How much flow is enough for healing

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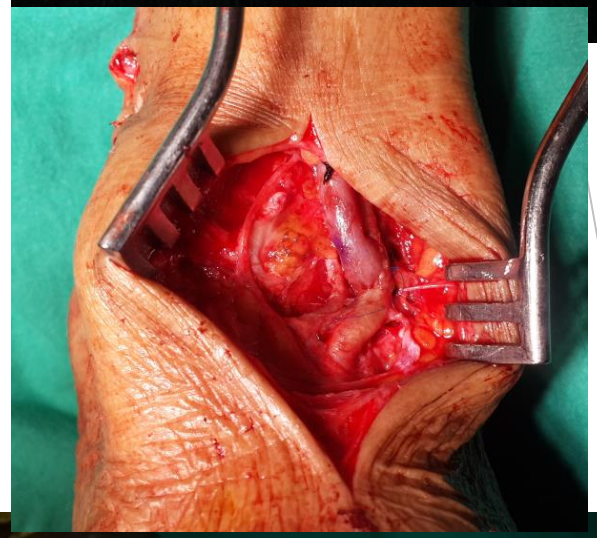
โรงพยาบาลอุดรธานี

การดูแลผู้ป่วย Near infrared camera



1. Ankle brachial pressure index (ABI)

Brachial presssure

Ankle pressure

- ABI ของขาขวา = $\frac{\text{ค่า Ps บริเวณข้อเท้าที่มากที่สุด (PTA หรือ DPA)}}{\text{ค่า Ps ของแขนที่วัดได้ค่ามากที่สุด (brachial artery)}}$

- PTA=posterior tibial artery
- DPA= dorsalis pedis artery

Interpretation

- **ABI**

- **ABI ≤ 0.90** **Confirm** PAD
- **ABI 0.91~0.99** Borderline
- **ABI 1.0-1.40** Normal
- **ABI > 1.40** Non-compressible Vessel

Vascular Lab

- ABI (Ankle/Brachial systolic Index)

1. Simple, reproducible, common noninvasive method
2. Screening ABI should be performed > 50yrs of diabetes
3. But falsely high due to mediasclerosis : 15%-40% (*Lehto. 1996*)

2. Toe pressure index

- Toe pressure

  Because calcification of the digital vessels is less pronounced than in proximal metatarsal, plantar, tibial vessels, it can be measured accurately than ABI

Toe pressure with Photo-plethysmography

- Toe pressure is useful in DM
- Toe pressure is useful in DM

Foot ulcer heals toe pr > 30mmHg in non DM, 55mmHg in *DM-(Carter et al)* .

- Normal toe brachial index is 0.75, less than 0.25 in severe occlusive disease

3. Segmental arterial pressure

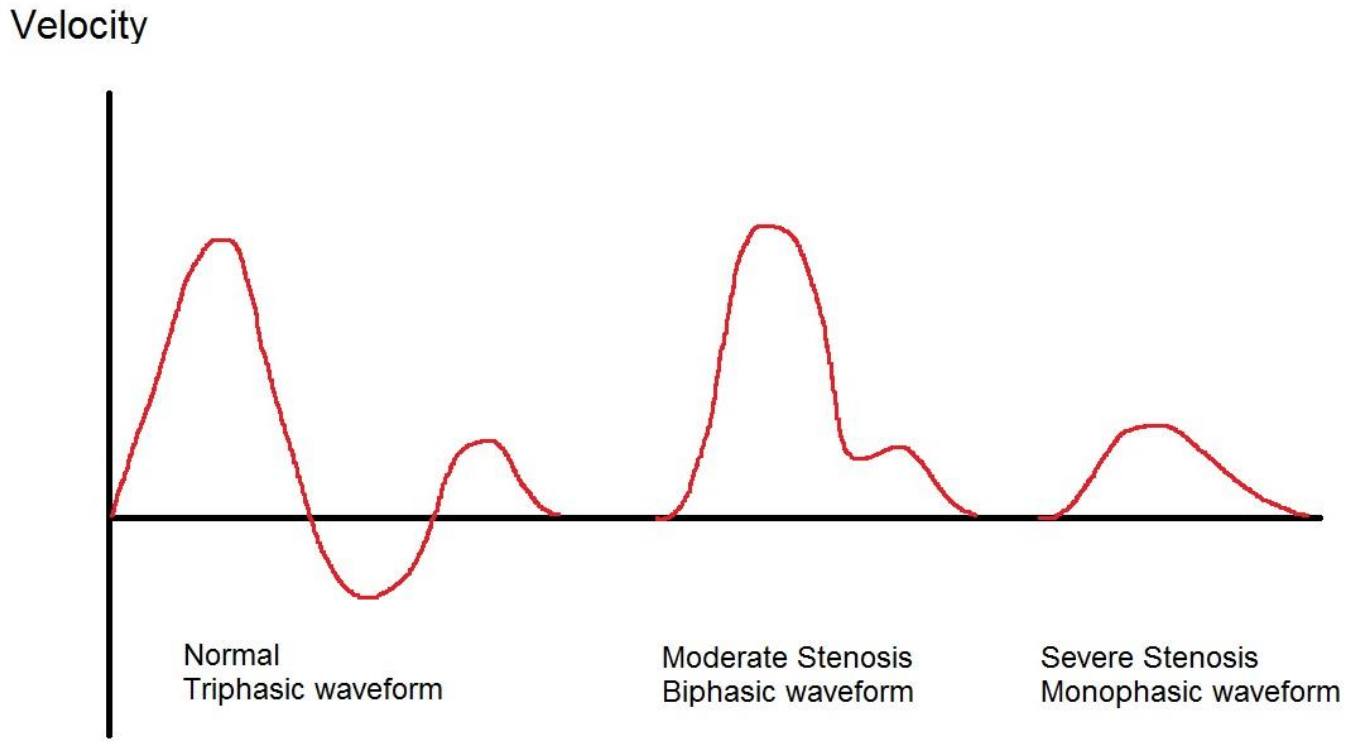
Cuff method

Thigh at groin / above knee / Calf / Ankle

normal gradient : less than 20-30mmHg

ถ้าความดันที่วัดได้ในตำแหน่งใด เทียบกับความดันในตำแหน่งที่เหนือกว่าหนึ่งระดับ มีค่าน้อยลงเกินกว่า 20 mmHg ถือว่ามีการตีบตันของหลอดเลือดอย่างมีนัยสำคัญ ซึ่งเป็นปัจจัยสำคัญที่ทำให้เกิดแผลเรื้อรัง

4. Doppler Velocity Wave Form analysis



5. Pulse volume recording

เป็นการตรวจหลอดเลือดแดงที่รยางค์โดยใช้หลักการเปลี่ยนปริมาตรของรยางค์ตาม arterial inflow ที่เป็นจังหวะตามการเต้นของหัวใจในรอบการไหลเวียนโลหิต

1. Apply pneumatic cuff

   Thigh – 18 * 36cm

   Calf - 12*23cm

2. Cuffs are inflated 65mmHg

   Thigh - 400±75ml

   Calf - 75± 10ml

3. Recordings are made successively

Vascular Lab

Pulse contour of PVR

Normal

Steep upstroke, downslope, prominent dicrotic wave

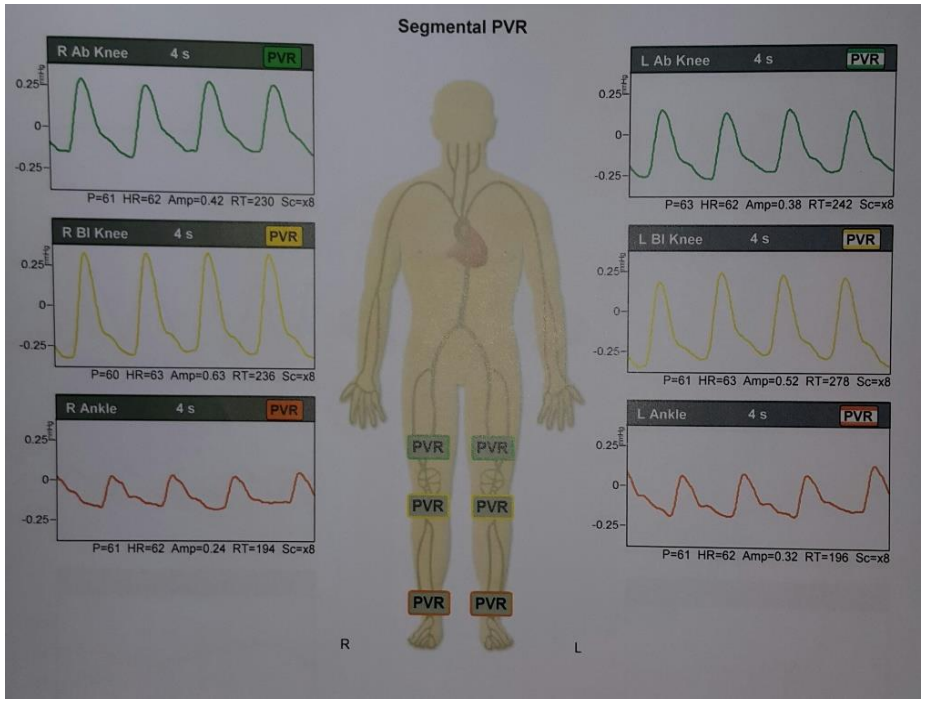
Occlusive

- Absence of dicrotic wave
- Peak becomes delayed and rounded

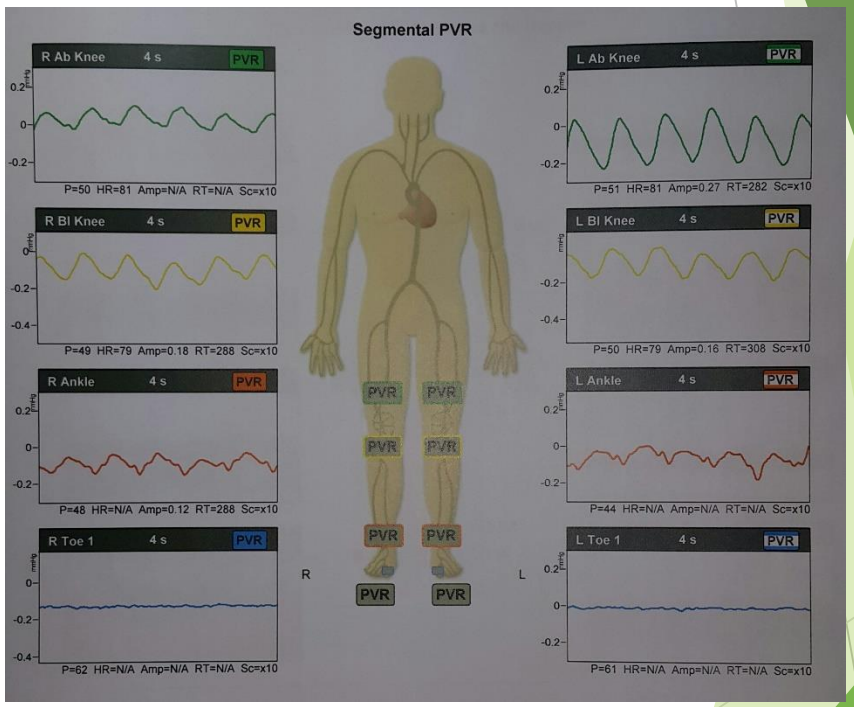
Severe occlusive

- Rise and fall nearly equal, amplitude decrease

Normal



Aortoiliac occlusive disease



Vascular Lab

- PVR correctly assess patency of femoral artery in 97% (*kempczinski et al.*)
- Positive & negative predictive value in Aorto-iliac disease 64%, 87%, and in Femoro-popliteal disease 91%, 85%
- Accuracy of combined test : simultaneous use of PVR and segmental pressure : 86-100%

6. Skin perfusion pressure

Relationship between skin perfusion pressure and probability of wound healing. SPP ≥40 mmHg is associated with a high likelihood of wound healing. Castronuovo JJ Jr. J Vasc Surg 1997;629

เป็นเครื่องมือที่ใช้ลำแสงเลเซอร์ในการตรวจการเคลื่อนที่ของเม็ดเลือดแดงในหลอดเลือดฝอยใต้ผิวหนัง

โดยมีการประมวลผลการตรวจเป็น mmHgการหายของแผลเรื้อรังจะมีโอกาสเกิดขึ้นได้ถ้ามี Skin perfusion pressure ≧ 40 mmHg

Limitations

1. Patient voluntary or involuntary movement will cause significant artifacts
2. Patient have to hold completely still for measuring time
3. Sensor placement must avoid any bony prominences, major veins, or varicosities

7. Transcutaneous oxygen tension

- Quantitative estimation of cutaneous oxygen delivery
- Reflect metabolic state of the target tissue rather hemodynamic changes
- Not detect moderate arterial occlusion, only severe occlusion
- Limit accuracy, hyperkeratosis, edema, cellulitis
- Wound heal > $TCPO_2$ 30mmHg, fail < $TCPO_2$ 20mmHg

Useful in predicting amputation, wound healing

CT angiographic patterns of Thai diabetic patients with critical limb ischemia

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Objectives To define the distribution pattern of peripheral arterial disease (PAD) in diabetic patients with critical limb ischemia (CLI) by using CT angiography.

Methods Ninety seven femoral run-off computed tomographic angiographies (CTAs) of diabetic patients with CLI were reviewed retrospectively from March 2010 to January 2013. Vascular obstructive lesions were classified as aortoiliac, femoropopliteal and below knee segments, with details of stenotic severity and lengths. Distribution patterns were analyzed by the Pearson Chi square test.

Results There were 478 lesions in 194 limbs. Aortoiliac and femoropopliteal diseases were found more frequently than below knee disease (133 vs. 68) in stenotic lesions less than 10 cm (p = 0.0001) long. However, below knee segment was involved more frequently than above knee disease (121 vs. 30, $p = 0.0001$) for occlusions equal in length or longer than 10 cm.

Conclusions Above knee arterial stenoses are seen frequently as significant in diabetic patients with CLI, and the findings of this study demonstrate both interest in and opportunities for inflow revascularization with endovascular therapy. **Chiang Mai Medical Journal 2013;52(3-4):51-55.**

Table 2. Distribution of obstructive lesions

Segment	Stenosis		Occlusion		Total
	< 10 cm	>= 10 cm	< 10 cm	>= 10 cm	
Aortoiliac	50	2	15	6	73
Femoropopliteal	83	17	21	24	145
Above knee	133*	19	36	30#	218
Below knee	68*	58	13	121#	260
Total	201	77	49	151	478

*$p < 0.001$, #$p < 0.001$,

Diabetic Foot Guideline

The management of diabetic foot: A clinical practice guideline by the Society for Vascular Surgery in collaboration with the American Podiatric Medical Association and the Society for Vascular Medicine

The management of diabetic foot: A clinical practice guideline by the Society for Vascular Surgery in collaboration with the American Podiatric Medical Association and the Society for Vascular Medicine

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Background: Diabetes mellitus continues to grow in global prevalence and to consume an increasing amount of health care resources. One of the key areas of morbidity associated with diabetes is the diabetic foot. To improve the care of patients with diabetic foot and to provide an evidence-based multidisciplinary management approach, the Society for Vascular Surgery in collaboration with the American Podiatric Medical Association and the Society for Vascular Medicine developed this clinical practice guideline.

Methods: The committee made specific practice recommendations using the Grades of Recommendation Assessment, Development, and Evaluation system. This was based on five systematic reviews of the literature. Specific areas of focus included (1) prevention of diabetic foot ulceration, (2) off-loading, (3) diagnosis of osteomyelitis, (4) wound care, and (5) peripheral arterial disease.

Results: Although we identified only limited high-quality evidence for many of the critical questions, we used the best available evidence and considered the patients' values and preferences and the clinical context to develop these guidelines. We include preventive recommendations such as those for adequate glycemic control, periodic foot inspection, and patient and family education. We recommend using custom therapeutic footwear in high-risk diabetic patients, including those with significant neuropathy, foot deformities, or previous amputation. In patients with plantar diabetic foot ulcer (DFU), we recommend off-loading with a total contact cast or irremovable fixed ankle walking boot. In patients with a new DFU, we recommend probe to bone test and plain films to be followed by magnetic resonance imaging if a soft tissue abscess or osteomyelitis is suspected. We provide recommendations on comprehensive wound care and various débridement methods. For DFUs that fail to improve (>50% wound area reduction) after a minimum of 4 weeks of standard wound therapy, we recommend adjunctive wound therapy options. In patients with DFU who have peripheral arterial disease, we recommend revascularization by either surgical bypass or endovascular therapy.

Conclusions: Whereas these guidelines have addressed five key areas in the care of DFUs, they do not cover all the aspects of this complex condition. Going forward as future evidence accumulates, we plan to update our recommendations accordingly. (J Vasc Surg 2016;63:3S-21S.)

PAD and Diabetic Foot Ulcer

- We suggest that patients with diabetes have ankle-brachial index (ABI) measurements performed when they reach 50 years of age (Grade 2C).

- We suggest that patients with diabetes who have a prior history of DFU, prior abnormal vascular examination, prior intervention for peripheral vascular disease, or known atherosclerotic cardiovascular disease (eg, coronary, cerebral, or renal) have an annual vascular examination of the lower extremities and feet including ABI and toe pressures (Grad 2C).

- We recommend that patients with DFU have pedal perfusion assessed by ABI, ankle and pedal Doppler arterial waveforms, and either toe systolic pressure or transcutaneous oxygen pressure (TcPO2) (Grade 1B).

Take home message

- Diabetes with any problem in the leg (pain, ulcer, gangrene)
- Pedal pulse assessment
- If absence pedal pulse, ABI, ankle pressure and pedal Doppler arterial waveforms, and either toe systolic pressure or transcutaneous oxygen pressure
- Refer….

Summary

- How much flow is enough?
- The more, the better (establishing at least 1 straight-line flow to the foot in each limb)
- Comprehensive, coordinated approach with hemodynamic and imaging study to diagnose ischemia in DM foot is important
- Noninvasive hemodynamic study is essential for screening and judging the revascularization results