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Near infrared spectroscopy would be assessed for lower extremity peripheral artery disease diagnosis in patients with normal ankle-brachial index at rest



We read with interest the article entitled “A low-cost, wireless near-infrared spectroscopy device detects the presence of lower extremity atherosclerosis as measured by computed tomographic angiography and characterizes walking impairment in peripheral artery disease” from Fuglestad et al.¹ This study is of

particular interest to improve the knowledge of the pathophysiologic process in patients with lower extremity peripheral artery disease (PAD) by the use of low-cost means. We have already reported that exercise transcutaneous oxygen pressure (exercise TcPO₂) could be also of interest in this aim.² Although more expensive and time consuming than near infrared spectroscopy (NIRS), exercise TcPO₂ could be better than NIRS as suggested by one study.³ However, the major challenge from a diagnosis point of view is to develop methods that can differentiate patients with PAD from patients without PAD when the ankle-brachial index (ABI) is greater than 0.90 at rest. Indeed, the Society for Vascular Surgery recommends to use exercise test in patients with exertional limb symptoms and normal ABI at rest.⁴ However, to date, criteria to define PAD in subjects with a normal ABI should be discussed since criteria proposed by the American Heart Association did not identified the same group of patients in one out of five patients.⁵ In our recent article about exercise tests criteria to diagnose PAD, we found that the positive predictive values of postexercise ABI and exercise-TcPO₂ were 90% (79%-96%) and 86% (77%-91%), respectively, in the whole population of 63 subjects whereas these values decreased to 52% (39%-64%) and 63% (41%-80%) in patients with normal ABI at rest (Table).⁶ These results suggest that there is still a lot to do to improve exercise tests. Therefore, we would like to invite the authors of the present study to perform a new study in patients with a normal ABI at rest to see whether or not this low-cost NIRS would be an optimal diagnosis tool in this population.

Table. Exercise test characteristics for identifying 50% or greater stenosis in patients (n = 63) whatever the ankle-brachial index (ABI) at rest and in patients (n = 39) with a normal ABI at rest

	Cutoff	Sensitivity, % (95% CI)	Specificity, % (95% CI)	Positive predictive value, % (95% CI)	Negative predictive value, % (95% CI)	Accuracy, % (95% CI)	Area under curve (95% CI)	P value
Population (n = 63); limb (n = 126)								
Postexercise ABI decrease	≥43%	57 (45-68)	89 (77-97)	90 (79-96)	55 (49-62)	69 (60-77)	0.79 (0.71-0.86)	<.01
Exercise-TcPO ₂ (Distal DROP)	≤-15 mm Hg	76 (65-85)	79 (64-89)	86 (77-91)	66 (56-75)	77 (69-84)	0.78 (0.69-0.85)	<.01
Population with normal ABI at rest (n = 39) Limbs (n = 60)								
Postexercise ABI decrease	≥18.5%	71 (48-89)	64 (47-79)	52 (39-64)	81 (67-90)	67 (53-78)	0.67 (0.53-0.78)	.02
Exercise-TcPO ₂ (distal DROP)	≤-15 mm Hg	48 (26-70)	85 (70-94)	63 (41-80)	75 (59-83)	72 (59-83)	0.67 (0.53-0.78)	.03

CI, Confidence interval; DROP, delta from rest oxygen pressure; TcPO₂, Transcutaneous oxygen pressure measurements. Adapted from Stivalet et al.⁶

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Reply



We thank Lanéelle et al for their interest in our recent article.¹ We also want to commend the authors for their excellent publication demonstrating the ability of transcutaneous oxygen pressure (TcPO₂) of the calf and buttock, applied during a treadmill exercise test, to identify patients who have significant lower extremity atherosclerotic burden as measured by computed tomography angiography.² Both TcPO₂ and near-infrared spectroscopy (NIRS) represent exciting methods to measure the balance of oxygen delivery, demand, and utilization in the legs of patients with peripheral artery disease (PAD) in real time. We agree with the authors that the provocative insights offered by these technologies elicit challenging questions that warrant further study. What are we to do with the, often asymptomatic, patients who experience significant, exercise-induced skeletal muscle ischemia (as measured by NIRS/TcPO₂) but have mild (<30% stenosis) atherosclerotic disease by computed tomography angiography, which is traditionally considered hemodynamically insignificant? Should these patients be treated conservatively or with a more aggressive approach? Furthermore, can the measurements obtained by NIRS/TcPO₂ help us to decide on the type of therapy (revascularization, exercise, medication, observation) that is most appropriate for each individual PAD patient?

Our group and others have demonstrated that patients with PAD have pathologic changes in their lower extremity affecting their myofibers, mitochondria, and metabolic, inflammatory, and fibrosis-related pathways.^{3,4} It remains unclear if these skeletal muscle pathologies, better known as PAD myopathy, are reversible with the current treatment strategies. However, there are many experts who are concerned that first-line treatment options, such as supervised exercise treadmill training, may induce further skeletal muscle damage in the ischemic limbs because of the ischemia-reperfusion produced by repeated cycles of exercise to moderate to severe pain.⁵ We believe it is a matter of little time before these technologies become more widely used to improve diagnosis of patients with PAD who have a resting ankle-brachial index of greater than 0.90. However, we must also test their potential to better understand the long-term outcomes in patients with PAD who demonstrate pathologic patterns of lower extremity oxygenation during mild, moderate, or heavy exercise. For example, it may be that patients who demonstrate prompt and significant desaturation during even mild exercise will benefit from a revascularization-first approach or a modified exercise program that limits the duration and severity of lower extremity ischemia as measured by NIRS or TcPO₂.

Ultimately, guiding treatment decisions based on NIRS, TcPO₂, and other tests evaluating pathophysiology-based end points in PAD may promote both the functional