

Letter to the Editor

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Breathing pattern in tetraplegic patients

Cariga *et al*¹ have associated neck pain with postural hypotension in spinal cord injury patients in the February issue of this journal. They attribute this discomfort to an ischemia of the neck musculature resulting from impaired circulation to the neck due to the postural hypotension. I am writing to complement the rationale for this pain.

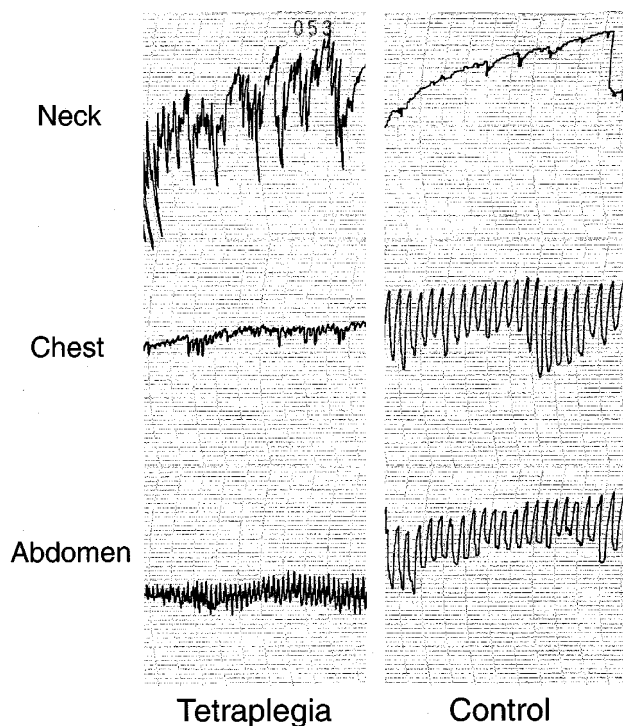


Figure 1 Tracing of neck (top), chest (middle), and abdominal (bottom) movements of a tetraplegic and an able-bodied man. Both subjects are sitting. Tracings are derived from stretch sensitive transducers (Pneumobelt, UFI, Morro Bay, CA, USA) fastened around the neck, the chest at the nipples, and the abdomen near the umbilicus at the level of maximal expansion. The same transducer is used for the same body part in each subject. The signal amplification and the chart speed were identical for each test. A polygraph with a strip chart recorder (Model 79E, Grass Instrument Co., Quincy, MA, USA) was used to draw the tracings. Some swallowing artifacts are present on the neck tracings of both subjects. The differences in neck activity with breathing had not been noticed clinically. The respiratory rate was 23 per minute for the tetraplegic subject and 11 for the control

It is known that pulmonary function is impaired in the tetraplegia patient, as demonstrated by the restricted lung capacity^{2,3} resulting from paralysis of the chest and abdomen muscles of respiration. Furthermore, this function is worsened in the upright position due to the lower position of the diaphragm and the resulting reduction in vital capacity.⁴ Consequently, the tetraplegic subject, having no ability to expand his chest and less ability to move his diaphragm in the upright, sitting position, must use the spared accessory muscles of respiration of the neck to raise and expand the chest. It has been observed, in fact, that neck size does increase after paralysis at the tetraplegic level.⁵ In previously unreported studies from this institution it can be shown that breathing motion of the neck and abdomen predominate in the tetraplegic man, in contrast to the able-bodied who breathe with chest and abdominal expansion (see Figure 1). The tetraplegic man expands the neck with breathing (interpreted as muscle shortening) in the absence of chest motion whereas the able-bodied has no neck activity but good chest expansion with breathing (see Table 1). None of our tetraplegic patients complained of neck pain in the sitting position observed, but it is noted that they had been paralyzed for many years (average of 27 years) and had conditioned themselves to their inability to expand the chest. It is suggested that the tetraplegic patients with positional neck pain on tilting described by the Cariga

Table 1 Comparative activity of breathing components in tetraplegic and able-bodied

	Neck	Chest	Abdomen	Total subjects
<i>Site of predominant respiratory movement</i>				
Tetraplegic	4	0	4	8
Able-bodied	0	7	4	11
<i>Site of least respiratory movement</i>				
Tetraplegic	1	7	0	8
Able-bodied	11	0	0	11

Eight tetraplegic and 11 able-bodied patients, aged 62 to 81 years and 37 to 60 years, respectively were compared for amplitude of neck, chest, and abdominal movements with breathing, using the technique described in Figure 1. Age alone is not a factor in neck hypertrophy and, implicitly, muscle activity.⁴ The tetraplegic patients were all motor complete and paralyzed for 7–52 years. The average amplitude of each tracing was determined by eye. Predominant respiratory movement was located in the neck more often in the tetraplegic than in the able-bodied $P=0.018$. Least respiratory activity was located in the neck in the able-bodied more often than in the tetraplegic, $P<0.001$, Fisher Exact Test

*et al*¹ were utilizing their neck muscles in breathing but were relatively unconditioned, the average duration of paralysis being 37 weeks. The exertion of neck breathing, coupled with the ischemia of postural hypotension as suggested, would contribute to the proposed neck muscle pain.

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