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Elective open tracheostomy in a patient with COVID-19

Elektivna odprta traheotomija pri bolniku s covidom-19

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Abstract

Tracheostomy and linked procedures in COVID-19 patients are regarded as high risk procedures for the transmission of SARS-CoV-2 to the operating team and the supporting staff. The purpose of this article is to present adjustments of the elective open surgical tracheostomy in long-term intubated patients secondary to SARS-CoV-2 infection. The protocol for the elective open surgical tracheostomy procedure in COVID-19 patients was prepared, beginning with a multidisciplinary evaluation of each patient. As opposed to ordinary circumstances, the tracheostomy in COVID-19 patients is performed later, in the intensive care department , and using appropriate personal protective equipment. It is recommended to establish a COVID-19 team of experienced personnel being able to carry out the surgery in a safe, fast and reliable manner. We are describing the open tracheostomy in which harmonized and specific cooperation of the surgical and anaesthesiological team, with steps planed in advance, is of utmost importance. In addition, the procedures should be executed without generating aerosolised particles. Similar precautions should also be implemented for all the subsequent procedures, such as taking care of the tracheal stoma and solving potential complications. It is essential that the cuff of the tracheal cannula is kept inflated all the time, and that the cannula replacement is postponed and done as rarely as possible.

Izvleček

Traheotomija in postopki, povezani z njo pri bolniku s covidom-19, se ocenjujejo kot visoko tvegani za prenos virusa SARS-CoV-2 na ekipo, ki poseg opravlja, in osebje, ki po operaciji skrbi za bolnika. Namen članka je prikazati prilagoditev postopkov elektivne odprte kirurške traheotomije pri dolgotrajno intubiranih bolnikih zaradi okužbe z virusom SARS-CoV-2. Pripravljen je bil osnovni protokol za elektivno odprto kirurško traheotomijo pri bolnikih s covidom-19, ki se začne pri multidisciplinarni postavitvi indikacije za traheotomijo za vsakega bolnika posebej. Za razliko od običajnih okoliščin se traheotomija pri bolniku s covidom-19 izvede kasneje, in sicer v sobi intenzivne enote in ob uporabi ustrezne osebne varovalne opreme. Svetuje se vzpostavitev tima za covid-19, sestavljenega iz izkušenega osebja, ki operacijo izvede varno, hitro in zaneslji-vo. Opisujemo kirurško izvedbo traheotomije, pri kateri je bistvenega pomena, prvič, usklajeno in specifično sodelovanje kirurške in anesteziološke ekipe po prej dogovorjenem postopku, in, drugič, odsotnost in izogibanje uporabi pripomočkov in postopkov, ki sprožajo nastanek aerosola. Pod podobnimi pogoji se nato opravljata tudi skrb za bolnika po operaciji in reševanje morebitnih zapletov po njej. Pomembno je, da je mešiček pri bolniku s covidom-19 stalno napihnjen in da se trahealna kanila menja čim manjkrat in čim kasneje.

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1 Introduction

Tracheostomy (TT) is a surgical procedure in which an airway is established through the skin on the neck to the trachea, where it is maintained with a tracheal cannula. It can be performed as open surgery or percutaneously. Our article is focused on the first option. TT is among the most common procedures in critically ill patients and is performed in 2–24% of cases (1,2). Indications for TT are divided into two groups. In the first group we include diseases, injuries, congenital defects and operations of the head and neck. All of the above cause a temporary or permanent airway closure at the level of the upper respiratory tract, thereby preventing respiration. This article is limited to open surgery TT for the second group of indications, which include long-term endotracheal intubation (LEI) for different reasons. Even though the time frames for LEI are defined differently, and some authors also include a period of more than 24 hours (3), only those patients who have been receiving mechanical ventilation for 10 days or more are suitable for TT following an endotracheal intubation (EI) (4).

In December 2019, there was an outbreak of a new infectious disease – the coronavirus infectious disease 2019 (COVID-19) in the Chinese city of Wuhan in the Hubei province. It is caused by the SARS-CoV-2, i.e., a betacoronavirus, which has an at least 70% genome match with that of SARS-CoV, which caused a severe epidemic in China in 2003 (5). From China, COVID-19 spread uncontrollably and quickly across the globe exceeding all expectations (6). This is a disease with a subacute course and a series of clinical signs: fever, coughing, fatigue (5), dyspnoea (7), loss of smell and taste (8). Dyspnoea is a sign of a dangerous phase of the disease, i.e., an atypical pneumonia: tachypnoea (>24/min), leukopenia and interstitial changes in the radiograph of the lungs (8,9). In 80% of the cases, the disease has a mild to moderate course, and in 15%, the outcome is severe and requires hospitalisation and oxygen supply, while with 5% it is critical and requires EI and mechanical ventilation (6,7). TT is utilised in the latter case.

The first COVID-19 case in Slovenia was confirmed on 4 March 2020. By 30 August 2020, 2,865 patients had fallen ill, of which 133 died. The incidence grew on a daily basis. With COVID-19, artificial ventilation is frequently long-term, so with regard to the epidemiological situation and the data from abroad regarding the duration of the epidemic, we expected more long-term intubated patients and thereby an increase in the demand for TT. This is highly problematic for COVID-19 patients because of the formation and spread of aerosol with viruses that can cause an infection of the surgical and anaesthesiologic team and staff that cares for the patient after TT. This makes TT a high-risk procedure (10). It means that the decision on the indication has to be thorough, and a multidisciplinary evaluation has to be made for each individual patient (11,12).

There are no effective medicines nor a reliable vaccine available for COVID-19 (in Slovenia). Therefore, the main strategy in the fight against COVID-19 is transmission prevention (13-17). The objective of this article is to clarify the importance and danger of open surgery TT and to provide instructions regarding preparations

for the procedure, its execution, and the measures to take following it. With regard to the development of the epidemic, the new knowledge coming in on COVID-19, the available technical means and the availability of the staff, it is expected that instructions in literature will gradually change and improve (18).

2 Danger of infection transmission during and after TT with COVID-19 patients

Before deciding on TT, all the benefits of TT should be carefully considered against the risks for virus transmission. Secretions from the trachea are excreted with coughing and aspiration of trachea together with viruses in the aerosol, which remains in the air for up to 3 hours. There is a danger of infection not only during the operation, but also during recovery (15).

The risk for infection transmission between medical workers (MW) is especially high. Among the first 138 patients hospitalised for COVID-19 in China, 40 were MW (29%). In the end, MW represented 3.83% of all infected in China. Building on experience of the previous epidemic, which was caused by the SARS-CoV virus, Tran established that the prospect ratio for infection transmission is 4.2 for a MW who conducted tracheotomy, compared to one who did not (19). According to Michetti's personal opinion (20), which is not supported with evidence, when taking into account the high transmission rate of the SARS-CoV-2 virus and the fact that the spread of the blood and droplets with a surgical TT is practically unavoidable, the prospect for transmission of the SARS-CoV-2 virus during a surgical TT is much higher than Tran's estimate for the SARS-CoV virus. Mecham's report that approximately 1% of MW who get infected with the SARS-CoV-2, die, is cause for additional concerns (21). This means that a different approach to TT is needed, as holding open surgery TT in the usual way is not appropriate and is even harmful (12).

3 Time of surgery

The results of the meta-analysis from 2018 showed that with LEI patients, an early TT, especially if conducted within 7 days after EI, statistically significantly reduces the incidence of hospital pneumonia, mortality, duration of mechanical ventilation and the duration of treatment in an intensive care unit (2). The main advantages of TT over LEI are a shorter respiratory tube, which lowers resistance for the ventilation workload and makes airway management easier. Other benefits include fewer injuries to the throat and the pharynx, greater independence of the patient, easier communication, easier (respiratory) physical therapy, and easier feeding. The patient can handle the tracheal cannula more easily than the endotracheal tube, therefore requiring fewer sedatives, which leads to less frequent delirium (2,22). All of this leads to faster removal from ventilation and earlier transfer from intensive care to a normal ward (23,24), which is especially welcome in a time of crisis, when there could be a shortage of ventilators and beds in intensive care units (12,25), as well as human resource shortages. The point of TT is also to prevent complications, such as ventilator-associated pneumonia (26) and laryngotracheal stenosis (4).

All of the above supports early TT with COVID-19; however, there is no evidence that early TT improves the course of COVID-19. Under regular circumstances, TT is performed 7–10 days after EI for shortening mechanical ventilation and intensive care treatment (2,3,27). With COVID-19 patients, the recommendation is to extend the duration of artificial ventilation over the endotracheal tube, and therefore perform TT later – between 14 and 21 days after EI (12,24,28). One of the arguments is that there is a high probabil-

ity for infection transmission to MW involved in the procedure, as TT is a procedure with a high risk for aerosol spreading (10).

The second argument for a delayed TT is a relatively low risk for postintubation laryngotracheal stenosis after long-term EI (1–2%) with tubes with low-pressure cuffs (28), which is prevented with a timely TT; however, due to a high risk for infection transmission to a MW, the 1–2% incidence represents an acceptable risk. Hence it is recommended to wait 14 to 21 days after EI before performing TT (12,24,28). That is when the viral load is lower, and therefore the procedure is safer for the team. However, Takhar points out that the viral load with the elderly and patients with a multi-organ failure remains elevated longer (27).

Therefore, it is understandable that recommendations are even stricter. Skoog, Hiramatsu and Shiba claim that with a long-term intubated patient, TT should only be performed exceptionally (12,15,29). Sommer and Heyd completely advise against TT, regardless of the duration of the intubation, until the patient has not been proven negative for the presence of the COVID-19-causing virus (25,30). The exception is insufficiently maintained airway despite ET, which is decided on a patient-by-patient basis (30).

The third argument for postponing the operation is the natural course of the disease. Experience has shown that the time from admitting a patient with COVID-19 to the intensive care unit and until their death is relatively short. In Wuhan, it was 5 (31), in the UK 6 (32) and in Lombardy, 7 days (33). In this respect, it is sensible to wait until the prognosis of the COVID-19 outcome is not clearer. A pointless TT and unnecessary endangerment of the involved MW are avoided in this manner (27).

ARDS as a result of COVID-19 requires an even longer intubation than ARDS not related to COVID-19. Average duration of mechanic ventilation for an ARDS developed from COVID-19 is 17 days, and mortality rate after 28 days is at 81%. For ARDS from other causes, the data states 8 days and 34.8% mortality rate (21). The survival rate of COVID-19 patients on mechanic ventilation is therefore below 20% (34). This raises the question whether it is sensible to provide patients who have a longer forecasted duration of COVID-19 – and with it, a higher mortality rate – with a more decisive treatment. In such cases, TT is not recommended (21). However, after long-term intubation, the need for TT cannot be forecast, as this is more of a clinical decision (2,23).

At the Ljubljana University Medical Centre, we opt for elective open-surgery TT on COVID-19 patients who are intubated and mechanically ventilated for at least 3 weeks.

4 Room for performing the operation

The UK recommendation is to perform TT in operating rooms that are exclusively dedicated to COVID-19 patients (35). However, elective TT on a patient with COVID-19 is not necessarily performed on an operating table in an operating room, but it can also be performed on a hospital bed in a room on the intensive care therapy unit. In any case, it is recommended that the room has negative pressure (12,21,28,36), which is not possible in most European hospitals with operating halls with positive pressure (27). If the procedure is performed in a room with normal pressure, it is recommended that all not essentially required MW remain outside the room for up to three hours after the procedure (20), and the French guidelines recommend regularly airing the room out (18).

Because of the danger of infection transmission when a COVID-19 patient is transferred from intensive care unit to an operating room, most authors recommend the procedure is performed on the bed of the intensive care unit (25,36). Ad-

ditional advantages are engaging fewer MWs, shortening the preparation for the procedure and using the same ventilator that the patient is using in the intensive care unit, instead of a new one if the patient is moved to an operating room (21).

At the Ljubljana University Medical Centre, elective surgical TT on COVID-19 patients is performed under normal pressure at the intensive care unit of the Clinic for Infectious Diseases and Febrile Conditions, which is also a COVID-19 hospital. The procedure is performed on a hospital bed. However, because it is wider than normal operating tables, performing TT is more difficult. We place the patient on the upper right part of the bed so that they lie right by the edge of the bed, where the operating surgeon stands. The assistant stands behind the patient's head so that they have a good overview of the operating field. The difference from a normal TT, performed on an operating table, is that with the latter, the assistant stands opposite the operating surgeon. We have to ensure a good (i.e., additional) lighting of the surgical field (15,21), as intensive care rooms are not equipped with suitable lighting for surgical activity.

5 The COVID-19 Team

In order to reduce exposure to harmful aerosol, the TT must be performed as reliably and as quickly as possible. Literature recommends constituting a COVID-19 team, i.e., a group of experts in charge of performing TT in an individual otorhinolaryngology department. The British recommendations are that they operate as the COVID-19 team one day per week, and to perform up to two TTs on that day. Different teams can operate a total of twice per week with a pause of at least a week in between. The team members are selected by a special group of otorhinolaryngologists, intensive care physicians and anaesthesiologists (27). MWs with chronic diseases that are risk factors for severe COVID-19 (arterial hypertension, diabetes, COPD), must not be included in a COVID-19 team (37).

Considering the reports that TT should be performed by the most experienced staff (21,36,38) in order to ensure maximum safety, only the required staff should be present during the operation, with no additional MWs (12,38). Consequently, specialty trainees should not participate in TTs of COVID-19 patients (20,25). Reducing the number of staff also saves up personal protective equipment (15). During a TT, the communication of team members involved in surgical work and the support MWs in the next room takes place over radio connection (35).

The serums of patients who overcame COVID-19 had antibodies up to 15–20 days after the onset of symptoms. It is possible that these patients developed immunity to the SARS-CoV-2 virus; however, this has not yet been proven. If this were true, Miles believes it would be sensible to include MWs who overcame COVID-19 and have a suitable level of protective antibodies in COVID-19 teams (28). Such decisions, which are not yet backed by science, but are mere predictions, are subject to each individual institution, at least until there is enough substantial and reliable proof.

At the Clinic for otorhinolaryngology and cervicofacial surgery, the COVID-19 team includes the following MWs: specialist otorhinolaryngologist, specialty trainee otorhinolaryngologist, two senior medical technicians for operations, and an anaesthesiologist with a qualified nurse. Active participants in the surgical work include both otorhinolaryngologists and one technician for operations, while a second technician is located outside of the room where the operation is taking place. They communicate over a computer connection (Skype). All the required instruments are preprepared per agreement. If it turns out that the team needs additional instruments, the second technician prepares them in a sterile environment and hands them over to the surgical team through

an intensive care unit nurse. Along with performing TT, the COVID-19 team must also change the cannula and tend the surgical wound after the surgery. Additionally, they perform all multidisciplinary team examinations and procedures on all COVID-19 units at the Ljubljana University Medical Centre.

6 Personal protective equipment

Personal protective equipment is the main resource for reducing the transmission of the SARS-CoV-2 virus on healthy MWs (34). Because of the possibility of spreading the virus from people who are infected with the SARS-CoV-2 virus, but exhibit no symptoms, David recommends that MWs who perform procedures where aerosol spread is possible, always protect themselves with protective equipment, regardless of the patient's status of COVID-19 infection. The same protective measures apply for MWs who treat the so-called positive and negative patients and patients whose status regarding COVID-19 is still not known (34). Because of the possibility of false negative results of the COVID-19 test and the quick transmission of the disease, the Canadian guidelines recommend the same. Therefore, consistent use of full personal protective equipment is also obligatory for MWs who treat COVID-19 negative patients (30,39). The safest option for MWs is to consistently use single-use personal protective equipment (36).

The surgical and anaesthesia teams of the Ljubljana University Medical Centre utilise a powered air-purifying respirator (PAPR) with a hood for protection of head and neck during open-surgery TT of a COVID-19 patient. The body is protected with a water-proof coat, under a sterile surgical coat, along with the regular single-use surgical clothing. The hands are protected with nitrile gloves, with sterile surgical gloves worn over them. Feet are covered with single-use booties and surgical footwear.

More details about personal protective equipment are available in a separate article.

7 Particularities in TT in patients with COVID-19

In order to limit the release of aerosol during open surgery TT, a diligent preparation is necessary. However, the most important thing is open and clear communication between the surgical and the anaesthesia teams (34). Even the smallest misunderstanding can lead to a significant spread of aerosol from the respiratory tract, which means a severe risk of infection for the surgical and anaesthesia teams. TT under general circumstances and TT with COVID-19 differ in the following elements:

- The anaesthesiologist ensures the patient is in deep anaesthesia and has completely relaxed muscles during the whole operation in order to prevent the formation and spread of aerosol during unwanted patient exertion (15,21,28,36,40,41). Before the operating phase, sufficient apnoeic oxygenation is ensured (27). The application of systemic anticholinergics is recommended in order to reduce excrements from the upper respiratory tract (glycopyrronium) (28).
- Some authors recommend the patient and the whole operating field are covered with a sterile transparent covering or some type of transparent screen that prevents the spread of aerosol, blood and mucous into the faces of the surgical team (36,42-44). The hands of the surgical team and the equipment the team uses are under this cover for the entire duration of TT. Smoke removers can also be used to remove smoke from under this screen (43).
- In order to reduce the haemorrhage, an anaesthetic with vasoconstrictor (lidocaine and adrenaline) is injected before the incision (45).
- The incision in the skin is vertical (and

not horizontal) so that after the window is excised from the trachea, the skin flaps are more easily sutured to the trachea. This way the tracheostomy can remain wide open even if the cannula falls out unexpectedly, and it also makes it easier to re-insert the cannula.

- Consequently, one or two holding sutures are made on both edges of the wound to retain the open tracheostomy. At this point, the holding sutures are only made through the skin, and through the trachea just after the excision of the window in the trachea.
- Haemostasis. Recent studies have proven the presence of RNA of the SARS-CoV-2 virus in the blood of patients with COVID-19 symptoms in 1–15% of cases (46-48). Other studies have shown that when using electrocoagulation instruments, viruses are released into the surrounding area with the smoke (49-51). For the SARS-CoV-2 virus, this has yet to be proven. Even so, as a precaution, we advise against using electric mono- and bipolar electrodes for haemostasis. On the other hand, Broderick has no reservations regarding this method, as he believes that the evidence on the danger of electric instruments is insufficient (35). Chow also uses electric instruments; however, he protects his surgical team with a transparent screen (44). Hiramatsu advises against electrocoagulation itself only after entering the trachea (29), whereas Shultz recommends to electrocoagulate as little as possible (18). Similar to most authors, we do not perform electrocoagulation during TT at all (28,37). Instead, we use other methods to achieve haemostasis using "cold instruments" (28), such as vascular ligation, installing surgical clamps (15), chemocauterisation and inserting adrenaline-soaked tampons on the location of haemorrhage.
- The entry point into the trachea is an important and, from the perspective of infection transmission, exceptionally dangerous point. Before entering, in order to ensure that work is easier and safer, a larger surface of the anterior wall is uncovered than in regular TT. At this point, the anaesthesiologist confirms deep anaesthesia, complete muscle relaxation and sufficient oxygenation. It is crucial that mechanic ventilation of the patient is stopped (15,18,36), so that there is enough time for a passive exhale with an open adjustable pressure-limiting valvula (APL) (27).
- The endotracheal tube is pushed first towards the carina (41) to prevent the rupture of the (constantly inflated) cuff when cutting the window in the trachea later on (38). The cuff must be installed lower than the planned windows (30,35). During TT procedures conducted by our COVID-19 team, we discovered that the position of the cuff, whose upper part appeared above the level of the bottom edge of the window, is too high, and therefore an additional warning to the anaesthesiologist during TT is recommended.
- Excising the tracheal window is the most critical point in TT for the infection transmission to the team. This part of the operation is performed in the apnoea (30,38). The patient must be well oxygenated in order for the operating surgeon to have enough time to securely perform this part of TT. To make sure that the cuff is not punctured, if it was installed too high (30,35), we have to constantly verify the position of the tube's cuff. First, we perform a horizontal incision with a scalpel through the annular ligament between the second and the third tracheal cartilage. This is followed by a planned right (if the operating surgeon is standing on the right) vertical incision using scissors through the third cartilage. This way, a small tracheal flap is formed and unhooked, providing an insight into the insides of the trachea and verifying the cuff's location. If it is appropriate, the right vertical incision is extended through the

fourth cartilage. If it is not, the endotracheal tube has to be again/additionally pushed towards the carina. This is followed by the second vertical incision on the opposite side through the third and fourth cartilage, then a horizontal incision through the angular ligament between the fourth and fifth cartilage. With the latter incision, the tracheal window is cut free.

- The holding sutures that we only placed through the skin at the start of the operation (line 5), are at this point made through the side edges of the trachea on both sides and tied. This is how we complete the holding sutures.
- The tracheal window must be smooth and without any sharp points in order to prevent piercing the cuff during the operation or later in the ward. Every unpredictable or even urgent replacement of the cannula presents a danger for the spread of aerosol. The haemostasis at the edge of the window, as well as on other parts of the trachea, should under no condition be chemocauterised, as this procedure has some time delay and is therefore unpredictable. Any bleeding on the trachea is therefore stopped only by pressing adrenaline-soaked tampons to the location of the haemorrhage.
- There can be a load of mucus or puss in the trachea. The literature advises against aspiration because of aerosol spread (30), therefore aspiration has to be included in a closed system (28,30) with HEPA filtration (high-efficiency particulate arrestance) (34) or a viral filter (15,40). At the Ljubljana University Medical Centre the trachea is carefully aspirated through the window with a closed system, and the location of the aspiration is temporarily covered with a gauze.
- This is followed by the deflation of the cuff and by pulling the endotracheal tube out, so that its tip is visualy located just above the upper edge of the window in the trachea (15,52).
- We insert the cannula (non-fenestrated with a low-pressure cuff (15,25,40), with a pre-installed HME filter (heat and moisture exchanger) (30,38) or a viral filter (25). Immediately following that, we inflate the cuff (41). This prevents potential spread of aerosol through the lumen of the newly inserted cannula, which can trigger coughing with insufficient level of anaesthesia and muscle relaxation (34). It has to be emphasised that because of the filters installed on the cannula, we cannot use a cannula guide, which would make the insertion into the tracheostoma easier. Insertion (without a guide) is thereby technically more demanding, but safer for the personnel. Hiramatsu recommends temporary suture of the cannula to the tracheal wall to prevent it from potentially falling out (29).
- After the cuff is inflated, apnoea is no longer required, as the airway is closed, so the anaesthesiologist connects the cannula through the HME filter with the ventilator's tube and in agreement with the operating surgeon, continues the ventilation (15). The endotracheal tube and the used material are thrown in a lid basket (36).
- The cannula is sutured to the skin and additionally fixed with a tape around the neck (20,32).
- The position of the cannula is assessed by placing the neck in the same position as it will have later in the ward (27). Hiramatsu confirms the correct position of the cannula by taking a radiograph later on (29).

8 Particularities in postoperative care of patients with COVID-19

Just as an operation for a COVID-19 patient is carefully planned, so must be their postoperative care (40), as the danger of aerosol spread is far from over (15). The same principles are used (11,52). Af-

ter TT, the patient must be ventilated with a closed system, and a closed system is also used for aspiration through the cannula, so that the aerosol with viruses is not released into the room (12,52). The cannula has a HME or viral filter (28,53). Every redress of the binding material on the tracheal cannula, deflation of the cuff or cannula replacement could cause the spread of aerosol and pose a danger of infection of a MW. Consequently, we perform these procedures as seldomly and with as much delay after the operation as possible. It is even safer and more optimal if the patient learns to take care for their own cannula (25), if their general condition permits it.

It is important that the cuff remains inflated after the operation (12,25), and that this is monitored (30), until the patient stops spreading the virus (34). With every deflation of the cuff and cannula replacement, personal protective equipment has to be used, and the patient ventilation temporarily stopped. Some authors recommend that before replacing the cannula, a local anaesthetic is applied in the form of a spray into the cannula (18), while others consistently advise against spray application.

When replacing the cannula, the patient has to be under general anaesthesia and relaxed, just like before entering the trachea during the operation (18). The redressing material of the cannula is not replaced, except with apparent signs of wound infection. Recommendations about the first replacement of the cannula differ: from seven days and up to three months after TT (12,27,34), while some completely advise against the replacement and permit it only in emergency situations, when the cuff is pierced (28) or when the viral load is very low (40), or when the COVID-19 disease has been completely cured (12,25,52).

At the Ljubljana University Medical Centre, we recommend replacing the redressing material for every open surgery TT of a COVID-19 patient only with signs of an infection of the surgical wound, and the cannula one month after surgery. Our past experience shows that at the request of the intensive care unit staff that provides postoperative care to the patient, the redress material is changed sooner, between one week and ten days after the operation.

Releasing patients with a tracheostomy into home care until their test for COVID-19 comes back clearly negative is advised against, because of the danger for further infection of family members (15).

9 Conclusion

Because performing an open surgery TT in the usual way represents a high risk for the transmission of the SARS-CoV-2 virus, special adjustments are needed for COVID-19 patients in this area. With COVID-19 patients, the time between EI and TT is extended from the usual 7–10 days to at least 3 weeks. The operation is performed at the intensive care unit for COVID-19, where the patient is hospitalised on their hospital bed. As TT must be performed quickly and reliably, it is recommended that a COVID-19 team is established, responsible for performing TT on such patients and later on, postoperative care. PPE is used, generally including a surgical gown, a waterproof coat, a sterile surgical coat, PAPR, nitrile gloves, sterile surgical gloves, single-use booties and surgical footwear.

Constant communication between the surgical and the anaesthesia teams is important. The main tasks of the anaesthesiologist in a TT of a COVID-19 patient are deep anaesthesia, complete muscle relaxation, sufficient oxygenation and pushing the tube towards the carina before surgically entering the trachea. From the surgical angle, the particularities of TT are haemostasis using "cold instruments", excision of the window of the trachea in the apnoea, ensuring smooth edges to the windows, the stay sutures, inserting a non-fenestrated cannula with a low-pressure cuff with a preinstalled HME filter and adjusting cannula both with sutures

to the skin as well as with the tape around the neck. After the operation, the cuff is constantly inflated, while the cannula has a permanent HME or viral filter. The redressing material and the cannula are replaced as seldomly and with as much delay as possible, or only with signs of an infection to the surgical wound.

The objective of this article is to ensure physicians, nurses and other staff participating in TT of COVID-19 patients are safe and remain healthy. This also fully applies to the patients and their family members. This article can serve as a preparation for epidemics that are sure to follow. Because, as the infectiologist Dr. Tomažič said in one of his articles at the start of the epidemic in Slovenia, bats, the natural hosts (reservoirs) of numerous different types of coronaviruses, can serve up new "surprises" in the future (6).

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