Letter to the Editor

To the editor:

Re: SCIREhab series, *J Spinal Cord Med.* 2011(Mar);34(2). Rehabilitation of the diaphragm – An opportunity

The March issue of the *Journal of Spinal Cord Medicine* contains many papers analyzing the time spent at various rehabilitation activities at multiple centers for the care of acute spinal cord injury (SCI). As such, it is an opportunity to advocate for a specific rehabilitation activity not likely to be included in the programs surveyed. Disability of the diaphragm after SCI is well recognized; the consequences of this disability are known; but a timely correction of the disability is seldom attempted.

The diaphragm is disabled due to paralysis of the abdominal musculature, which normally resists the descent of the contracting diaphragm and serves as a fulcrum against which the diaphragm raises and expands the chest. Without the normal abdominal resistance, the diaphragm eventually atrophies, as demonstrated by ultrasonic imaging of the diaphragm in chronically paralyzed individuals with tetraplegia.¹ The abdominal musculature is weakened by the central denervation of SCI; the diaphragm is weakened by a reduced workload.

The physiological consequences of the disabled diaphragm are impaired ventilation of the lungs and reduced venous return, the determinant of cardiac output. Both tidal volume and blood pressure diminish progressively as the level of SCI becomes higher and the assistance of the intercostal muscles in expanding the chest is diminished. For the person with tetraplegia, vital capacity and the cardiac output are each reduced 40% in the sitting position.^{2,3} The clinical effects are recurrent atelectasis and pulmonary infections, recurrent orthostatic hypotension, and reduced tissue perfusion with impaired wound healing.

Parameters of breathing have been consistently improved by the application of an abdominal binder in individuals with tetraplegia, as reviewed by Wadsworth *et al.*⁴ However, the improvements have been marginal and of questionable clinical significance. Since the subjects reviewed had been paralyzed for many years and had not been trained with a binder, the failure to dramatically improve breathing ability can be attributed to uncorrected deconditioning of the diaphragm and its inability to contract against a restored abdominal fulcrum with normal force.

It is suggested that the early application of an abdominal binder will either prevent the deconditioning of the diaphragm or shorten the reconditioning time for the diaphragm, depending on the timing. The addition of such a garment should be no burden upon the individual.

However, it can be anticipated that the colonic enlargement with increasing age and duration of paralysis, noted in some subjects, might expand the abdomen and erode the effectiveness of the abdominal binder.⁵

Well-planned outcomes-based trials of the abdominal binder, begun soon after paralysis and continued, are needed for the fair evaluation of this technique as an addition to the rehabilitation of individuals with acute SCI.

References

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- 2 Baydur A, Adkins RH, Milic-Emili J. Lung mechanics in individuals with spinal cord injury: effects of injury level and posture. *J Appl Physiol* 2001;90(2):405–11.
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- 4 Wadsworth BM, Haines TP, Comwell PL, Paratz JD. Abdominal binder use in people with spinal cord injuries: a systematic review and meta-analysis. *Spinal Cord* 2009;47(4):274–85.
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