

Tracheostomy in intensive care unit in a patient with COVID-19.



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ABSTRACT

INTRODUCTION: For many months now, the entire world experiences effects of the COVID-19 pandemic, and current data indicate that this condition will continue even longer. About 5% of patients who become infected with the SARS-CoV-2 coronavirus may develop a critical form of severe respiratory failure, due to which they will undergo intubation and mechanical ventilation. Prolonged mechanical ventilation will be an indication for an open tracheostomy, burdened with an increased production of aerosol containing virus particles and an increased risk of transmitting the highly contagious pathogen to medical personnel. In this situation, surgical departments with a limited number of operating theaters may be dedicated only to COVID-19 patients. Their use for other procedures will be significantly reduced or even impossible to prevent transmission of infections and exposure to other people. Taking into account the well-being of patients and staff and limiting the transmission of the virus to other departments, other safe solutions are being sought to perform a tracheostomy. An alternative procedure may be to perform a tracheostomy directly at the bedside (point-of-care) of a patient hospitalized in an intensive care unit (ICU).

PURPOSE: The purpose of the study is to present an effective performance of safe, open tracheostomy in the ICU.

METHODS: The bedside tracheotomy as an alternative to the procedure performed in the setting of an operating theater has been presented. A case study was based on the analysis of the procedure performed in a 42-year-old patient who was installed an open tracheotomy tube on the twenty-ninth day of intubation.

CONCLUSIONS: In order to limit the transmission of the SARS-CoV-2 coronavirus outside the intensive care unit, it is recommended to perform a tracheotomy in ICU, in patients requiring mechanical ventilation, as the method is effective and safe.

KEY WORDS: SARS-CoV-2 coronavirus, COVID-19 pandemics, respiratory failure, tracheostomy, aerosolization.

INTRODUCTION

Respiratory failure is a life-threatening condition, that can lead to extreme hypoxia as a result of disturbances in gas exchange in the lungs [1, 2]. This mechanism may be influenced by many causes, one of them is COVID-19 disease, caused by the SARS-CoV-2 coronavirus infection. The nature of respiratory failure in COVID-19 patients is such that it may often require prolonged mechanical ventilation [3]. These patients are hospitalized in ICU, as 5% of patients will develop a critical illness and will be qualified for prolonged invasive ventilation, preceded by intubation [3]. Treatment of these patients is a long process, and the maintenance time of the tracheal tube is defined, so if the patient requires further connection to the ventilating machine, open tracheostomy will be necessary [4]. Longer intubation is not recommended due to possible complications for the patient: the risk of damage to the trachea due to a pressure ulcer, difficulties in long-term care of the oral cavity and throat, risk of maintaining upper respiratory tract infection, inability to wake the patient.

Tracheotomy is a surgical procedure that involves opening the anterior wall of the trachea and inserting a tracheotomy tube in order to keep the airways open [2]. During this procedure, aerosol particles are generated and there is a risk of virus transmission to medical staff. This operation is performed in the operating theater, with the involvement of two teams: anesthesiology and surgical. The SARS-CoV-2 virus is a highly contagious pathogen, its transmission is via droplets and direct contact with an infected person [2]. Management of a patient with this infection requires extreme caution and the application of restrictions that will protect the personnel from infection. The perioperative procedure must be highly restrictive, and the operating room intended for the procedure must be temporarily excluded from normal operation and reorganized [5]. During the procedure, the equipment remaining inside should be limited to the necessary minimum. Cleaning up after the procedure, for which a patient infected with a highly contagious pathogen has been qualified, is a long process that has to follow caution and safety rules for the person performing decontamination [1]. Performing a tracheotomy in a patient infected with coronavirus, in an operating suite with only one or two operating rooms, makes the problem even more difficult and introduces further limitations.

Unfortunately, in many countries, insufficient financing of health care means that housing conditions in hospitals do not allow the use of large, multi-module operating theaters. This is the case in Poland, where most hospitals have small two-room operating rooms at their disposal. Then, unfortunately, elective procedures have to be cancelled. Small operating theaters can be designed so that treatment rooms are close together, have common rooms for staff to move around, and patients to enter. There is a high risk of contact between an infected patient and an uninfected patient, and the staff working in both rooms. A failure to perform elective surgery entails undesirable consequences. Patients' health problems worsen, which increases the risk of postoperative complications. Waiting time for elective surgical procedure is longer, which causes frustration and dissatisfaction among patients, favoring deterioration of health due to the delay of surgical treatment [6].

In order to ensure access to treatment to all those in need of medical assistance and at the same time to carry out procedures with maximum safety for each patient, it is necessary to implement new options that would open a way out of this difficult situation. One of such solutions is tracheostomy to a patient infected with SARS-Cov-2 performed in the ward in which he/she is hospitalized, most often in the ICU [4]. A surgical procedure performed outside the operating theater must be carefully prepared and planned. There must be no violation of any rules, all assumptions of asepsis and antisepsis must be met, and above all, the patient's rights, including the widely understood right to safety, must be respected. By doing so, the risk of transmission of the highly contagious pathogen among staff, patients and other wards can be reduced. The patient's environment in the ICU ward will be reorganized and adapted to the professional conduct of the surgical procedure, the purpose of which will be to insert a tracheotomy tube.

Preparation and implementation of a well-prepared perioperative algorithm during tracheotomy in the ICU ward can bring tangible benefits for everyone. For a patient with respiratory failure requiring long-term ventilator therapy, for patients qualified for elective procedures and for those requiring emergency procedures. The aim of this study is to demonstrate the effectiveness of CAR as a 30-day mortality indicator in COPD patients admitted to ICU, as well as to evaluate the reliability and predictive power of CAR by comparing it with other parameters indicating mortality in ICU.

The purpose of the study is to present a possibility of effective performance of a bedside tracheostomy in an ICU, in a patient connected to a ventilator, infected with the SARS-CoV-2 coronavirus, as a result of which the critical form of COVID-19 disease has developed, in order to reduce the risk of spreading the infection beyond the space where the patient resides, by limiting transmission of viral aerosol particles, ensuring maximum protection for medical personnel.

CASE PRESENTATION

A 42-year-old young man was transferred from the internal ward to the intensive care unit due to a rapidly intensifying shortness of breath caused by the SARS-CoV-2 coronavirus infection, as a result of which he developed a full-blown, severe form of COVID 19 disease. The patient was in a six-bed room intended only for patients infected with coronavirus – the pathogen characterized by high contagiousness. The man was connected to oxygen, and then, due to the increasing dyspnea and deteriorating condition, a decision was made within a few hours to intubate the patient and start a mechanical ventilation. Respiratory therapy was carried out for several weeks and the patient's condition did not improve, therefore, after four weeks (on the twenty-ninth day), the final decision was made to perform open tracheostomy. After a thorough analysis and assessment of the situation, the anesthesiologist and a team of surgeons decided to perform the procedure at the ICU. Preparations were started to adjust environmental conditions in which the patient stayed to the planned surgery. Patient positioning is an indispensable element of the safe performance of any surgical procedure. For this purpose, the patient was placed on a couch as the standard width of the intensive care bed is 1200 mm, and the maximum height at which it could be raised was not sufficient for the ergonomic work of the surgical team.

In addition, the headboard was not movable enough to ensure proper positioning with a bend under the shoulders for the surgical procedure, which is a tracheostomy. Therefore, carrying out operations on an ordinary intensive surveillance bed would cause many inconveniences, reducing visibility in the operating field. The prepared bed was narrower, height-adjustable, and a 15 cm roller was inserted under the patient's shoulders, thanks to which the patient was properly positioned with the upper part of the chest bent forward. Aspirators from the ICU were used to carry out this procedure.

To improve visibility in the operating field, a mobile single-focus lamp was used, which could be manually set to illuminate the operating field. ICU does not have an electrocoagulation platform as a standard equipment. This was borrowed from the operating theater. Transporting the unit was not a problem as it was mobile according to the equipment guidelines. A set of surgical instruments typical for such a procedure was used, packed in a container, safe for the transport of both sterile and contaminated instruments, which were laid out on a prepared, sterile-lined table (Figure 1).



Figure 1. Tracheotomy treatment station prepared at the ICU: a narrow bed, a mobile single-focus lamp, an aspirator, a cardiac monitor, an electrocoagulation platform, a set of surgical instruments

Standard disposable tracheotomy drapes were used. Surgical gowns, suture material, dressing material and instruments, i.e. the electrocoagulation electrode, were disposable, because unused equipment is also considered highly contaminated material. The lock at the ICU was a preparation site for the operating team, which included two surgeons and an assisting scrub nurse. In this room, they washed their hands and put on personal protective equipment (PPE) including coverall, surgical cap, FFP3 mask, goggles or visor, disposable sterile surgical gown and double sterile gloves.

There was a supporting scrub nurse outside the room, who, using a walkie-talkie, gave all the instructions necessary for the professional and safe conduct of the procedure to the assisting persons, who were the personnel employed in the ICU on a daily basis. The instructions concerned, among others: a help for surgeons in dressing up, selecting the place to stick the passive electrode on the surgeon's thigh or opening the equipment in accordance with the principles of asepsis and antisepsis. In addition, she secured a surgical operating team in the event of the need to provide any non-standard equipment for this type of operation. Thanks to these activities, it was possible to perform the bedside open tracheostomy in a professional, safe and effective way, in the ICU. The course of the procedure itself was uneventful.

The surgical and anesthesiologic team did not make any comments regarding the technical facilities, ergonomic or medical conditions during or after the procedure. There were no intraoperative complications. The postoperative course was also uneventful and allowed for further mechanical ventilation of the patient through the tracheostomy tube. The disposable material used for the operation was properly packed as highly contagious material and prepared for incineration. Surgical instruments were packed in a container and delivered for sterilization. After the end of the procedure, the operating team disposed of personal protective equipment in the airlock, observing the safety rules and following the order of removal, and each team member took a shower and put on a new disposable clinical outfit. Devices, i.e. the electrocoagulation platform, which were used for the procedure, were first decontaminated using the method of fogging with hydrogen peroxide and finally returned to the operating theater.

DISCUSSION

As a result of the SARS-CoV-2 coronavirus pandemic, 5% of infected patients will develop critical form of acute, severe respiratory failure, requiring intubation and mechanical ventilation. Prolonged invasive ventilation is an indication for an open tracheotomy, burdened with transmission of viral aerosol particles [7]. As a standard, routine tracheotomy is performed in the operating theater, with the use of its equipment, and after prior designation of zones and rooms adapted to reception of patients infected with the highly contagious pathogen [6]. Small operating theaters should be allocated to patients undergoing tracheotomy procedures with a critical course of COVID-19 only, as the simultaneous operation of these patients and non-infected

patients is very difficult and risky. With the outbreak of the COVID-19 pandemic, teams of experts around the world, also in Poland, developed guidelines for adaptation of operating theaters to the new epidemic situation [8]. All these activities were aimed at reducing the spread of infections among patients and the staff working in these wards. One of the important guidelines was the appointment of a separate operating theater, operating room or COVID-19 restricted zone. The next step was to separate clean zones. For this purpose, the color coding was used [9]. The SARS-CoV-2 free zone is marked green, the restricted access zone is colored yellow, and the contaminated zone intended for patients infected or potentially infected with coronavirus is red.

Attention was paid to leaving the necessary equipment in these rooms, without which a surgical procedure could not be performed [5, 9]. Items designed to stay within the red zone need to be foiled or covered with covers that are easy to clean. Sets of tools, dressings and suture material should be carefully completed beforehand and prepared on mobile trolleys. If it is necessary to use any additional equipment, it should be introduced into the room before the patient enters. Reorganization of the operating theater, separation of zones and rooms for SARS-CoV-2, is not a major problem in operating suits with many operating rooms. When the operating suite has one or two operating rooms, a great difficulty arises, because this kind of unit should be entirely dedicated to patients with COVID-19 only. Adaptation of a small operating suite would involve actions that were impossible to implement. Small, non-air-conditioned operating rooms, intersecting access roads and zones would pose a great risk of transmission of infection. Uninfected patients would be exposed to COVID-19 patients, and staff securing all operating theaters would meet in social rooms. The time required for decontamination would be significantly extended.

Scrupulousness and strictness in the performance of activities by a cleaning person is a very important element of ensuring the safety of staff and patients [4, 9, 10]. Failure to comply with the relevant standards would completely disorganize operation of the operating suite. Elective surgeries would need to be called off, dissatisfaction among patients would increase and queues waiting for elective surgery would be significantly extended [5]. Patients' dysfunctions and health problems may worsen, leading to an increased risk of postoperative complications. To minimize the problem, clinicians must focus on finding alternative solutions, so that the availability of health services is equal for all [2]. The problem-solving situation, especially in the

case of small hospitals, may be the open tracheotomy performed at the point of care of a patient hospitalized in the ICU. Such a solution may have many benefits, it would reduce the risk of disease transmission during patient transport, reduce the need for qualified surgical personnel and reduce the burden on time and operating room personnel during the pandemic [2]. Limiting the transmission of infection among the operating theater staff - the group of specialists who perform difficult and specific work, and who are difficult to replace in the workplace is the argument of utter importance that needs to be considered. Another advantage of this solution is the equal availability of surgical procedures both for patients hospitalized in ICU, undergoing chronic ventilator therapy, and for patients waiting for elective procedures. Difficult and problematic situations motivate to act and search for solutions for institutions sharing the same problem.

CONCLUSIONS

Due to an increased risk of becoming infected with SARS-CoV-2, in case of patients with respiratory failure requiring a prolonged mechanical ventilation the procedure of tracheostomy must be carried out in isolation and the procedure may be safely completed in the point of care, in the ward where the patient is hospitalized. This procedure should be considered especially in facilities where it is not possible to set-up an operating room dedicated to Covid-19 patients only.

Disclosure statement

The authors did not report any potential conflict of interest.

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