

Possible Complications and Re-Hospitalization of Cardiac Surgery Patients

¹Alina M. Artagalieva*, ²Aminat K. Khamzatkhonova, ³Nikita Y. Shiryaev, ⁴Nadezhda S. Sizova, ⁵Anastasia S. Vaskova, ⁶Malfa M. Gandarova

^{1,2}Federal State Budgetary Educational Institution of Higher Education «Astrakhan State Medical University» of the Ministry of Healthcare of the Russian Federation

³I.M. Sechenov First Moscow State Medical University (Sechenov University), Russian Federation

^{4,5}Pirogov Russian National Research Medical University (Pirogov Medical University) Ostrovitianov str. 1, Moscow, 117997, Russia

⁶Federal state budgetary educational institution of higher education, Kemerovo State Medical University

ABSTRACT

The article examines the issues of complications and re-hospitalization of cardiac surgery patients. It was determined that preoperative risk assessment is crucial for identifying cardiac surgery patients at risk of rehospitalization in the intensive care unit and hospital mortality. Potentially modifiable risk factors, including but not limited to Chronic Obstructive Pulmonary Disease (COPD) and preoperative arrhythmia, require optimization of treatment before surgery. Repeated hospitalization in the intensive care unit is shown as an independent risk factor for in-hospital mortality.

Corresponding Author: art894577@mail.ru

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INTRODUCTION

Despite the fact that for almost two years the world has been intensively struggling with coronavirus infection, patients with other equally complex diseases also required the attention of doctors of various profiles. For this reason, the provision of cardiac surgery has been and is no less an urgent problem than overcoming the consequences of the spread of infections, even on a global scale. However, it should be noted that, as in other branches of medicine, patients who have had heart surgery might experience various complications, because of which they will need re-hospitalization.^[1]

Repeated hospitalization in the intensive care unit (ICU) after heart surgery is a known cause of prolonged hospital stay and worse clinical outcomes. It should be noted that preoperative risk assessment is crucial for identifying cardiac surgery patients at risk of re-hospitalization in the intensive care unit and hospital mortality.

The purpose of the study is to consider the peculiarities of complications and the implementation of re-hospitalization of cardiac surgery patients.

MATERIALS AND METHODS

The study was conducted on the basis of an analysis of theoretical and practical approaches to the study of the issue of re-hospitalization of patients who underwent heart surgery, as well as to the study of possible complications in such patients. In the process of writing the work, analytical, as well as comparative research methods were applied.

RESULTS

The COVID-19 pandemic and its burden on national health systems have seriously affected services in many areas of medical care. In addition, there is a sharp reduction in surgical cases in many cardiothoracic surgery centers [2].

COVID-19 syndrome is often characterized by acute respiratory failure with radiological signs of interstitial pneumonia, frosted glass or bilateral spotted shading. In some cases, acute respiratory distress syndrome (ARDS) and shock may also occur.

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Several studies examining the clinical outcomes of COVID-19 patients undergoing surgery have reported an increase in morbidity and mortality. Some authors reported 44% mortality, mainly due to severe respiratory failure.^[3]

In addition to respiratory and renal complications, patients with COVID-19 may develop blood-clotting disorders. An increased risk of thromboembolic complications has also been documented. The risks of perioperative bleeding in patients with COVID-19 who underwent heart surgery were of particular interest.^[4]

Some researchers observed a marked increase in the frequency of postoperative bleeding compared to that in patients without COVID-19. Another group of researchers, based on the analysis of their own clinical cases, noted that the frequency of general repeated surgical examinations for bleeding in patients without COVID who underwent artificial circulation was 4% (30 out of 750 patients).

Among patients with perioperative COVID-19, it was possible to observe a high frequency of surgical re-examination due to bleeding, cases of intracranial hemorrhage, massive hemorrhagic pleural effusion, prolonged hemostasis time, noticeable and prolonged blood loss from drains and extensive need for transfusions of blood components and procoagulative medicines.^[5]

The pathophysiological mechanisms responsible for the observed postoperative bleeding in these patients have not been fully studied. As reported in the literature, COVID-19 causes excessive oxidative stress caused by a “cytokine storm” characterized by overexpression of pro-inflammatory mediators (interleukin-1 β , interleukin-6 and tumor necrosis factor- α) responsible for massive diffuse inflammation.

An overactive immune response can lead to multiple systemic effects, including direct damage to blood vessels and microvessels with vasculitis, edema of endothelial cells, cellular apoptosis, necrosis and severe endothelial damage.^[6]

Angiotensin converting enzyme II receptor expressed on arterial and venous endothelium and arterial smooth muscle cells promotes viral invasion of vascular and microvascular tissue. This increases endothelial damage with increased permeability of the capillary wall, contributing to diffuse systemic bleeding, vasospasm and, possibly, ARDS and multiple organ failure.^[7]

A similar mechanism has been described for intracranial hemorrhagic complications that occur spontaneously or after a biopsy procedure and probably occur with any form of bleeding during COVID-19. In addition, endothelial damage and diffuse bleeding can lead to thrombocytopenia, consumption of blood clotting factors and fibrinolysis with a possible clinical evolution progressing to acute disseminated intravascular coagulation, which exacerbates hemorrhagic complications.

In addition, direct virus-mediated thrombocytopenia has been widely described. In a multicenter analysis of 1,099 patients with laboratory-confirmed COVID-19, researchers reported a thrombocytopenia rate of 36.2%. In this vicious circle, an inflammatory storm with endothelial damage associated with thrombocytopenia and possible fibrinolysis may explain and justify the observed frequency of late bleeding.^[8]

The most probable pathophysiological mechanisms, in addition to surgical trauma, are an inflammatory reaction associated with artificial circulation, interstitial edema, heparinization, hemodilution, hemolysis and consumption of blood clotting factors that could contribute to the development of postoperative hemorrhagic complications.

Cardiopulmonary bypass can exacerbate the harmful effect of COVID-19 on the blood clotting system, which leads to its disruption and a tendency to deregulation towards a hemorrhagic pattern. For these reasons, patients with perioperative COVID-19 who have undergone heart surgery are apparently more susceptible to postoperative bleeding, requiring surgical revision of the mediastinum and a large number of blood components transfusions.

An increased hemorrhagic risk can be observed in patients with active COVID-19 during surgery or in the early postoperative period, as well as in patients with cured infection before surgery, which suggests a possible persistent hyperinflammatory reaction even after recovery from coronavirus. Accordingly, patients with perioperative COVID-19 who have undergone heart surgery have an unfavorable outcome, with a high incidence of complications, including early and late postoperative bleeding.^[9]

However, in addition to the above factors, there are other causes of complications in cardiac surgery patients. It should be noted that a number of studies devoted to the study of risk factors for re-hospitalization in the intensive care unit after heart surgery have shown disparate results.^[10] The question of whether prolonged stay in the intensive care unit leads to better clinical outcomes remains controversial. Although there are no widely used and proven tools, a recent analysis of preoperative factors has been used to extrapolate a risk prediction tool for repeated hospitalizations to the intensive care unit.^[11]

In times of limited ICU capacity worldwide due to the coronavirus pandemic, it was important to optimize patient care, reduce perioperative morbidity and mortality, and maximize the use of ICU resources. Therefore, it was very important to determine the risk factors associated with repeated hospitalization in the ICU, as well as hospital mortality after cardiac surgery.

Clinical cases of repeated hospitalization of cardiac surgery patients at the Clifford Clinic in Guangzhou were reviewed. Thus, among 2,290 patients who underwent heart surgery, 7% of patients were readmitted to the intensive care unit during the same hospital stay. Respiratory failure (34% of patients), decompensation of cardiac activity (17%), cardiac tamponade (14%), cardiopulmonary resuscitation (10%) and repeated operations (10%) were noted among the main reasons for repeated hospitalization in the ICU.^[12]

Patients who were re-hospitalized had a longer initial stay in the intensive care unit compared to those who were not re-hospitalized.^[13] The average time to re-hospitalization was 6 days after discharge from the intensive care unit. The reasons for repeated hospitalization are presented in Table 1.^[14]

There was no significant difference either in average age (60-74 years for re-hospitalized patients compared to 57-74 years for non-repeat hospitalized patients) or in gender

Table 1: Reasons for repeated hospitalization in the intensive care unit

| Reasons for hospitalization | Percentage of hospitalized, % |
|--------------------------------|-------------------------------|
| Respiratory disorders | 34.13 |
| Cardiac decompensation | 17.37 |
| Tamponade of the heart | 14.37 |
| Cardiopulmonary resuscitation | 9.58 |
| Repeated operations | 9.58 |
| Changes in mental state | 4.79 |
| Sepsis | 3.59 |
| Gastrointestinal complications | 3.59 |
| Kidney failure | 3.00 |

distribution (34% of women for re-hospitalization versus 31% of women for non-repeat hospitalized patients) between the groups. Concomitant diseases of patients associated with repeated hospitalization in the intensive care unit included chronic obstructive pulmonary disease (COPD), preoperative arrhythmia and end-stage renal failure.^[15]

Intrahospital mortality was 19.2% in re-hospitalized patients compared with 5.1% in non-repeat hospitalized patients. Although preoperative anemia (hemoglobin <10.0 g/dl) was not associated with repeated hospitalization in the ICU, it significantly affected mortality. In addition, two of the aforementioned comorbidities, namely COPD and end-stage renal failure, were also associated with hospital mortality. The age of more than 80 years also acted as an independent risk factor for hospital mortality. Operations associated with the highest chances of death were thoracic aortic aneurysms, as well as combined valve surgery. Intraoperative blood loss >500 ml and postoperative extracorporeal membrane oxygenation (ECMO) support were strong predictors of hospital mortality. Interestingly, the average body mass index (BMI) was lower in re-hospitalized patients (26.4 kg/m² versus 27.2 kg/m² in the general population).^[16]

DISCUSSION

Repeated hospitalization in the intensive care unit remains a serious problem, as it is associated with high mortality. An analysis of studies in this area has shown that there are certain risk factors that provoke re-hospitalization in this group of patients. Thus, repeated hospitalization was required for patients with renal insufficiency, COPD, arrhythmia, as well as those whose age exceeded 80 years. It was also indicated that the re-hospitalized patients had a significantly higher chance of death compared to those who did not need re-hospitalization. In particular, the mortality rate among the first group was 4.3%, according to the results of one of the studies, while among the patients of the second group; the mortality rate was only 1.7%.^[17]

It can be concluded that the re-hospitalized patients were initially in the intensive care unit for 2-3 days longer than the re-hospitalized patients, and this does not support the idea that early discharge from the intensive care unit is unlikely to be the cause of readmission.

However, there is also an opinion that an early discharge from the intensive care unit should also be excluded. It was suggested that extending the stay in the intensive care unit for another

48 hours could reduce the mortality of patients at risk by 39%. Another group of authors showed that patients discharged from the intensive care unit at night and included in the group of deceased as a result of postoperative complications had a significantly shorter stay in the intensive care unit (their stay was 2 days there).^[18]

The capacity of the intensive care unit, however, is an important practical consideration. The researchers note that for this department, an important factor is the timely turnover of beds, since planned operations involve the admission of new patients to this department according to a certain schedule. The delay in this department of cardiac surgery patients for various reasons can cause a decrease in such turnover, which will lead both to disruption of the schedule of operations and to the fact that the timely provision of surgical care to people who need it will be disrupted.^[19]

The authors showed that in patients who underwent heart surgery, concomitant diseases, including COPD, arrhythmia, renal failure and anemia, are associated with repeated hospitalization in the ICU and increased mortality. Accordingly, respiratory failure was the most common cause of repeated hospitalization in the intensive care unit, followed by cardiac decompensation, cardiac tamponade and cardiopulmonary resuscitation.

It is worth saying that the average age of patients is steadily increasing, and with it the number of concomitant diseases at the time of surgery in cardiac surgery departments. In addition, concomitant diseases often involve a long stay in the hospital, which also leads to a higher mortality rate.^[20]

The identification of partially modifiable risk factors suggests that optimized care can increase the level of patient tolerance of surgical intervention and lead to better results. For example, intravenous iron therapy has shown promising results in the treatment of preoperative anemia in cardiac surgery patients.

It must be said that not all researchers agree that among the risk factors in cardiac surgery patients, previous myocardial infarction, increased body mass index (BMI), etc. should be indicated. The researchers note that although most patients may be overweight, it is difficult to demonstrate that BMI is an independent risk factor for re-hospitalization or in-hospital mortality. At the same time, there is an opinion that in patients with obesity and a BMI of ≥ 30 , an association with postoperative complications was shown.^[21]

In recent years, so-called accelerated protocols have been introduced in European centers in an attempt to reduce both the length of hospital stay and the associated costs. Early results showed no increase in morbidity or mortality, but long-term data are still inconclusive, especially for patients with preoperative comorbidities.

CONCLUSION

Thus, preoperative risk assessment is crucial for identifying cardiac surgery patients at risk of re-hospitalization in the intensive care unit and hospital mortality. Potentially modifiable risk factors, including but not limited to COPD and preoperative arrhythmia, require optimization of treatment before surgery. Repeated hospitalization in the intensive care

unit is shown as an independent risk factor for in-hospital mortality.

Author Contributions

All authors contributed in reviewing the final version of this paper.

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