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Lower limb vascular assessment for people with diabetes: a multifaceted assessment of objective screening techniques

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CELEBRATING 50 YEARS

50

1965-2015

Background

Non-invasive lower limb vascular assessment in diabetes cohorts

Macrovascular Disease

Peripheral Arterial Disease

- Increased risk (x4) ⁽¹⁾
- More diffuse & severe
- Distally located disease ⁽²⁾
- Co-exists with medial arterial calcification & cardiovascular disease ⁽³⁾
- Ischaemic ulceration, gangrene & amputation ⁽⁴⁾

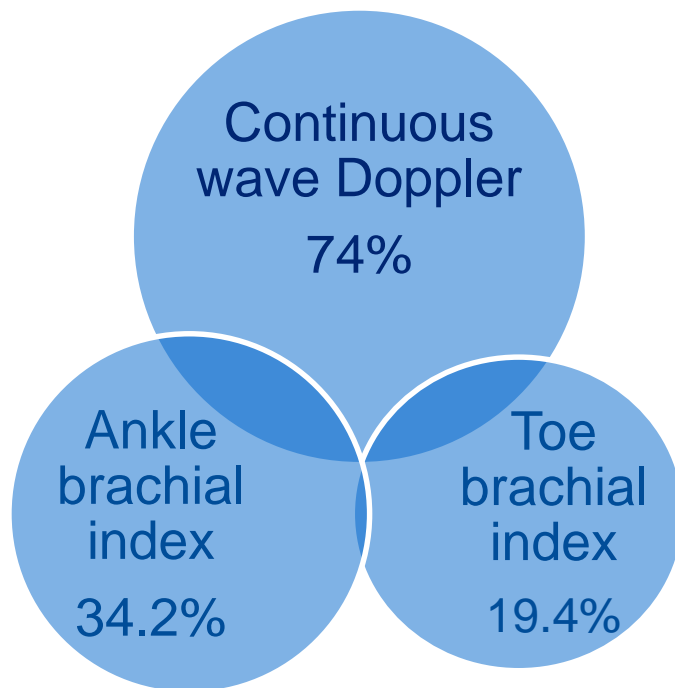
Microvascular disease

Lower extremity manifestations

- Altered skin blood flow, localised tissue hypoxia, poor healing & peripheral neuropathy ⁽⁵⁾
- Can occur independent of macrovascular disease ⁽⁶⁾

Background

Non-invasive vascular assessment in diabetes cohorts



- **Used for diagnosis and ongoing monitoring**
- **Altered presentation and co-existent pathologies make clinical assessment challenging in people with diabetes**

Reliability, diagnostic accuracy & clinical utility

Survey of most commonly used non-invasive vascular assessment techniques by Podiatrists
n=377

Reliability

Test-retest reliability

Test	Agreement	95%CI	Rating
CWD			
Diabetes (N=27)	K=0.34	-0.31 to 0.65	Poor
Control (N=24)	K=0.24	-0.09 to 0.49	Poor
ABI			
Diabetes (N=32)	ICC=0.75	0.67 to 0.89	Excellent
Control (N=30)	ICC=0.85	0.75 to 0.95	Excellent
TBI			
Diabetes (N=40)	ICC=0.75	0.64 to 0.88	Excellent
Control (N=40)	ICC=0.80	0.72 to 0.96	Excellent



Reliability

Inter-tester reliability

Test	Agreement	95%CI	Rating
CWD			
Diabetes (N=27)	K=0.44	0.02 to 0.89	Moderate
Control (N=24)	K=0.42	0.02 to 0.91	Moderate
TBI			
Diabetes (N=40)	ICC=0.80	0.70 to 0.91	Excellent
Control (N=40)	ICC=0.81	0.72 to 0.91	Excellent

Diagnostic Accuracy

Receiver Operating Curve

N=72 (M48, F25)

Mean ABI: 1.16 (SD 0.24)

Mean TBI: 0.70 (SD 0.23)

Reference standard: CDU

Incompressible arteries: 8

PAD:36

- Distal PAD: 27
- Proximal PAD:10

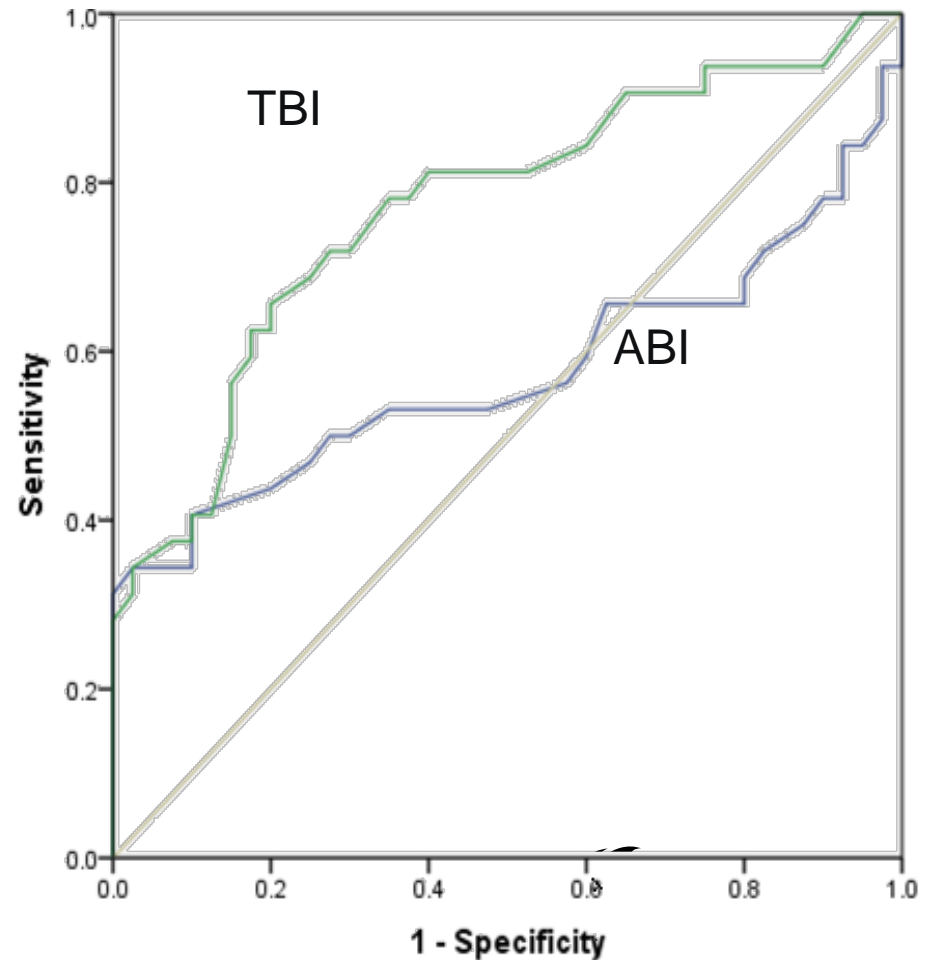
Total Occlusion: 24

Cut-offs: ABI <0.90, TBI <0.70

Area Under the Curve

TBI: 0.75

ABI: 0.58



Diagnostic accuracy

Sensitivity and Specificity

	Continuous Wave Doppler (95%CI)	Ankle-Brachial Index (95%CI)	Toe-Brachial Index (95%CI)
Sensitivity	74.19% (55.38 to 88.11)	45.16% (27.33 to 63.96)	63.64% (45.13 to 79.58)
Specificity	92.86% (80.49 to 98.42)	92.86% (80.49 to 98.42)	82.05% (66.46 to 92.43)

Sensitivity: the ability of the test to correctly identify those patients **with** the disease

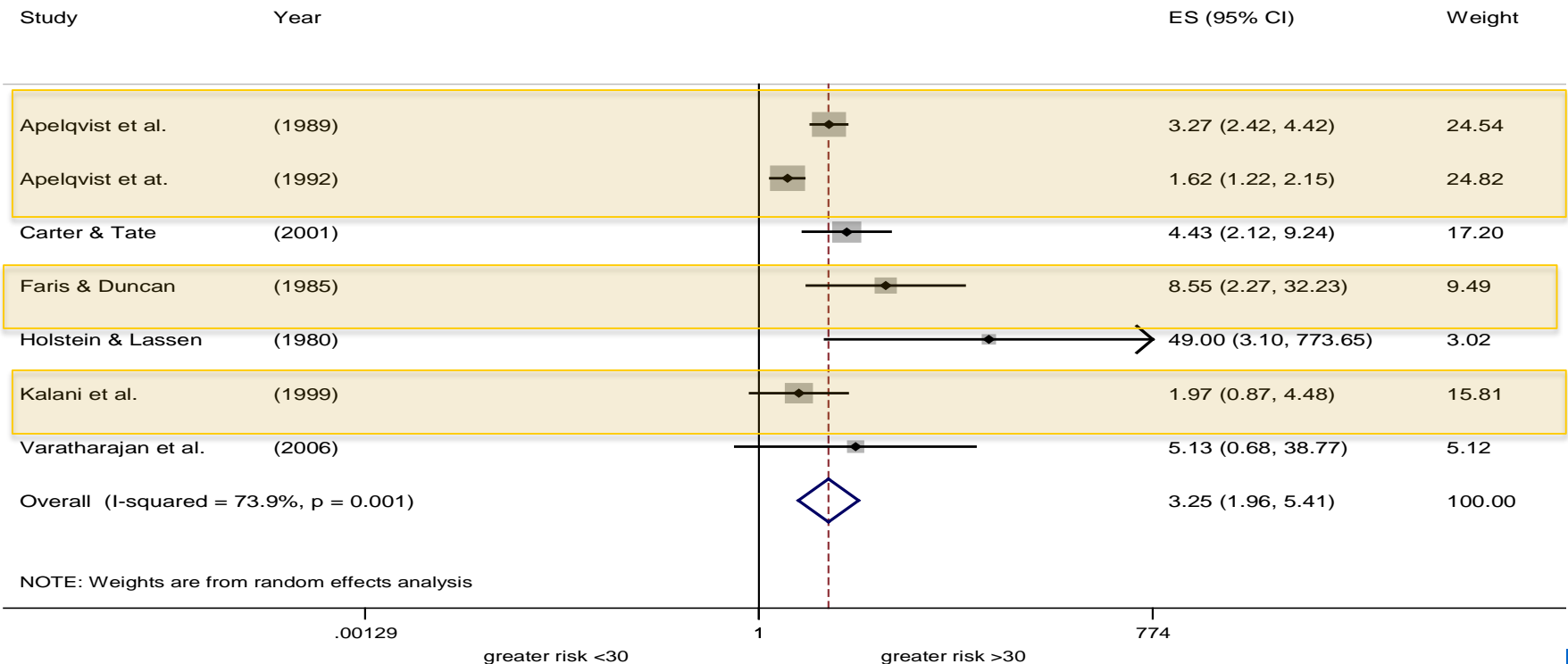
Specificity: the ability of the test to correctly identify those patients **without** the disease

Clinical Utility

Toe-Brachial Index

Little evidence of clinical utility of TBI beyond assessment for PAD

- Predictive capacity for cardiovascular mortality ⁽⁷⁾
- 3.25 X increased risk of non-healing/amputation (toe pressures) ⁽⁸⁾



Clinical Utility

Toe-Brachial Index and History of Foot Complications

Test	Odds Ratio	95% CI		Significance
		Lower	Upper	
CWD	0.62	0.08	4.81	0.65
ABI	2.31	0.12	41.51	0.57
TBI	10.73	1.03	112.34	0.04*
HbA1C	0.64	0.38	1.09	0.11
Duration of diabetes	1.19	0.79	0.98	0.03*

N=100, M=55, mean age=64.87y (SD11.26), mean BMI 27.76 (SD3.79y) diabetes duration 8.76y (SD 7.93y). Cut-off ABI <0.9, TBI<0.6

* significant at $p < 0.05$



Limitations

Reliability studies were conducted under tightly controlled conditions

Diagnostic accuracy studies focused on large artery disease

- Grading system for the TBI is yet to be established
- Unknown the extent to which TBI is associated with microvascular function

Clinical utility assessment of the TBI and foot complications in people with diabetes was not prognostic

- Further longitudinal investigation is required

Conclusion

No one test is sufficient for vascular assessment in people with diabetes however...

Our research indicates:

- CWD has the highest accuracy for PAD but clinically lacks reliability and does not address microvascular disease
- The TBI is less likely to miss PAD than the ABI and has excellent reliability and is a more accurate test for PAD for all people with diabetes
- A low TBI is associated with previous diabetic foot complications and may have greater clinical utility than previously recognised

thank you



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QUESTIONS

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