**Relationship Between Snoring Intensity and Severity of Obstructive Sleep Apnea.**


Determined the relationship between snoring intensity and sleep apnea severity in 404 patients (338 males, age 46.5±14.8, BMI 24.7±3.4), who underwent a home-based sleep study using Watch-PAT 100. Subjects were divided into 4 groups; no OSA (pAHI <5/hour), mild OSA (pAHI = 5-14/hour), moderate OSA (pAHI = 15-30/hour), or severe OSA groups (pAHI >30/hour), and corresponding snoring intensity and percent sleep time with snoring.

**RESULTS:** Mean AHI and RDI were 16.5±15.3/hour and 20.8±14.3/hour, respectively. Mean snoring intensity in the no, mild, moderate, and severe OSA groups was 44.0±2.7, 45.4±6.0, 47.7±5.0, and 50.5±5.6 dB, respectively (P<0.001). There was a positive correlation between snoring intensity and pAHI or PAT RDI (r=0.391 and r=0.385, respectively, both P<0.001), and a positive correlation between percent sleep time with snoring intensity greater than 50 dB and pAHI or pRDI (r=0.423 and r=0.411, respectively, both P<0.001).

**CONCLUSION:** This study revealed that intensity of snoring increased with severity of sleep apnea, suggesting that snoring loudness might be indicative of OSA severity.


**Breath-by-breath detection of apneic events for OSA severity estimation using non-contact audio recordings.**


Tested whether breath-by-breath, inspiratory and expiratory phases audio analysis of the respiratory cycle during sleep can reliably estimate the apnea hypopnea index (AHI) in 186 referred adults using in-laboratory polysomnography, (PSG), and at-home WatchPat studies respectively.

**RESULTS:** A/H events were automatically segmented and classified using a binary random forest classifier. Total accuracy rate of A/H event detection was achieved in PSG and at-home conditions respectively.

**CONCLUSION:** A/H events can be reliably detected at their exact time locations during sleep using non-contact audio approach, to evaluate AHI in at home conditions.


**High-resolution wrist-worn overnight oximetry has high positive predictive value for obstructive sleep apnea in a sleep study referral population.**

Kunisaki KM, Bohn OA, Wetherbee EE, Rector TS. Sleep Breath. 2016 May;20(2):583-7

Determined if an established sleep apnea screening questionnaire (STOP-BANG) and overnight oximetry could provide high positive predictive value for the presence of OSA based on a prospective observational study of 234 consecutive patients undergoing WatchPAT 200 testing. Assessed area under the receiver-operating characteristic curve (ROC AUC) and positive predictive value (PPV) of STOP-BANG score and oxygen desaturation index (ODI) for a respiratory disturbance index (RDI) ≥15/h as determined by WatchPAT.

**RESULTS:** 65% had an RDI ≥15/h. STOP-BANG had a poor ROC AUC of 0.62, but adding ODI increased ROC AUC to 0.86. STOP-BANG score did not contribute diagnostic information to ODI alone (ROC AUC 0.86). Forty nine percent had an ODI ≥7/h, which had a PPV of 92%. In a validation sample of 1,196 consecutive patients, ODI ≥7/h had a PPV of 97%.

**CONCLUSION:** Among patients with a high prevalence of OSA, high ODI has high PPV for OSA, suggesting that overnight oximetry could significantly reduce the number of patients requiring sleep studies.


**The effect of maternal sleep-disordered breathing on the infant’s neurodevelopment.**


Examined the effect of maternal sleep-disordered breathing (SDB) on infant general movements (GMs), and neurodevelopment in 74 pregnant women with uncomplicated full-term pregnancies, who completed a sleep questionnaire and underwent WatchPAT testing. Mothers were categorized as SDB (apnea hypopnea index≥5) or controls. Infant GMs were assessed in the first 48 hours and at 8-11 and 14-16 weeks of age. At 12 months the Infant Developmental Inventory and the Brief Infant Sleep Questionnaire were administered.

**RESULTS:** Eighteen (24%) women had SDB. No differences in GM scores in all 3 evaluations were found between infants of mothers with SDB and controls. Low social developmental score was detected at 12 months in 64% of infants born to SDB mothers vs. 25% of infants born to controls (adjusted P=.036; odds ratio, 16.7). Infant snoring was reported by 41.7% of mothers with SDB vs. 7.5% of infants born to controls (adjusted P=.036). Infant social developmental score was detected at 1 year.

**CONCLUSION:** Maternal SDB during pregnancy had no adverse effect on neonatal and infant neuromotor development but may affect social development at 1 year.

**Latest PAT® Publications**

**TranQuill sling snoreplasty for snoring: A single-arm pilot study for safety and effectiveness.**

*Murphey AW, Nguyen SA, Fuller C, Weber AC, Camilon MP, Gillespie MB.*

Determined the safety and efficacy of TranQuill Sling Snoreplasty (TSS), for the treatment of snoring in in 20 adults recruited to TSS; (13 males, average age 49.1, BMI <32), with chronic, disruptive snoring as assessed by bed partner, with benign snoring or mild obstructive sleep apnea sleep disordered severity (apnea hypopnea index < 15, minimum oxygen saturation >85%, assessed by WatchPAT and flexible endoscopy). Outcomes were assessed comparing the results of quality-of-life questionnaires, bed partner-assessed snoring, pain visual analog scales measured at baseline and 90-day follow-up.

**RESULTS:** TranQuill Sling Snoreplasty significantly reduced snoring symptom scores from 8.70 ± 4.27 to 6.42 ± 4.14, P = 0.012. Snoring visual analog scores were reduced from 59.4 mm ± 22.1 to 41.6 mm ± 29.2, (p=0.0184). Thirty-five percent (7/20) of subjects reported complications related to the trial, with no serious adverse events.

**CONCLUSION:** TranQuill Sling Snoreplasty is a safe therapy that improves snoring symptoms in most adult subjects with benign snoring or mild sleep apnea. Further study is required to better identify patients likely to respond to TSS.


**Peripheral arterial endothelial dysfunction of neurodegenerative diseases.**


Evaluated EndoPAT-RHI and serological data of neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS, n=75), Parkinson’s disease (PD, n=180), progressive supranuclear palsy (PSP, n=30), multiple system atrophy (MSA, n=35) and spinocerebellar ataxia (SCA, n=53), compared with age/gender matched normal controls (n=302).

**RESULTS:** RHI in ALS and PD, but not in PSP, MSA or SCA, were significantly lower than normal controls (p<0.01). RHI was negatively correlated with serum triglycerides (TG) and immunoreactive insulin (IRI) levels in ALS, but not with disease severity or rates of disease progression. PD showed a negative correlation of RHI with a progressive disease severity, and a positive correlation of RHI with early/delayed MIBG scintigraphy, but not with serological data.

**CONCLUSION:** RHI was significantly reduced in ALS and PD. RHI in ALS was more correlated with disease duration and serum parameters while RHI in PD was more correlated with disease severity and MIBG, suggesting different mechanisms of endothelial dysfunction.


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**Impact of teneligliptin on oxidative stress and endothelial function in type 2 diabetes patients with chronic kidney disease: a case-control study.**

*Sagara M, Suzuki K, Aoki C, Tanaka S, Taguchi I, Inoue T, Aso Y.*

Elucidated the effect of teneligliptin on oxidative stress and endothelial function in 45 Japanese patients with type 2 diabetes and chronic kidney disease (CKD), who had received sitagliptin for at least 12 months, randomized to either continue sitagliptin (n = 23) or switched to teneligliptin (n = 22) for 24 weeks. Treatment groups were matched for age body habitus and clinical parameters. Changes in blood pressure, HbA1c, eGFR, albumin excretion, EndoPAT-RHI, reactive oxygen metabolites (ROMs), 8-hydroxy-2’-deoxyguanosine, urinary liver-type fatty acid binding protein (L-FABP), and urinary 8-isoprostane were measured at baseline and after 24 weeks.

**RESULTS:** Treatment with teneligliptin, but not sitagliptin, significantly improved RHI values and was correlated with the percent changes in RHI and d-ROMs. No significant changes of HbA1c, eGFR, or urinary albumin excretion levels between the two groups after 24 weeks of treatment.

**CONCLUSION:** Teneligliptin can improve EndoPAT-RHI, and reduce renal and vascular oxidative stress in patients with type 2 diabetes and CKD, independently of reducing albuminuria or improving glucose control.


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**Lack of Evidence for Deterioration in Endothelial Function Following Ticagrelor Treatment Cessation.**

*Xanthopoulou I, Vogiatzi C, Bampouri T, Chasapi A, Bei I, Davlouros P, Halahis G, Alexopoulos D.*

Assessed the possibility of endothelial function deterioration following ticagrelor treatment cessation in 30 stable CAD patients (86.7% men, 13.3% with diabetes and 33.3% current smokers; mean age: 63±11.5 years), with prior percutaneous coronary intervention (PCI) for acute coronary syndrome 1 year earlier, under ticagrelor maintenance dose (90 mg bid), and due to discontinue. EndoPAT-RHI was measured immediately after the last dose of ticagrelor (Day 0) and at days 2 and 5 post-ticagrelor cessation. Endothelial dysfunction (ED) was defined as an RHI <1.67.

**RESULTS:** Neither RHI nor ED rate at Day 0 differed significantly to RHI at Day 2, or Day 5.

**CONCLUSION:** In stable CAD patients there is no evidence of deterioration in endothelial function after discontinuing ticagrelor.

**Effective Apnea-Hypopnea Index ("Effective AHI"): A New Measure of Effectiveness for Positive Airway Pressure Therapy.**


Assessed a new measure of positive airway pressure (PAP) effectiveness, the Effective AHI, which measures residual sleep disordered breathing events during PAP treatment with PAP on or off, per total sleep time by using in-laboratory polysomnogram (PSG) in 28 (21 males), PAP treated patients. WatchPAT 200 (WP) accuracy was concomitantly tested for measurement of Effective AHI.

**RESULTS:** Mean Effective AHI of 18.3, was significantly lower than the mean Diagnostic AHI of 67.9 (P < 0.0001). All patients using PAP ≥6 h had an Effective AHI <5.

**There was a high correlation between the PSG and WP for the Effective AHI (r = 0.871).**

**CONCLUSION:** Significant disease burden, as measured by the Effective AHI, may exist in many patients with severe OSA in whom PAP therapy is not utilized for the entire sleep period. WP is a reasonably accurate device to measure the Effective AHI.


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**C-type natriuretic peptide is closely associated to obesity in Caucasian adolescents.**


Clin Chim Acta. 2016 Sep 1;460:172-7

Evaluated C-type natriuretic peptide (CNP) plasma levels in normal-weight (N), overweight (OW) and obese adolescents (O), in 82 subjects without cardiac dysfunction, [age:12.8±2.4, years]. NT-proBNP, MR-proANP, AGEs, EndoPAT-RHI, and standard clinical chemistry parameters were measured.

**RESULTS:** 0 and OW adolescents had higher values of BMI and fat mass than N. CNP levels were significantly higher in N vs. OW and O (p<0.0003, p=0.0001, respectively).

LogCNP was significantly inversely correlated with BMI z-score, FM%, TF%, CRP, insulin, total cholesterol, LDL, triglycerides, LogNT-proBNP and LogMR-proANP values, and with skin AGEs and was positively correlated with RHI. Using ROC analysis, the risk of obesity was significantly associated with CNP values (AUC=0.9724, p<0.0001).

**CONCLUSION:** CNP may play a more important role than BNP and ANP related peptides, as risk marker of obesity, in addition to its involvement in adipogenesis and endothelial dysfunction.


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**Assessment of vascular autonomic function using peripheral arterial tonometry.**


Aimed to establish a novel index to evaluate vascular autonomic function based on the ratio of the post-occlusion pulse amplitude to the baseline pulse amplitude in the non-occluded arm following a 5 min occlusion of the contralateral arm (RPN) using the EndoPAT, in 65 subjects including healthy subjects, cases with sympathetic nerve blockers, and diabetic patients. Calculated the ratio of the post-occlusion pulse amplitude to the baseline in the non-occluded arm with a 1min sliding window.

**RESULTS:** In healthy subjects, RPN gradually increased over time but not in cases with sympathetic nerve blockers. Plasma norepinephrine was significantly increased after the blood flow occlusion. RPNs had the highest correlation with the change in sympathetic heart rate variability (HRV) parameter 5 min after reperfusion, and was named the sympathetic hypoemia index (SHI). SHI was significantly lower in diabetic patients than matched controls.

**CONCLUSION:** SHI, a novel index derived from EndoPAT, represents peripheral sympathetic activity, and may be useful for assessing vascular autonomic activity in diabetic patients.


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**Determined the clinical value of WatchPAT in 50 snoring children aged 3–11, during simultaneous in-lab polysomnography (PSG). ROC curve analysis was performed to assess sensitivity and specificity in the diagnosis of OSA with WatchPAT.**


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**RESULTS:** OSA was diagnosed by both WatchPAT and PSG in 14 6–11 years olds. In 3–5 year olds, 6 children were diagnosed as OSA, with significant difference between WatchPAT and PSG (P<0.05). Among 6–11 year olds, WatchPAT showed that OSA children had decreased sleep stages III+IV, REM sleep duration, total sleep time, (TST), and sleep efficiency, with increased sleep stages I+II, arousal index, AHI, and RDI vs. non-OSA. WatchPAT TST and sleep efficiency were higher than by PSG.

**CONCLUSION:** WatchPAT can be used at home in school age children due to its high consistency with PSG, and its high compliance.


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Dr. Ding Zou is a senior researcher at the center for sleep and vigilance disorders, University of Gothenburg, Sweden. He trained in cardiology at Fu Wai Hospital, Peking Union Medical College and the Chinese Academy of Medical Sciences, Beijing. His PhD thesis from the University of Gothenburg, Sweden in 2010 was focused on clinical applications in sleep with the PAT signal: “Assessment of Peripheral Arterial Tone – Clinical Applications in Sleep Medicine”.

Dr. Zou’s current research interests includes cardiovascular and autonomic regulation in sleep, the clinical utility of nocturnal finger pulse wave signal as an alternative method for sleep apnea diagnosis, cardiovascular risk assessment and the pharmacological treatment of obstructive sleep apnea.

Dr. Zou and colleagues have made major contributions to the physiological underpinnings and scientific base as well as the clinical acceptance of the WatchPAT as evidenced by the following publications:


