

Laterality of Motor Control and Breathing Share the Same Hemisphere: Considerations Regarding Neuroaxial Anesthesia in Cases with Intracranial Pathology

To the Editor:

As a clinical neurologist with interest in laterality of motor control, I read the review by Leffert and Schwamm¹ regarding neuroaxial anesthesia in parturients with intracranial pathology. They emphasized the role of transtentorial and lateral shifts of the brain in the management of those patients harboring space-occupying lesions. However, as shown in the hitherto neglected figure 7 of the classical article by Kernohan and Woltman,² only half of the patients with supratentorial lesions (35 patients total) developed the ominous pyramidal signs ipsilateral to the tumor, whereas all of them showed notching of the contralateral cerebral peduncle (*i.e.*, only 17 of 35 had ipsilateral pyramidal signs). Clearly, therefore, transtentorial herniation must be discounted as the physiological underpinning for the emergence of those classically described pyramidal signs; the harbinger of “herniation.”^{3–5} Instead, according to the new insight, occurrence of interhemispheric diaschisis provides the proper explanation for the emergence of the pyramidal signs ipsilateral to the major hemisphere (harboring the lesion). As to the authors’ references to lateral shifting of supratentorial contents, it does not fair any better than the transtentorial displacement alternative in explicating the semiology, given the recent insights to the laterality of consciousness and breathing.^{3–7} Thus, motor control (*i.e.*, the command center for movements regardless of the laterality of the effectors involved) resides in the hemisphere which handles respiration and speech at the same time.^{4–7}

One manifestation of this sharing of resources is that speech occurs exclusively as we exhale. Another is the fact that speeches and nonverbal tasks interrupt the performance of the dominant hand more than the nondominant hand, also indicating sharing of resources.^{8,9} Turning to the laterality-indexed symptoms in clinical neurology and similar to the data provided by Kernohan and Woltman, the incidence of epilepsy in lesions distributed equally between the two hemispheres does not exceed 50%. This signifies that only one of the two hemispheres is capable of generating seizures.^{10,11}

Finally, bimanual simultaneous drawing always results in a longer and straighter line drawn by the hand opposite to the major hemisphere (the hemisphere of action) because the nondominant hand falls behind the dominant by an interhemispheric transfer time. The dominant hand, therefore, moves faster than the nondominant if one

swings his or her arms from side to side, manifested by a wider distance between the fists as one moves the arms to his or her neurally dominant side.¹² In the same vein, earlier activation and wider excursion of the right diaphragm while breathing have been documented using dynamic magnetic resonance imaging.⁷

Clinically, lack of a relationship between lateral displacement of the brain (*i.e.*, midline shift) and development of coma has been noted in a prospective study involving emergency room referrals in a metropolitan area.¹³ Interestingly, the study conducted by Melo *et al.* revealed a left to right hemispheric ratio of 7:2 for an ischemic infarction causing coma (among the nine patients studied). This ratio is very similar to that which has been reported in a reaction time study of lexical decision making conducted by Hamer and Lambert¹⁴ where 12 of the 15 right-handed bilingual adults responded faster to stimuli arising in the right visual field with the remainder performing faster in the opposite direction. In conclusion, it is the laterality of the lesion as it relates to the neural handedness of the subject that determines the fate of the patient in the circumstances detailed by the authors, affecting their ability to breathe spontaneously.

Given the above data, a patient’s Glasgow Coma Scale should be the determining factor in the outcome in these patients as the latter is heavily biased toward the integrity of the major hemisphere wherein the command center lies.

Acknowledgments

The author dedicates this work to the tender memories of his beloved sister Farkhondeh Derakhshan (died in exile).

Competing Interests

The author declares no competing interests.

Iraj Derakhshan, M.D., Raleigh General Hospital, Charleston, West Virginia. idneuro@hotmail.com

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In Reply:

The authors wish to thank Dr. Derakhshan for his detailed letter in response to our review,¹ and for reminding the readers that the phenomenology of herniation is complex and may vary between individuals. In his letter, he calls attention to the first descriptions by Kernohan of the falsely localizing hemiparesis; in several cases of patients with supratentorial intracranial lesions and mass effect, the neurologic impairment was found ipsilateral to the side of hemispheric injury rather than the usual contralateral location. This was thought to be due to descent of the ipsilateral uncus of the temporal lobe pushing the brainstem contralateral rather than downward, with a resulting notching of the crus cerebri against the contralateral cerebellar tentorium.^{2,3} These findings were of greatest importance in the preimaging era when neurosurgeons needed to be persuaded by clinical findings alone as to which side of the skull to place a burr hole or larger craniotomy.⁴

Although the etiology of ipsilateral *versus* contralateral symptoms and whether the cause is vertical *versus* lateral displacement of brain tissue are still not fully elucidated,^{2–5} it is important to note that these signs of neurologic impairment are in no way false and are generally harbingers of significant pathology. Our article attempts to provide the reader with an understanding of how to assess the risk of herniation in patients with differing types of intracranial pathology, and the impact of neuraxial anesthetics in these cases. It does not address the varied neurologic manifestations of brain herniation, which, itself, is the proper subject of a dedicated review.

Specifically, we would like to remind the reader against maneuvers that will acutely lower the cerebrospinal fluid pressure in the lumbar cistern of patients who already have imaging evidence of a shift of brain tissue into neighboring compartments. The laws of physics dictate that when a pressure gradient develops between two compartments, there will be a movement to equilibrate this difference. When this occurs rapidly across the foramen magnum and without ample and free-flowing intracranial cerebrospinal fluid in reserve, brain tissue will shift. This produces neurologic impairment which may progress to stupor or coma if untreated. However, many patients with intracranial lesions with favorable characteristics can safely receive neuraxial anesthetics, as is catalogued in the online supplementary material to our review.¹

We thank Dr. Derakhshan for reinforcing the point that that not all patients with intracranial lesions will develop devastating neurologic complications from brain herniation, and hope that our article has empowered the reader to be a more thoughtful participant in the conversation about what anesthesia technique is best for individual patients.

Competing Interests

The authors declare no competing interests.

Lisa R. Leffert, M.D., Lee H. Schwamm, M.D. Massachusetts General Hospital, Boston, Massachusetts (L.R.L.). lleffert@partners.org

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Association of Intraoperative Hypotension with Postoperative Acute Kidney and Myocardial Injuries in Noncardiac Surgery Patients

To the Editor:

In an observational study including 33,330 noncardiac surgeries performed in 27,381 patients with detailed intraoperative blood pressures, Walsh *et al.*¹ showed that intraoperative mean arterial pressure less than 55 mmHg was associated