

Consequences of Long-Term Translaryngeal Intubation for Transition to Noninvasive Support

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Abstract

Introduction: Intubated ventilator unweanable patients with uncomplicated ventilatory pump failure (VPF) can be extubated to up to continuous noninvasive positive pressure ventilatory support (CNVS), with mechanical in-exsufflation (MIE) used to clear the central airways, and without resort to tracheotomies. The purpose of this work is to determine possible long-term consequences on speech and swallowing of delays in extubation to CNVS and MIE.

Methods: Retrospective chart review of VPF patients intubated 3 weeks or more to determine need for post-extubation gastrostomy tubes and consequences on speech and swallowing.

Results: Eighty-six of 88 VPF patients, intubated and unweanable for over 20 days, were successfully extubated to CNVS and MIE with one patient extubated only to MIE. Post-extubation to CNVS and MIE, all returned to pre-hospitalization ventilator use regimens. Forty-four weaned back to sleep NVS, 42 returned to CNVS, and one quickly weaned only by using MIE. All returned to pre-hospitalization speech and swallowing status, the former in 2 hours to 2 days and the latter in up to 2 months. Only four underwent gastrostomies post-extubation.

Discussion: Since many patients with VPF who undergo tracheotomy never wean from continuous ventilatory support, and suffer morbidity and mortality due to the tube, one option is to permit patients to remain intubated for 3 weeks or more to facilitate extubation to CNVS and MIE rather than resort to tracheotomy. This study suggests that despite long-term intubation, untoward clinically significant consequences to the larynx and swallowing mechanism may be unlikely.

Keywords: Ventilatory Pump Failure (VPF); Mechanical In-exsufflation (MIE)

Introduction

Ventilatory pump failure (VPF) patients with high level spinal cord injury (SCI), neuromuscular disorders including the muscular dystrophies, spinal muscular atrophies (SMAs), and motor neuron diseases (MNDs), morbid obesity, and severe chest wall disease can be continuously ventilator dependent without resort to tra-

cheotomies [1]. They can also require intubation for intercurrent respiratory tract infections and be extubated back to up to continuous noninvasive positive pressure ventilatory support (CNVS) and use mechanical insufflation exsufflation (MIE) to clear their airways by which they can maintain normal oxyhemoglobin saturation (O₂ sat) in ambient air [2,3]. This, however, is not offered in most critical care units where tracheotomy is the convention for

patients unable to pass spontaneous breathing trials and ventilator weaning parameters with little to no ventilator free breathing ability (VFBA) or vital capacity (VC).

While invasive airway tubes can be life-saving, they can also cause morbidity and mortality. Respiratory complications of long-term tracheostomy ventilatory support (TMV) have been reported to be directly responsible for 50% to 80% or more of the deaths of people with ventilatory pump failure (VPF) including those with SCI, Duchenne muscular dystrophy (DMD), and MNDs [4-9]. The tube related deaths were ascribed to accidental disconnections, mucus plugging, chronic bronchitis, tracheomalacia, tracheal stenosis, perforation, hemorrhage, etc. [7]. For example, Carter, *et al.* reported that 17 of 35 deaths of SCI TMV users over a mean 1.5 years post-injury were caused by the tubes themselves [7].

Long-term complications of translaryngeal intubation, likewise, can include mucosal/dermal pressure ulcers, vocal cord paralysis, invasive interface (hospital) associated pneumonia (HAP), sinusitis, tracheomalacia, tracheoesophageal and tracheoarterial fistulas, laryngotracheal stenosis, and others [10]. All of these potential complications can have direct bearing on speech, swallowing, and airway protection.

Realizing that for patients with uncomplicated VPF, tracheostomy tubes are not needed for ventilatory support nor, usually, for clearing the airways except in the event of irreversible upper air-flow obstruction, and that most of the 257 patients who were intubated for up to 5½ months before transfer to be extubated to CNVS and MIE were unседated, the last argument for urging tracheotomy for intubated patients is to avoid laryngeal complications. This report considers the ventilator unweanable patients, intubated for 3 weeks or more awaiting transfer to a specific ICU to be extubated to CNVS and MIE to avoid tracheotomies, in two publications [2]. Three weeks were considered the upper limit of what may be considered acceptable for intubation [11]. While “early tracheostomy (may) reduce the rates of aspiration pneumonia, bacteremia, septic shock, ARDS, and multisystem organ failure” for the usual ICU patient” [10], this is clearly not the case for patients with uncomplicated VPF who can be extubated despite being unweanable and who, when remaining ventilator dependent via tracheostomy tubes, may very well suffer morbidity and mortality from having them. Not only does “early tracheostomy (not) accelerate weaning

from mechanical ventilation” for patients with VPF, but tracheotomy can render weaning impossible for them [12,13]. Likewise, the consequences of unnecessary tracheotomies on quality of life and cost are enormous but beyond the scope of this paper and discussed elsewhere [13].

Methods

A retrospective chart review of 257 ventilator unweanable, previously reported VPF patients, to determine their number of failed extubations before being successfully extubated to CNVS and MIE [2,3], total days intubated, and their pre-hospitalization and post-extubation paroral (PO) nutritional intake status. Diagnoses, ages, and genders were also recorded as well as need for gastrostomy tubes both pre-intubation and post-extubation, and whether PO intake was full, partial, or none. Time to return to pre-intubation speech status was also noted. Post-extubation, patients were permitted to take food PO when cleared by dysphagia therapists on the basis of clinical examination and modified Barium swallow and/or fiberoptic endoscopic evaluation of swallowing.

Results

Eighty-seven of 88 long-term intubated and unweanable patients were successfully extubated to CNVS and MIE [2,3]. Forty-four of the 87 weaned from need for CNVS at extubation, to partial, mostly sleep-only NVS, within 3 weeks post-extubation. Forty-two remained CNVS dependent, including the 21 who had been CNVS dependent for 10 years or more, indeed for up to 32 years, prior to intubation. One Alzheimer patient, who had been unweanable while intubated, weaned off ventilator use entirely once her O2 sat baseline normalized in ambient air by using MIE aggressively both before and after extubation.

All returned to pre-intubation speech status, in terms of articulation and volume, within 2 hours to 2 days of extubation although two of the six ALS patients were a verbal all along. This included the one patient who failed extubation to CNVS. He was a 48 year old man with bulbar ALS who received all nutrition via a GT both prior to hospitalization and following tracheotomy after a total of 138 days of intubation. For those with minimal VCs, voice volume was often augmented by using mouthpiece or nasal NVS during the day. No de-novo vocal cord paralysis, or any other complication, caused anyone to become a verbal or diminish voice quality.

Forty-nine of the 88 received all nutrition PO before intubation and 42 did so within 10 days following extubation without placement of a GT. Seven, however, underwent gastrostomies in the immediate post-extubation period. For three the GT was temporary. A 68 year old with myasthenia gravis who had been intubated four times for 31 days had a GT placed for 26 days. A 53 year old with limb girdle muscular dystrophy, intubated twice for a total of 23 days, retained a GT for 65 days, and a 5 year old with SMA type 3 who had been intubated 3 times for 84 days had the GT removed 60 days post-extubation. However, four of the seven retained post-extubation GTs for partial nutritional support. They were a 65 year old with rapidly progressive ALS who had been intubated for 21 days, a 70 year old man with multisystem disease who had been intubated for 24 days, a 32 year old with DMD had been intubated 32 days, and a 32 year old woman with SMA type 2 intubated twice for 35 days.

Thirty-nine patients had GTs prior to intubation. Twenty-four received all nutrition via GT before intubation and following extubation, 12 received partial nutrition via GT both before and post-extubation. One went from partial intake via GT to total intake via GT, however, this was an infant with SMA type 1 prior to availability of effective medications, after 4 intubations and 91 days intubated and with a diagnosis that necessitates all nutrition via GT. A 4 year old with a mitochondrial myopathy, had a GT that was not used either before intubation or post-extubation. One 34 year old with SMA type 3 and morbid obesity had partial nutrition via a GT for 3 years pre-intubation but ultimately had the tube removed 3 months post-extubation.

Discussion and Conclusion

For only four of 87 VPF patients, who had acute on chronic respiratory failure requiring intubation for 3 weeks or more, did weakening or damage to the swallowing mechanism significantly change their PO status long-term and all four had progressive neuromuscular disorders that, in themselves, could explain much if not all of the deterioration. Only these four required definitive post-extubation GTs. One of the four had rapidly progressive bulbar ALS that most certainly would have resulted in need for a GT even without intubation. Further, all 87 patients weaned from total ventilator dependence with no significant VFBA while intubated, to their

pre-hospitalization ventilator use status. Forty-four weaned back to sleep only nasal NVS and 42 back to the CNVS they had been dependent on prior to hospitalization. The Alzheimer patient weaned off the ventilator entirely.

Reviews and meta-analyses of 700 publications on over 200,000 patients on the optimal timing of tracheotomy for intubated patients have led to suggestions that early tracheotomy within 7 days of intubation should be done if "prolonged intubation is needed" [10]. This might decrease the incidence of HAP for adults, mortality, time to wean from ventilatory support, and length of ICU stay. However, in neither case, with early nor late timing, was a patient population with primarily VPF and potentially healthy lungs differentiated from other more typical ICU patient populations. Successful extubation of 254 of 257 entirely ventilator unweanable patients with VPF was successful to full CNVS via mouth pieces and nasal interfaces eliminated need for invasive airway tubes. This included patients with 0 ml of VC [2,3]. Many of these patients had been CNVS dependent for decades before being intubated. Some used CNVS for over 65 years since leaving Iron Lungs in 1954 [1]. Therefore, suggesting that intubated patients requiring mechanical ventilation for more than 10 days, 21 days [14], or even for decades, undergo tracheotomies can be unnecessary for this patient population that can be managed noninvasively.

There is also considerable debate about whether early tracheotomy reduces HAP rates with many authors finding no difference between early vs. late tracheostomy in the rates [15-20]. Again, not only were VPF patients with relatively healthy lungs not singled out, but neither was MIE used via the tubes. The extubation of 254 of 257 ventilator unweanable VPF patients to CNVS would have been impossible without the family using MIE to re-normalize every post-extubation ambient air oxyhemoglobin desaturation below 95% [2,3]. Likewise, the muscular dystrophy patients of our orthopedic surgeons who had spinal instrumentation surgeries for scoliosis performed on them despite being CNVS dependent with as little as 80 ml (2%) of predicted normal VC had a zero incidence of HAP and all were successfully extubated to CNVS and MIE post-op [21-23].

Considering tracheotomy to facilitate ventilator weaning, the VPF population also needs to be considered a part. Of the 254 ventilator unweanable patients extubated to CNVS and MIE [2,3], all

weaned back to their ventilator use regimen prior to the hospitalization even though none could pass ventilator weaning parameters or spontaneous breathing trials at the time of extubation. This is in marked contrast to the large minority of muscular dystrophy patients, and virtually all SMA type 1 patients who had never used a ventilator but became permanently and continuously dependent on TMV upon and following tracheotomy [24-28]. Likewise, of the 61 ventilator unweanable VPF patients decannulated of tracheot-

omy tubes reported in 2014, most with VCs over 250 ml weaned to sleep-only nasal NVS following decannulation despite having no VFBA while using TMV [12]. Many had no VFBA at all until their tracheotomy tubes were removed and then weaned from CNVS to sleep nasal NVS [13]. Thus, considering the often severe long term complications and consequences of tracheostomies on quality of life, morbidity, mortality, and cost of nursing care, it is an option to leave VPF patients intubated for 3 weeks or more to extubate them to CNVS and MIE without resort to tracheotomy.

Figure 1

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Shane where did the following sentence come from?

It is critical that patients are extubated within a reasonable time frame to prevent many of these devastating complications and to preserve the invaluable ability to speak and swallow.

This was a summary statement by me.

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