Specific technical refinements of tracheotomy in Covid-19 patients. A report of four procedures

Daniela Pasero[1], davide rizzo[1], Antonio Piras[1], Leda Floris[1], Claudio Parrilla[2], Francesco Riu[1], Pierpaolo Terragni[1], and Francesco Bussu[1]

[1]Azienda Ospedaliero Universitaria di Sassari
[2]Università Cattolica del Sacro Cuore Facoltà di Medicina e Chirurgia

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Key points:

- Covid-19 patients are often intubated for a long time, with indication to tracheotomy, at high risk for transmitting the disease.
- Open surgical sub-isthmic tracheotomy above the ETT cuff should always be performed on fully paralyzed patients, to minimize the airflow and aerosolisation from alveolar space.
- Other technical refinements described in the paper are finalized to reduce the "no seal" time from ETT cuff deflation and cannula cuff inflation, which can become shorter than 2 seconds.
- Risks connected to tracheotomy in Covid-19, a conceptually extremely hazardous procedure, can be significantly reduced by rational measures and teamwork.

Dear Editor,

Tracheotomy, more than any other procedure, increases the risk of transmission from Covid-19 patients to operators because of aerosolisation[1]: a cough with an opened trachea and no seal from a cuff is the worst exposure situation.

We describe our experience with tracheotomy in Covid-19, analyzing steps at risk and describing technical refinements to minimize such risk.

Methods

Open surgical sub-isthmic bedside tracheotomies were performed, following most of the suggestions of already published guidelines for tracheotomy in Covid-19 [1-4] with some technical refinements.

Proper use of personal protective equipment (PPE) is mandatory[5]. Some authors[1] recommend a powered air-purifying respirator (PAPR), being it not available we used FFP3 masks. For eyes we use closed surgical goggles, misting up for sweating must be prevented by anti-fog spray or simply by soap and water[6].

The patient is fully paralyzed in supine position with hyper-extended head. To minimize airflow between the tracheal wall and the tube, with ETT always connected, the ventilation is hold at the end of expiration until cuff is deflated, advanced distal to the tracheotomy site to the level of the carina, then fully reinflated.

After a horizontal 1.5-3cm skin incision 0.5cm cranial to the jugular suprasternal notch, a blunt dissection along the midline is carried out, until the exposure of 3 rings and 2 inter-cartilaginous spaces. The most cranial inter-cartilaginous space visible under the isthmus is weakened by low-power monopolar coagulation so that, through palpation, it is possible to verify the position of the cuff and to push further down the cuff as described above if it is close to the tracheotomy site. There is no reason to transect the isthmus as described elsewhere[7], as it is always possible in our experience to retract it cranially and comfortably tailor

a sub-isthmic tracheostomy. The most cranial inter-cartilaginous space under the isthmus is weakened by low-power monopolar coagulation so that, through palpation, it is possible to verify the position of the cuff and to push further down the cuff as described above if it is close to the tracheotomy site. Then the trachea is opened without any damage to cartilage and to the cuff itself. With the ETT tube always inflated and in place, the opening is widened so that the suture of the caudal rings to the skin with Ethilon 0 tailors a stable tracheostomy, large enough to loosely place a n.8.5 cuffed cannula (RuschTracheoFix TFC), without any damage to the cartilage nor need for a Bjork flap.

The crucial phase is the exchange between ETT and cannula, with a time frame from ETT cuff deflation to cannula cuff inflation without a seal from the alveolar space to the environment ("no-seal" time). When the surgeon is ready the intensivist holds MV at the end of the expiration, clamps the tube with an ECMO clamp (Landangerinc., Paris, France), disconnects the tube itself connecting the cannula with already the inner tube in place (no obturator is needed with the previously tailored large opening) and puts it within easy reach of the first operator. Subsequently, the ETT cuff is deflated and pulled up by the intensivist, the already connected cannula is placed into the trachea under direct vision immediately below the ascending end of the tube by the otolaryngologist and cannula cuff, previously connected to the syringe, is inflated by the nurse. Then the ventilation is resumed, and correct positioning is confirmed by checking End Tidal CO_2 values as usual [4].

We recorded clinical and surgical variables, including potential transmission (i.e. if any team member was recorded positive or showed symptoms of Covid-19 in the following days/weeks).

Results

Since March 8th, 2020 to April 25th 2020 thirty Covid-19 patients were managed in the Covid intensive care units(ICU) of [Blinded for review]. Ten patients died, eleven patients were discharged and nine patients are being currently managed. Four (13%) tracheostomies were performed at bedside in our Covid ICUs. Demographic and clinical variables are reported in table 1.

All four patients needed prolonged mechanical ventilation, because of the acute respiratory failure, and had developed ventilator associated pneumonia (VAP) before performing tracheotomy. In three patients, gram-negative bacteria were isolated from the bronchial aspirates and one developed lung and paranasal fungal infection from zygomices. All patients underwent tracheotomy while recovering from septic shock and were still hemodynamically supported by a low dose of vasopressors.

After tracheotomy, one patient (PA) has been weaned from mechanical ventilation on day 28th, one (OI) died after 18 days of mechanical ventilation because of recurrent severe septic shock, associated with gram-negative infection with a progressive worsening of multi-organ functions. MG developed a severe invasive fungal infection, with isolation of a *zygomices* from the bronchial aspirate and he is still on mechanical ventilation. The last one (FI) resulted negative for SARS-nCoV2 on bronchoalveolar lavage after 22 days of mechanical ventilation, with a significant improvement of oxygenation (PaO2/FiO2>300) and he has been considered cured from COVID-19 and moved to a COVID-free ICU to complete the weaning from the ventilator.

"Surgical" endpoints are reported in table 2.

Discussion

Advantages of "early" tracheotomy in prolonged MV are generally acknowledged[8]. However, transmission risks in Covid-19 patients lead to much longer time threshold (up to 3 weeks from intubation) in most guidelines, dealing with the issue[1-4], and we followed this suggestion.

Only few real-life data have been published [7], with mixed techniques. Differently from such report, to avoid aerosolisation and airflow from lower airways we always opened the trachea above the ETT cuff through an open surgical technique in fully paralyzed patients, as recommended [1,4]. The described isthmus

transection[7]should be avoided as well, especially in a bedside procedure, because it increases operating time and complication rate.

However, there are 2 moments when pulmonary airspace is not sealed and airflow can be generated: the step of pushing downward the cuff and, most of all, the "no-seal" time. These two steps must be the shortest possible. To stabilize intrapulmonary pressure, in both steps we held ventilation at the end of expiration before the cuff is deflated until it is fully reinflated. In addition, we clamped the tube with an ECMO clamp in the no-seal time, to obtain 3 small but potentially decisive achievements: a) to disconnect the ETT from the circuit without allowing airflow to environment; b) to connect in advance the circuit to the cannula while still holding ventilation; c) to reduce alveolar de-recruitment.

As for the surgical technique, we describe above some tricks, which, applied by all the members of the team in coordination, allowed us to reduce the no-seal time to less than 2 second. The only problem during the procedures was in one case misting up of the goggles, probably due to insufficient use of surfactant, a trivial issue to keep in mind and avoid.

In conclusion, tracheotomy has been shown to be an aerosol generating procedure that increases the risk of transmission to healthcare workers, with an odds ratio of 4.15 for transmission in those who performed tracheotomies during the SARS epidemic [9]. The present results on COVID patients are still preliminary, and largest series are expected, but they suggest that such risks can be significantly reduced with an extensive and appropriate use of PPE, a proper surgical technique and at the same time additional rational measures and tricks both by all the members of the team in coordination.

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