



# Vascular dysfunction and vulnerable skin

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## Vascular dysfunction can be said to exist when:

Cellular demand > Available supply

- Cellular activity
- Pulmonary function
- Bacterial load
- Cardiac output

These factors are NOT  
constant

↑demand in: exercise,  
inflammation, infection,  
repair process

- Macro-circulation
- Micro-circulation
- Local biochemistry
- Oxygen transfer

# What circulation factors makes skin more vulnerable?

- Vascular disease more common
  - In the elderly
  - In the diabetic
  - In the immobile
- Reduced skin perfusion occurs in patients with:
  - PAD
  - Poor cardiac function
  - Diabetes
  - Peripheral oedema
  - Thrombotic and microvascular disease
  - Poor nutrition
  - Acute shutdown
    - Inotropes
    - Shock
    - Tourniquet
  - Hypothermia



*Unrelieved pressure 4-6 x systolic BP cause necrosis in less than 1 hour.*

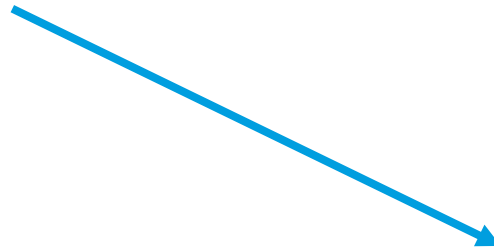
*Pressure less than systolic BP might require 12 hours to produce a similar lesion*

*Kosiak (1959) Arch Phys Med Rehab*



# Learning the lessons from Surgical Site Infection

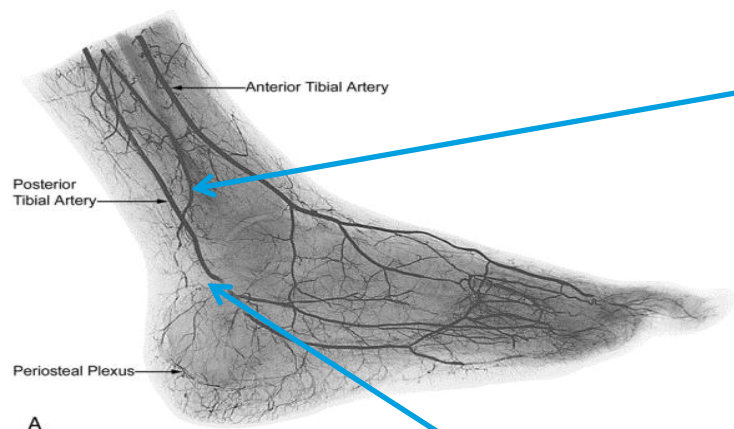
- During anaesthesia vascular dysfunction can occur through:
  - Hypotension
  - Hypoxia
  - Hypothermia



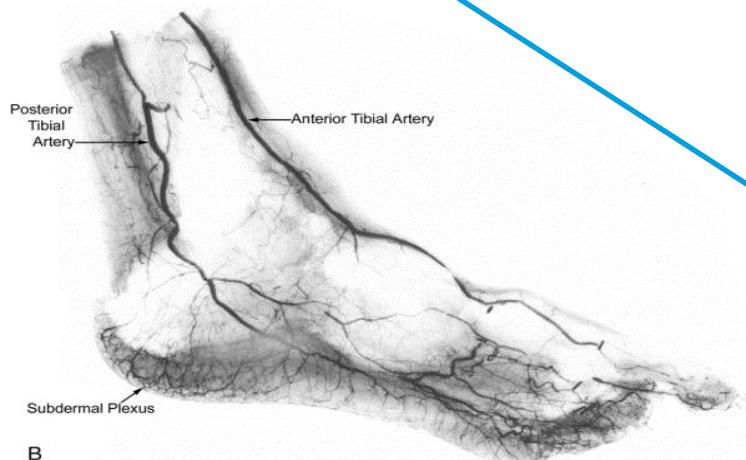
These factors are known to contribute to SSI but will also contribute to pressure related skin damage



# The concept of the angiotome



Perineal artery supplying the Achilles area



Posterior tibial artery supplying the os calsis

A: Radiograph of the arterial supply of the foot demonstrating the periosteal plexus and subdermal plexus.

B: Following removal of the underlying bones.

***The Heel: Anatomy, Blood Supply, and the Pathophysiology of Pressure Ulcers.***

Cichowitz, Adam; Pan, Wei; Ashton, Mark

*Annals of Plastic Surgery.* 62(4):423-429, April 2009.



# Skin, tissue damage and arterial disease



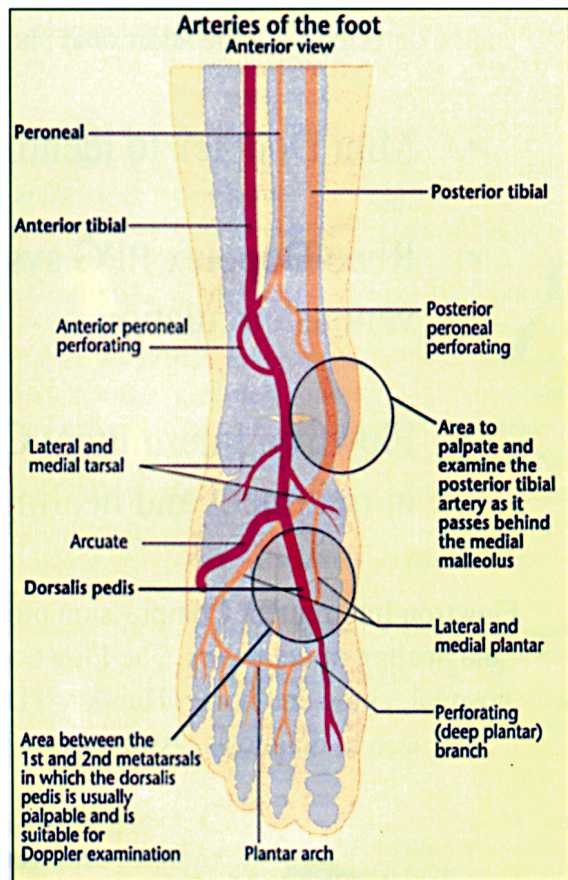
Hazards of  
compression treatment  
of the leg: an estimate  
from Scottish Surgeons

*Callam et al 1987*





## Three arteries, three compartments, three pressures



Despite featuring in all guidelines relating to leg ulcer management Doppler ABPI was not performed in over 80% of patients

## Alternatives to conventional Doppler ABPI

- Synchronous arm blood pressure measurement
- Automatic selection of highest arm systolic pressure
- Repeat estimate with arm and ankle
- Automatic calculation of ABPI



Huntleigh Dopplex Assist



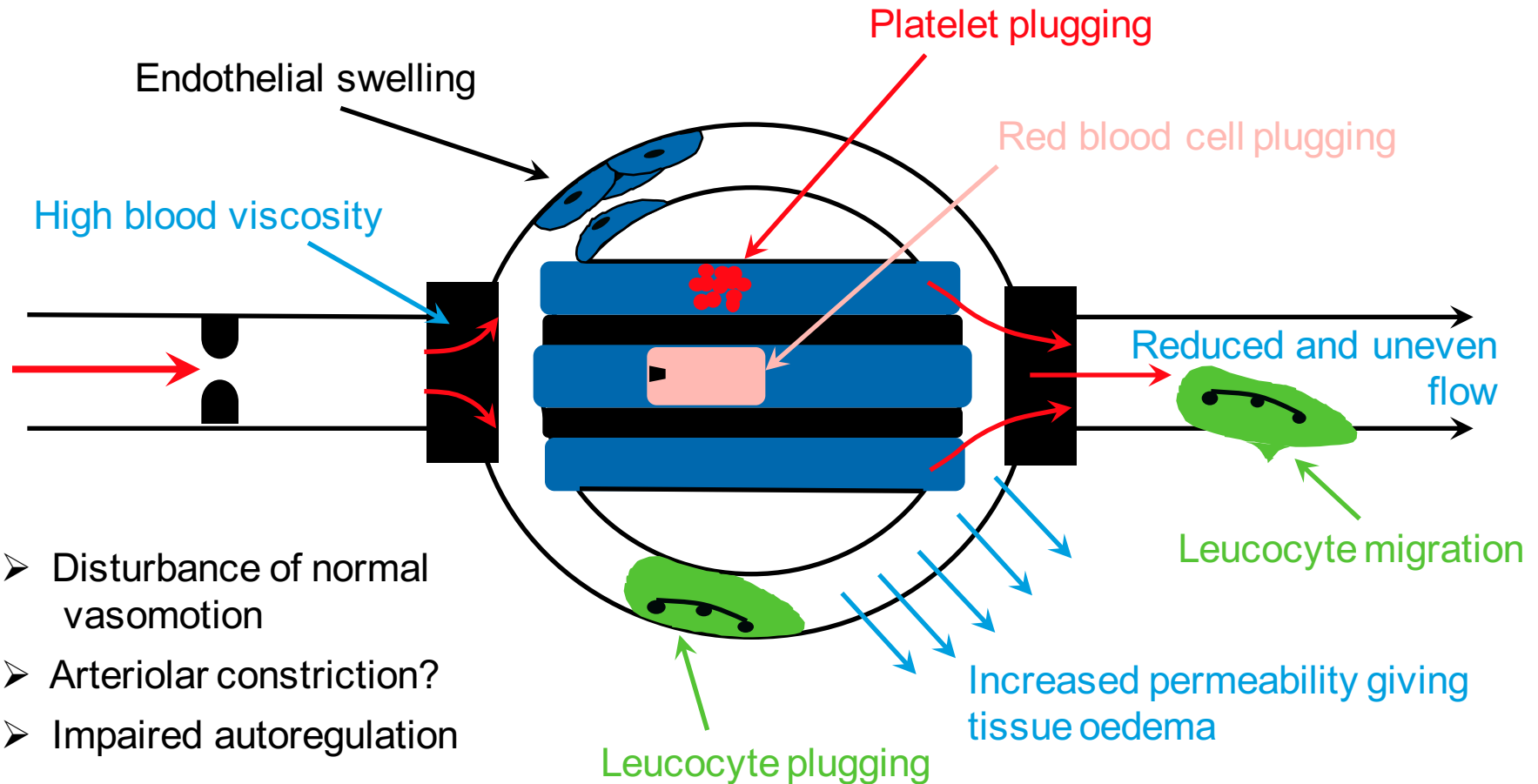
Mesi ABI



Watch BP Office ABI

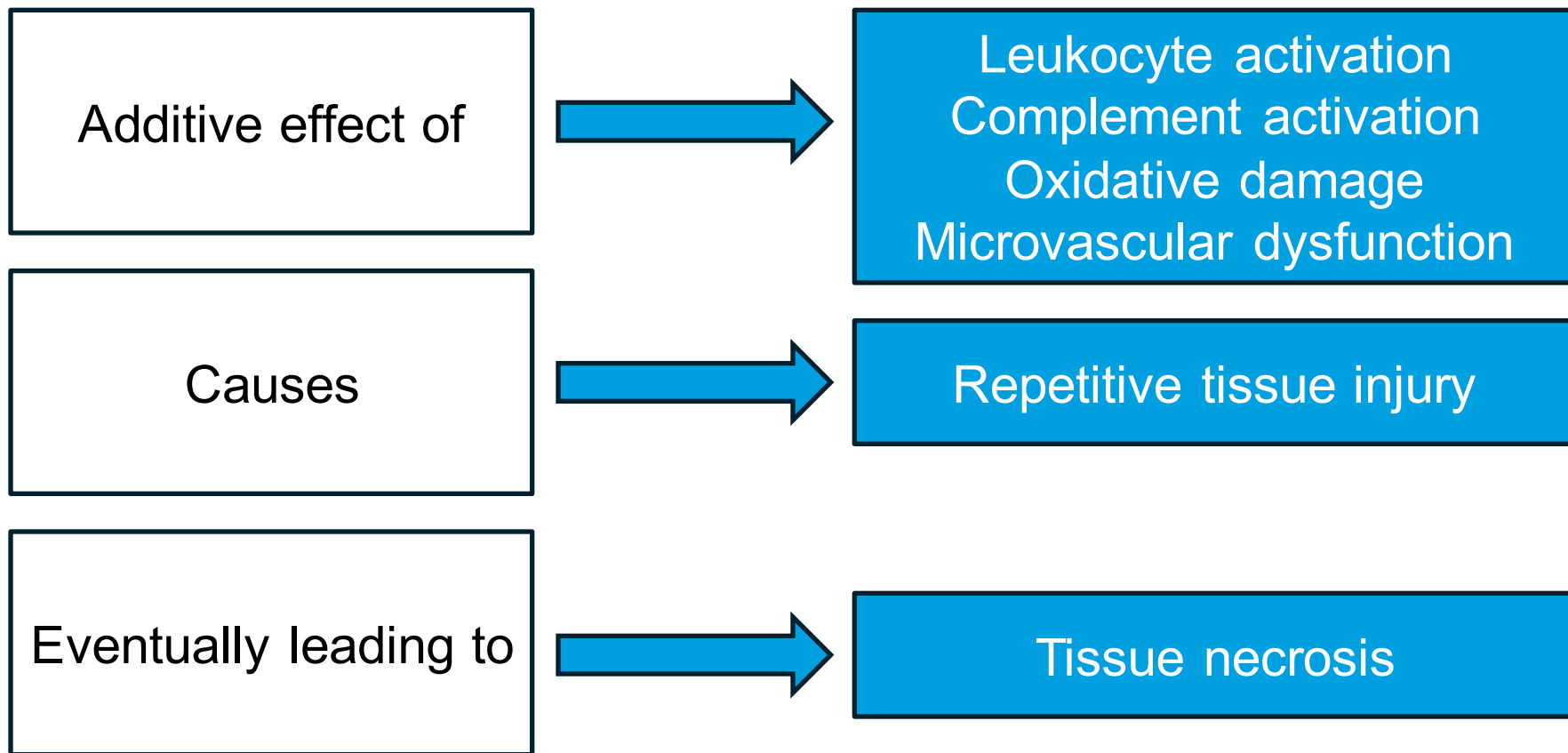


# Flow disturbance in Critical Limb Ischaemia



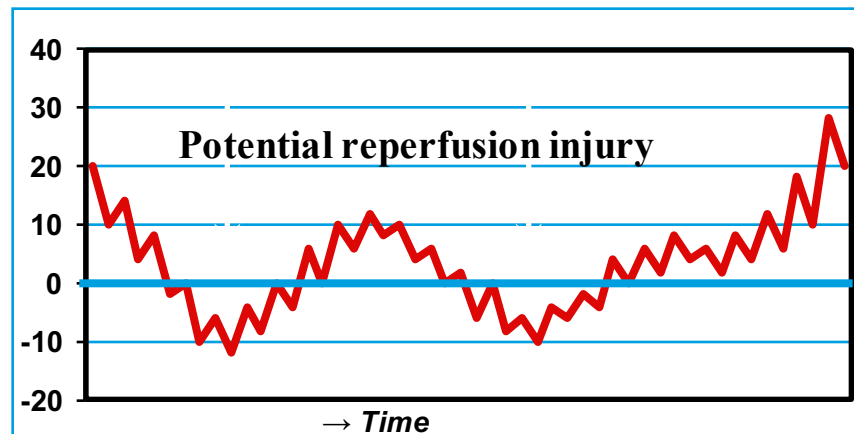


## Repetitive ischaemia-reperfusion injury



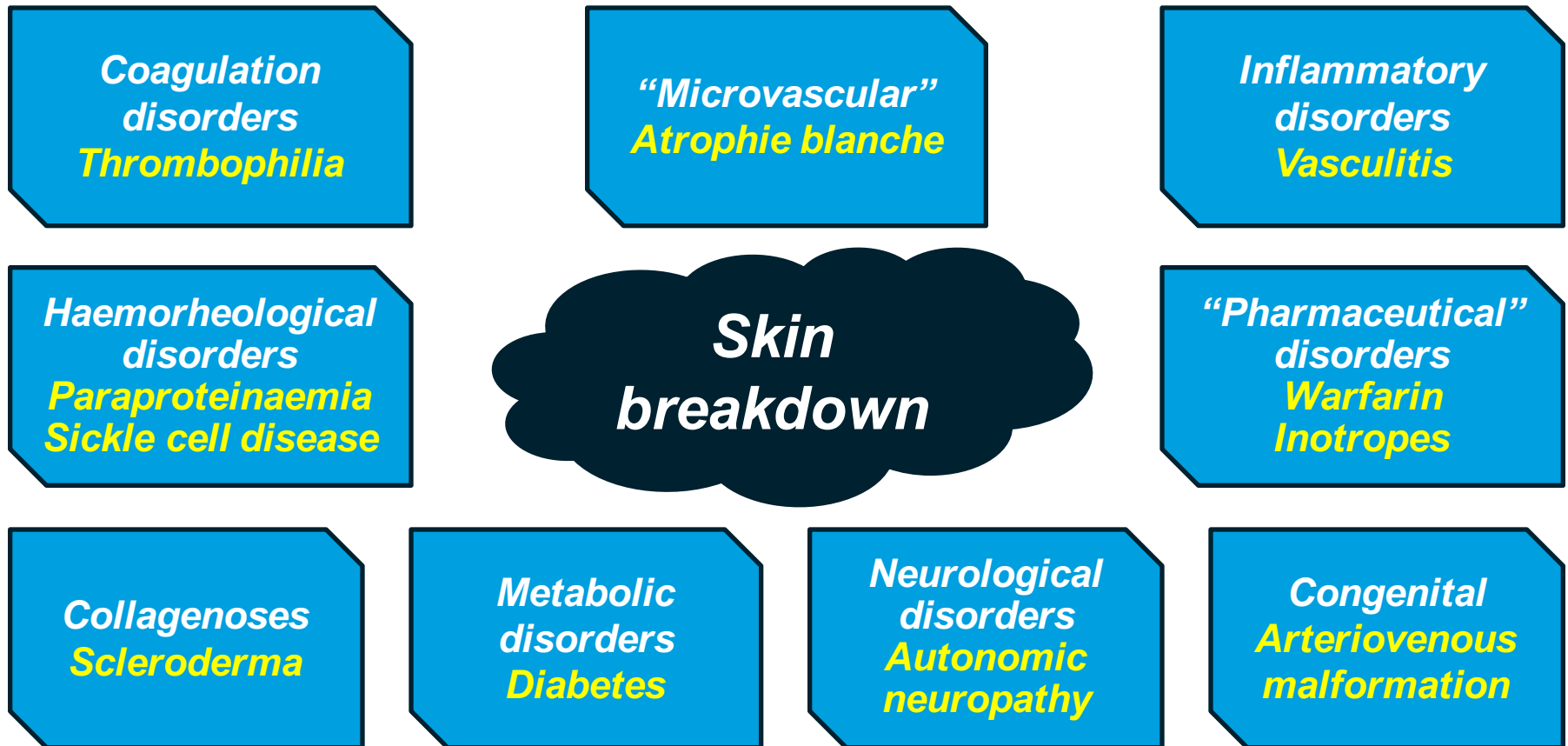
# Ischaemia-Reperfusion: A repetitive insult to tissues

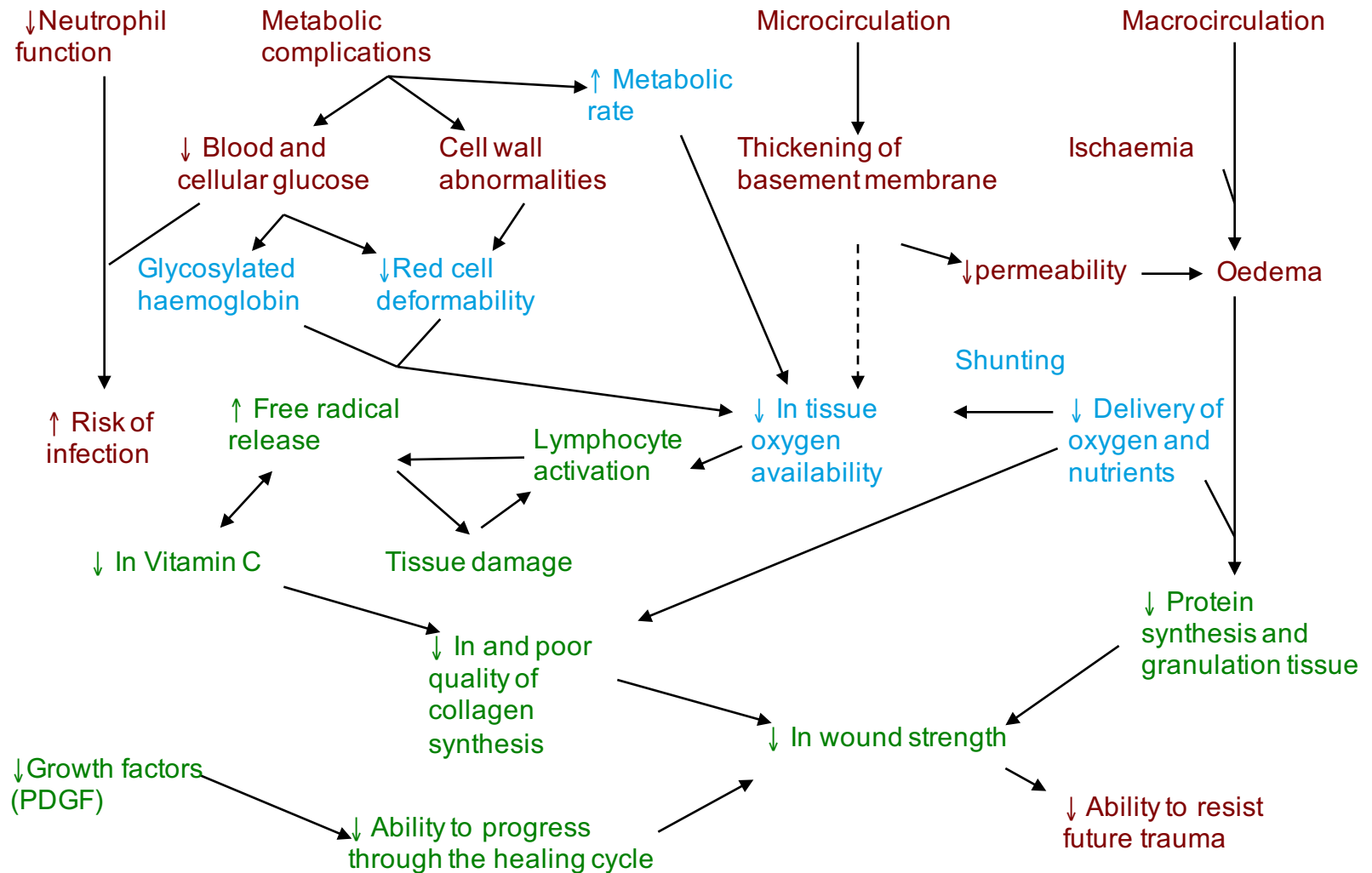
- Arterial disease
  - Exercise induced ischaemia
  - Elevation induced ischaemia
- Venous disease
  - Failure of the calf-muscle pump produces periods of relative ischaemia
- Pressure induced ischaemia
  - During repositioning





# Conditions contributing to vascular dysfunction



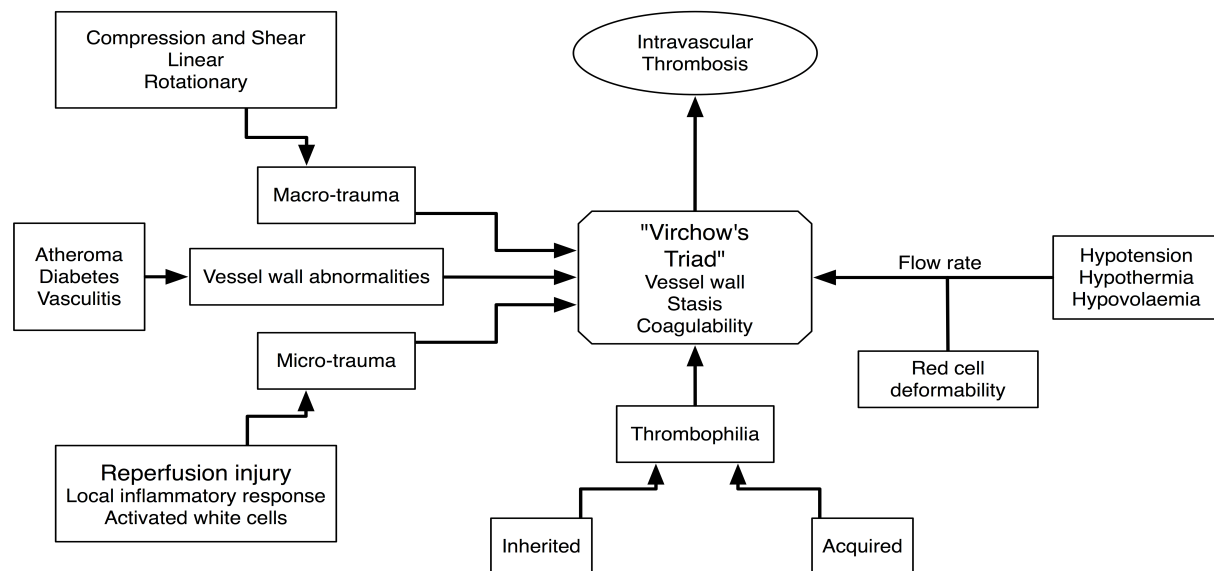


Diabetic foot ulceration



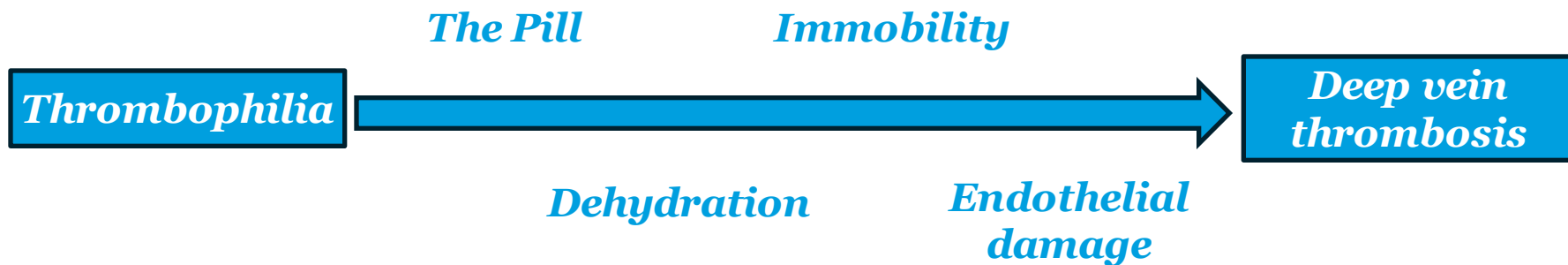


# Intravascular thrombosis



Thrombophilia  
predisposes to the  
development of superficial  
and deep lower limb  
venous reflux, and so to  
VV and VLU

*Darvall et al 2009*



## NIHR WoundTec HTC Health Economic Study

Comparison of 1000 patients with wounds and 1000 age, sex and practice controls identified:

- nutritional status  
and
- pre-existing dermatological conditions  
as independent risk factors for skin breakdown

## Conclusion

- Vascular dysfunction does not solely relate to macrovascular disease
- Complex interactions of haemorheology, coagulation, neuropathy, perfusion pressure, resistance and extraneous factors such as pressure all act together
- The outcome of this interaction is largely dependent on the tissue type involved and varies over time and demand
- Pre-existing skin damage or disease appears to make the skin more vulnerable to “ischaemic” insults



Bradford Teaching Hospitals   
An NHS Foundation Trust

Wound Healing Unit