

Trauma Care in COVID-19 Pandemic

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Abstract

The development of COVID-19 pandemic is the serious challenge for trauma care systems across the world. Recommendations on general principles of trauma care in the settings of pandemic, medical staff protection and prevention of the spread of infection based on the data from international centers are presented in the article. Delay of all elective cases, restriction of surgical treatment of fractures with relative indications for surgery are recommended. The segregation of cases into COVID-19 confirmed or suspected and COVID-19 negative patients is important. When possible before the admission to inpatient department the patient shall be tested on COVID-19. When the COVID-19 status of the patient is unclear all possible protection measures shall be used: patient isolation and medical staff protection. To prevent the spread of infection it is recommended to split the staff of the trauma-center into 2 or 3 groups. Each of the groups is working during the week with subsequent period of the self-isolation (remote work) for the period of 1-2 weeks (according to the duration of incubation period of the COVID-19). During the surgical treatment the most dangerous stages of the surgery are endotracheal intubation / extubation and also aerosol-generative procedures: electrocoagulation, pulsed wound lavage, drilling, the use of oscillating saw and medullary reaming. The staff in the OP-theatre has to be accordingly equipped (personal protection equipment). The risk factors for the medical staff are fatigue from overwork, the absence of real-time training in infection-prevention measures and non-compliance with PPE.

Keywords: COVID-19, trauma care, staff protection.


Introduction


On March 11, 2020, WHO announced a global pandemic because the spread of COVID-19 was reported in more than 100 countries. COVID-19 is a disease that is caused by the SARS-CoV-2 virus. The virus affects through mucous membranes after contact with an aerosol containing the pathogen (sputum droplets), or by direct contact of the hands with a contaminated object and the subsequent transfer of the virus to areas susceptible to it (for example, touching the nose and face). It was demonstrated the possibility of transferring the virus in an aerosol, formed primarily during patients intubation/extubation, as well as in the course of surgical interventions, namely electrocautery and the medullary canal reaming. SARS-

CoV-2 can be detected within 3 hours in the air as an aerosol (which indicates the importance of ventilation), and on surfaces: up to 24 hours on cardboard and up to 3 days on plastic and metal [1, 2, 3].

Trauma surgery is one of the branches of medicine that cannot suspend its activities, even despite the dangers of the epidemic. The injuries rate decreases somewhat during the periods of self-isolation and restrictions of social activities, although remains significant.

The purpose of the review is to summarize the current data on the organization of trauma care for maintaining a stable and efficient system in the conditions of the COVID-19 pandemic.

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A quite large number of recommendations have been developed which can be combined in the following four important directions [2]:

- prevention of unnecessary contacts, patients transfer, surgeries;
- limit the number of consultations, visitors;
- reduction of waiting time, treatment volumes;
- use of personal protective equipment (PPE).

Organization of patient flows, indications for hospital admissions in the pandemic

In most cases, patients with acute injury and the need for surgery usually were admitted to a hospital for examination and preparation for operation. In a pandemic, this approach can cause local outbreaks of infection directly in an in-patient setting involving both patients and medical personnel. This can lead to the inability to the specialized care provision. Therefore, the primary measure is to limit optional hospitalizations until the patients' COVID status is clarified.

The patients admission for elective orthopedic surgery during the pandemic should be completely ceased both due to the danger of infection and the necessity to release potentially important intensive care units resources [4, 5, 6, 7, 8]. S. Lei et al. performed a survival analysis of the patients with elective surgery unintentionally performed during the COVID-19 incubation period. Of 34 patients with an average age of 55 (43–63 years), developed postoperative viral pneumonia, the intensive care unit admission was necessary in 15 (44.1%), and 7 (20.5%) patients died for virus-induced ARDS, shock, arrhythmias, and acute heart failure [6].

Thus, in the pandemic, the admission in a trauma hospital is indicated only for fractures that really require surgical fixation, in which delaying the surgical treatment for a period of 30 days or more will lead to outcome worsening. All patients with fractures that can be treated conservatively and on an outpatient

basis, should not be hospitalized. In the pandemic, such cases should also include fractures in which surgery reduces the recovery time of the patient, but does not improve the final long-term outcome, e.g., the clavicle, humerus, distal radius fractures with an acceptable position of the fragments [4, 9].

Referral to the clinic of a patient with a fracture needed the urgent surgery requires a clear action plan. Measures should be taken to separate patient flows into COVID-19-negative and COVID-19-confirmed or non-excluded. If surgery cannot be delayed until test results are obtained, the patient should be considered infected and all appropriate precautions should be taken. Currently, there are documented cases of nosocomial spread of the virus; therefore, the strict protocol is extremely important [9, 10, 11]. In cases where the surgery can be delayed for several days, the initial outpatient care and preoperative outpatient examination are optimal. This should also include testing for SARS-CoV-2 at a time as close to the appointed admission for surgery date as possible [4, 9, 12]. If the test is positive, preference is given to conservative treatment, or surgical treatment is delayed until the virus is eliminated from the body. If emergency fracture surgery is really necessary, it should be performed, but the treatment plan must take into account all measures to prevent the spread of the virus.

The extremely high risk of life-threatening complications in the patients with SARS-CoV-2 should be considered [6, 10]. B. Mi et al. analyzed the clinical course of COVID-19 in 10 patients with fractures. In seven of them, the infection occurred in the hospital, three became infected before injury. Three out of 10 underwent surgery, the rest were treated conservatively. Four patients died within 2 weeks after admission. The authors recommend limiting the indications for surgery for infected patients, taking into account the type of fracture and the risk factors on the part of the patient [10]. If outpatient treatment is not possible and admission for the emergency/urgent surgery is necessary, e.g., a fracture of the femur, the patient should be tested for

COVID-19 as soon as possible. In the presence of a viral disease signs and symptoms, the admission should be carried out at a specially designed box (ward/department) until the status of the patient is clarified. If the test result is negative, the patient is transferred to the general department for subsequent surgical treatment [1, 4, 9, 12].

Organization of work of the trauma center personnel

Many hospitals provide the inpatient care only for emergency cases now. This leads to the release of a sufficiently large number of specialists who previously were engaged in planned orthopedic work. Several protocols have been proposed to minimize the spread of SARS-CoV-2 and ensure continuity of the treatment process.

The main goal is to create a sustainable model that provides a reasonable allocation of resources to ensure the optimal trauma care and, at the same time, to minimize patient-to-patient and patient-to-personnel virus spread.

E.g., A. Schwartz et al. described the creation of a system of two completely independent teams: one team works in a hospital, and the other — remotely. The shift of the teams takes place in a week. This should provide the chance of the virus manifestation in a sick member of the team before the person returns to work in the hospital. The symptoms manifestation in an employee who is in relative isolation outside the hospital will protect other team members and patients from the risk of infection [13].

Given that the incubation period of the virus can reach 14 days, the optimal model is three teams: one team works in the hospital for a week, and the other two work remotely in isolation from the flow of patients and colleagues for 14 days. To limit the spread of the virus, such teams should include not only physicians, but also trainees, nurses and junior medical staff. It is clear that the remote work in medical conditions is difficult to organize, but it is necessary to take all measures for the social separation of personnel during the pandemic [1, 4, 7, 8].

For coordination of actions in the conditions of the necessary social distance, instead of traditional conference, and clinical rounds, video conferences began to be used [7].

Surgical treatment

Surgery of a patient with an identified or suspected COVID-19 requires a number of precautions. In the operating room, the presence of optional medical personnel should be limited by minimizing the number of assistants. In view of the high risk of viral aerosol formation during intubation and extubation, the preference should be given to regional anesthesia. The patient's face should be covered with a surgical mask or protective respirator. If intubation and extubation are necessary, they should, if possible, be carried out in separate rooms. During intubation/extubation directly in the operating room, all other medical personnel must leave the room for the period of airing [4, 5, 9, 12, 14, 15].

It is recommended to maintain the negative pressure in the operating room throughout the treating of COVID-19-positive patients in order to prevent the virus from spreading outside the premises. This slightly increases the risk of surgical infection in a particular patient, therefore it is advisable to know the patient's status before surgery [1, 4, 7, 9].

The dangerous stages of the operation are the so-called aerosol-generating procedures. Besides intubation/extubation, these include the use of electrocautery, an oscillating saw, and a bone and a bone marrow canal drilling. These procedures require appropriate precautions: the employment of a smoke evacuator when electrocautery is used, the use of protective shields or glasses during aggressive processing of bone tissue (sawing and drilling) [1, 4, 9, 16, 17].

To reduce the total operative time, it is recommended that the surgery should be performed by the most experienced surgeons. Of the possible surgical approaches and options, it should be chosen one with the minimal operative time and the optimal final expected outcome [14].

Wound closure is usually performed with a removable surgical suture or stapler. In a pandemic, it is necessary to reduce the number of outpatient visits; therefore, if possible, a completely buried continuous suture of the skin with absorbable threads should be used [4].

After the surgery of the patient with the suspicion for or confirmed COVID-19 is completed, the operating room should remain free for the time necessary to completely airing in accordance with the capabilities of the ventilation system. Only after this, the personnel are allowed into the operating room for cleaning and washing surfaces (if they do not use PPE with a high degree of protection) [9, 14, 16].

Outpatient treatment and counseling

If possible, the face-to-face patient consultations are replaced by telemedicine ones (with appropriate documentation). This is especially true for the patients from remote regions to reduce the spread of the virus between regions.

To limit the patients visits to the clinic, the necessary examinations are limited to the following cases:

- acute injury;
- direct control after surgery to remove the sutures (if absorbable sutures were not used or no one else can remove them);
- control of the position of the fragments in the conservative fracture treatment;
- high potential risk of complications;
- the cases when the change in the dweight-bearing regime depends on the X-ray data or requires the removal of the mplaster cast) dressing.

In the latter case, if possible, it is recommended that X-rays should be performed at the patient's location and their evaluation should be done by telemedicine counseling.

If it is necessary to immobilize with plaster, the wider use of longette rather than circular casts is recommended to reduce the duration of the contact between the patient and medical personnel at further stages of treatment [4, 17].

Use of personal protective equipment

Recommendations for the use of PPE vary significantly. Many countries and clinics experience acute deficiency of PPE. Unfortunately, sometimes there is a tendency to make the local recommendations on the basis on PPE actual availability, not on the principles of evidence-based medicine. The hospital should be divided into several zones depending on the level of danger, and personnel should be protected accordingly [7, 18].

Level 1. Preliminary triage and general outpatient department: disposable surgical caps and masks, work uniforms, disposable gloves and protective clothing.

Level 2. Hospital admission department, intensive care unit, isolation wards, surgical instrument processing: above plus safety glasses and 95 medical respirator.

Level 3. Operating room (confirmed case of COVID-19 or suspicion), intubation, tracheostomy, esophagogastroduodenoscopy, bronchoscopy: all of the above and a protective shield/mask for the entire face.

A brief outline of the use of PPE developed by the University of Kansas is presented in the Table [19].

X. Guo et al. performed an analysis of the COVID-19 morbidity in 24 orthopedic trauma surgeons from hospitals in Wuhan (China). According to their data, the peak incidence among doctors was observed 8 days earlier than the peak of the epidemic, which indicated not only the likelihood of doctors contacting the virus within the hospitals, but also the danger of transmission of the virus by medical personnel. All the trauma surgeons recovered, but in 15 cases hospitalization was required. Possible places of infection in this group of the patients were: general wards (80%), public areas of hospitals (20%), operating rooms (12.5%), intensive care unit (4.2%) and outpatient department (4.2%). It was revealed that in 25% of cases the infected orthopedists were infection carriers, including 20.8% of case — to the members of their families [11].

Table

Recommendations for PPE employment, by University of Kansas [19]

Care for the patients not suspected for COVID-19	Care for the patients suspected or positive for COVID-19	Aerosol-generating procedures* on the patients suspected positive for COVID-19 and airway procedures on ALL patients
When		
Patient has no COVID-19 symptoms	Patient has COVID-19 symptoms OR COVID test pending Positive test	Aerosol-generating procedures are being performed
Where Outpatient care Admission departments Intensive care units		
PPE required		
Surgical mask	Surgical mask Eye protection (glasses/face shield) Gown Gloves	Respirator N95/FFP3 Eye protection (glasses/face shield) Gown Gloves
Hand hygiene before and after any patient		

*Aerosol-generating procedures include laryngoscopy, intubation/extubation, cardiopulmonary resuscitation, bronchoscopy, esophagogastroduodenoscopy, the use of an electrocautery, the use of saws and drills in the operating room, etc.

The authors evaluated the risk factors for morbidity by comparing the studied group of trauma surgeons with a group of 48 trauma surgeons who worked under the same conditions but did not get COVID-19. These factors were: overwork and lack of sleep (up to 2 months prior to epidemic), absence of personal training in infection prevention (use of PPE), unsystematic wearing of a N95 respirator or surgical mask at work [11].

The main lines of action for the COVID-19 pandemic should be:

- to minimize or postpone the elective orthopedic care;
- to separate the patients and medical personnel flows;
- to test all patients for COVID-19 before admission/emergency surgery;
- to treat any patient undergoing emergency surgery with unconfirmed COVID-19 as infected with all possible precautions and personnel protection;

- to divide the personnel into 2–3 trauma teams with alternating periods of active work in the hospital (usually 1 week) and periods of isolation (remote work for 1–2 weeks).
- strict and regulated use of PPE.

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Authors' contributions

A.A. Sitnik — research concept, collection of material, data analysis and interpretation, text preparation.

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P.A. Volotovski — research concept, collection of material, data analysis and interpretation, text preparation.

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