

Term	Definition	Analogy / Example
"String of Beads" Appearance	The characteristic angiographic and ultrasound appearance of fibromuscular dysplasia, showing alternating segments of narrowing and dilation.	Like popcorn strung on a thread--alternating bulges and constrictions along the artery.
Tortuosity	Excessive twisting, looping, or kinking of a blood vessel, making examination technically challenging.	Like a meandering river--the vessel doesn't follow a straight path, making it harder to image and measure.

Chapter 6: Ultrasound Following Surgery and Intervention

Term	Definition	Analogy / Example
Carotid Endarterectomy (CEA)	Surgical removal of atherosclerotic plaque from the carotid artery to reduce stroke risk in patients with significant stenosis.	Like cleaning out a clogged pipe--the surgeon opens the artery and removes the plaque buildup.
Carotid Stent	A metal mesh tube placed in the carotid artery to keep it open after angioplasty, an alternative to endarterectomy for some patients.	Like a scaffold holding a tunnel open--the metal framework props the artery open from inside.
In-Stent Restenosis	Narrowing that develops within a previously placed stent due to neointimal hyperplasia (tissue growth inside the stent).	Like scar tissue growing inside a pipe--the body's healing response can cause tissue buildup that re-narrows the stented area.
Neointimal Hyperplasia	Tissue growth inside a stent or at a surgical site that can cause restenosis, representing an exaggerated healing response.	Like overzealous scar formation--the body heals too aggressively, creating tissue that narrows the vessel.
Patch Angioplasty	Use of a synthetic or vein patch to close the arteriotomy after endarterectomy, widening the vessel to prevent restenosis.	Like patching a hole with extra material--instead of sewing the edges together directly, a patch is added to make the vessel wider.
Residual Stenosis	A remaining area of narrowing immediately after intervention, caused by incomplete plaque removal or stent expansion.	Like not quite finishing the job--some narrowing remains even after treatment.
Restenosis	Return of narrowing after an initially successful intervention, typically due to neointimal hyperplasia or progression of atherosclerosis.	Like a clog coming back--the narrowing returns after being cleared.
Velocity Criteria for Stents	Modified Doppler velocity thresholds used to evaluate stented carotid arteries, which differ from native vessel criteria due to altered vessel compliance.	Like using different speed limits for different road surfaces--stented arteries need their own reference values because they behave differently.

Chapter 7: Intracranial Cerebrovascular Examination (Transcranial Doppler)

Term	Definition	Analogy / Example
Acoustic Window	A thin area of the skull that allows ultrasound penetration for TCD examination, including transtemporal, transorbital, and suboccipital windows.	Like a window in a stone wall--the thin spots in the skull let sound waves through to see inside.

Term	Definition	Analogy / Example
Anterior Cerebral Artery (ACA)	A branch of the ICA supplying the medial brain surface. Normal depth: 60-75 mm; normal flow: away from the transducer.	Like a side road to the inner brain--the artery running along the midline of the brain.
Bubble Study (Contrast TCD)	Injection of agitated saline (microbubbles) during TCD monitoring to detect right-to-left cardiac shunts. Bubbles appearing in the brain indicate a shunt.	Like dropping dye in water to trace flow--if bubbles meant for the lungs show up in the brain, there's a shortcut.
Carotid Siphon	The S-shaped portion of the intracranial ICA as it passes through the cavernous sinus.	Like a siphon hose curved in an S-shape--the carotid makes a distinctive bend as it enters the skull.
Cerebral Circulatory Arrest	Absence of net forward blood flow to the brain, indicated by specific TCD patterns (oscillating flow, systolic spikes). Used to confirm brain death.	Like traffic completely stopped--the patterns show blood just wiggling back and forth without actually flowing forward.
Cerebral Vasospasm	Narrowing of intracranial arteries due to smooth muscle contraction, typically occurring 3-14 days after subarachnoid hemorrhage. Detected by elevated velocities on TCD.	Like muscles cramping around a pipe--arteries clamp down after bleeding in the brain, dangerously reducing blood flow.
Emboli Detection	TCD monitoring to detect microembolic signals (MES) appearing as high-intensity transient signals (HITS) within the Doppler spectrum.	Like hearing pebbles hitting a pipe--small clots or debris passing through make distinctive "clicks" or bright spots on the waveform.
High-Intensity Transient Signal (HITS)	A brief, high-amplitude signal on TCD indicating a microembolus passing through the sample volume.	Like a bright flash on the screen--a momentary spike showing something solid passed through.
Hyperemia	Increased blood flow to the brain, causing elevated velocities that can mimic vasospasm. Distinguished from spasm by low Lindegaard ratio (<3).	Like a flood of traffic--more cars on the road make speeds appear higher, but the road isn't narrower.
Lindegaard Ratio (MCA/ICA Ratio)	The ratio of MCA mean flow velocity to ipsilateral ICA mean flow velocity. Ratio >3 suggests vasospasm; ratio >6 indicates severe spasm.	Like comparing highway speed to the on-ramp--if the MCA is much faster than the feeding ICA, the speed-up is due to spasm (narrowing), not just increased flow.
Mean Flow Velocity (MFV)	The time-averaged velocity in an intracranial vessel, the primary TCD parameter for detecting vasospasm. Normal MCA MFV: <80 cm/s.	Like the average speed on a highway--gives a single number representing overall flow speed.
Middle Cerebral Artery (MCA)	The largest branch of the ICA, supplying the lateral surface of the brain. Normal depth: 50-65 mm; normal flow: toward the transducer.	Like the main highway through the brain's side territory--the biggest branch carrying blood to important brain regions.
Ophthalmic Artery	The first major branch of the intracranial ICA, supplying the eye and orbit. Flow direction: toward the transducer via transorbital approach.	Like the delivery route to the eye--the artery that brings blood to the eyeball and surrounding structures.
Oscillating Flow	A TCD pattern showing equal forward and backward flow components, indicating no net forward blood flow. A sign of cerebral circulatory arrest.	Like a pendulum swinging equally both ways--blood moves back and forth but doesn't go anywhere.
Posterior Cerebral Artery (PCA)	Terminal branch of the basilar artery supplying the occipital lobe. Normal depth: 60-70 mm; flow direction varies by segment.	Like the back road to visual centers--carries blood to the part of the brain that processes sight.
Pulsatility Index (PI)	A measure of waveform pulsatility: $(PSV - EDV) / MFV$. Elevated PI suggests increased intracranial pressure or distal obstruction.	Like measuring how much the waveform bounces--high pulsatility means the waveform has big peaks and valleys, suggesting downstream resistance.

Term	Definition	Analogy / Example
Right-to-Left Shunt	An abnormal connection between the right and left sides of the heart, allowing venous blood to bypass the lungs. Detected by TCD bubble study.	Like a shortcut in a building--blood skips the lungs and goes directly to the arterial circulation.
Submandibular Approach	TCD window under the jaw, used to evaluate the distal ICA as it enters the skull.	Like approaching from below--imaging the carotid through the soft tissue under the jaw.
Suboccipital Window	The acoustic window at the back of the head, through the foramen magnum, used to image the vertebral and basilar arteries.	Like entering through the back door--the opening at the base of the skull gives access to posterior circulation vessels.
Systolic Spikes	Very brief, narrow velocity spikes in early systole with no diastolic flow, a sign of severely compromised cerebral circulation.	Like a faint pulse with no follow-through--just a tiny blip of flow when the heart contracts, nothing during relaxation.
Temporal Bone Window	The most commonly used acoustic window for TCD, located above the zygomatic arch. May be absent or inadequate in 10-20% of patients.	Like the side door to the brain--the thin area near the temple that usually allows imaging.
Transcranial Doppler (TCD)	An ultrasound technique using low-frequency transducers through acoustic windows (temporal, orbital, foramen magnum) to evaluate intracranial vessels.	Like looking through a keyhole to see inside a room--using "windows" in the skull to image brain blood vessels.
Transforaminal (Suboccipital) Approach	TCD window through the foramen magnum at the base of the skull, used to evaluate the vertebral arteries and basilar artery.	Like entering through the basement--the opening at the base of the skull allows access to the posterior circulation.
Transorbital Approach	TCD window through the eye, used to evaluate the ophthalmic artery and carotid siphon.	Like looking through a window--the eye socket provides access to arteries behind the eye.
Transtemporal Approach	The primary TCD window through the thin temporal bone, used to evaluate the MCA, ACA, PCA, and ICA (terminal portion).	Like entering through the side door--the thin area of the skull near the temple provides access to the major brain arteries.

Quick Reference: ICA Stenosis Criteria (NASCET/Consensus)

Stenosis	PSV	EDV	ICA/CCA Ratio
Normal	<125 cm/s	<40 cm/s	<2.0
<50%	<125 cm/s	<40 cm/s	<2.0
50-69%	125-230 cm/s	40-100 cm/s	2.0-4.0
≥70-99%	>230 cm/s	>100 cm/s	>4.0
Near Occlusion	Variable	Variable	Variable
Occlusion	No flow	No flow	N/A

Quick Reference: TCD Normal Values

Vessel	Depth (mm)	Mean Velocity (cm/s)	Flow Direction
MCA	50-65	46-86	Toward
ACA	60-75	41-76	Away
PCA	60-70	33-64	Toward/Away
Carotid Siphon	60-70	37-82	Toward/Away
Vertebral	60-90	27-55	Away
Basilar	80-110+	30-57	Away

Quick Reference: Vasospasm Severity (Lindegaard Ratio)

MCA MFV	Lindegaard Ratio	Interpretation
<120 cm/s	<3	No spasm / Hyperemia
120-200 cm/s	3-6	Mild-Moderate Spasm
>200 cm/s	>6	Severe Spasm

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