# Posters

## 68 Clinical Implications of Excess Parasympathetic Responses to Sympathetic Challenges

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Autonomic nervous system (ANS) monitoring based on real-time heart rate variability and wavelet spectral analysis provides an independent, objective means of monitoring both ANS branches at the same time. Recent findings from concurrent parasympathetic and sympathetic measurements in response to sympathetic stimuli have uncovered an unexpected, clinically relevant condition, which has been labeled the Paradoxic-Parasympathetic Syndrome (PPS). PPS is a dynamic ANS imbalance that seems to accompany many diffuse and ill defined symptoms mostly occurring together, including sleep difficulties, night edema (with jittery legs), mild cognitive difficulties, and low grade morning headaches. PPS has also been found to manifest as different disorders in different patients.

PPS seems to destabilize the disease response or the therapy response or both. Whether PPS is the cause of the disorder or is caused by the disease or a little of both is not known, and probably an individual by individual issue, however, physicians have observed that correcting for this dynamic autonomic imbalance can reduce the severity of the disease or disorder, and in some cases eliminate the symptoms all together. The current working hypothesis is that PPS is independent of the clinical state of the patient and can be treated independently.

Current therapy for PPS targets systemic parasympathetic outflow from the ANS centers in the Medullary Brainstem. To date, patients with healthier ANSs have had this imbalance corrected in 9 to 12 months and have been weaned, thus, utilizing the plasticity of the patient's nervous system to re-establish and maintain a new more appropriate operating balance for the patient.

Sample longitudinal studies from ADD patients are included to illustrate the syndrome and demonstrate the possible therapy plans. The patients are diagnosed with ADD or ADHD and some included depression. The patients (as previously diagnosed) were on Aderol or Ritalin. After beginning the ANS therapy (25 mg Elavil QHS with 100 mg Norpace BID) the patients were weaned from the Aderol or Ritalin with no change in their ability to concentrate and focus. As and if needed, patients can be titrated up to 50 mg Elavil and 200 mg Norpace). In some cases, orthostasis can exist or can be unmasked as the PPS is reduced. In these cases, 2.5 mg ProAmatine BID for four to six months, or until the orthostasis is resolved. The patients depicted here all reported feeling "more alive" and still able to concentrate and focus, even after being weaned from therapy and are now drug free.

## Effects of Industrial Solvents on Human Autonomic Nervous System

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**Introduction:** It has been shown in anesthetized animals that heavy metals and industrial solvents affect blood pressure (BP), heart rate (HR), and HR variability (HRV). It has also been shown that these agents affect the functioning of sympathetic nerves (Kobayashi, *et al.*, 1983; Kobayashi, *et al.*, 1987; Laine, *et al.*, 1996; Xu, *et al.*, 2002). Recently we studied workers in heavy industry and compared their autonomic test results with patients with known damage to medullary autonomic centers.

**Methods:** Seven workers (ages 36 to 57), three age matched normals, an elderly normal, and two patients were studied. The two patients include, one (age 54) with known medullary autonomic injury due to auto accident, and the other with late stage diabetes and cancer (age 79) with proven severe autonomic neuropathy. A non-invasive, autonomic monitor was used to measure the subjects' and patients' autonomic responses at rest and to challenges: a five minute period of rest, a one minute parasympathetic challenge of deep breathing, a 1:35 minute sympathetic challenge of a series of short Valsalva maneuvers (10-15 seconds), and a quick postural change from sitting to standing and remain standing for five minutes. Autonomic nervous system (ANS) responses were computed using continuous wavelet transform analysis of published HRV practices using respiration (Akselrod, *et al.*, 1981, 1985, 1987, 1988).

**Results:** All seven workers showed altered resting and dynamic autonomic functioning as compared with their age matched normals and published HRV normal ranges. Baseline measures of workers' ANS activity declined with time of expo-

sure, with the parasympathetic measure declining faster. All workers, except those with the shortest exposures, showed little if any parasympathetic response to deep breathing and highly altered ANS responses to sympathetic challenge, including an excess parasympathetic response (paradoxic parasympathetic syndrome, PPS: an unexpected increase in parasympathetic activity in response to a sympathetic challenge). The workers' autonomic responses to postural change were not correlated; however, it has been reported that orthostasis can be masked by PPS (Stoupakis, *et al.*, 2002). Workers with the longest exposures matched or nearly matched both the resting and dynamic responses of the two patients, and were significantly lower than the elderly normals' autonomic responses.

**Conclusions:** The results of autonomic testing seem to indicate a significant correlation between severity of autonomic dysfunction and time of exposure to industrial solvents. The test results from those with long term exposures indicate autonomic dysfunction characteristic of patients with known autonomic damage. Thus, it seems as if long-term exposure to industrial solvents can accelerate autonomic demise, similar to severe injury or chronic disease and hasten "autonomic aging."