

**Neural substrates linking balance control and anxiety.**

- [Balaban CD.](#)

Department of Otolaryngology, University of Pittsburgh, Pittsburgh, PA, USA. [cbalaban@pitt.edu](mailto:cbalaban@pitt.edu)

This communication provides an update of our understanding of the neurological bases for the close association between balance control and anxiety. New data suggest that a vestibulo-recipient region of the parabrachial nucleus (PBN) contains cells that respond to body rotation and position relative to gravity. The PBN, with its reciprocal relationships with the extended central amygdaloid nucleus, infralimbic cortex, and hypothalamus, appears to be an important node in a primary network that processes convergent vestibular, somatic, and visceral information processing to mediate avoidance conditioning, anxiety, and conditioned fear responses. Noradrenergic and serotonergic projections to the vestibular nuclei also have parallel connections with anxiety pathways. The coeruleo-vestibular pathway originates in caudal locus coeruleus (LC) and provides regionally specialized noradrenergic input to the vestibular nuclei, which likely mediate effects of alerting and vigilance on the sensitivity of vestibulo-motor circuits. Both serotonergic and nonserotonergic pathways from the dorsal raphe nucleus and the nucleus raphe obscurus also project differentially to the vestibular nuclei, and 5-HT(2A) receptors are expressed in amygdaloid and cortical targets of the PBN. It is proposed that the dorsal raphe nucleus pathway contributes to both (a) a tradeoff between motor and sensory (information gathering) aspects of responses to self-motion and (b) a calibration of the sensitivity of affective responses to aversive aspects of motion. This updated neurologic model continues to be a synthetic schema for investigating the neurological and neurochemical bases for comorbidity of balance disorders and anxiety disorders.

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**Neurological bases for balance-anxiety links.**

- [Balaban CD,](#)
- [Thayer JF.](#)

Department of Otolaryngology, University of Pittsburgh School of Medicine, PA, USA.

This review paper examines neurologic bases of links between balance control and anxiety based upon neural circuits that are shared by pathways that mediate autonomic control, vestibulo-autonomic interactions, and anxiety. The core of this circuitry is a parabrachial nucleus network, consisting of the parabrachial nucleus and its reciprocal relationships with the extended central amygdaloid nucleus, infralimbic cortex, and hypothalamus. Specifically, the parabrachial nucleus is a site of convergence of vestibular information processing and somatic and visceral sensory information processing in pathways that appear to be involved in avoidance conditioning, anxiety, and conditioned fear. Monoaminergic influences on these pathways are potential modulators of both effects of vigilance and anxiety on balance control and the development of anxiety and panic. This neurologic schema provides a unifying framework for investigating the neurologic bases for comorbidity of balance disorders and anxiety.

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**A clinical taxonomy of dizziness and anxiety in the otoneurological setting.**

- [Furman JM](#),
- [Jacob RG](#).

University of Pittsburgh School of Medicine, PA, USA.

Dizziness can be associated with otologic, neurologic, medical, and psychiatric conditions. This paper focuses on the interface between otologic and psychiatric conditions. Because dizziness often is situation specific, concepts of space and motion sensitivity (SMS), space and motion discomfort (SMD), and space and motion phobia (SMP) are needed to understand the interface. We present a framework involving several categories of interactions between balance and psychiatric disorders. The first category is that of dizziness caused by psychiatric disorder (psychiatric dizziness), including hyperventilation-induced dizziness during panic attacks. The second category involves chance cooccurrence of a psychiatric disorder and a balance disorder in the same patient. The third category involves problematic coping with balance symptoms (psychiatric overlay). The fourth category provides psychological explanations for the relationship between anxiety and balance disorders, including somatopsychic and psychosomatic relationships. The final category, neurological linkage, focuses on the overlap in the neurological circuitry involved in balance disorders and anxiety disorders.

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**The vestibular dysfunction and anxiety disorder interface: a descriptive study with special reference to the elderly.**

- [Nagaratnam N,](#)
- [Ip J,](#)
- [Bou-Haidar P.](#)

Aged Care and Rehabilitation Services, Department of Medicine, Blacktown-Mt.Druitt Health, Blacktown, NSW 2148, Australia. nage@mail2me.com.au

Vestibular abnormalities co-existing with anxiety disorders are not uncommon and there has been a renewal of interest in recent times. Although well known over centuries, there is often a delay in the recognition of this relationship by the primary care physician and the specialist alike. Dizziness embracing vertigo, unsteadiness and imbalance are common in the elderly, so is generalized anxiety disorder, which is a common psychiatric problem in later life. This is a retrospective study of eight patients with vestibular symptoms and an anxiety disorder present over several years with lack of awareness of their relationship. The diagnoses of the anxiety disorders were based on the Diagnostic and Statistical Manual (DSM-IV) criteria and the effect of treatment measured on a clinician-based impression interview. There was one male and seven females and the mean age was 72 years. Apart from the vestibular symptoms present in all the patients, the anxiety disorders comprised, generalized anxiety disorder in three, panic attacks in five and with agoraphobia in three. Four patients had hyperventilation, one sleep apnea, and two somatization disorders. They had all presented to clinicians in different disciplines and had had several investigations. Five had been treated in this study with alprazolam and three with citalopram, with modest to good results. Two had rehabilitation therapy as well. The cases described mirror the well-documented co-existence of vestibular and anxiety disorders together with hyperventilation and sleep apnea. The positive findings associated with vestibular dysfunction need recognition in addition to the non-specific psychiatric and behavioral symptoms. We emphasize this relationship and review the literature to alert the clinician.

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**Serotonin reuptake inhibitors for dizziness with psychiatric symptoms.**

- [Staab JP,](#)
- [Ruckenstein MJ,](#)
- [Solomon D,](#)
- [Shepard NT.](#)

Department of Psychiatry, Hospital of the University of Pennsylvania, Founders Pavilion, F11.015, 3400 Spruce St, Philadelphia, PA 19104, USA. jeffrey.staab@uphs.upenn.edu

**OBJECTIVE:** To investigate the efficacy and tolerability of selective serotonin reuptake inhibitors (SSRIs) for the treatment of patients with dizziness and major or minor psychiatric symptoms, with or without neurotologic illnesses. **DESIGN:** Review of 60 consecutive cases of patients with dizziness who were treated with an SSRI for at least 20 weeks during the 30-month period from July 1998 to December 2000. **SETTING:** Tertiary care, multidisciplinary referral center. **PATIENTS:** Sixty men and women, aged 13 to 81 years, with (1) psychogenic dizziness, (2) dizziness due to a neurotologic condition, as well as significant psychiatric symptoms, or (3) idiopathic dizziness. **INTERVENTIONS:** Open-label treatment with an SSRI titrated to 1 of 3 end points: optimal clinical benefit, intolerable adverse effects, or no therapeutic response. **MAIN OUTCOME MEASURE:** Change in dizziness and psychiatric symptoms measured by the 7-point, clinician-rated, Clinical Global Impressions-Improvement Scale. **RESULTS:** Thirty-eight (63%) of 60 patients in the intent-to-treat sample and 32 (84%) of 38 patients who completed treatment improved substantially. The response rates did not differ between patients with major psychiatric disorders and those with lesser psychiatric symptoms. Patients whose only diagnosis was a psychiatric disorder and those with coexisting peripheral vestibular conditions or migraine headaches fared better than patients with central nervous system deficits. Before being treated with an SSRI, two thirds of the study patients took meclizine hydrochloride and/or benzodiazepines, with minimal benefit. **CONCLUSIONS:** Treatment with SSRIs relieved dizziness in patients with major or minor psychiatric symptoms, including those with peripheral vestibular conditions and migraine headaches. Patients fared far better with SSRI treatment than with treatment with vestibular suppressants or benzodiazepines.

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