Balance task and head orientation dependency of vestibular reflexes in neck muscles

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Publication date
2013

Print this Page

Neuroscience 2013

Presentation Abstract

Program#/Poster#:	367.10/EEE6
Presentation Title:	Balance task and head orientation dependency of vestibular reflexes in neck muscles
Location:	Halls B-H
Presentation time:	Monday, Nov 11, 2013, 9:00 AM -10:00 AM
Topic:	++D.07.d. Perception, posture, and spatial orientation
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Abstract:	Human upright posture of both the head and body is facilitated by the CNS's ability to integrate multiple sensory feedback signals, as well as its discernibility of the motor commands that maintain this stabilization. The vestibular organ in particular detects motion of the head-in-space, which is transformed according to on-going head and body orientation into appropriate motor responses. However, when motor commands do not contribute to the control of standing posture, and are incongruent with their expected sensory consequences, vestibulomuscular responses in the lower limb undergo unconscious suppression. In this study, we investigated whether vestibular response suppression occurs in neck muscles under conditions where the muscles are active but not engaged in a task to balance the head. In addition, we examined the effects of head orientation to identify spatial transformation of vestibular reflex responses. Eight subjects were exposed to stochastic vestibular stimulation (0-75 Hz) in a seated condition while their head was either free or fixed, and rotated at either 0 or 60°. In head-free conditions, subjects were asked to rotate their head 60° to the left in order to activate agonist neck muscle pairs (sternocleidomastoid - SCM and splenius capitis - SPL). In head-fixed conditions, subjects performed isometric neck muscle contractions in yaw at orientations of 0° and 60°, as well as flexion, extension and co-contraction at an orientation of 0°. Intramuscular EMG was collected bilaterally in SCM and SPL muscles. Muscle responses correlated to the input stimuli were significant ($P < 0.05$) for all conditions provided the muscle was used in contraction. Neither muscle underwent the expected vestibulomuscular suppression when not engaged in the balance task (i.e. head-fixed). Nevertheless, the

magnitude of the SPL responses decreased by 22% when the head was fixed whereas SCM responses were unaffected. The effect of head fixation only in SPL suggests differences in neural pathways across muscles, possibly via alternative pathways known to exist in the SPL from the well-established monosynaptic vestibulospinal inputs in SCM and SPL. For both muscles, the effect of orientation and force direction had no effect on muscles responses. Since the stimulation is fixed relative to the head, the same muscles are activated to respond to the input stimulus at both orientations and all force directions. These results indicate that the vestibular pathways connecting neck muscles are less susceptible to suppression than lower limb muscles, most likely because the monosynaptic inputs innervating them are subject to less central control.

Disclosures: **P.A. Forbes:** None. **G.P. Siegmund:** E. Ownership Interest (stock, stock options, royalty, receipt of intellectual property rights/patent holder, excluding diversified mutual funds); MEA Forensic Engineers and Scientists. **R. Happee:** None. **A.C. Schouten:** None. **J. Blouin:** None.

Keyword(s): VESTIBULAR

MUSCLE

BALANCE

Support: Dutch Technology Foundation STW, which is part of the Netherlands Organization for Scientific Research (NWO) and partly funded by the Ministry of Economic Affairs, Agriculture and Innovation

National Sciences and Engineering Research Council of Canada

Canada Foundation for Innovation

Canadian Institutes of Health Research

Canadian Chiropractic Research Foundation