Prevention of Respiratory Complications of Spinal Cord Injury: A Challenge to “Model” Spinal Cord Injury Units

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“Paradigm paralysis is the failure to learn new and superior approaches because they differ radically from the generally employed methods in which one has invested time and energy. It is the terminal disease of misplaced certainty” (1).

In 1990, we reported 25 ventilator-dependent patients with traumatic tetraplegia who were supported by noninvasive means of ventilatory support (2). Twenty-four of the 25 were initially intubated and 23 of these went on to tracheostomy before being converted to full-time support by mouthpiece/nasal intermittent positive pressure ventilation (IPPV). Seventeen of the 23, including 7 with no ventilator-free breathing ability, were decannulated and their ostomies closed. Of the 7 with no inspiratory muscle function, 5 mastered glossopharyngeal breathing (GPB) for ventilator-free breathing. These 17 patients had been using noninvasive IPPV continuously for a mean of 7.4 years (range, 1 to 22 years). It was concluded that because of their youth, intact mental status and bulbar musculature, and absence of lung disease, these ventilator-dependent patients were good candidates for decannulation and conversion to noninvasive ventilation. Subsequently, we reported patients with high level SCI in the acute setting who were managed noninvasively rather than via invasive tubes (3).

In 1991, similar outcomes were reported in Dallas where 15 SCI patients with no ventilator-free breathing ability were decannulated and switched to noninvasive IPPV. Six of 13 mastered GPB and had maximum GPB breaths of 2205 mL despite a mean vital capacity (VC) of 402 mL. GPB permitted ventilator-free breathing for 4 patients. For 3 individuals, acute respiratory failure was managed without translaryngeal intubation by using noninvasive IPPV. Forty-five patient-years of continuous noninvasive ventilatory support were reported without complications or respiratory hospitalizations.

Since 1991, we have continued to decannulate ventilator-dependent SCI patients as well as patients with neuromuscular disease, and have published protocols of how to accomplish this (5–7). We continue to manage patients who have had no measurable VC or any muscle function below the neck without tracheostomy tubes for more than 50 years (8); we manage continuously ventilator-dependent infants and children with spinal muscular atrophy type 1 without tracheostomy tubes (9), and have eliminated the need for tracheostomy tubes for self-directed ventilator users with neuromuscular conditions like Duchenne muscular dystrophy (10). Intercurrent respiratory tract infections are managed by continuous noninvasive ventilatory support and mechanically assisted coughing at home.

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Patients who have used both invasive and noninvasive ventilation with access to mechanically assisted coughing invariably prefer noninvasive ventilation for appearance, comfort, safety, swallowing, speech, and overall (11). Noninvasive approaches for full-time ventilator users also eliminate the need for skilled care for tracheal suctioning, permit the mastery of GPB for ventilator-free time, avoid the complications associated with tracheostomy as well as the need for invasive airway suctioning and uncomfortable tube changes, eliminate the heavy burden of pathogenic bacteria that is inevitably present with invasive tubes and exceeds the commonly accepted threshold for diagnosing ventilator-associated pneumonia (12), result in fewer hospitalizations and less pulmonary morbidity than tracheostomy (13), facilitate airway clearance by assisted coughing (14), and are less costly (15). Despite this, no “model” SCI unit has made any attempt to reproduce our results. Of the hundreds of ventilator-dependent patients we have decannulated, no patient with SCI or neuromuscular disease ever failed decannulation or required replacement of invasive tubes except for patients with amyotrophic lateral sclerosis who subsequently lost the function of bulbar-innervated muscles.

We recently defined the indication for tracheostomy as a decline in oxyhemoglobin saturation below 95% because of saliva aspiration and an inability to normalize it by using noninvasive ventilation or mechanically assisted coughing (16). This rarely happens in individuals with SCI because they almost always have excellent bulbar-innervated muscle function. As for patients with neuromuscular disease, the extent of inspiratory and expiratory muscle paralysis is irrelevant to the indications for tracheotomy for patients with SCI.

The appropriate treatment paradigm is to assist or substitute for weak or paralyzed inspiratory and expiratory muscles with the inspiratory and expiratory muscle aids used in physical medicine (17,18). This is very different from the currently accepted paradigms that tracheostomy is safer; it is needed when patients cannot breathe or cough; it is needed for airway control; that it is unsafe to remove invasive tubes when patients cannot breathe; and, anyway, patient volume is too low to invest the time to learn new approaches. Thus, while our center continues to claim that noninvasive methods are superior and highly desirable for ventilator-dependent SCI patients, the “model” centers that should investigate and attempt to validate or repudiate such claims continue to ignore these options. J. B. S. Haldane (1892–1964), among others, understood the problem when he said, “*There are four stages of acceptance: this is worthless nonsense; this is an interesting, but perverse, point of view; this is true, but quite unimportant; I always said so.*”

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