

Potential Mechanisms of Laryngotracheal Injuries in Patients With COVID-19 Subjected to Invasive Ventilation

According to the current literature, an increasing number of acute laryngotracheal complications such as mucosal lesions and tracheoesophageal fistulas have been reported in patients with COVID-19 subjected to invasive mechanical ventilation.¹⁻⁴ At the same time, papers regarding late laryngotracheal complications and their potential life-threatening sequelae, such as tracheal stenosis and tracheomalacia, were increasing.⁵⁻⁸

In this issue of *RESPIRATORY CARE*, Guarnieri et al⁹ focused their attention on tracheomalacia, analyzing its incidence and potential onset mechanisms in a cohort of subjects to their tertiary referral hospital during the first wave of the COVID-19 outbreak. The authors identified 8 (5%) cases of tracheomalacia among 151 subjects included in the study, an incidence about 8 times greater than the data reported in the literature prior to the pandemic.^{10,11} They also identified 5 potential risk factors that may have favored the onset of tracheomalacia: female sex, obesity, tracheostomy (regardless of the technique used), duration of invasive ventilation, and sepsis. The authors should be commended for their effort in seeking a pathophysiological explanation for each risk factor, even if some of them such as tracheostomy and prolonged invasive mechanical ventilation are a direct consequence of the logical thought and data already present in the literature. What is extremely surprising is that the risk factors listed by the authors were commonly present in a typical cohort of ICU patients even before the COVID-19 pandemic, but the incidence of tracheomalacia was certainly lower. In our opinion, this led us to identify the main limitation of this work not listed among others at the end of the discussion, which is that it may have been more fruitful to compare the current cohort of subjects with COVID-19 with a non-COVID-19 control group, (ie, matched for age and sex in a similar time frame). This would have allowed the authors to confirm or not the same risk factors, or to identify new ones.

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Correspondence: Giacomo Fiacchini MD, Otolaryngology, Audiology and Phoniatric Operative Unit, Department of Surgical, Medical and Molecular Pathology and Critical Care Medicine, Azienda Ospedaliero-Universitaria Pisana (AOU), University of Pisa, Via Paradisa, 2, 56124 Pisa, Italy. E-mail: g.fiacchini@gmail.com.

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Many other etiopathogenetic hypotheses have been proposed to try to explain the increased incidence of early and late laryngotracheal complications. In the discussion sec-

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tion, the authors highlighted the importance of microvascular injuries of the laryngotracheal mucosa caused by the prothrombotic and antifibrinolytic state of these subjects, also noted intraoperatively and from cadaver studies.¹² As already reported in the current literature, they identified the pronation maneuvers that could increase the cuff pressure on the tracheal wall and an excessive cuff pressure of the orotracheal/tracheostomy tube to prevent viral spread as other possible causes of the onset of these complications. We would like to add 2 other possible causes of laryngotracheal complications: the high viral replication within the laryngotracheal mucosa¹³ with a pathophysiological mechanism similar to that proposed for repetitive bacterial infections, and the use of high-dose systemic steroids that may cause mucosal atrophy and alter normal healing of the tracheal epithelium. Unfortunately, the authors did not report the medical treatments performed in this cohort of subjects; therefore, it is not possible to further corroborate this hypothesis.⁹

From this brief discussion, it is clear that, to date, no clear explanation has been identified; and it is conceivable that the cause of the increased incidence of laryngotracheal complications must be sought in a combination of multiple factors, among which, however, emotional and physical exhaustion of health care professionals and the recruitment of inexperienced nursing staff played a fundamental role. It should also be remembered that this study analyzed a cohort of subjects during the Italian first wave, when hospitals and medical staff were caught unprepared by a large number of patients to manage and a lack of protocols to follow. The fact that the authors performed 54 (74%) surgical tracheostomies and 19 (26%) percutaneous tracheostomies was pathognomonic of this uncertain situation. A few hundred kilometers from them, in our tertiary referral hospital during the first wave almost exclusively percutaneous tracheostomies were performed,¹ reserving the surgical technique only for very selected cases.

Another aspect that must be discussed is how to prevent these complications. In our recent paper,¹ we have already

proposed some possible measures to be adopted in patients with COVID-19 subjected to prolonged invasive mechanical ventilation such as periodic bronchoscopy, the careful use of high-dose steroids, and the strict monitoring of the cuff pressure, especially during pronation maneuvers. Moreover, other authors proposed their advice in the management of these particular patients.¹⁴ Following these simple recommendations, we saw a progressive reduction in the incidence of these complications during subsequent pandemic waves (unpublished data). In conclusion, we would like to commend the authors for their work to further report and clarify the pathophysiological aspects of late laryngotracheal lesions,⁹ and we hope that papers like this will stimulate the debate also regarding the prevention and treatment of them.

Giacomo Fiacchini

Otolaryngology, Audiology and Phoniatic Operative Unit
Department of Surgical Medical and Molecular Pathology
and Critical Care Medicine
University of Pisa
Pisa, Italy

Francesco Forfori

Department of Surgical, Medical and Molecular
Pathology and Critical Care Medicine
University of Pisa
Pisa, Italy

Fabio Guarracino

Department of Anaesthesia and Critical Care
Cardiothoracic and Vascular Anaesthesia and Intensive
Care Medicine
Azienda Ospedaliero Universitaria Pisana
Pisa, Italy

Luca Bruschini

Otolaryngology, Audiology and Phoniatic Operative Unit
Department of Surgical
Medical and Molecular Pathology and
Critical Care Medicine
University of Pisa
Pisa, Italy

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