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Elective Tracheostomy in COVID-19 Patients: A Retrospective Case Series

Traqueostomia Eletiva em Doentes com COVID-19: Uma Série de Casos Retrospetiva

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ABSTRACT

The COVID-19 outbreak represents a global health threat due to the unprecedented number of patients admitted to intensive care units and the overwhelming need for mechanical ventilation. Performing a tracheostomy in COVID-19 patients represents a risk for patients and healthcare workers. We report a case series of 10 patients with COVID-19 who underwent elective open tracheostomies in a negative pressure operating room, carried out by an experienced multidisciplinary team. They were tracheostomized after a mean intubation period of 18.6 days (range, 13-23 days). Only one patient developed postoperative complications and no viral transmission to health care workers was documented. Hence, our experience supports the safety of tracheostomy in COVID-19 patients, provided that meticulous planning and strict safety recommendations are followed.

RESUMO

O surto de COVID-19 representa uma ameaça de saúde pública a nível mundial devido ao elevado número de pacientes admitidos em unidades de cuidados intensivos e à necessidade de ventilação mecânica. A traqueostomia em doentes com COVID-19 representa um risco para os pacientes e para os profissionais de saúde. Apresentamos uma série de casos de 10 doentes com COVID-19 submetidos a traqueostomia cirúrgica eletiva numa sala operatória de pressão negativa, com o apoio de uma equipa multidisciplinar experiente. Estes doentes foram traqueostomizados após um tempo médio de 18.6 dias de intubação (intervalo, 13-23 dias). Apenas um paciente desenvolveu complicações pós-operatórias e nenhum profissional de saúde foi infetado durante o procedimento. Assim, a nossa experiência suporta que a traqueostomia em doentes com COVID-19 é um procedimento seguro, desde que seja realizada após um planeamento meticuloso e seguindo rígidas recomendações de segurança.

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INTRODUCTION

In December 2019, a novel outbreak of coronavirus was identified in the city of Wuhan, Hubei Province, China. This new coronavirus was named SARS-CoV-2, and the disease, COVID-19.[1]

On the 12th March 2020, the World Health Organization declared COVID-19 as a pandemic. As of 30th April 2020, there have been 3 299 603 cases confirmed worldwide, including 233 824 deaths.[2] Evidence from China suggest that between 9.8% and 15.2% of patients will require invasive mechanical ventilation or extracorporeal membrane oxygenation (ECMO).[3]

Portugal has the lowest number of critical care beds per 100 000 capita of population (4.2/100 000) in Europe.[4] Therefore, this epidemic urged the reorganization of our healthcare system, including the intensive care units. In order to provide the best of care to COVID-19 patients in critical condition, an appropriate management of these scarce resources is of utmost importance.

Similarly to other institutions, we selected patients with severe acute respiratory distress syndrome (ARDS) who would benefit from tracheostomy to wean off intubation, thus allowing us to transfer them to an intermediate care unit. This strategy improved patient comfort and increased the availability of intensive care unit (ICU) beds for new patients in our hospital.[5]

Tracheostomy is one of the most hazardous procedures in COVID-19 patients, potentially exposing healthcare workers.[3] However, it is frequently necessary for facilitation of

mechanical ventilation for long periods or after unsuccessful extubation. Considering the inherent risk of this procedure, it should be performed judiciously and follow strict safety recommendations.

A consensus has yet to be reached on whether a percutaneous tracheostomy is less aerosol-generating than a controlled open tracheostomy.[6-8] The evidence on this matter is limited and there are proponents of both techniques. All in all, the aim is to minimize the risk of exposure considering local conditions and team experience. Therefore, in our institution, we performed open tracheostomies in an operating room allocated for COVID-19 patients, allowing for a more controlled environment and resorting to an experienced team in airway management. These patients were managed by anesthesiologists throughout the procedure; the open tracheostomy was performed by experienced surgeons.

In this article, we share our experience with 10 COVID-19 patients who underwent elective open tracheostomy. Our aim is to present the clinical data of these patients and focus on safety and infection prevention among healthcare workers.

CASES[1-10]

From April 1 to April 30, 2020, 10 open tracheostomies were performed electively in COVID-19 patients in our hospital. In all cases, tracheostomy was performed for respiratory failure and need for prolonged ventilation. In addition, 9 patients had bacterial superinfection and would further benefit from tracheostomy.

There were seven men and three women, with a mean age of 61 years (demographic characteristics shown in Table 1). All patients presented with fever and respiratory symptoms and two also exhibited gastrointestinal symptoms; SARS-CoV-2 infection was confirmed by PCR analysis of upper respiratory tract samples. Chest radiographs showed bilateral pulmonary infiltrates in nine patients and peribronchial thickening in one patient, all suggestive of COVID-19.[9] Nine patients were treated with hydroxychloroquine; one patient (patient #10) was treated with hydroxychloroquine and lopinavir/ritonavir. Throughout their stay in the ICU, all patients developed septic shock.

At the time of tracheostomy, they had required a mean mechanical ventilation period of 18.6 days and exhibited a mean PaO_2/FiO_2 ratio of 242.8 (Table 2). Four patients had previously failed an extubation attempt; the remaining did not present evidence of lung function improvement and therefore were not suitable for extubation . All patients still tested positive for SARS-CoV-2 at the time of tracheostomy. After tracheostomy, patients were transferred to an intermediate care unit.

SETTING AND STAFF

The procedures took place in a negative pressure operating room allocated for COVID-19 patients. The team included two ENT surgeons, one anesthesiologist, one anesthesia nurse, one scrub nurse and one circulating nurse. A support team composed by one circulating nurse and one ancillary stayed outside the room. These procedures were planned and, as such, only widely experienced ENT surgeons and

Table 1. Demographic, clinical and radiologic data of patients at admission in the ICU

Patient (#)	Gender	Age (years)	Comorbidities	COVID-19 symptoms	Radiologic findings	COVID-19 treatment
1	Male	61	Hypertension, type 2 diabetes, dyslipidemia	Fever, respiratory symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
2	Female	62	Hypertension, type 2 diabetes, dyslipidemia, hypothyroidism	Fever, respiratory symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
3	Female	55	Asthma, osteoarticular disease	Fever, respiratory and gastrointestinal symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
4	Male	65	Hypertension, type 2 diabetes, dyslipidemia	Fever, respiratory symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
5	Male	59	Hypertension, dyslipidemia	Fever, respiratory symptoms	Peribronchial thickening	Hydroxychloroquine
6	Female	62	Hypertension, obesity, venous insufficiency	Fever, respiratory symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
7	Male	61	Hypertension, dyslipidemia	Fever, respiratory and gastrointestinal symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
8	Male	64	COPD, peripheral artery disease, peptic ulcer disease	Fever, respiratory symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
9	Male	67	Hypertension, bladder cancer	Fever, respiratory symptoms	Bilateral alveolar consolidation	Hydroxychloroquine
10	Male	62	Hypertension	Fever, respiratory symptoms	Bilateral alveolar consolidation	Hydroxychloroquine and lopinavir/ritonavir

COPD: Chronic obstructive pulmonary disease

Table 2. Clinical data of patients at the time of elective tracheostomy

Patient (#)	Elective tracheostomy indication	Length of mechanical ventilation (days)	Previous extubation attempts	PaO_2/FiO_2 ratio	Ventilation requirements	Need for vasopressor support	Fever	C-reactive protein levels
1	Need for prolonged ventilation, bacterial superinfection	22	1	321	FiO_2 24%, PEEP 5	NA 36 mcg/ min (weaning)	No	Decreasing
2	Need for prolonged ventilation, bacterial superinfection	23	1	231	FiO_2 40%, PEEP 5	NA 33 mcg/ min (weaning)	Yes	Decreasing
3	Need for prolonged ventilation, bacterial superinfection	17	0	165	FiO2 40%, PEEP 10	None	No	Decreasing
4	Need for prolonged ventilation, bacterial superinfection	13	0	185	FiO_2 40%, PEEP 6	NA 46 mcg/ min (weaning)	No	Decreasing
5	Need for prolonged ventilation, bacterial superinfection	21	0	309	FiO_2 40%, PEEP 6	NA 19 mcg/ min (weaning)	No	Decreasing
6	Need for prolonged ventilation, bacterial superinfection	16	1	308	FiO2 30%, PEEP 8	NA 33 mcg/ min (weaning)	Yes	Decreasing
7	Need for prolonged ventilation, bacterial superinfection	16	0	185	FiO_2 40%, PEEP 5	NA 33 mcg/ min (weaning)	No	Decreasing
8	Need for prolonged ventilation	16	1	213	FiO_2 35%, PEEP 5	NA 10 mcg/ min (weaning)	No	Decreasing
9	Need for prolonged ventilation, bacterial superinfection	20	0	204	FiO_2 35%, PEEP 7	NA 26 mcg/ min (weaning)	No	Decreasing
10	Need for prolonged ventilation, bacterial superinfection	22	0	307	FiO_2 30%, PEEP 5	None	No	Decreasing

PaO_2: Partial pressure of oxygen, FiO_2: fraction of inspired oxygen, PEEP: positive end-expiratory pressure, NA: noradrenaline, mcg: micrograms

anesthesiologists were selected. The whole team strictly followed the available international recommendations regarding personal protective equipment and surgical and anesthesic protocols.[3]

ANESTHETIC CONSIDERATIONS

In all cases, total intravenous anesthesia was used. A peripheral nerve stimulator was used to monitor neuromuscular paralysis. A deep neuromuscular paralysis was guaranteed during the entire procedure. Although suction was generally avoided, it was used within a closed system with a viral filter when needed.

Our hospital's anesthetic protocol was followed. Prior to the beginning of the surgery, a 5 minute pre-oxygenation (FiO_2 100%) and tracheal suction were performed. A closed in line system (Fig. 1) with a viral filter (Fig. 2) was used for tracheal suction.

Figure 1. Closed in line system (from catalog)

Figure 2. Viral filter (from catalog)

By the time the surgeons were ready to open the trachea, the anesthesiologist pre-oxygenated with PEEP and then stopped ventilation. The endotracheal tube was clamped and then pulled out 3 cm.

After insertion of the tracheostomy tube, the cuff was inflated and the tube was rapidly connected to an antiviral filter and to the ventilator. Placement was then confirmed with end tidal CO_2. At this point, the endotracheal tube was completely removed.

SURGICAL CONSIDERATIONS

Diathermy was not used in order to reduce aerosolization risk; alternative hemostatic techniques were preferred. An infiltration of lidocaine with adrenaline was used to minimize bleeding and the need for suction.

A cuffed non-fenestrated tracheostomy tube was used in all procedures. The team ensured there was no leak from the cuff, secured the tube in position and placed a heat and moisture exchanger (HME) filter on the tube.

There are no reports of accidental piercing of the endotracheal tube. One of the patients (patient #7) had a pneumothorax and postoperative continuous bleeding as complications of the procedure. None of the other patients experienced postoperative complications.

INFECTION CONTROL AND PREVENTION

As previously described, all members of the team wore FFP2 or N95 facial masks, gown, gloves, eye protection and apron, following international recommendations. The protocols established by our hospital for donning and removing this equipment were strictly followed. An assistant who was familiar with these protocols provided guidance through the steps of gowning and de-gowning. Moreover, an exclusive route was established for these patients' transportation as to avoid contact with unprotected staff or other patients.

Two weeks after each procedure, none of the team members had reported COVID-19 symptoms.

DISCUSSION

In this report, we describe our experience and local protocol for tracheostomy in COVID-19 patients. Turri-Zanoni *et al* reported 32 elective tracheostomies, with no procedure-related complications.[10] In this report, we described nine successful cases and one with complications (pneumothorax and postoperative continuous bleeding). Both postoperative bleeding and pneumothorax are known early complications from this procedure; it would be interesting for future studies to evaluate whether the complication rate is higher in these patients. Tracheostomy generally allows for (1) easier weaning off intubation, (2) better tracheobronchial toileting, (3) lower requirement for sedation in ventilated patients, and (4) decreased intensive care unit length of stay.[11] In this series, all patients were tracheostomized for weaning off intubation, as the need for prolonged ventilation was apparent. Given that the most common reason for tracheostomy in the ICU is to provide access for prolonged mechanical ventilation,12 these data were expectable. Even though there is limited evidence regarding the optimal timing of tracheostomy in COVID-19 patients, experts suggest delaying tracheostomy until at least day 10 of mechanical ventilation.[13] This recommendation was followed for all patients included in this series. Ventilation requirements at time of the procedure were appropriate,[3] allowing for tolerance to apnea and potential decruitment.[14] Ideally, tracheostomy in COVID-19 patients should be performed in apyretic patients, with falling inflammatory markers.[14] The fact that two patients were febrile before tracheostomy should have prompted the staff to postpone the procedure, in order to reduce the risk of clinical deterioration. Most guidelines recommend avoiding elective tracheostomy in patients who still test positive for SARS-CoV-2.[15] We recognize that these recommendations were not followed in our institution, which is a limitation of this report. COVID-19 has high rates of transmission[7] and there have been reports of infections related to aerosol-generating procedures.[16]

As such, performing a tracheostomy in a COVID-19 patient poses unique risks and demands for safety precautions. Therefore, the anesthesic plan should follow a step-by step approach. Additionally, the team should be able to communicate effectively throughout the entire procedure. We believe that these positive outcomes are ascribable to the fact that we adjusted our practice according to the available recommendations. We cannot overemphasize the importance of using adequate personal protective equipment (PPE) and following the available recommendations. During the SARS epidemic, a controlled approach to open tracheostomy proved to be safe, bearing a minimal risk for healthcare workers. Likewise, we believe this procedure can be done safely in the COVID-19 setting, provided that meticulous planning and strict safety measures are carried out. Similarly to Turri-Zanoni *et al*,[10] we did not report any case of viral contamination following tracheostomy. Even though none of the team members developed symptoms, we cannot rule out the possibility of asymptomatic carriers. This limitation would be resolved if a SARS-CoV-2 testing program for healthcare workers were to be implemented in our hospital. It is likely that new recommendations further contribute to minimizing the risk of nosocomial infection. During this pandemic, we should do our best to remain updated and keep our practice safe and smooth.

Ethical Disclosures
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Confidentiality of Data: The authors declare that they have followed the protocols of their work center on the publication of data from patients.
Protection of Human and Animal Subjects: The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).
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SUPPLEMENTAL DIGITAL CONTENT

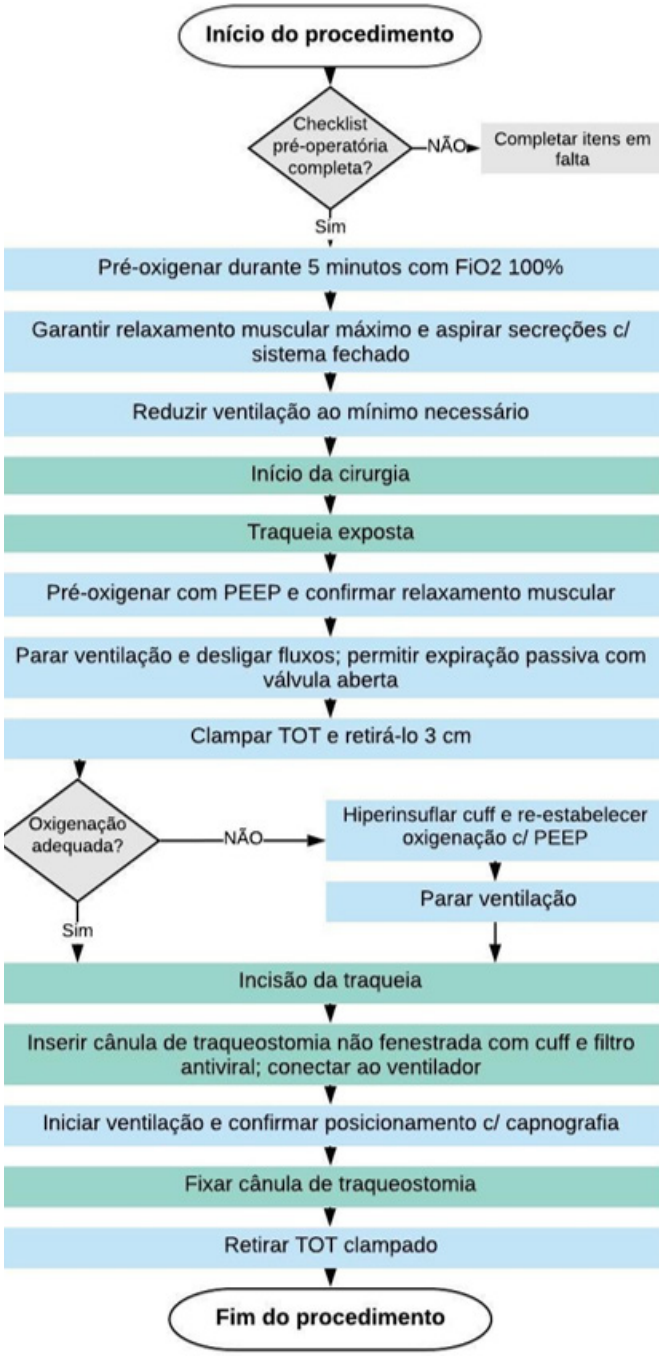

Figure 4. Anesthesic protocol for tracheostomy in COVID-19 patients (portuguese)

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