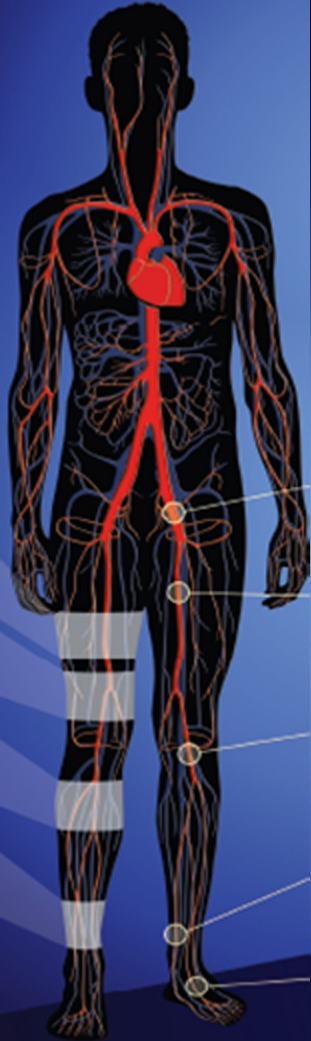


GLOBAL
LEADERSHIP



Use of a Vascular Doppler in Diabetics with PAD

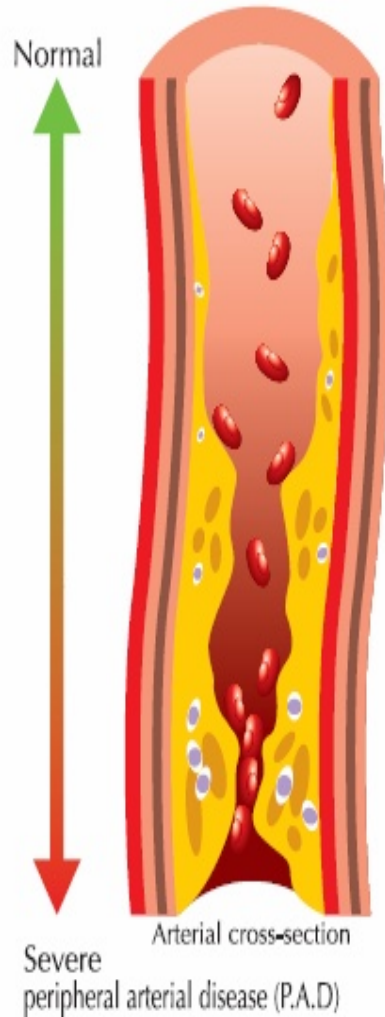
**Dr. Anita Kharbteng,
Clinical Support Manager,
Asia Pacific, Cardinal Health**

Nicolet
VASCULAR

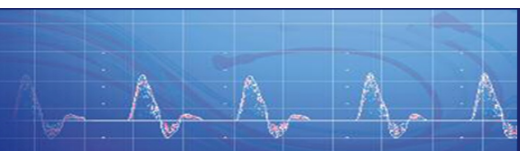
Peripheral
Vascular
Evaluation



Peripheral Arterial Disease (PAD)



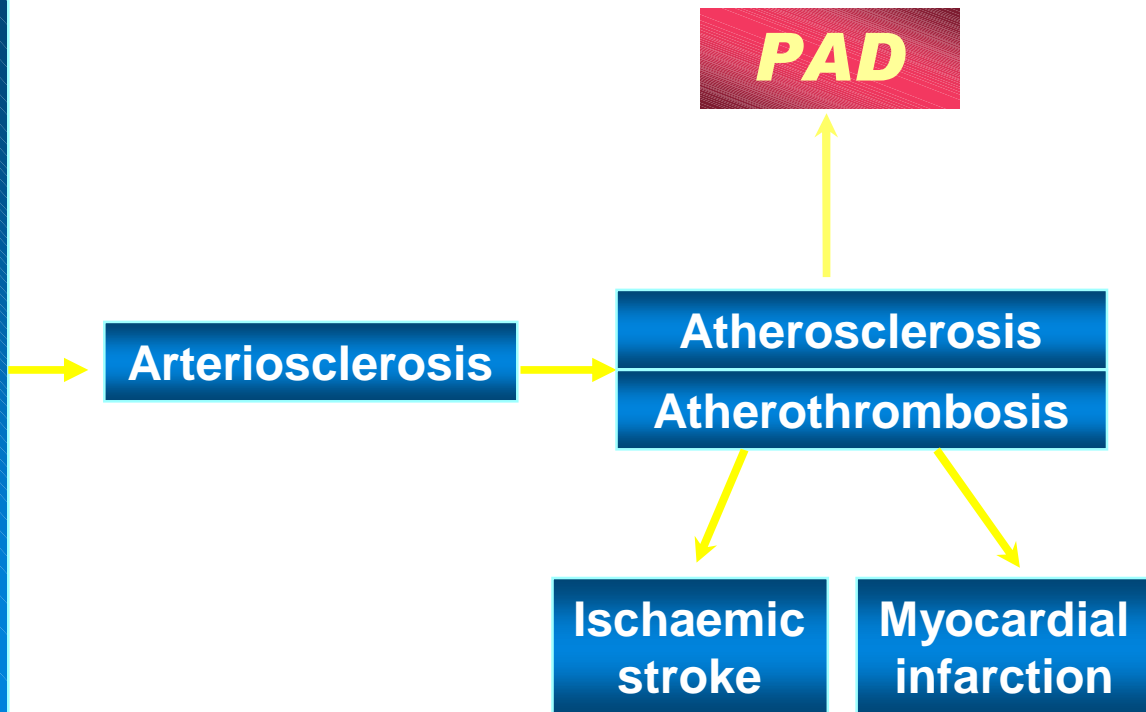
- PAD is a condition characterised by atherosclerotic occlusive disease of the lower extremities.
- The most common symptom of PAD is intermittent claudication (IC). More extreme presentations of PAD include rest pain, tissue loss, or gangrene; collectively termed 'Critical Limb Ischaemia' (CLI).
- The symptoms are often subtle and hence physicians need to be proactive in looking for PAD, realising that it may often be asymptomatic.



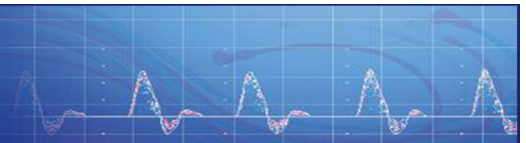
RISK FACTORS

Diabetes and smoking are the strongest risk factor for PAD.

- Gender (male)
- Increasing Age
- Smoking
- High blood pressure
- Diabetes
- High Cholesterol
- Family history of heart attack or stroke
- Fibrinogen
- Homocysteinaemia



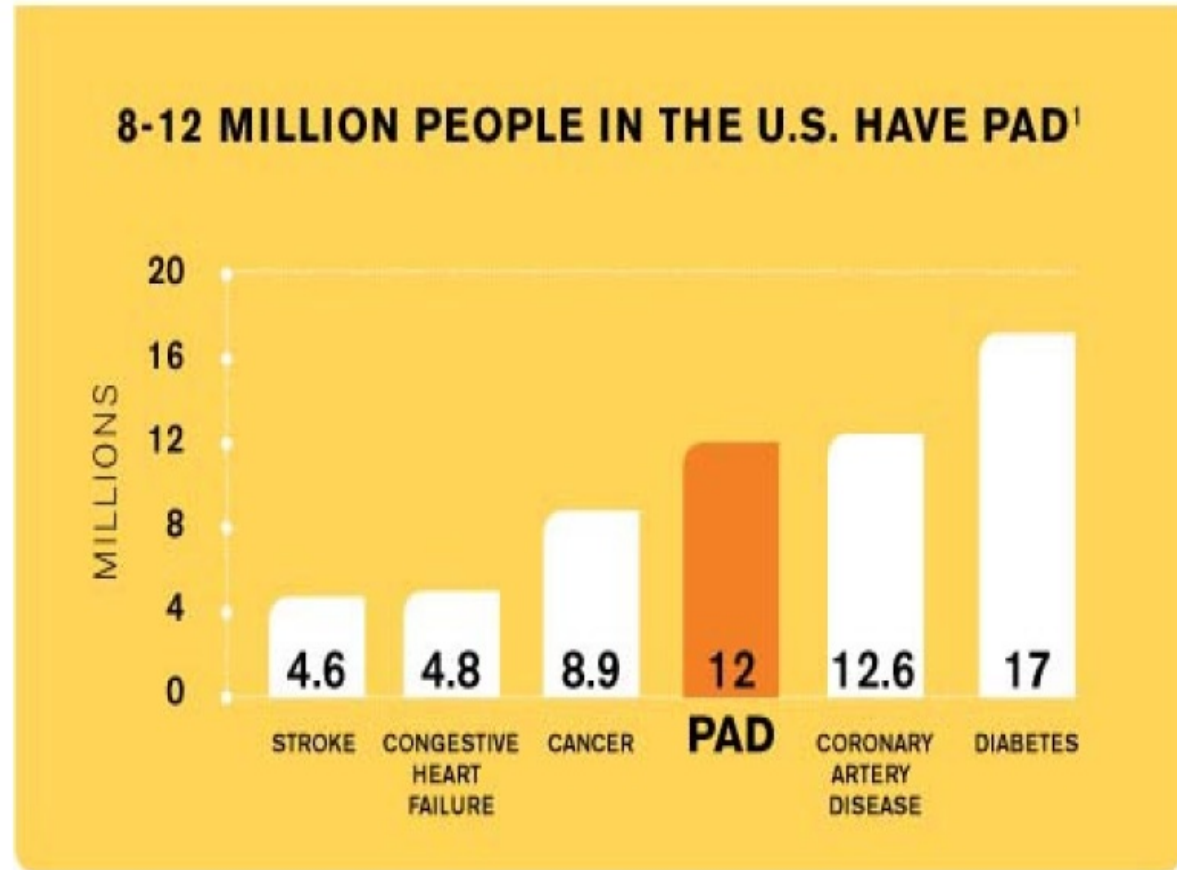
Murabito JM et al. Circulation 1997;96:44–49; Laurila A et al. Arterioscler Throm Vasc Biol 1997;17:2910–2913; Malinow MR et al. Circulation 1989;79:1180–1188; Brigden ML. Postgrad Med 1997;101:249–262.



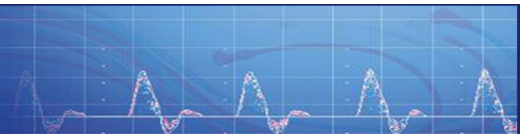
Statistics

Use of ABI has shown the prevalence of Diabetes in PAD individuals:

- 40yrs old is 20%
- 50yrs old is 29%



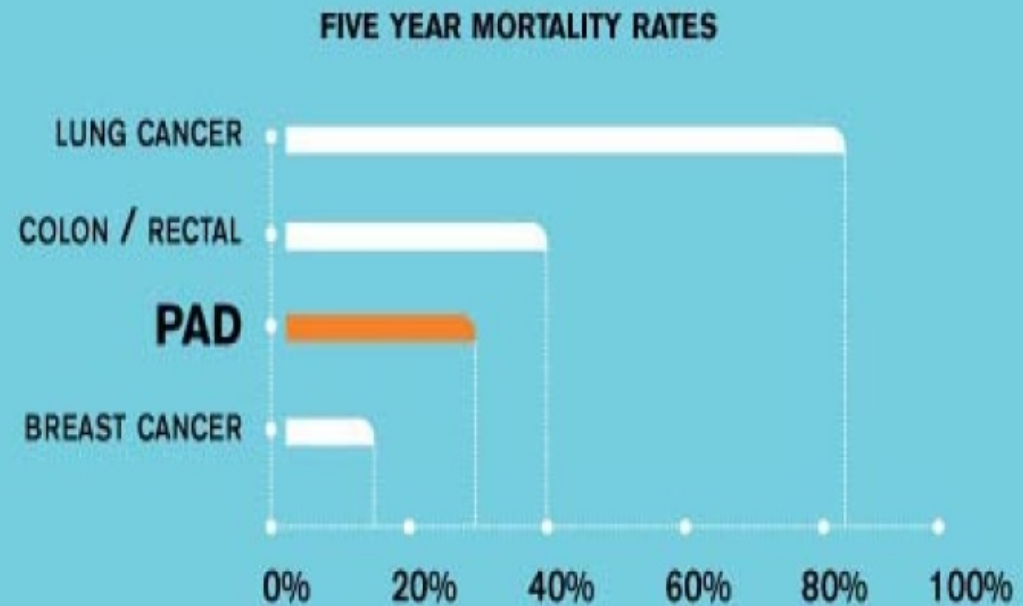
”Peripheral Arterial Disease Detection, Awareness and Treatment in Primary Care”
Alan T. Hirsch, MD et al. JAMA, 2001;286-1317-1324



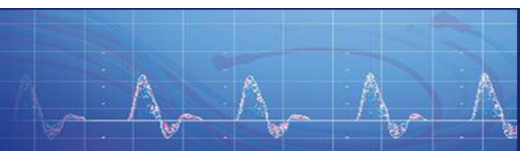
PAD a Walking Time Bomb!

- ❖ Patients with PAD have a higher 5-year mortality rate than breast cancer
- ❖ ~40% of amputees die within 2 years of amputation

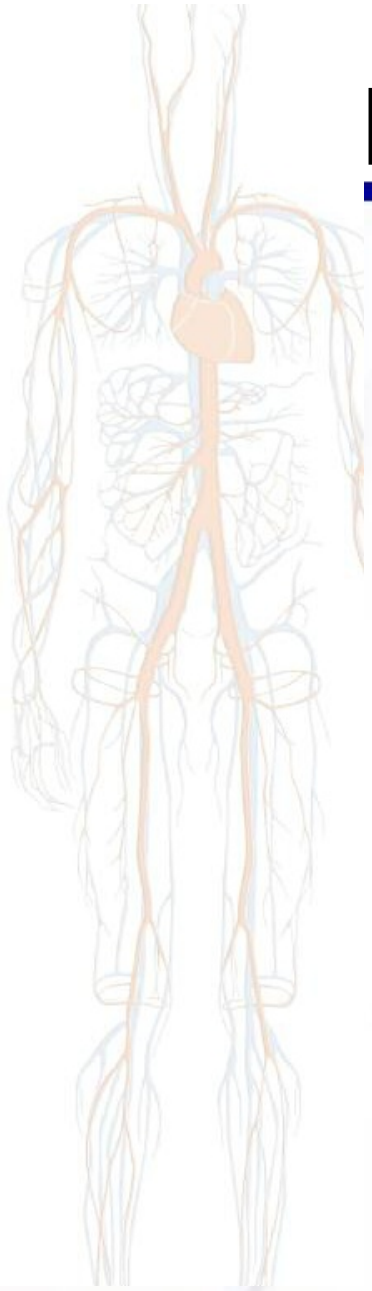
PATIENTS WITH SYMPTOMATIC PAD HAVE A HIGHER MORTALITY RATE THAN BREAST CANCER²



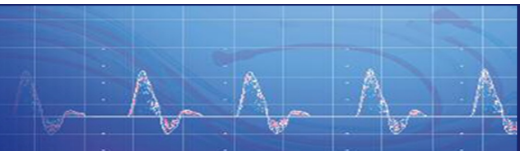
Vascular Disease Foundation and the American Cancer Society



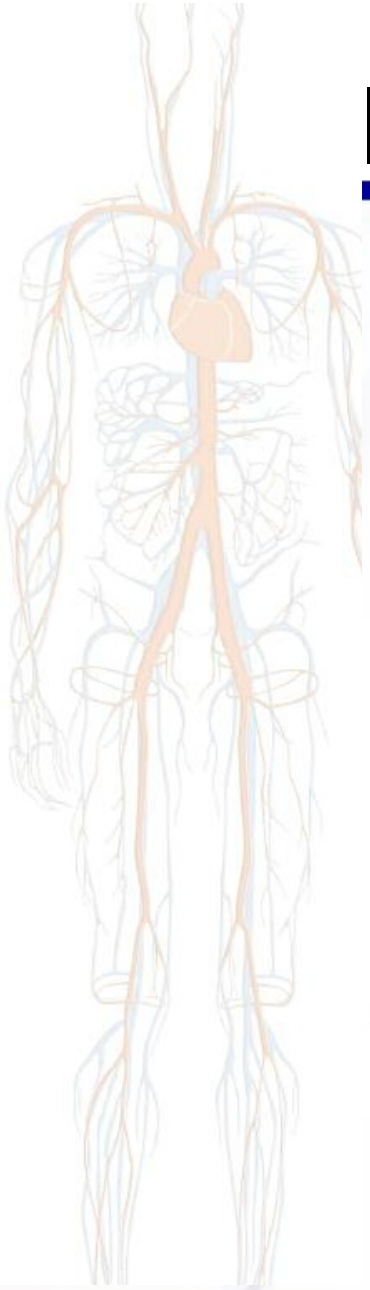
PAD in Diabetes



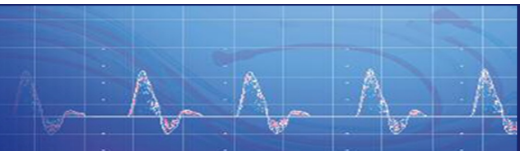
- Diabetes is the strongest risk factor for PAD
- PAD in diabetes is different in its biology, clinical presentation, and management.
- In contrast to the focal and proximal atherosclerotic lesions of PAD in other high risk patients, in diabetics the lesions are more diffuse and distal - tibial vessels below the knee.
- PAD in diabetes is usually accompanied by peripheral neuropathy with impaired sensory feedback. Thus they may not present with the classic symptom of IC. They have subtle symptoms like leg fatigue and slow walking velocity and thus they are simply attributed to old age.
- Diabetic pts with PAD experience worse lower-extremity function than non-diabetics
- These Pts are more prone to sudden ischemia of arterial thrombosis leading to CLI and risk of amputation.
- This lends urgency to the task of diagnosing PAD in those apparently asymptomatic individuals with diabetes.



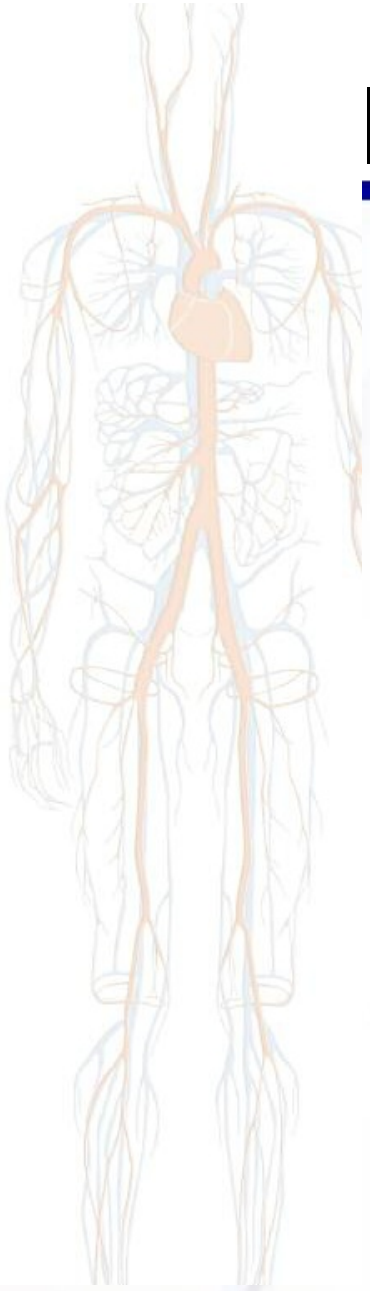
Impact of PAD



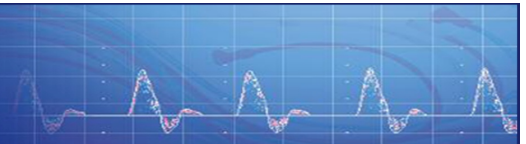
- PAD sufferers have a five-fold risk of death from heart attack or stroke. Diabetic patients are at an even higher risk.
- Approx 27% of patients with PAD show progression of symptoms over a 5-year period with limb loss in ~4%.
- The majority of patients remain stable in their lower limb symptoms but there is a striking excess in cardiovascular events in the same 5-year period with 20% sustaining nonfatal events (MI and stroke) and a 30% mortality rate.
- Patients with CLI have worse outcomes:
 - 30% have amputations
 - 20% die within 6 months



Impact of PAD



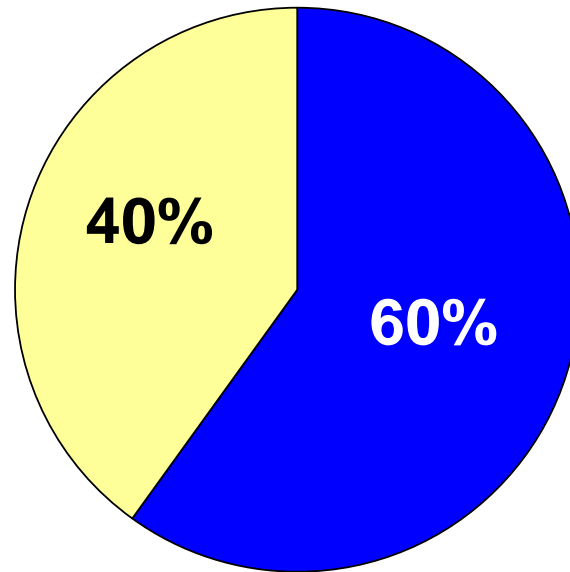
- PAD in diabetes also adversely affects quality of life, contributing to long-term disability and functional impairment that is often severe
- There are significant economic costs of health care, reduced productivity, and personal expenses associated with a chronic manifestation of PAD.
- Identifying a patient with subclinical disease and instituting preventative measure may possibly avoid acute, limb-threatening ischemia, MI and stroke.



Diagnosis of PAD

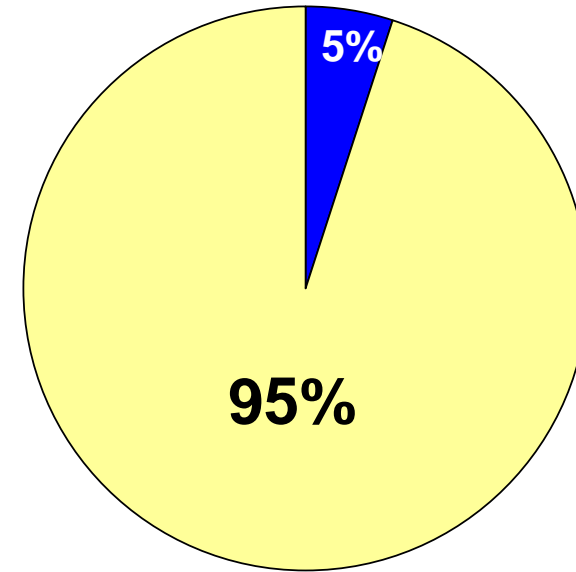
PAD is still under-diagnosed!

Symptomatic PAD



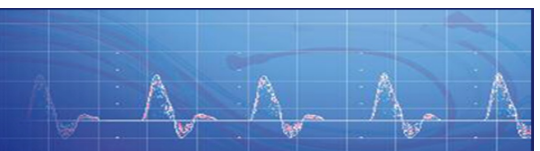
■ Diagnosed PAD ■ Undiagnosed PAD

Asymptomatic PAD

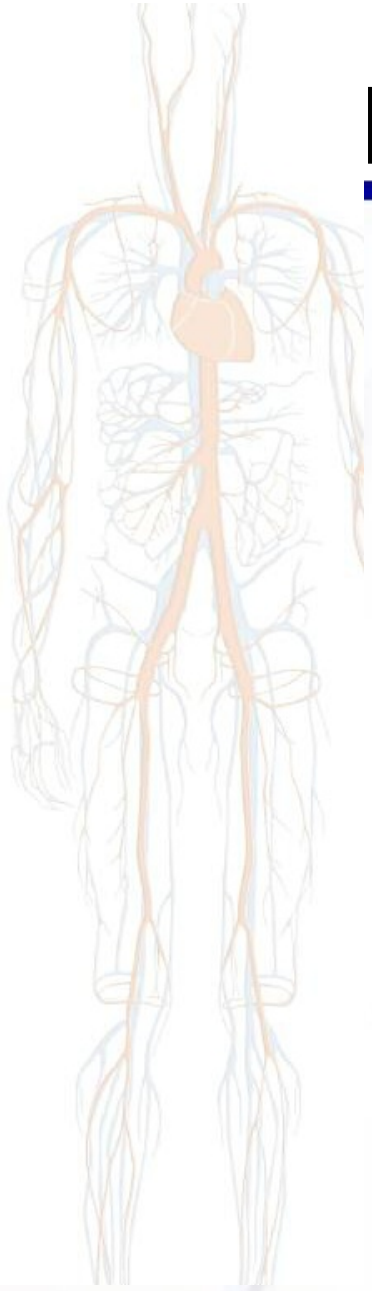


■ Diagnosed PAD ■ Undiagnosed PAD

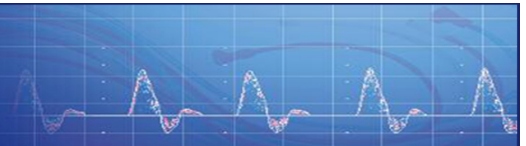
Source: US PAD Market Assessment Study – May 2003



Diagnosis of PAD in Diabetes



- Medical History and Physical Examination
- Palpation of peripheral pulses (high degree of false-positive and false-negative)
- Ankle Brachial Index (ABI): a reproducible, reasonably accurate, noninvasive measurement of PAD and the determination of disease severity. It has been validated against angiogram and found to be 95% sensitive and almost 100% specific.



The ANKLE-BRACHIAL INDEX (ABI)

- The ABI is a simple (5 mins) and inexpensive test that can identify patients with PAD
- The ABI test is a systolic blood pressure comparison between the arms (brachial) and ankles (dorsalis pedis and posterior tibial)
- You only need to use standard blood pressure cuffs and a Nicolet Doppler to listen and look at the blood flow.

ABI

=

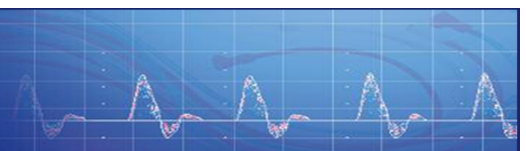
HIGHEST ANKLE
SYSTOLIC PRESSURE

HIGHEST BRACHIAL (ARM)
SYSTOLIC PRESSURE



Why do an ABI Exam?

- It is a fast, effective tool for screening for PAD
- It is non-invasive, easy , and affordable
- Recommended in patients with:
 - 65+ years old
 - High blood pressure
 - Inactive or bedridden
 - Family history of heart attack or stroke
 - diabetic
 - overweight
 - high cholesterol



Performing the ABI Exam

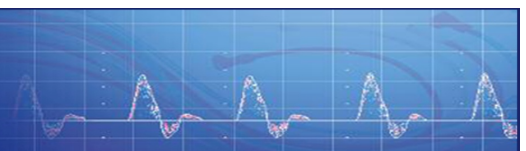
*Using your Nicolet Vascular
Doppler*

What you'll need to perform the ABI Exam

- Your Nicolet Vascular Doppler with 8 MHz probe
- Ultrasound gel
- 6.5 cm, 10 cm or 12 cm blood pressure cuffs
- Sphygmomanometer
- Pen, paper and Nicolet ABI chart

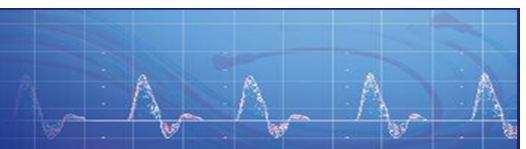


Typical ABI Components

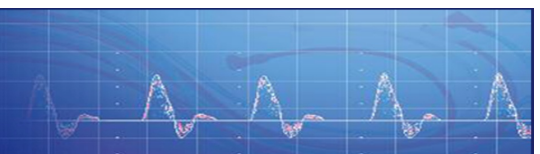
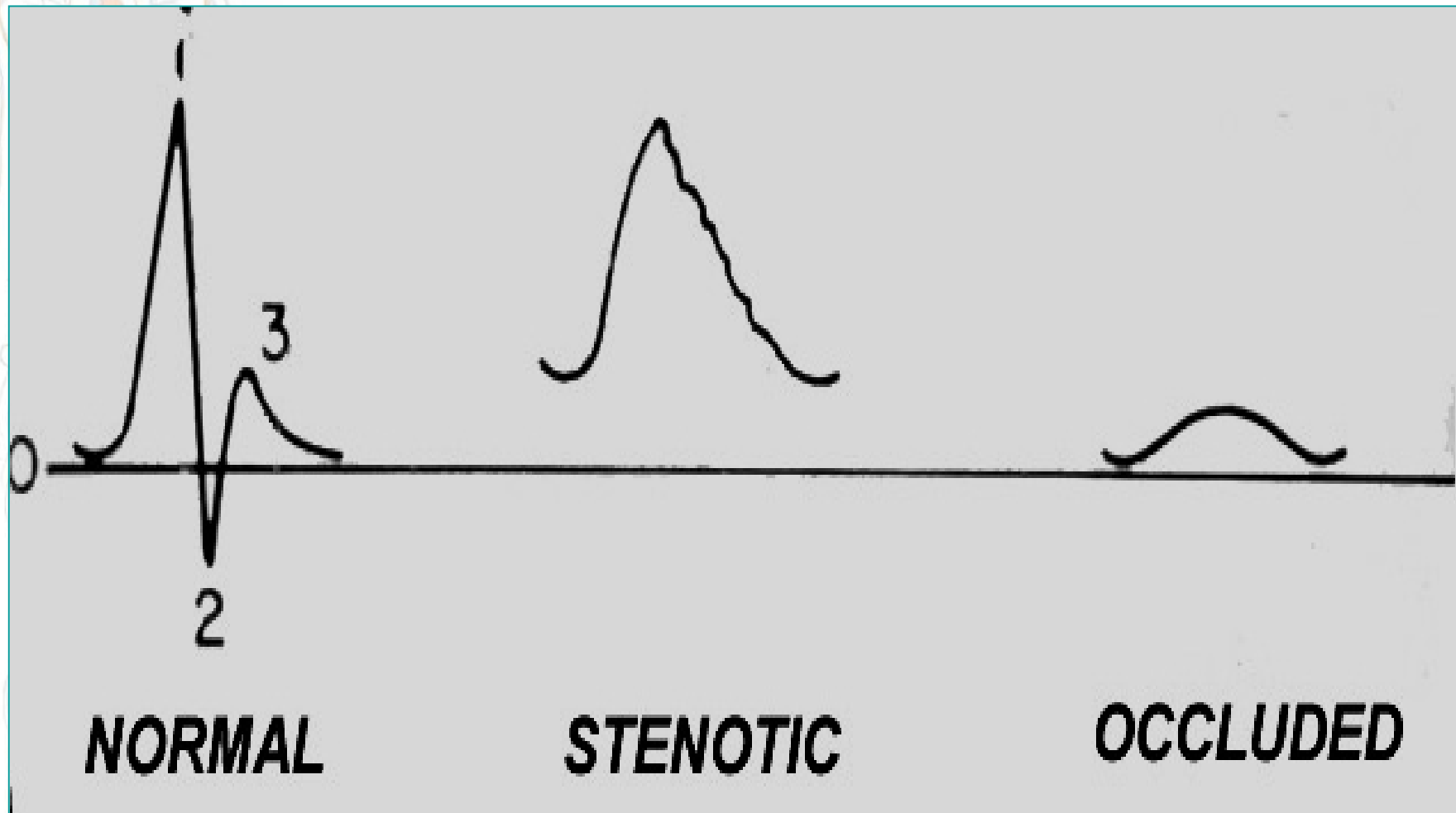


What You'll Need to Perform the ABI Exam

- Nicolet VersaLab w/ 8 MHz probe
- Ultrasound gel
- Proper size cuffs
- Sphygmomanometer
- Pen, paper and Nicolet ABI chart

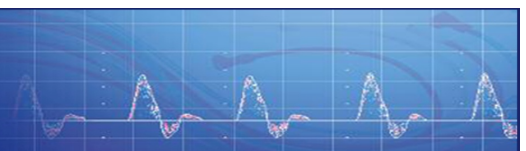


Doppler Waveforms



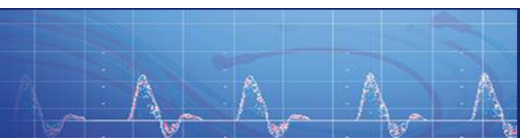
Choose the proper cuff

- The AHA recommends the cuff bladder size be 20% wider than the limb diameter.
- Generally, a 10 cm cuff is fine for use at both the ankle and arm sites.
- Use a 12 cm cuff for patients with larger limbs or a 6.5 cm cuff for smaller limbs.
- Be sure to use the same size cuffs on both the arms and ankles.



Obtaining the Correct Brachial Pressure

- Have the patient lie supine for a few minutes prior to test.
- Place the appropriate size blood pressure cuff about midway up the patient's upper arm above the elbow.



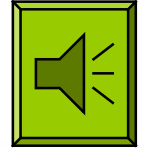
Obtaining Brachial Pressures



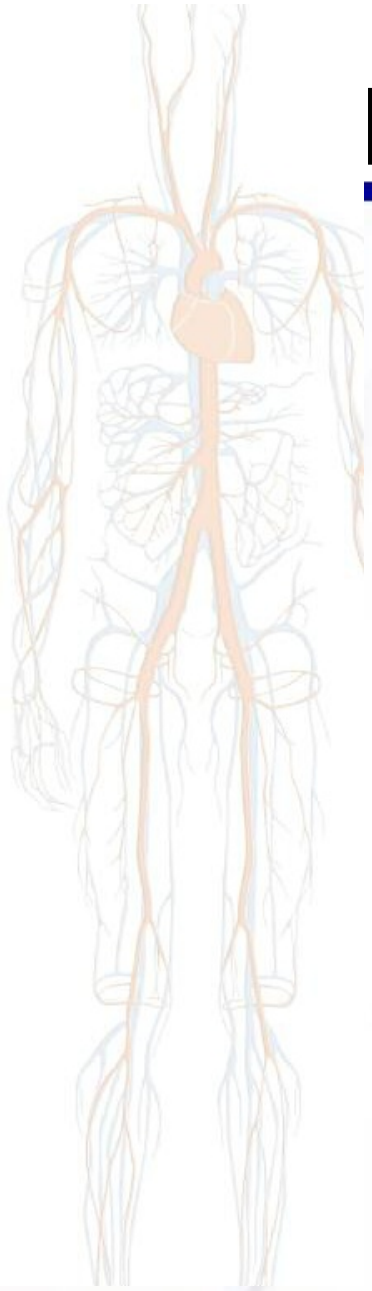
- Attach the sphygmomanometer.
- Place ultrasound gel at the right arm brachial location.
- Hold the probe as if it were a pen or pencil, angling it so it points up the patient's arm. The angle will be 45-60 degrees for most probes.

- Slowly move the probe across the brachial area until the pulsating, “whooshing” sound is heard.

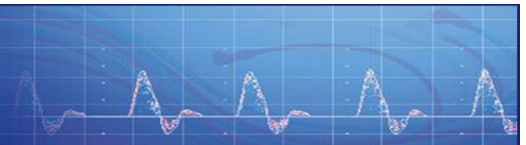




Distinguish Arterial Sounds

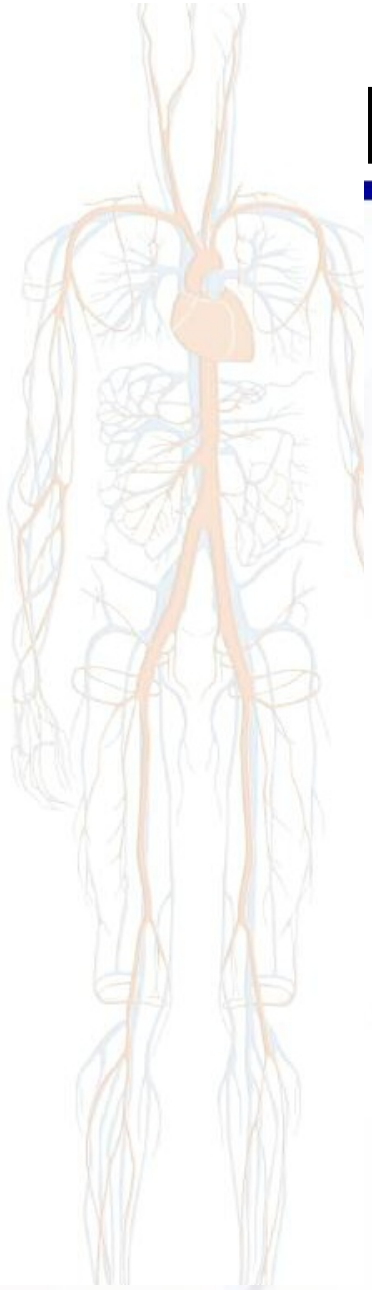


- It is very important to distinguish arterial from venous sounds.
- Arterial sounds:
 - are synchronized with every heartbeat.
 - have a rhythmic “whooshing” sound.
- Make sure that you always use an artery to take blood pressures!

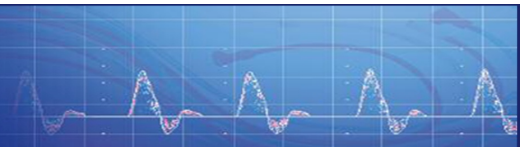




Distinguish Venous Sounds

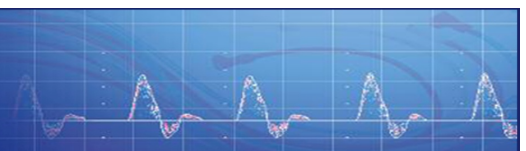


- It is very important to distinguish venous from arterial sounds.
- Venous sounds are significantly different from arterial sounds, they:
 - are spontaneous and vary with respiration.
 - sound like the wind blowing through the trees.
- Make sure that you always use an artery to take blood pressures!

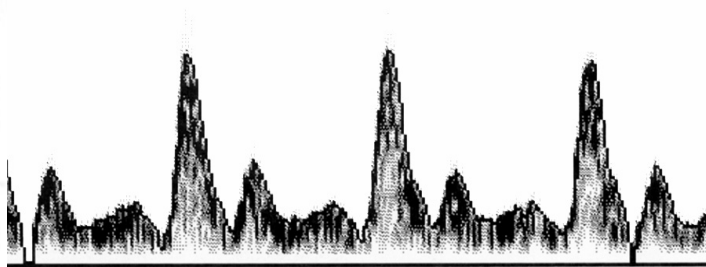
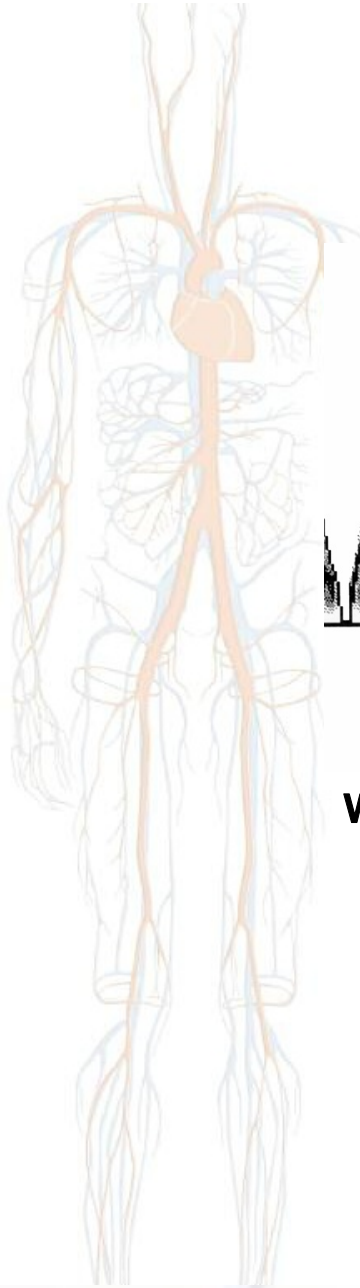


Obtaining Brachial Pressures

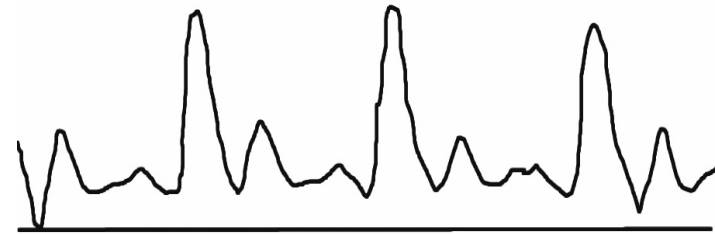
- Once you find an arterial sound, adjust the probe to find the loudest possible signal.
- Hold this position and signal for the rest of the procedure.
- Begin inflating the blood pressure cuff.
- Now is a good time to print a waveform on the Versalab.



Sample Brachial Waveforms

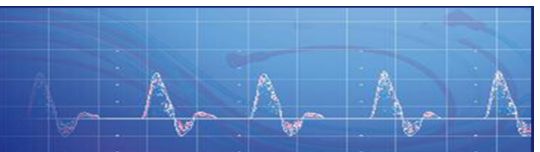


Waveform with Spectral Analysis.



Simple Waveform Trace Example.

Note smooth, uninterrupted pulsatile trace.



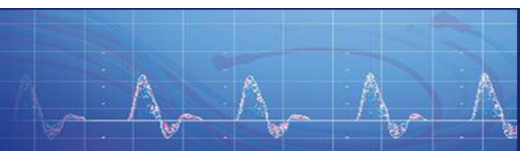
Obtaining Brachial Pressures



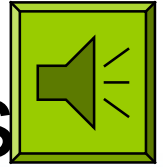
- Continue inflating, the flow sound will cease as the cuff pressure begins to stop the blood flow.
- Stop inflating at about 10 - 20 mmHG past this point.



Elite with 8 MHz probe



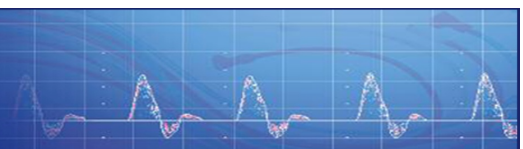
Obtaining Brachial Pressures



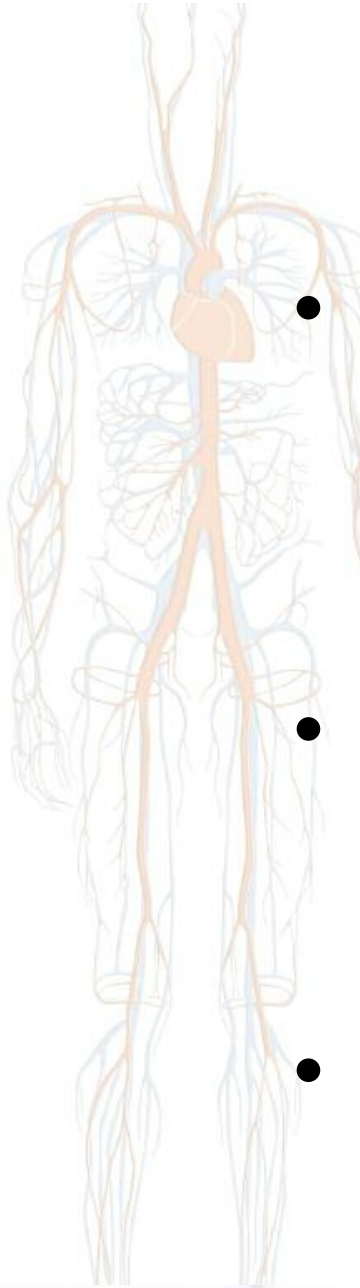
- Slowly deflate the cuff until the sound returns.
- At the point the sound returns, note the location of the gauge needle. That is the arm's systolic pressure
- Quickly deflate the blood pressure cuff to 0 mmHg.



Elite with 8 MHz probe



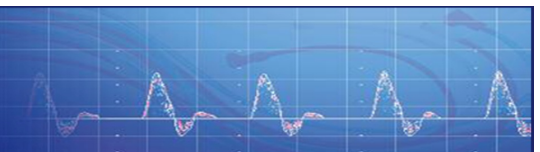
Recording Pressures



- Record the pressure on your Nicolet ABI report form shown at the right or on the VersaLab printout.
- We recommend attaching the printout to the back of the ABI form.
- Repeat the procedure for the other arm.

Ankle/Brachial Index (ABI) Report Form		Date:
Patient Name:		Facility Performing Test:
Patient Number:		
Indications: Diabetes <input type="checkbox"/> Hypertension <input type="checkbox"/> Hyperlipidemia <input type="checkbox"/> Previous Vascular Surgery <input type="checkbox"/> Stroke (TIA) <input type="checkbox"/> Heart Disease <input type="checkbox"/>	<input type="checkbox"/> High Fat Diet <input type="checkbox"/> Cigarette/Tobacco Use <input type="checkbox"/> Sedentary <input type="checkbox"/> Impotence <input type="checkbox"/> Obesity <input type="checkbox"/>	Current Symptoms: Claudication <input type="checkbox"/> (leg pain during walking which disappears with rest) <input type="checkbox"/> Limb Hair Loss/Absence <input type="checkbox"/> Skin Color Changes <input type="checkbox"/> Trophic Nails <input type="checkbox"/>
		Numbsness, Tingling <input type="checkbox"/> Cold Hands or Feet <input type="checkbox"/> Extremity Weakness <input type="checkbox"/> Ulcerations <input type="checkbox"/>
Notes:		
Ankle/Brachial Index (ABI) Results (Note: Use the higher arm pressure for both the left and right ABI calculations.)		
Right ABI Right Ankle Pressure = _____ mmHg Highest Arm Pressure = _____ mmHg		Ankle/Brachial Index Interpretation* 0.95 or Above - Generally Normal 0.81 - 0.95 - Mid Disease 0.51 - 0.80 - Moderate Disease 0.31 - 0.50 - Moderate to Severe Disease 0.30 or below - Severe Disease <small>* Techniques in Noninvasive Vascular Diagnosis: R.J. Dalghe BA, RVT Summer Publishing (8/3/75A-178) www.SummerPublishing.com</small>
Left ABI Left Ankle Pressure = _____ mmHg Highest Arm Pressure = _____ mmHg		Diagram of a human figure showing pressure measurement sites on the arms and ankles.
Example = $\frac{\text{Ankle Pressure}}{\text{Brachial Pressure}} = \frac{125 \text{ mmHg}}{114 \text{ mmHg}} = 1.09$		
<small>Nicolet Vascular a division of W&W Facilities</small>		
<small>To order this report form, refer to catalog # ABI10 and contact us: 5225 Verona Road, Bldg. 2 • Madison, WI USA 53711 • toll-free: (800) 525-2519 option 3 • ph: (608) 441-2266 • fax: (800) 939-4639 www.NicoletVascular.com • info@nicoletvascular.com</small>		
<small>© Nicolet Vascular 2003 M8-0703REV D</small>		

ABI Report Form (Catalog #ABI12)



Obtaining Ankle Pressures

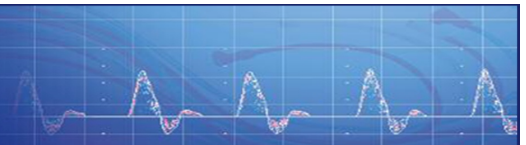
- There are two locations suitable for obtaining the ankle pressure:



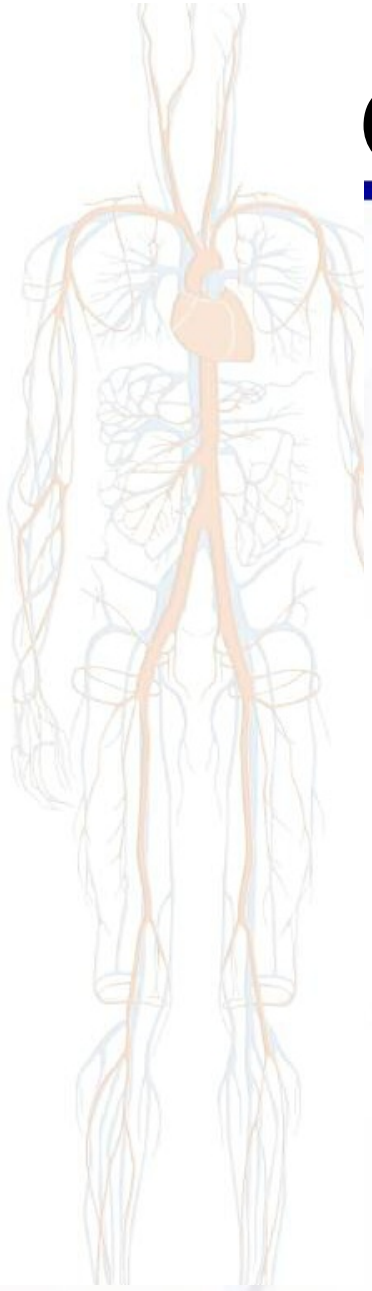
Posterior tibial artery



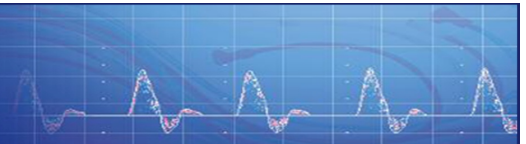
Dorsalis pedis artery



Obtaining Ankle Pressures

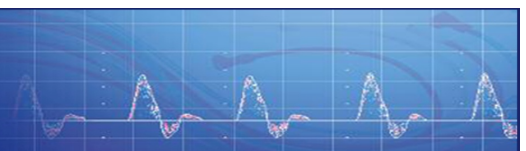


- Most clinicians try to obtain the posterior tibial pressure first.
- Use the dorsalis pedis pressure if posterior tibial pressure can't be obtained.
- If values for both sites are obtained, use the highest value for the index.



Position the Ankle Cuff

- Use the appropriate size cuff.
- Wrap the cuff snugly around the patient's ankle, just above the foot.
- Attach the sphygmomanometer to the cuff.

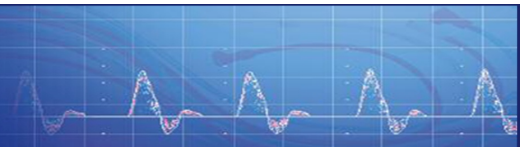


Posterior Tibial Artery

- Position the probe tip and gel just behind the ankle bone.
- Angle the probe pointing up the leg.
- Slowly move the probe near the ankle's center point under the ankle bone.
- When the pulsating sound of an artery is heard, slowly move the probe to obtain the loudest sound.

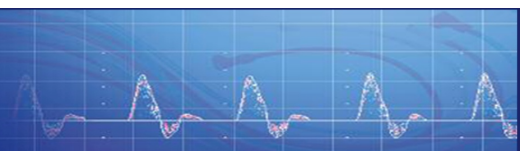


Elite with 8MHz probe

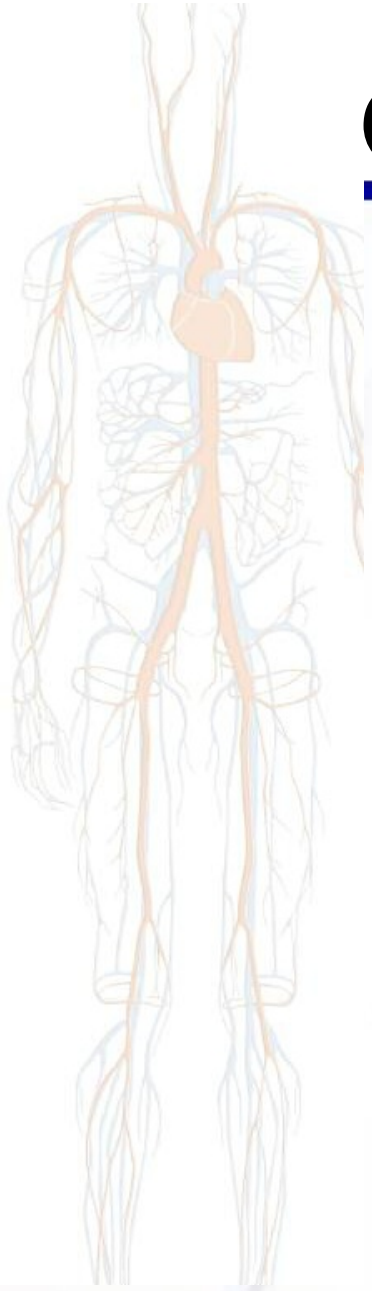


Using the Dorsalis Pedis Artery

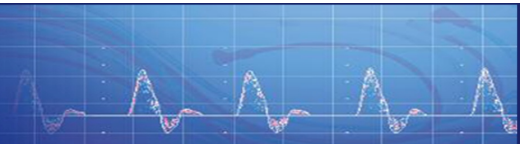
- To take an ankle pressure using the dorsalis pedis artery, position the probe on top of the foot in between the big toe and second toe, and halfway up the foot.
- Press lightly because this artery can be easily compressed against the bone, stopping the flow of blood.



Obtaining Ankle Pressures



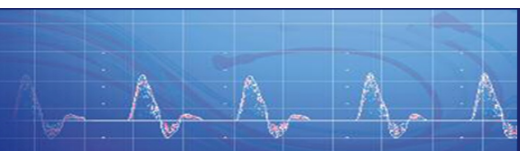
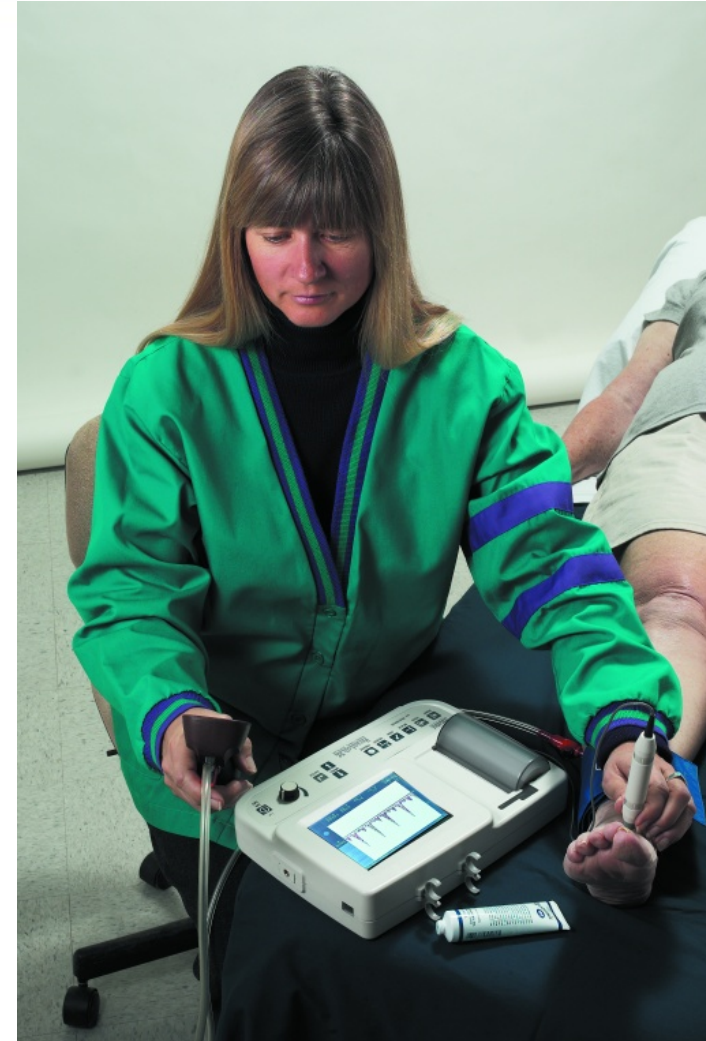
- Very slowly move the probe across the dorsalis pedis or posterior tibial until the pulsating sound of the artery is heard.
- Once you find an arterial sound, adjust the probe to find the loudest possible signal.
- Hold this position and Doppler signal for the rest of the procedure.
- Now is a good time to print a waveform, if desired.



Obtaining Ankle Pressures

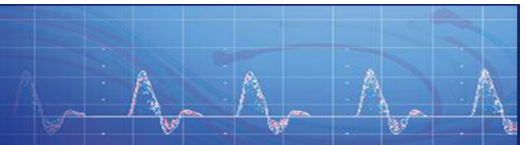


- Begin inflating the blood pressure cuff by squeezing the sphygmomanometer bulb.
- Continue inflating, the flow sound will cease as the cuff pressure stops the blood flow.
- Stop inflating 10-20 mmHg past this point.



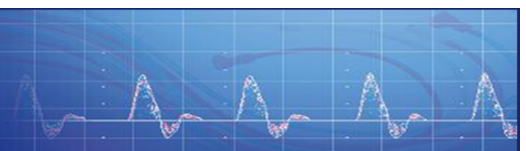
Obtaining Ankle Pressures

- Now slowly deflate the cuff until the sound returns.
- Note the location of the gauge needle at the point the sound returns. That is the ankle's systolic pressure.
- Quickly deflate the blood pressure cuff to 0 mmHg.



Obtaining Ankle Pressures

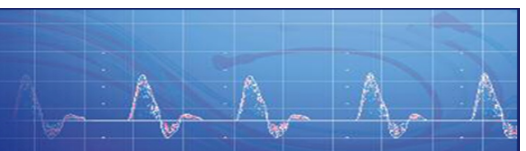
- If desired, press the PRINT button on the VersaLab for a waveform print out.
- Record the pressure on your Nicolet ABI report form or the VersaLab printout.
- We recommend attaching the printout to the back of the ABI form.
- Repeat the procedure for the other ankle.



Calculating the ABI

- Select the highest brachial value and use that number in determining the ABI for both the right and left sides.
- If values for both ankle sites are obtained (DP and PT), use the highest value for the index.

Ankle/Brachial Index (ABI) Report Form Using VersaLab		Date: Jan 15, 2002
Patient Name: J. Jones		Facility Performing Test: Nicolet Clinic
Patient Number: #00702		
Risk Factors: Diabetes: <input checked="" type="checkbox"/> High Fat Diet: <input checked="" type="checkbox"/> Hypertension: <input type="checkbox"/> Cigarette/Tobacco Use: <input checked="" type="checkbox"/> Hyperlipidemia: <input type="checkbox"/> Sedentary: <input checked="" type="checkbox"/> Previous Vascular Surgery: <input type="checkbox"/> Impotence: <input type="checkbox"/> Stroke (TIA): <input type="checkbox"/> Cholesterol: <input checked="" type="checkbox"/> Heart Disease: <input type="checkbox"/>		Current Symptoms: Claudication: Rt. <input type="checkbox"/> Lt. <input checked="" type="checkbox"/> Numbness, Tingling: <input type="checkbox"/> Leg pain during walking which disappears with rest: <input type="checkbox"/> Cold Hands or Feet: <input type="checkbox"/> Limb Hair Loss/Absence: <input type="checkbox"/> Excessive Weakness: <input type="checkbox"/> Skin Color Changes: <input type="checkbox"/> Ulcerations: <input type="checkbox"/> Trophic Nails: <input type="checkbox"/>
Notes: Right ABI = 0.65 and Left ABI = 0.67. Indication of moderate vascular disease in right leg, left leg within normal range.		
Ankle/Brachial Index (ABI) Results (Note: Use the higher arm pressure for both the left and right ABI calculations.)		
		Ankle/Brachial Index Interpretation* 0.96 or Above - Generally Normal 0.81 - 0.95 - Mild Disease 0.51 - 0.81 - Moderate Disease 0.31 - 0.50 - Moderate to Severe Disease 0.30 or below - Severe Disease <small>* Technique is dependent on vascular diameter. Perioval and peripheral vascular disease, such as leg or foot ischemia, should be noted.</small>
Right ABI Right Ankle Pressure = 65 mmHg Highest Arm Pressure = 100 mmHg $\frac{65}{100} = 0.65$		Left ABI Left Ankle Pressure = 63 mmHg Highest Arm Pressure = 100 mmHg $\frac{63}{100} = 0.63$
Nicolet To order blank report forms, visit colabg.com and contact us: 8355 Jayral Drive, Golden, CO 80401 Toll-Free: (800) 526-2676 ph: (303) 437-4400 fax: (303) 431-0429 www.NicoletVascular.com info@nicolevascular.com <small>© Nicolet Vascular, Inc. 2001</small>		



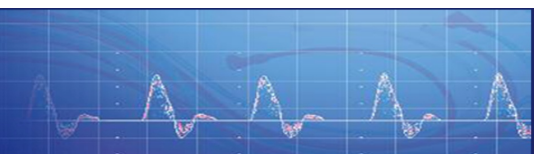
Calculating the Right Side ABI

- In the left column of the ABI chart, find the brachial pressure closest to the one you selected.
- Then in the row at the top of the ABI chart, find the closest right ankle pressure.
- The box where the column and row intersect shows the Ankle/Brachial Index for the right side.

ABI Chart for PAD

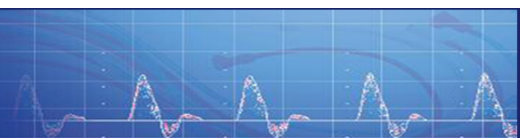
Ankle Pressure (mmHg)

	200	195	190	185	180	175	170	165	160	155	150	145
200	1.00	.98	.95	.93	.90	.88	.85	.82	.80	.78	.75	.73
195	1.03	1.00	.97	.95	.92	.90	.87	.85	.82	.79	.77	.75
190	1.05	1.03	1.00	.97	.95	.92	.89	.87	.84	.82	.79	.77
185	1.08	1.05	1.03	1.00	.97	.95	.92	.89	.86	.84	.81	.79
180	1.11	1.08	1.06	1.03	1.00	.97	.94	.92	.89	.86	.83	.81
175	1.14	1.11	1.09	1.06	1.03	1.00	.97	.94	.91	.89	.86	.83
170	1.18	1.15	1.12	1.09	1.06	1.03	1.00	.97	.94	.91	.88	.85
165	1.21	1.18	1.15	1.12	1.09	1.06	1.03	1.00	.97	.94	.91	.88
160	1.25	1.22	1.19	1.16	1.13	1.09	1.06	1.03	1.00	.97	.94	.91
155	1.29	1.26	1.23	1.19	1.16	1.13	1.10	1.06	1.03	1.00	.97	.94
150	1.33	1.30	1.27	1.23	1.20	1.17	1.13	1.10	1.06	1.03	1.00	.97



Calculating the Right Side ABI

- Or using a calculator, divide the pressure for the right ankle by the highest brachial pressure.
- Right Ankle Pressure ÷ Highest Brachial Pressure = Right ABI



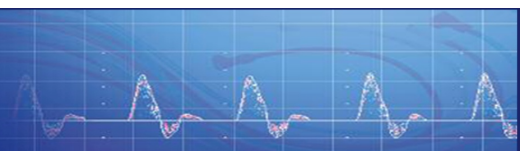
Calculating the Left Side ABI

- In the left column of the ABI chart, find the brachial pressure closest to the one you selected.
- Then in the row at the top of the ABI chart, find the closest left ankle pressure.
- The box where the column and row intersect shows the Ankle/Brachial Index for the left side.

ABI Chart for PAD

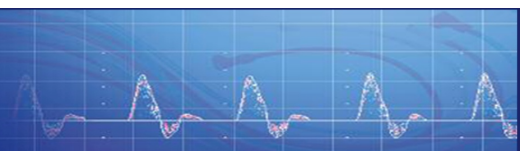
Ankle Pressure (mmHg)

	200	195	190	185	180	175	170	165	160	155	150	145
200	1.00	.98	.95	.93	.90	.88	.85	.82	.80	.78	.75	.73
195	1.03	1.00	.97	.95	.92	.90	.87	.85	.82	.79	.77	.7
190	1.05	1.03	1.00	.97	.95	.92	.89	.87	.84	.82	.79	.7
185	1.08	1.05	1.03	1.00	.97	.95	.92	.89	.86	.84	.81	.7
180	1.11	1.08	1.06	1.03	1.00	.97	.94	.92	.89	.86	.83	.81
175	1.14	1.11	1.09	1.06	1.03	1.00	.97	.94	.91	.89	.86	.83
170	1.18	1.15	1.12	1.09	1.06	1.03	1.00	.97	.94	.91	.88	.85
165	1.21	1.18	1.15	1.12	1.09	1.06	1.03	1.00	.97	.94	.91	.88
160	1.25	1.22	1.19	1.16	1.13	1.09	1.06	1.03	1.00	.97	.94	.91
155	1.29	1.26	1.23	1.19	1.16	1.13	1.10	1.06	1.03	1.00	.97	.94
150	1.33	1.30	1.27	1.23	1.20	1.17	1.13	1.10	1.06	1.03	.97	.94



Calculating the Left Side ABI (#2)

- Or using a calculator, divide the pressure for the left ankle by the highest brachial pressure.
- $\text{Left Ankle Pressure} \div \text{Highest Brachial Pressure} = \text{Left ABI}$





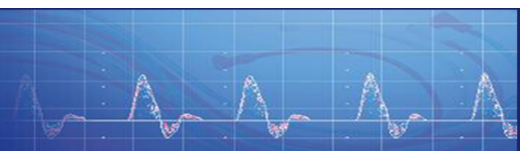
Resting ABI values

- 0.91-1.30 = Normal
- 0.70-0.90 = Mild obstruction
- 0.40-0.69 = Moderate obstruction
- < 0.40 = Severe obstruction
- $> 1.30^*$ = Poorly compressible (due to medial arterial calcification)

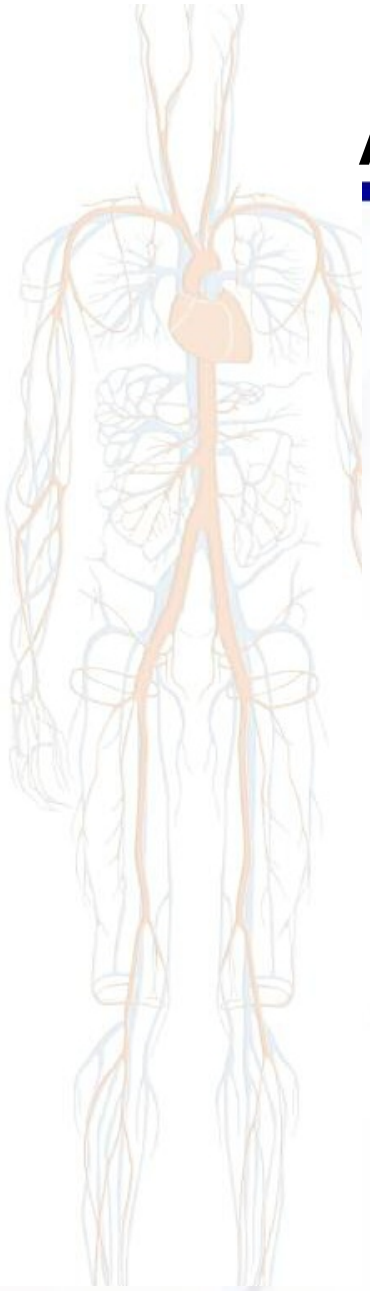
An ABI (Ankle-Brachial Index) of 0.78 portends an approximately 30% 5-year risk of heart attack, stroke and vascular death.

ADA Recommendation

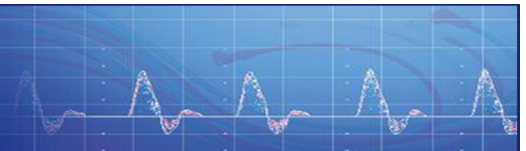
- Perform a screening ABI in patients with diabetes who are >50 years of age, and, if normal, repeat the test every 5 years.
- Consider a screening ABI in patients with diabetes who are <50 years of age and have other PAD risk factors (e.g., smoking, hypertension, hyperlipidemia, or duration of diabetes >10 years).
- Perform a diagnostic ABI in any patient with symptoms of PAD.



Additional Evaluation



- Vascular lab evaluation, segmental pressures and pulse volume recordings to assess location and severity of PAD: for pts with abnormal ABI, or for pts with poorly compressible vessels (ABI >1.3) or for pts with normal ABI but high suspicion of PAD
- Treadmill functional testing: to diagnose pts with atypical symptoms or to diagnose pts with a normal ABI with symptoms of claudication.
- Other studies: toe pressure, transcutaneous partial pressure of oxygen, sonography or MRA: to make decisions for revascularization
- X-ray angiography: for patients where a revascularisation procedure is intended. It is an invasive test and should not be done for diagnosing PAD.

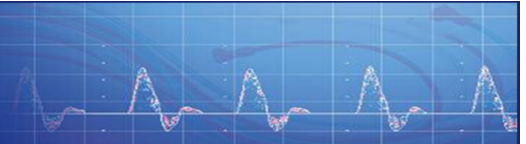




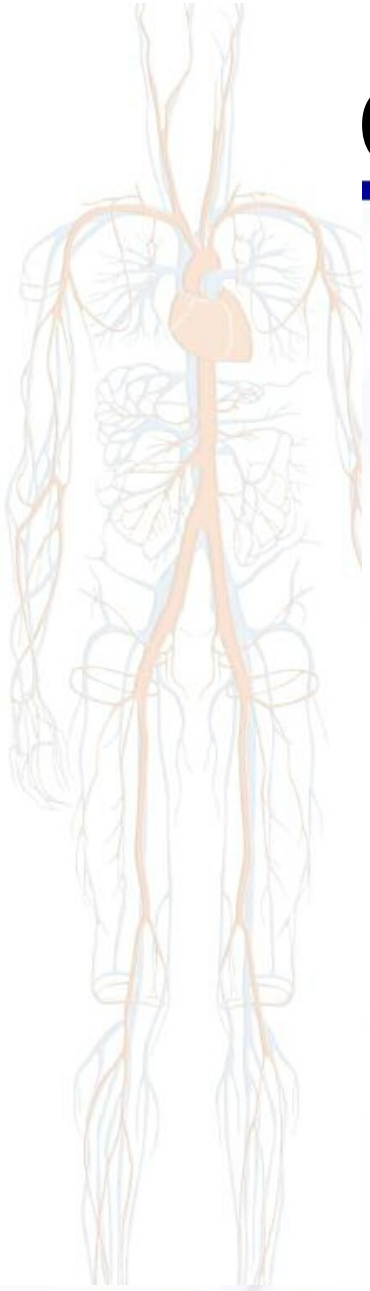
Treatment

Treatment of the patient with diabetes and PAD should be twofold:

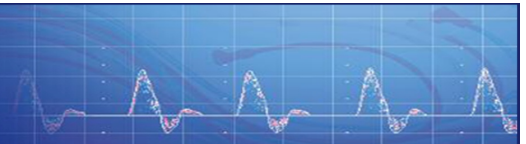
- 1) primary and secondary cardiovascular disease risk factor modification and
- 2) treatment of PAD symptoms (claudication and CLI) and limiting progression of disease.



Conclusions



- ABI screening for PAD in patients with diabetes is enormously productive.
- Routine screening of individuals with diabetes of > 50 yrs of age with the ABI test can identify PAD in nearly a third of the individuals; e.g highly effective identification.
- Identifying PAD before it has progressed to its more severe stages allows effective treatment to be offered.
- These therapies may arrest PAD development and, perhaps reverse its advance, while reducing cardiovascular risk (MI and stroke).





In Conclusion

- PAD is a common complication of pts with diabetes. It is more commonly asymptomatic and thus patients present with more severe disease with greater risk of amputation, MI and stroke.
- Diagnosis of PAD in diabetes is thus very important and justifies screening with the simple ABI test.
- The use of a simple ABI test has been proven as an accurate means of identifying, treating and managing your at risk patients.

THANK YOU