Applications of Tissue Oximetry in the Assessment of Endothelial Dysfunction-Pilot Study

Presenting Author: Abdubadie Kutubi, MS

Co-Authors: Nadeem Elbetebsi, MB, ChB, Aymen Alian, MD
Anesthesia Department, Yale University School of Medicine

Introduction: Patients with Endothelial Dysfunction (ED) produce abnormal hemodynamic parameters as in diabetes mellitus and peripheral vascular disease [1] [2] [3]. Flow Mediated Ultrasound (FMD) is the gold standard non-invasive method for ED assessment [4], but is susceptible to observer bias and requires specialist training. The 2nd best method for ED assessment is peripheral arterial tonometry (PAT) which isn't readily available and is costly. This pilot study aims to investigate the potential of tissue oximetry to assess endothelial function in healthy subjects and diseased patients.

Methods: The study involved 13 subjects and 14 patients whose endothelial function was assessed using Tissue Oximetry (Nonin SenSmart OEM) and PAT (EndoPAT). The patient selection criteria involved diagnosed disorders linked with ED.
PAT captures beat-to-beat plethysmographic recordings of the finger arterial pulse wave amplitude with pneumatic probes and produces a Reactive Hyperaemia Index (RHI) score specifying endothelial health on a distribution of a non-selective population [5].
Tissue oximetry sensors were applied to both forearms. The experiments involved taking baseline tissue oximetry and PAT readings for 6 mins, followed by BP cuff inflation causing arterial occlusion for 5 mins, then BP cuff deflation inducing reactive hyperaemia for 5 mins. Readings were also simultaneously recorded from the control arm.

Data analysis: PAT measurements were analyzed with an algorithm, eliminating observer bias. RHI values were reported as the natural log (LnRHI) and indicated the critical value to be 0.51, values below which indicate ED.
Tissue Oximeter readings were graphed as figure (1) and the parameters calculated: Area of desaturation curve (dAUC) (metabolic reserve), area under of reperfusion curve (rAUC) (magnitude of reactive hyperaemia), desaturation slope (dSlope), reperfusion slope (rSlope) (rate of reperfusion), difference between baseline and peak (Delta) and ratio of peak to baseline.

Results: Analysis of tissue oximetry data showed significant differences between the ED and the healthy group with regards to Delta, rAUC, dAUC, rSlope and dSlope (table 1). P values in all variables were significant except for peak: baseline ratio.

Table 1: summary of the tissue oximetry variables. Data presented as Mean and SD.
SD: standard deviation. ED: endothelial dysfunction. * p value < 0.05

Tissue oximetry Variables	Mean		SD		Difference between normal and ED groups	P value
	ED Group	Normal Group	ED Group	Normal Group		
Delta (peak-baseline)	12.79	20.33	7.9	8.7	1.60	0.017 *
rAUC	0.13	0.28	0.012	0.013	2.15	0.002 *
dAUC	0.072	0.11	0.031	0.043	1.52	0.017 *
rSlope	14112	21769	4388	8933	1.54	0.009 *
dSlope	133451	219614	60486	82021	1.65	0.004 *
ratio of peak: baseline	1.23	1.31	0.15	0.18	1.07	0.117

Conclusion: Our data showed that somatic rSO_2 as a promising tool for assessment of endothelial function. Further study is needed to assess the fidelity of tissue oximetry against a gold standard test for endothelial dysfunction.

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