

Peripheral Arterial Disease

Emily Reardon, MD, MHSc, RPVI
Valley Health Vascular Surgery



PAD **Peripheral Artery Disease**

PAD is most often caused by atherosclerosis — plaque formation in arteries that supply blood to the extremities, such as legs and arms.

When these fatty deposits collect in arteries and harden, it narrows the opening and blocks effective blood flow.

A diagram of a human figure showing the circulatory system. The heart is in the center, with red arteries and blue veins branching out to the limbs. Several yellow and red spheres representing plaque are shown floating around the body. A circular callout on the right side of the body shows a cross-section of an artery. Inside the artery, there is a large accumulation of yellow and red fatty deposits (plaque) that significantly narrows the lumen, preventing blood from flowing through.

Peripheral Arterial Disease

- Vascular Surgery
- Epidemiology
- Heterogeneity
- Treatment
- Changing Paradigms

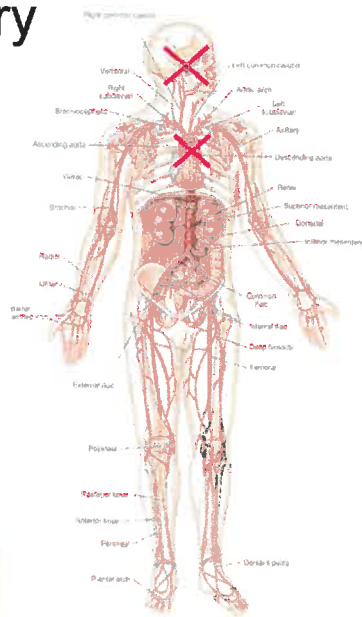


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Vascular Surgery



Operating Room



Angiography Suite



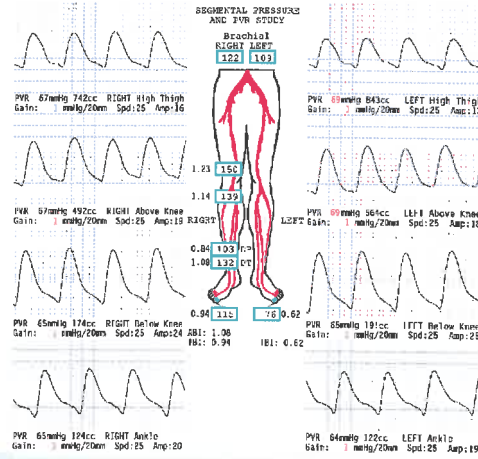
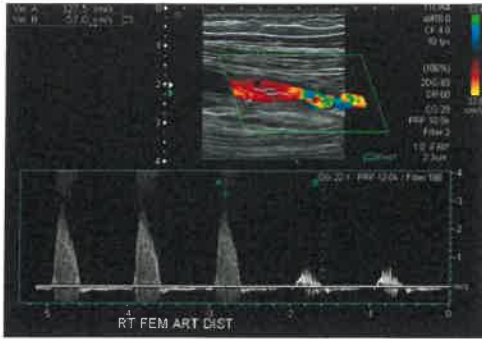
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Hybrid Operating Room



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Peripheral Vascular Lab



Vascular Surgery Office



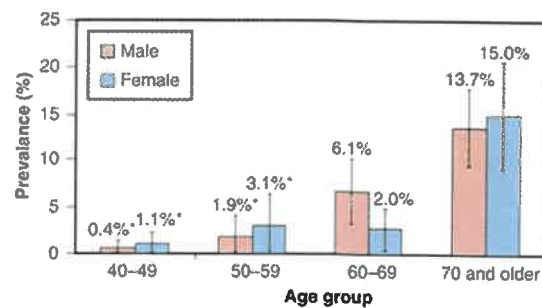
Peripheral Arterial Disease

- Vascular Surgery
- Epidemiology
- Heterogeneity
- Treatment
- Efforts to Improve



Peripheral Arterial Disease (PAD)

- There is a strong age-dependent increase in the U.S., with a prevalence of greater than 20% in individuals older than 80 years.



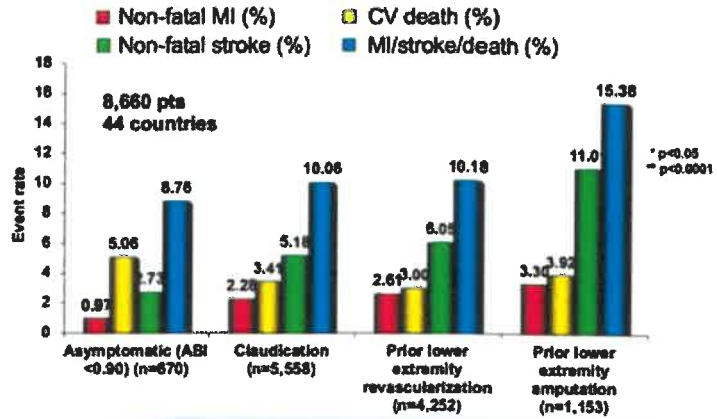
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Selvin E et al, Circulation 2004

PAD is a risk

- The diagnosis of PAD confers a heightened risk of atherothrombotic events, including myocardial infarction and stroke.

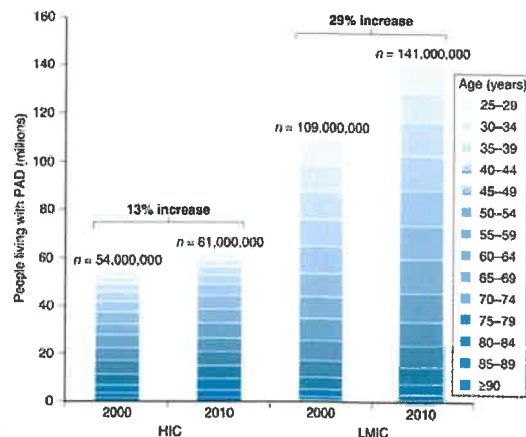


Bhatti et al, JAMA 2006



Peripheral Arterial Disease (PAD)

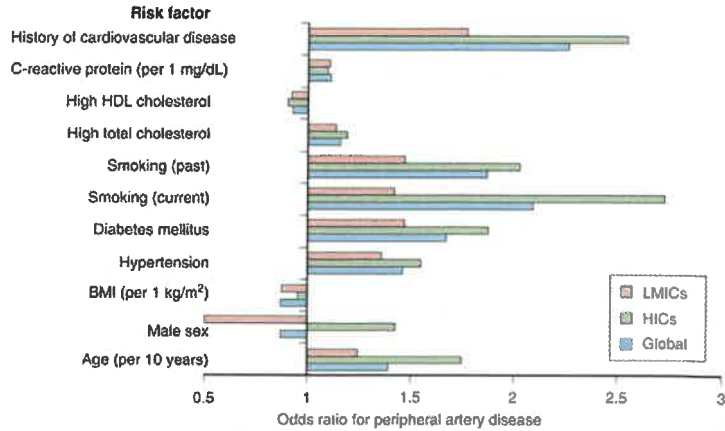
- 2nd most common manifestation of atherosclerosis in the U.S. and world wide, affecting >200 million persons¹



1. Murray et al, Lancet 2015
 2. Fowlkes et al, Nat Rev Cardiol 2017



PAD Risk Factors



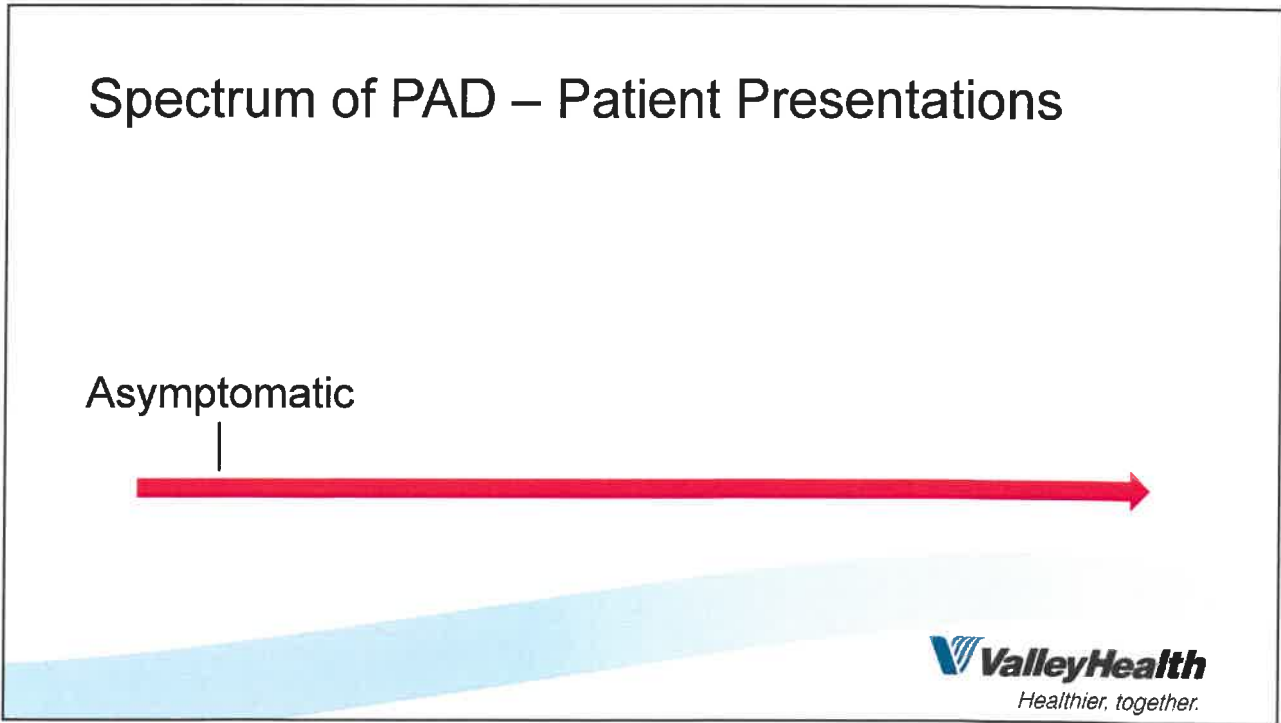
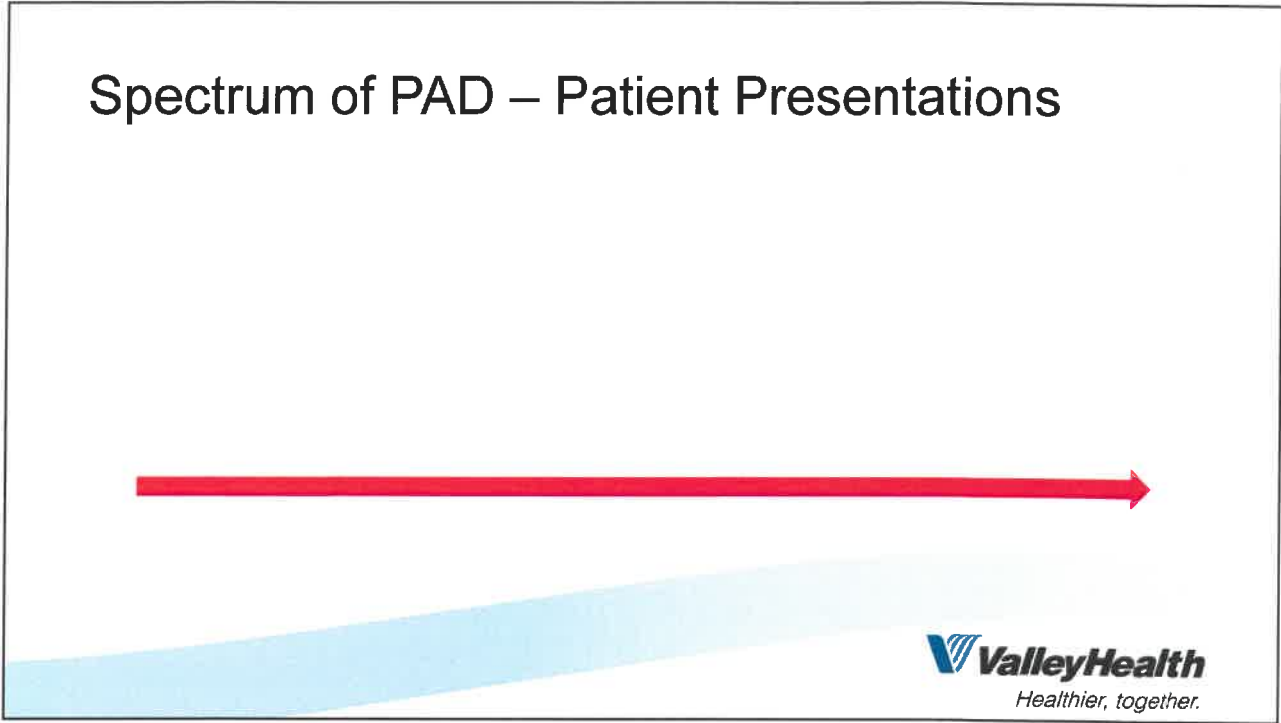
Fowlkes et al, Nat Rev Cardiol 2017



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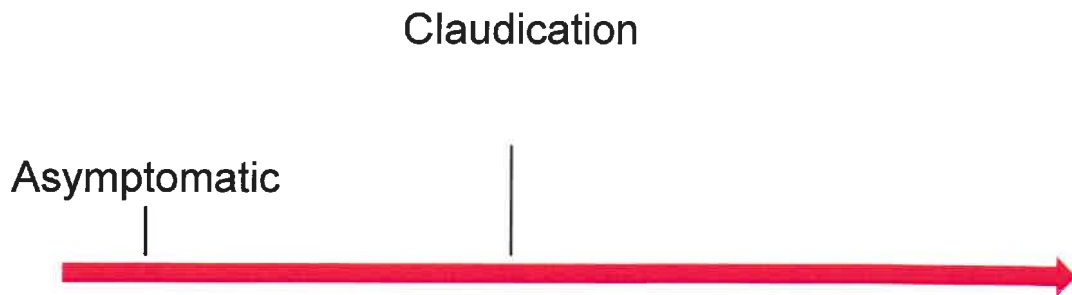


PAD Screening Update (USPSTF 2018)

- No benefit to screening asymptomatic patients who **DO NOT** have a known diagnosis of PAD, CAD, CKD or DM
 - Update from 2013 recommendations
 - Expanding to include DM and walking programs
 - No benefit of intervention
 - Balance with risks
 - Bleeding (ASA)
 - Further studies (CTA/MRA/Angiogram)
 - Anxiety/labeling/opportunity costs



Spectrum of PAD – Patient Presentations



Claudication?



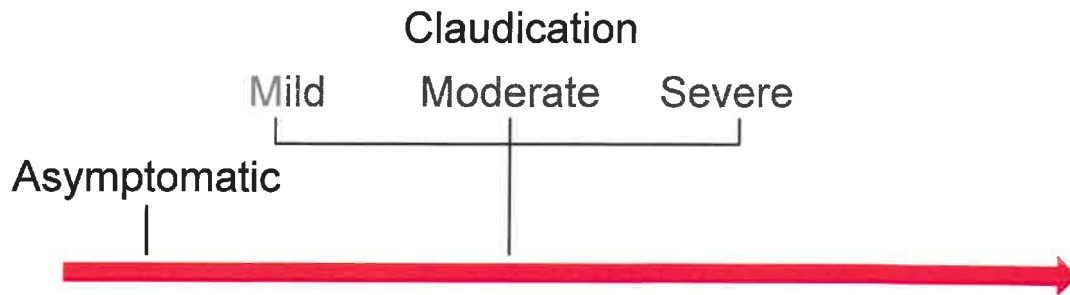
Intermittent Claudication

Table 1. Differentiation of True Claudication from Pseudoclaudication (Nonvascular Causes).

Characteristic	Intermittent Claudication	Spinal Stenosis	Arthritis	Venous Congestion	Compartment Syndrome
Character of discomfort	Cramping, tightness, or tiredness	Same symptoms as with claudication or tingling, weakness, or clumsiness	Aching	Tightness, bursting pain	Tightness, bursting pain
Location of discomfort	Buttock, hip, thigh, calf, foot	Buttock, hip, thigh	Hip, knee	Groin or thigh	Calf
Exercise-induced discomfort	Yes	Variable	Variable	After walking	After excessive exercise
Walking distance	Reproducible	Variable	Variable	Variable	Variable
Discomfort with standing	No	Yes	Yes, changes with shift in position	Yes, changes with shift in position	Yes, changes with shift in position
Relief of discomfort	Rapid relief with rest	Relief with sitting or otherwise changing position	Slow relief with avoidance of bearing weight	Slow relief with leg elevation	Slow relief with leg elevation
Other	Associated with atherosclerosis and decreased pulses	History of lower-back problems	Discomfort at joint spaces	History of deep venous thrombosis, signs of venous congestion	May occur in athletes after strenuous exercise



Spectrum of PAD – Patient Presentations

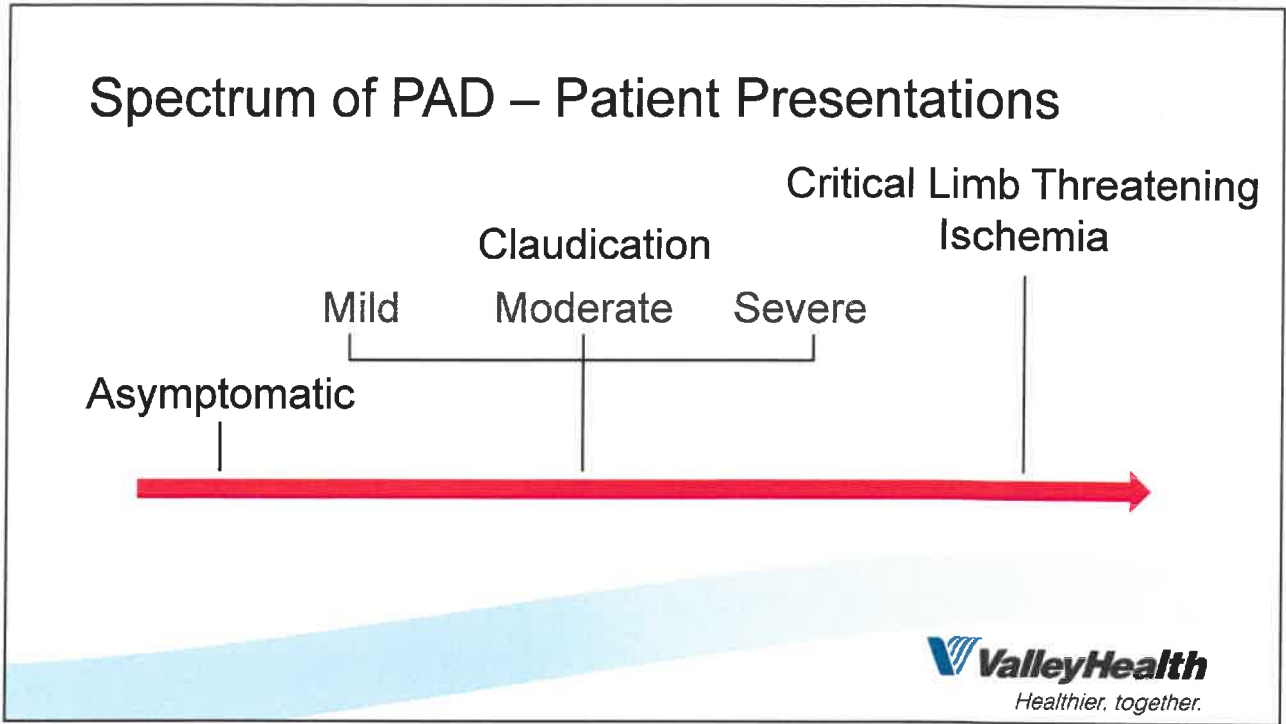


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Intermittent Claudication (IC)

- Severity described in terms of distance, lifestyle limitation
- Limb prognosis fairly benign
 - Risk of major amputation <1% per year
 - 20% patients experience deterioration over 5 years
- Significant associated CV morbidity and mortality
 - 20% patients with IC experience major CV event over 5 years
 - 10-15% mortality over 5 years

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Critical Limb Threatening Ischemia (CLTI)

- Rest pain
- Non-healing ulceration
- Gangrene

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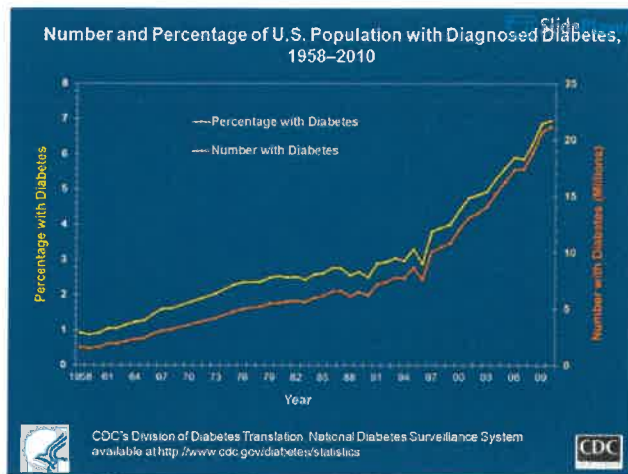


Critical Limb Threatening Ischemia (CLTI)

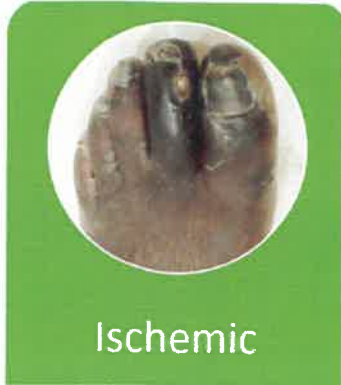
- Mortality rates as high as 20% within 6 mos from diagnosis to greater than 50% at 5 years
- 30% risk of amputation within at 1 year



CLTI and Diabetes



CLTI and Diabetes



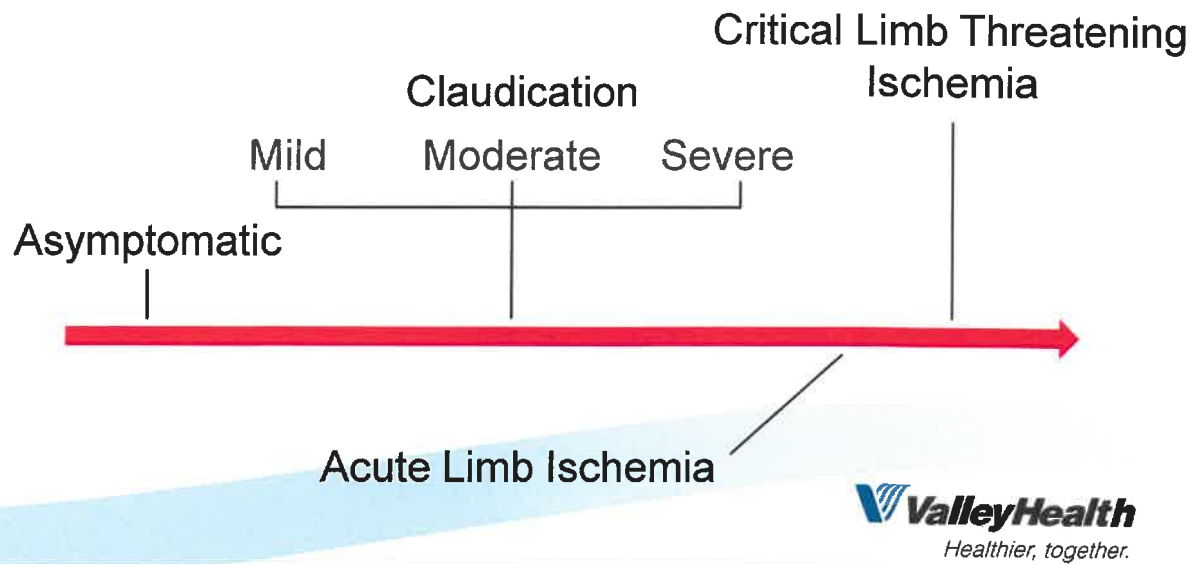
CLTI and Diabetes

Diabetic Foot Complications

- Diabetes is diagnosed once every 17 seconds!
- Up to **70% of the lower extremity amputations** in the world are associated with diabetes
- **Every 20 seconds**, somewhere in the world, a lower extremity is amputated in a patient with diabetes



Spectrum of PAD – Patient Presentations



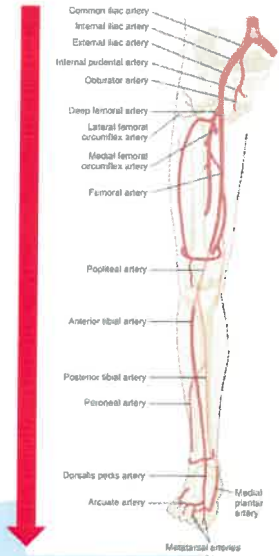
PAD - Acute Limb Ischemia

• 6 P's

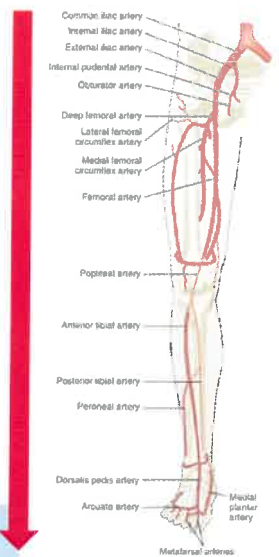
- Pain
- Pallor
- Pulse deficit
- Parathesia
- Poikilothermia
- Paralysis



Spectrum of PAD – Anatomic Distribution



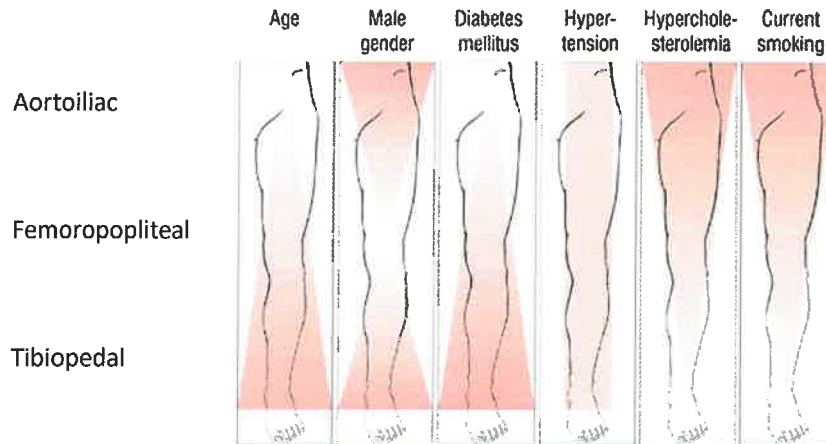
Spectrum of PAD – Anatomic Distribution



- Aortoiliac
- Femoropopliteal
- Tibiopedal



Spectrum of PAD – Anatomic Distribution



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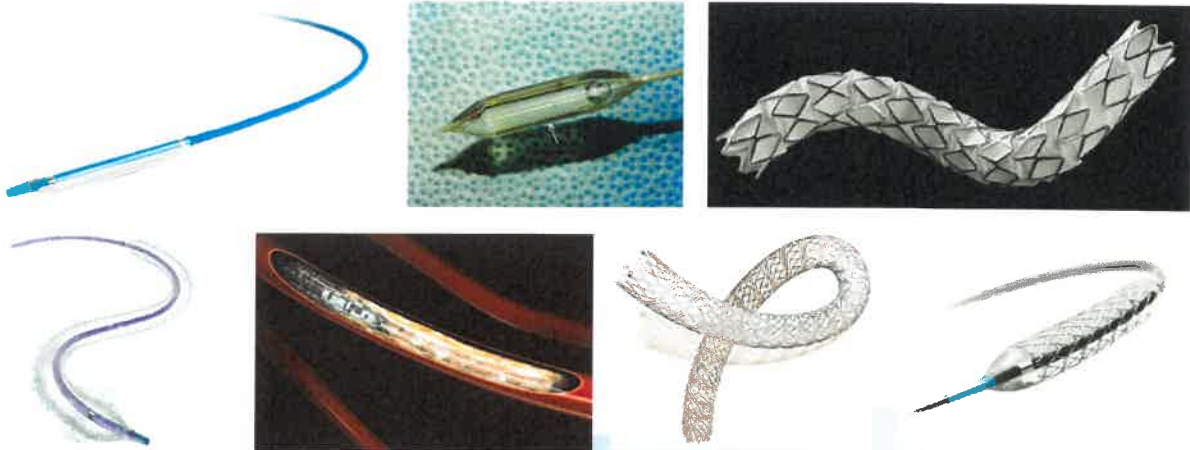
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Medical Management

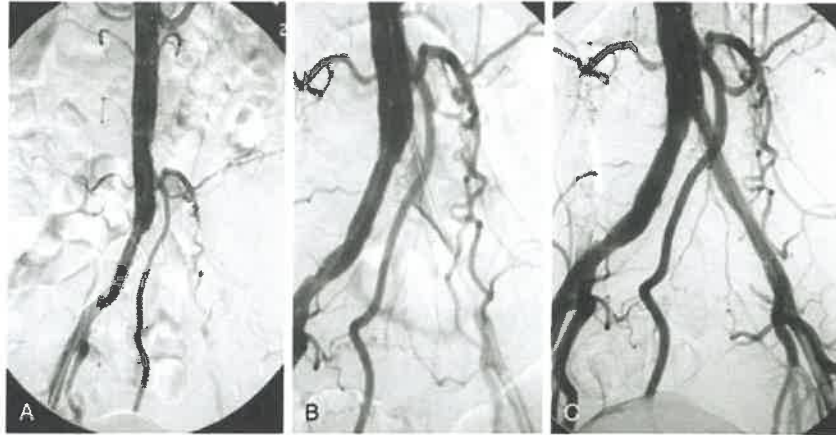
- Antiplatelet (ASA or Plavix) and Statin (CV risk)
 - Xarelto 2.5mg BID
- Diabetes management
- Smoking cessation
- Walking program
- Pletal (Cilostazol)



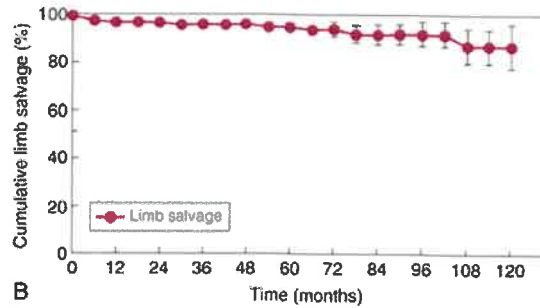
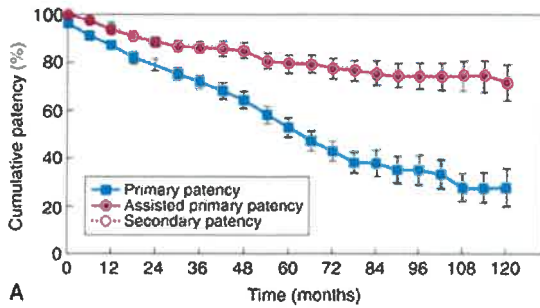
PAD – Endovascular Treatment



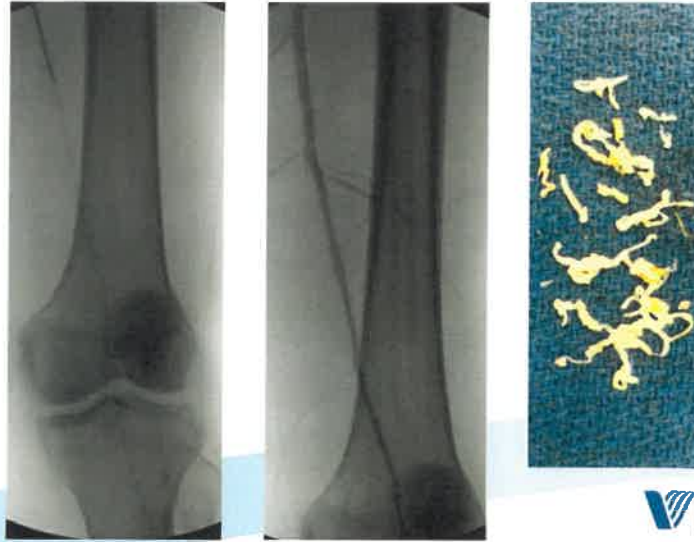
PAD – Aortoiliac Endovascular Treatment



PAD – Aortoiliac Endovascular Treatment

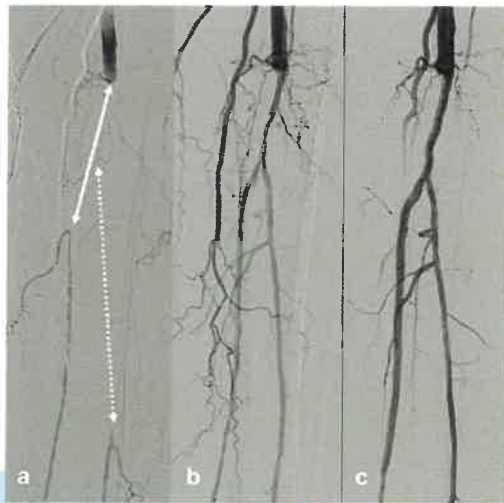


PAD – Endovascular Treatment



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PAD – Endovascular Treatment

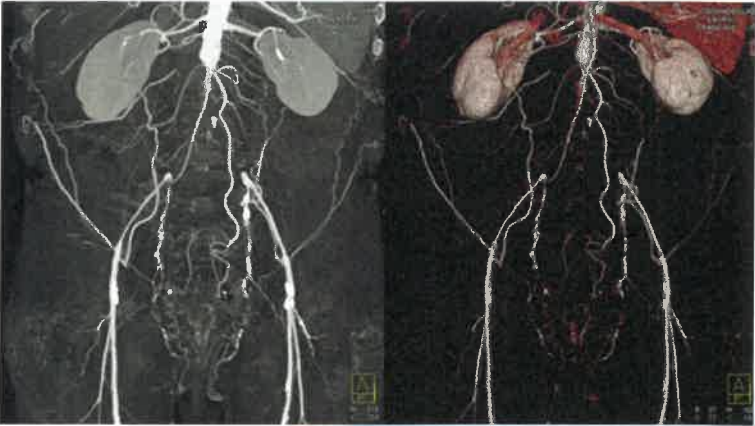


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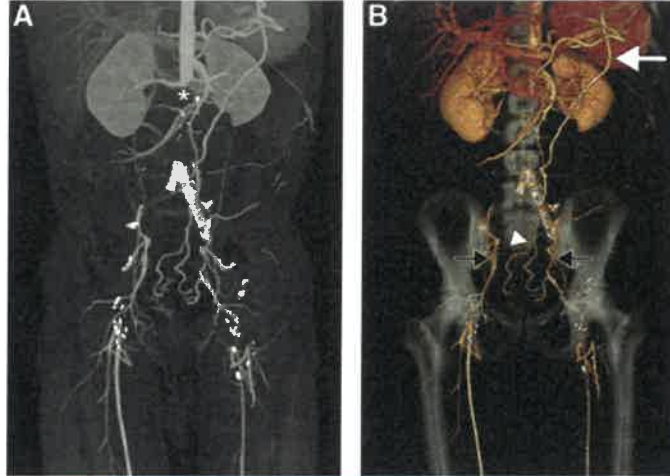
PAD – Endovascular Treatment



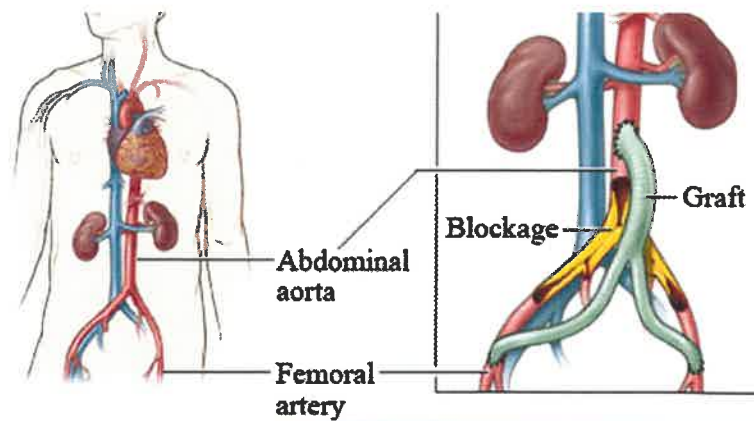
PAD – Open Surgery



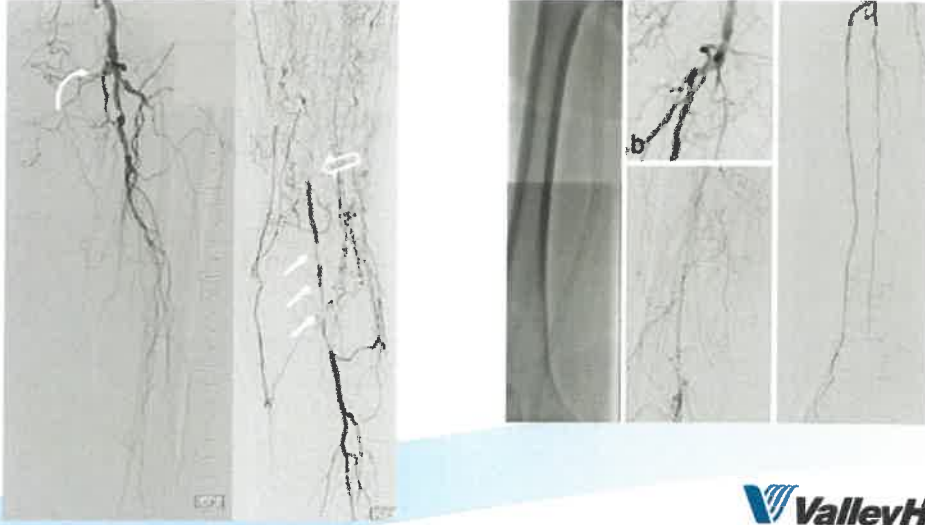
PAD – Open Surgery



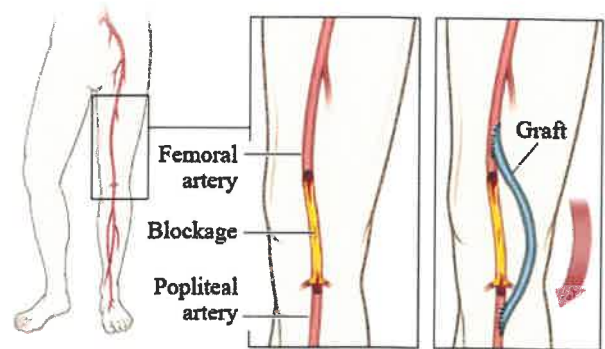
PAD – Open Surgery



PAD – Open Surgery



PAD – Open Surgery



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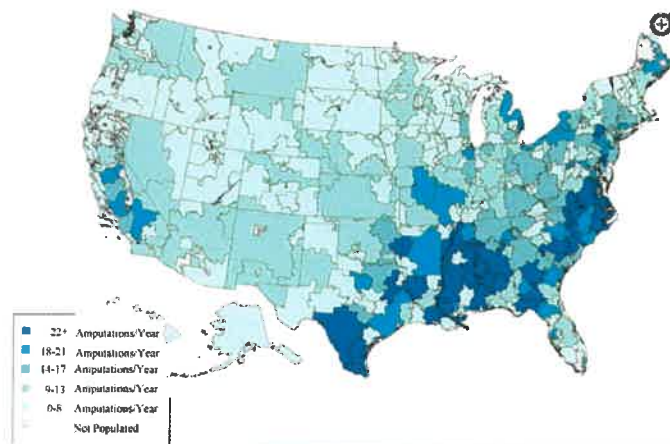


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Regional Amputation Rates



Goodney et al, J Vasc Surg 2013



Regional Amputation Characteristics

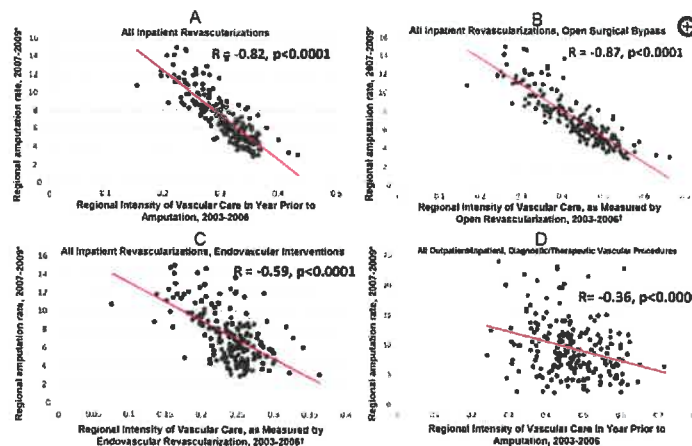
Table 1
Patient characteristics of those undergoing major amputation, by quintile of amputation rate.

	Quintile of Amputation Rate (n=94,873)					Rate (Very High to Very Low)	p value (anova)
	Very Low	Low	Medium	High	Very High		
Age (mean)	78.3	78.0	78.4	78.8	78.7	1.00	0.104
Proportion Male	54.9%	53.4%	50.5%	46.9%	47.7%	0.87	<0.001
Proportion African American	12.8%	17.4%	26.1%	34.2%	50.3%	3.93	<0.001
Proportion with Diabetes	30.8%	33.6%	36.5%	35.4%	38.4%	1.25	0.002
Proportion with Congestive Heart Failure	34.4%	35.0%	35.4%	36.2%	36.5%	1.06	0.256
Proportion with Coronary Artery Disease	13.4%	13.1%	14.6%	15.2%	11.5%	0.85	0.01
Proportion with Renal Insufficiency	16.1%	17.0%	19.0%	17.5%	18.0%	1.11	0.011
Charlson Score	3.3	3.3	3.5	3.6	3.6	1.08	0.289
Per Capita Income	\$19,454.22	\$19,286.93	\$19,237.19	\$18,687.09	\$17,980.95	0.92	0.001



Goodney et al, J Vasc Surg 2013

Regional Vascular Care and Limb Salvage



Goodney et al, J Vasc Surg 2013

PAD Awareness

Comparative Study > J Vasc Surg. 2019 Jul;70(1):241-245.e2. doi: 10.1016/j.jvs.2018.12.042. Epub 2019 Mar 7.

Knowledge gap of peripheral artery disease starts in medical school

Musaad AlHamzah ¹, Rad
Konrad Salata ³, Mark W

Multicenter Study > JAMA. 2001 Sep 19;286(11):1317-24. doi: 10.1001/jama.286.11.1317.

Peripheral arterial disease detection, awareness, and treatment in primary care

A T Hirsch ¹, M H Criqui, D Treat-Jacobson, J G Regensteiner, M A Creager, J W Olin, S H Krook, D B Hunninghake, A J Comerota, M E Walsh, M M McDermott, W R Hiatt

> Vasc Med. 2020 Jun;25(3):263-273. doi: 10.1177/1358863X19893003. Epub 2020 Jan 30.

Knowledge of peripheral artery disease: What do the public, healthcare practitioners, and trainees know?

Bernadeta M Bridgwood ¹, Andrew To Nickinson ¹, John Sm Houghton ¹, Coral J Pepper ², Rob D Sayers ¹



PAD – Global Vascular Guidelines Initiative

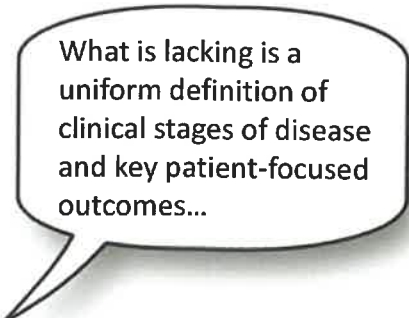
CLINICAL PRACTICE GUIDELINE DOCUMENT

Global vascular guidelines on the management of chronic limb-threatening ischemia

Michael S. Conte, MD (Co-Editor),¹ Andrew W. Bradbury, MD (Co-Editor),² Philippe Kolh, MD (Co-Editor), John V. White, MD (Steering Committee),³ Florian Dick, MD (Steering Committee),⁴ Robert Fitzridge, MBBS (Steering Committee),⁵ Joseph L. Mills, MD (Steering Committee),⁶ Jean-Baptiste Ricco, MD (Steering Committee),⁷ Kalkunte R. Suresh, MD (Steering Committee),⁸ M. Hassan Murad, MD, MPH, and the CVG Writing Group.⁹ San Francisco, Calif; Birmingham, United Kingdom; Wallonia, Belgium; Niles, Ill; St Gallen, Switzerland; Adelaide, South Australia; Houston, Tex; Poitiers, France; Bangalore, India; and Rochester, Minn

Joint guidelines of the Society for Vascular Surgery, European Society for Vascular Surgery, and World Federation of Vascular Societies

Endorsed by the American Podiatric Medical Association, British Cardiovascular Society, British Society for Endovascular Therapy, British Society of Interventional Radiology, Circulation Foundation, College of Podiatry, Society of Interventional Radiology, Society for Vascular Nursing, the Society for Vascular Technology of Great Britain and Ireland, and the Vascular Society of Great Britain and Ireland



Conte et al, J Vasc Surg 2019



PAD – Global Vascular Guidelines Initiative

- New conceptual framework for management of CLTI seeks to improve awareness, treatment outcomes and research
 - New nomenclature – “critical limb threatening ischemia”
 - Disease staging systems – WiFi and GLASS
 - End points and trial designs
 - Importance of multidisciplinary teams

Conte et al, J Vasc Surg 2019

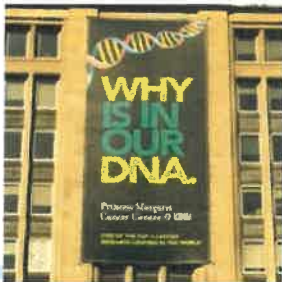


Vascular Surgery

Personalized Cancer Therapy



Center for Personalized Cancer Therapy
 Precision Medicine: The Future of Cancer Treatment



Duke Center for Personalized and Precision Medicine

What about personalized vascular surgery?

OPINION Vascular surgery – it’s personal

BY THOMAS L. FORBES, M.D.

Let's get personal for a moment. The next time you walk past your local cancer center, pay attention to the signs, the branding, and the message. I'll bet you won't have to look too hard to see reference to personalized or precision medicine. Our oncology colleagues have completely invested in these principles and it's easy to see why. The concept of personalized medicine involves therapeutic strategies that take individual variability into account. Along with advances in patient care this strategy has resonated with patients, funding agencies, philanthropists, and governments. Most recently, President Obama announced a new precision medicine initiative in his State of the Union Address, and this month we've seen these ideas reflected in Vice President Biden's "mission" to cure cancer.

All well and good, but what about vascular surgery? Let's see – making therapeutic decisions at the individual patient level, taking patient variability into account, whether it's analyzing comorbidity, genetic profile – isn't this what we do every day? Of course, it is! We just haven't been as forth-



Dr. Forbes is professor and chair of the Division of Vascular Surgery at the University of Toronto.

right in owning it or broadcasting it. If we think about it, we are further along the path to personalized vascular therapy than we think. *Vascular*, 20 to Jan 13, pp1170-1171. In a practical sense, we do it every day, whether it's custom devices for aortic therapy, applying data from registries and randomized, controlled trials to individual patients, or using genetic information to make recommendations regarding medical, surgical, or endovascular therapy. We regularly make recommendations "taking individual patient variability into account." There are ongoing debates in all of these areas-

by our innovative vascular surgery colleagues. Dr. Benjamin W. Starmer is using 3-D printing to develop custom templates for personalized "pumps of care" *vascular endovascular intervention* *J Vasc Surg* 2015;61:1637-41. Gene variability is being considered when applying medical therapy, known as pharmacogenetics, but also when applying surgical therapy, as "surgicogenetics." A prime example in the pioneering work led by Dr. Michael S. Comie and the late Dr. Alexander Clowes. They have attempted to explain some of the variability in outcomes following infrapopliteal bypass surgery by differences in a single nucleotide polymorphism *J Vasc Surg*, 2013 May; 57:1179-85. Genetics drives surgical outcomes, *surgicogenetics* indeed! These are just some of the examples of "Personalized Vascular Therapy" that all vascular surgeons practice to a certain extent and where there are lively areas of investigation. So the time has come for us to not only practice personalized medicine, but to own it, to broadcast it, to leverage it, as well. Personalized Vascular Therapy has a nice ring to it, don't you think? We do it, let's not be shy about it. ■



Vascular Surgery – Personalized Approach to PAD

- Diagnose and determine acuity
- Manage risk factors
- Establish treatment goals (meaningful benefit)
- Delineate extent of disease
- Implement revascularization strategy
- Closely monitor



Thank You

