Accuracy of peripheral arterial tonometry in the diagnosis of obstructive sleep apnea

**Pinto JA, Mello de Godoy LB, Ribeiro RC, Mizoguchi EI, Medeiros Hirsch LA, Gomes LM**

Thirty patients with suspected obstructive sleep apnea, (OSA), underwent WatchPAT and assisted nocturnal polysomnography concomitantly.

**RESULTS:** The apnea/hypopnea index (AHI) values of both sleep studies were significantly correlated (r = 0.762). There was a high correlation between variables: minimum oxygen saturation (r = 0.842, p < 0.001), oxygen saturation < 90% (r = 0.799, p < 0.001), and mean heart rate (r = 0.931, p < 0.001). Sensitivity and specificity were 69% and 96.2% (AUC: 0.727; p = 0.113), respectively, when at a threshold value of 5 events/h.

In severe cases (≥30 events/h), the result was a sensitivity of 77.8% and a specificity of 86.4% (AUC: 0.846, p = 0.003). Mean WatchPAT AHI was significantly higher than that by polysomnography (p < 0.001).

**CONCLUSION:** Peripheral arterial tonometry is a useful portable device for the diagnosis of obstructive sleep apnea; its accuracy is higher in moderate and severe cases.


Home-based diagnosis of obstructive sleep apnea in an urban population.

**Garg N, Rolle AJ, Lee TA, Prasad B.**

Tested the feasibility of WatchPAT-200 with an in-laboratory simultaneous polysomnography (PSG) study, and an at home WatchPAT only study in 75 (57 females, age 45 ± 11 years), urban African Americans with high pre-test probability of obstructive sleep apnea (OSA), identified with the Berlin questionnaire.

**RESULTS:** WatchPAT technical failure rates were 5.3% for home vs. 3.1% for in-lab. tests. There was good agreement amongst the apnea hypopnea indices. The areas under the curve for the receiver-operator characteristic curves for home WatchPAT were 0.90 for AHIPSG ≥ 5, 0.95 for AHIPSG ≥ 10, and 0.92 for AHIPSG ≥ 15. 62/75 (82%). Participants preferred home over in-laboratory testing.

**CONCLUSION:** Home WatchPAT monitoring for diagnosis of OSA in a high risk urban population is feasible, accurate, and preferred by patients. As home testing may improve access to care, the cost-effectiveness of this diagnostic strategy for OSA should be examined in underserved urban and rural populations.


Secondary prevention strategy of cardiovascular disease using endothelial function testing.

**Matsuzawa Y, Guddeti RR, Kwon TG, Lerman LO, Lerman A.**

Review of secondary prevention strategy of cardiovascular disease using endothelial function testing, in which the authors summarize current knowledge on the contribution of endothelial dysfunction to atherosclerotic CV disease in the secondary prevention setting and focus on the potential of an endothelial function-guided management strategy in secondary prevention.

Authors discuss the desirability of having a methodology for directly assessing the functional significance of atherogenesis, and for managing individual patients based on their comprehensive vascular health, and focus on the pivotal role of endothelial function in all stages of atherosclerosis, from initiation to atherothrombotic complication. They surmise that endothelial function reflects the integrated effect of all the atherogenic and atheroprotective factors present in an individual.

**CONCLUSION:** The mainstays of noninvasive assessment of endothelial function, principally FMD and EndoPAT-RHI, may provide important information for individual patient risk and guidance of therapy at different stages of atherosclerotic disease. However, more solid clinical evidence on the utility of endothelial function-guided treatment strategy in preventing CV diseases is required before it can be widely adopted in daily clinical practice.


Treating coronary disease and the impact of endothelial dysfunction.

**Matsuzawa Y, Guddeti RR, Kwon TG, Lerman LO, Lerman A.**

(Authors abstract). Ischemic heart disease is the leading cause of morbidity and mortality throughout the world. Many clinical trials have suggested that lifestyle and pharmacologic interventions are effective in attenuating atherosclerotic disease progression and events development. However, an individualized approach with careful consideration to comprehensive vascular health is necessary to perform successful intervention strategies. Endothelial dysfunction plays a pivotal role in the early stage of atherosclerosis and is also associated with plaque progression and occurrence of atherosclerotic complications. The assessment of endothelial function provides us with important information about individual patient risk, progress and vulnerability of disease, and guidance of therapy. Thus, the application of endothelial function assessment might enable clinicians to innovate ideal individualized medicine. In this review, we summarize the current knowledge on the impact of pharmacological therapies for atherosclerotic cardiovascular disease on endothelial dysfunction, and argue for the utility of non-invasive assessment of endothelial function aiming at individualized medicine.

Investigated the predictive value of EndoPAT-InRHI for deep vein thrombosis (DVT) after lower limb arthroplasty in 126 osteoarthritic patients who underwent total knee arthroplasty (TKA) or hip arthroplasty (THA). InRHI was measured on the day before surgery, and presence of DVT was checked by ultrasonography or phlebography before and after surgery.

**RESULTS:** Following arthroplasty, DVT was diagnosed in 51 patients (40.5%). InRHI in the DVT group (0.58±0.25) was significantly lower than in the non-DVT group (0.71±0.25, P=0.004). InRHI was a significant and independent predictor of postoperative DVT in multivariate logistic regression analyses and improved net reclassification index (23.8%, P=0.022). Subgroup analyses according to operation site with adjustment for Qthrombosis score demonstrated that InRHI significantly predicted postoperative DVT in the THA group (P=0.03), but did not reach statistical significance in the TKA group.

**CONCLUSIONS:** Low lnRHI was significantly associated with DVT after lower limb arthroplasty. Endothelial dysfunction, as assessed by EndoPAT-lnRHI, is potentially useful for identifying patients at high risk for VTE especially after THA.


Utility of Noninvasive Endothelial Function Test for Prediction of Deep Vein Thrombosis After Total Hip or Knee Arthroplasty.

**Utility of both carotid intima-media thickness and endothelial function for cardiovascular risk stratification in patients with angina-like symptoms.**


Investigated whether the addition of carotid intima-media thickness (CIMT) and EndoPAT-RHI to Framingham Cardiovascular Risk Score (FCVRS) and Myocardial perfusion scintigraphy (MPS) improves comprehensive cardiovascular risk prediction in patients presenting with angina-like symptoms, in 343 consecutive patients with angina-like symptoms suspected of having stable angina. MPS, CIMT, and RHI were performed and patients were followed for cardiovascular events (CEs) for a median of 5.3 years (range 4.4-6.2). Patients were stratified by FCVRS and MPS.

**RESULTS:** During follow-up, 57 patients (16.6%) had CEs. Among patients without perfusion defect, low RHI was significantly associated with CEs. Hazard ratio (HR) [95% confidence interval (CI)] of RHI 2.11 was 6.99 [1.34-128] in the intermediate FCVRS group and 6.08 [1.08-114] in the high FCVRS group. RHI but not MPS predicted hard CEs (cardiovascular death, myocardial infarction, and stroke) independent of FCVRS. Adding RHI to FCVRS improved net reclassification index (20.9%, 95% CI 0.8-41.1, p=0.04). RHI was significantly associated with hard CEs in the high FCVRS group (HR [95% CI] of RHI 1.93 was 5.66, p=0.007).

**CONCLUSION:** EndoPAT-RHI may improve discrimination in identifying at-risk patients for future CEs when added to FCVRS-MPS-based risk stratification.


Attenuation in peripheral endothelial function after continuous flow left ventricular assist device therapy is associated with cardiovascular adverse events.

Eighteen heart failure (HF) patients with continuous flow left ventricular assist device (CF-LVAD) implantation were prospectively observed for adverse cardiovascular events, (death, thrombosis, bleeding, HF, renal failure, or arrhythmia).

EndoPAT-RHI was measured before and after CF-LVAD implantation to evaluate sequential changes in endothelial function.

**RESULTS:** Preoperative RHI was 1.77±0.39, 7-14 days after operation RHI significantly decreased to 1.19±0.31 (P<0.001). At 4-6 weeks and 3-7 months after operation, RHI remained lower at 1.48±0.50 (P=0.030) and 1.26±0.37 (P=0.002), respectively. The decrease in early postoperative RHI relative to preoperative RHI was significantly associated with adverse cardiovascular events after CF-LVAD (age-adjusted risk ratio for 0.25 decrease in RHI, 1.35; 95% confidence interval: 1.13-1.62, P=0.001).

**CONCLUSION:** RHI had a significant and persistent decline up to 5 months following implantation of CF-LVAD, and this decline was associated with adverse cardiovascular events. These findings may provide insight into some of the vascular complications following CF-LVAD in HF patients.

Association of Lp-PLA2 with digital reactive hyperemia, coronary flow reserve, carotid atherosclerosis and arterial stiffness in coronary artery disease.


Investigated the association of blood levels of lipoprotein-associated Phospholipase A2 (Lp-PLA2) with 1) carotid intima-media thickness (CIMT), 2) EndoPAT-RHI, 3) coronary flow reserve (CFR), by Doppler echocardiography 4) pulse wave velocity (PWV) in 111 patients with angiographically documented chronic CAD.

**RESULTS:** Patients with Lp-PLA2 concentration > the 50th percentile had higher CIMT, PWV and lower RHI and CFR compared to those with lower Lp-PLA2 (p < 0.05 for all). Lp-PLA2 was positively associated with CIMT (r = 0.02), PWV (p = 0.04) and inversely with RHI (p < 0.001) and CFR (p = 0.002). In multivariate analysis, Lp-PLA2 was an independent determinant of RHI, CFR, CIMT and PWV (p < 0.05 for all vascular markers). Lp-PLA2, RHI and CFR were independent predictors of cardiac events during a 3-year follow-up.

**CONCLUSION:** Elevated Lp-PLA2 concentration is related to endothelial dysfunction, carotid atherosclerosis, impaired coronary flow reserve and increased arterial stiffness and adverse outcome in CAD patients. Its prognostic role in chronic CAD may be due to a generalized detrimental effect on endothelial function and arterial wall properties.


Endothelial Function Predicts New Hospitalization due to Heart Failure Following Cardiac Resynchronization Therapy.


Thirty-four consecutive patients implanted with Cardiac resynchronization therapy (CRT) for the treatment of advanced HF were evaluated with EndoPAT-RHI at baseline (Immediately before CRT) and 6-8 months after CRT. In 24 patients CFR was determined by transthoracic echocardiography. Depressed RHI was defined as 1.5, based on ROC curve analysis. Follow-up during 34±120 days was obtained in 20 preserved RHI group (age 66±1.8 years) and 14 depressed RHI group (71±2.2 years).

**RESULTS:** Kaplan-Meier survival analysis demonstrated that depressed RHI group had higher prevalence of new hospitalization due to HF progression (log-rank 5.40). Cox proportional hazards regression analysis revealed that baseline log 8-type Natriuretic Peptide (BNP) and baseline RHI were independently associated with the incidence of new hospitalization due to HF progression. Baseline RHI values were positively correlated with the 6-8 month change of CFR (R = 0.434, p = 0.0343).

**CONCLUSION:** Baseline RHI could predict the long-term outcome of CRT, and improvement of coronary microcirculation might be associated with better baseline RHI.


Physical activity below the minimum international recommendations improves oxidative stress, ADMA levels, resting heart rate and small artery endothelial function.


Studied the impact of a lower than moderate level of physical activity (PA) level on cardiovascular health in 64 overweight/obese men and women who were enrolled in a community program of 4 months of 1h, low-intensity PA two days per week. Before and after the intervention, PA level (METs/h/wk), endogenous antioxidant status (SOD and GPX concentration and activity and oxidised LDL), ADMA concentrations, endothelial function (EndoPAT - RHI), and resting heart rate (RHR) were assessed.

**RESULTS:** After the intervention, significant increases occurred in RHI (P=0.031), SOD and GPX activities, and decreases in ADMA plasma concentrations, and RHR (P<0.001 for all). Increases in PA were positively associated with increases in RHI (n=0.341, P=0.022), GPX (r=0.303, P=0.047) and decreases in RHR (r=-0.302, P=0.047). Multivariate analyses showed that independent predictors of RHI improvement were an increase in PA, decrease in RHR, and an increase in GPX.

**CONCLUSION:** In obese and overweight men and women, an increase in PA, even below the minimal international recommendations, improves antioxidant capacity, RHR and RHI.


Impact of physical training on endothelial function in myocardial infarction survivors-pilot study.


Assessed the influence of cardiac rehabilitation (CR) on endothelial function determined by EndoPAT-RHI in 29 patients after ST-segment elevation myocardial infarction (STEMI) scheduled for CR which began at least 4 weeks after STEMI and consisted of 12 or 24 training sessions.

**RESULTS:** ED was diagnosed in 16 of 29 patients before CR, 25 of whom had RHI assessments before and after CR. In univariate analysis the factors of negative response of EndoPAT-RHI to CR were higher baseline lnRHI (p=0.01) and higher peak serum troponin I level during hospitalization (p=0.04). The independent negative predictor of response to CR was lnRHI (p=0.03). Patients training for 24 sessions (n=16), or 12 sessions (n=9) had similar lnRHI changes.

**CONCLUSION:** ED is frequent in STEMI survivors. Despite the lack of statistically significant improvement of endothelial function after CR between the groups, some factors can influence the efficacy of this type of physical activity. The best effect of CR on RHI was observed in patients with baseline ED.

Spotlight on
Dr. Yasushi Matsuzawa

Dr. Yasushi Matsuzawa MD, PhD. is currently at the Division of Cardiology, Yokohama University Hospital, Yokohama, Japan, where he serves as a cardiologist and researcher. He is a graduate of the Toyama University; Toyama, Japan, and subsequently worked in Prof Ogawa’s prestigious group in Komamoto University, Komamoto City.

From 2013 to 2015 Dr. Matsuzawa worked as a research fellow with Prof. Amir Lerman at the Mayo Clinic in Rochester, MN, USA, where he was particularly involved in PAT research.

His current research interest is focused on the association of microbiota related inflammation, frailty, sarcopenia, and inflammation in acute phase post myocardial infarction with endothelial function. He has published over 70 original peer-reviewed publications.

Dr. Matsuzawa and his colleagues have contributed greatly to the scientific base and clinical acceptance of the EndoPAT in the growing field of ENDOPAT research, as can be appreciated from the following list of publications, including a 2010 publication which demonstrated that EndoPAT can predict high-risk women for ischemic heart disease, and especially non-obstructive coronary artery disease before angiography, at 81% sensitivity and 80% specificity.


