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# The Influence of the COVID-19 Pandemic on Mortality of Patients Hospitalized in Surgical Services in Romania: A Cross-Sectional Study of a National Survey

**Rodica Bîrlă [1], Eugenia Panaitescu [2,*], Cornelia Ceban [3], Andra-Victoria Radu [4], Petre Hoară [1,*], Adrian Constantin [1], Dan Nicolae Păduraru [5], Anca Bordianu [4], Daniel Alin Cristian [6] and Silviu Constantinoiu [1]**

1 General Surgery Department, Clinic of General and Esophageal Surgery, "Sf. Maria" Clinical Hospital, Faculty of Medicine, "CarolDavila" University of Medicine and Pharmacy, 050474 Bucharest, Romania
2 Medical Informatics and Biostatistics Department, "Carol Davila" University of Medicine and Pharmacy, 050474 Bucharest, Romania
3 Oftalmology Department, "NicolaeTestemițanu" State University of Medicine and Pharmacy of the Republic of Moldova, 2004 Chișinău, Moldova
4 Faculty of Medicine, "Carol Davila" University of Medicine and Pharmacy, 050474 Bucharest, Romania
5 University Emergency Hospital of Bucharest, Faculty of Medicine, "Carol Davila" University of Medicine and Pharmacy, 050474 Bucharest, Romania
6 Clinical Hospital Colțea, "Carol Davila" University of Medicine and Pharmacy, 050474 Bucharest, Romania
* Correspondence: eugenia.panaitescu@umfcd.ro (E.P.); petre.hoara@umfcd.ro (P.H.); Tel.: +40-722-694-084 (E.P.); +40-744-807-637 (P.H.)

**Abstract:** Surgical practice worldwide has changed rapidly in response to the coronavirus disease 2019 (COVID-19) pandemic. The study aimed to analyze the impact of the COVID-19 pandemic on mortality, in hospitalized patients, in Romanian surgical services. We have developed our research on a national survey of the consecutive records of hospitalizations, surgical interventions and deaths performed in Romania between March and August 2020. Results show that 47 surgical departments responded to the request. The admissions in the period March–August 2020 represented 52% of that from the similar period of 2019. In the studied period, the share of surgical interventions in patients admitted to non-COVID-19 centres was 98.7%, respectively 78.2% in COVID-19 support hospitals ($p < 0.05$), and emergency interventions of 43.4% in non-COVID-19 hospitals, respectively 84.8% in COVID-19 support hospitals ($p < 0.05$). Overall mortality in this period was 5.82%, compared to 3.28% in a similar period in 2019, ($p < 0.05$). Postoperative mortality in COVID-19-positive patients was 19%. In conclusion, in the hospitals in Romania included in the survey, the overall mortality in the studied period was higher than in a similar period in 2019. In patients with COVID-19 positive, the recorded postoperative mortality was higher than overall mortality.

**Keywords:** COVID-19 support hospitals; COVID-19 outbreak; COVID-19 positive patient; COVID-19 suspected patient



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## 1. Introduction

The novel SARS-CoV-2 pandemic broke out in December 2019 in the city of Wuhan, China, and spread with astonishing speed to the rest of the world. Europe was quickly affected, in the first months of 2020. With the declaration of the SARS-CoV-2 pandemic, by the World Health Organization starting on 11 March 2020, surgical activity in hospitals was restricted and limited to emergency interventions and interval oncological surgery, considering that it was necessary to ensure the safety of patients and medical personnel [1,2].

Romania registered its first case of COVID-19 at the end of February, and the health system tried to cope with this big challenge. The legal regulations have varied a lot, since the appearance of the first case of COVID-19 in Romania, and four main periods can be distinguished: 27 March–14 May (state of emergency, mandatory hospitalization of

all COVID-19-positive patients), 15 May–2 July (state of alert, continuation of previous measures), 3–20 July (legislative vacuum after the decision which eliminated the mandatory hospitalization of COVID-19-positive patients), and 21 July–31 August (admission only of symptomatic patients, the possibility of discharge after 14 days even in conditions of a positive COVID-19 polymerase chain reaction (PCR) test).

The health system in Romania was overburdened, during the onset of the pandemic, and barely coped with this extreme pressure, which affected every service, from the level of primary care, city hospitals, county hospitals and university clinics, emergency services, etc. Some surgery wards have been completely closed to the medical circuit, being designated as COVID-19 support centres, and the remaining ones have also allocated beds for suspected or positive patients following the epidemiological circuits.

Special measures have been taken all over the world. Some authors noted that it was also necessary to establish intra-hospital circuits and reserve some operating rooms for surgical interventions on suspected or positive patients for COVID-19. The redesign of pre-and post-operative care networks, together with the establishment of circuits and the application of social distancing measures, also determined the reduction of available beds for the admission of patients for scheduled interventions [3–5].

In other countries, the recommendation was to suspend elective surgery, prioritize emergency and oncological operations and reduce the surgical staff to essential members [6].

Some authors have recommended, for the protection of medical personnel, the wearing of full special protective equipment, during surgical interventions and strictly following the postoperative decontamination circuits [7].

Some studies found that COVID-19 represented an increased risk for severe complications in cancer patients undergoing an oncological treatment protocol or in those who required surgical interventions [8,9].

The difficulties of accessing oncological or surgical treatment, as well as the infection with the virus in these patients, which requires priority treatment and the postponement of other treatments until the patient's recovery, had an important negative impact on the prognosis of oncological patients [10].

Due to the restricted access to the tumor board, in some centres, multidisciplinary meetings for the management of oncological patients were organized via videoconference [11].

Also, the European Society for Medical Oncology (ESMO), International Society of Disease of the Esophagus (ISDE), American College of Surgeons (ACS) and Society of Surgical Oncology (SSO) issued recommendations regarding the management of oncological patients during the COVID-19 pandemic [12–15].

Some authors noted that, during the pandemic, there was a significant increase in mortality, among the entire population of patients, in surgical hospitals [16]. Other authors found, in a study that included 16 centres, in a national survey, that, during that period, the majority of the included centres reported similar or lower morbidity rates when compared to the pre-COVID phase and six centres (37%) reported slightly higher mortality in the active COVID phase [17].

Based on the main lines of research identified in the literature review, we have formulated the following research hypotheses:

**Hypothesis 1 (H1).** *Due to the pandemic, specific measures have been imposed in the health system all over the world. In the first phase of the pandemic, evidence of overwhelmed hospital services (China, Italy) constituted the only examples of an unprecedented situation. As such, the recommendations to abandon elective surgical interventions, to reduce laborious surgical procedures [18,19], to postpone elective endoscopy, and to perform only emergency surgical interventions, aimed to preserve intensive care facilities and material resources, in order to respond to the rapid increase in new cases of COVID [19,20]. Data from the literature suggest that, through the measures adopted in different hospitals, surgical activity was reduced in the first period of the pandemic [3–6,21], while other studies report other data [22]. Based on this aspect, we would like to check if surgical*

*activity during the pandemic decreased in Romanian hospitals also, in the period March–August 2022.*

**Hypothesis 2 (H2).** *Some authors have shown that operated COVID-19 positive patients present an increased risk for serious perioperative morbidity and mortality and every effort should be made to utilize nonoperative therapies or to delay surgery whenever feasible [23]. In this consensus, another data from the literature suggest the recommendation that, in positive patients, the priority is the treatment of the infectious disease, and the surgical condition should be resolved later, if it is not an emergency [10]. Taking this in consideration, we researched whether this recommendation is also taken up in Romania by evaluating the activity in the COVID-19 support hospitals and the non-COVID ones, and observed that COVID-19 support hospitals had a lower surgical activity, compared to non COVID hospitals.*

**Hypothesis 3 (H3).** *Taking into account the recommendations suggested by the data in the literature, about performing only emergency surgical interventions in positive patients [12–15], both in benign and malignant pathology [24] we want to investigate whether in Romanian hospitals, the rate of emergency surgery was higher in the COVID support hospitals, which provided surgical care for positive patients from outside the outbreaks, but also in the hospitals in the outbreak, compared to those non COVID.*

**Hypothesis 4 (H4).** *The screening of patients before surgery was one of the general recommendations [12–15], even in the conditions of a completely asymptomatic patient [25], but the pandemic surprised, worldwide, a health system insufficiently prepared to face such a challenge. The lack of specialized laboratories for PCR testing COVID-19 constituted a problem in the selection of patients, on the other hand data from the literature suggest that a substantial number of patients with COVID-19 are not identified until after surgery [23]. The lack of PCR test results at the time of surgery has led to the treatment of a large number of false positive patients, especially in non-COVID centers.*

**Hypothesis 5 (H5).** *The creation of COVID support centers, according to the regulations of the Romanian Ministry of Health, led to the selective hospitalization of positive patients in these centers, but all hospitals received the recommendation to create epidemiological circuits, as in other countries [5,17]. Once the capacity of the COVID-19 centers was exceeded, the non-support centers were obliged to take care of their own surgical patients who tested positive, even though they were included in the screening program upon admission. Other authors have also noticed that a significant number of patients can become positive postoperatively [23]. Based on this observation, we considered that, there was a small proportion of positive patients treated in the non COVID centers, significantly different from the one in the centers designated for the treatment of these patients and want to verify this hypothesis.*

**Hypothesis 6 (H6).** *Data from the literature present different aspects regarding postoperative mortality, the vast majority showing that it was increased during the pandemic, between 4.5 and 16% [16,23,26], while others deny this aspect [17]. A comparative study showed that for similar operations during the same time period and after adjusting for other perioperative risk factors, those with COVID-19 had higher morbidity and mortality [23]. A series of 34 patients from China with occult COVID-19 infections at the time of surgery reported dismal outcomes including development of pneumonia in all patients, ARDS in 32%, shock in 29% and a perioperative mortality rate of 21% [27]. Another study showed that on a cohort of COVID-19 positive patients, 58% experienced serious complications and the perioperative mortality rate was 17% [23]. In order to verify this information for Romania as well, we tried to conclude that the mortality rate for patients hospitalized in surgery wards during March–August 2022 was higher than in the similar period of 2021.*

**Hypothesis 7 (H7).** *Several studies have shown that the postoperative mortality in COVID-positive patients is higher and that, as much as possible, surgery should be postponed until after the resolution of the infectious disease [10]. One prospective study showed that after 7 weeks, the*

*postoperative mortality goes down to normal values [27]. Surgery appears to exacerbate the course of the disease of COVID-19. Severe or critical illness associated with COVID-19 was identified in 19% of patients in one study, with a mortality rate of 49% in critical cases [28]. The vast majority of previous reports found that most cases of COVID-19 [25] lead to a mild form. A number of factors, including the physiological stress of surgery, the need for mechanical ventilation and the increased risk of other infections could theoretically exacerbate the course of COVD-19 in patients undergoing surgery. The support hospitals selected the positive patients on the one hand, but, on the other hand, if they were in an epidemiological outbreak, they had to provide surgical assistance to all patients in the outbreak. Because the patients treated during the pandemic had a combined pathology, both infectious and surgical, we suspected that COVID-19 support hospitals had a higher postoperative mortality, compared to non COVID-19 hospitals and we wanted to verify this hypothesis.*

**Hypothesis 8 (H8).** *Data from the literature [17] suggest that postoperative mortality in positive patients may be different, depending on the reporting center. One study made a comparison between private, university and usual hospitals [29]. Also, almost half of the patients were identified as COVID positive, after the admission in the hospital [23]. In Romania, the screening of surgical patients, in non-support centers, led to the strict admission of negative patients. The subsequent appearance of the symptoms of COVID-19, together with the positive test, allowed the initiation of treatment from the first stages of the disease, allowing for a better prognosis. Based on this observation, I suspected that The mortality rate in positive patients from COVID-19 support centers was higher than that of those from non-COVID support centers.*

**Hypothesis 9 (H9).** *Some studies suggest that, in most of the cases, the causes of postoperative death, in positive patients, are related to the complications of COVID-19, although this was hard to differentiate [29]. A study highlighted that Cardiac arrest, sepsis/shock, respiratory failure, pneumonia, acute respiratory distress syndrome, and acute kidney injury were more common in those with COVID-19 [23]. Considering that in Romania, firm recommendations were issued regarding the hospitalization and only emergency surgical treatment of COVID-19 patients, we observed that, by following these rules, the postoperative mortality was determined rather by the complications of the surgical disease, and we wanted to we check if the causes of death, in positive patients, operated for surgical conditions, are related in particular to the surgical disease.The major hypothesis in this study is: The pandemic in Romanian hospitals induced a decrease in surgical activity and an increase in postoperative mortality.*

The purpose of the study is to compare postoperative mortality during the pandemic both with the pre-pandemic period and between different COVID-19 support and non-COVID-19 hospitals. Secondarily, we evaluated mortality in positive patients from the surgery wards, in hospitals with and without COVID-19 support and the causes of death.

## 2. Materials and Methods

### *2.1. Study Design*

A descriptive, cross-sectional design, using the questionnaire method, was employed. This type of design provides data on patients hospitalized, operated on or deceased in the surgical departments of hospitals in Romania between March and August 2020. For a comparative analysis, we used data from a similar period in 2019. By grouping the reporting centres according to criteria COVID-19 support/non-COVID-19, we statistically assessed the proportion of surgical interventions among hospitalized patients, emergency interventions, surgical interventions in COVID-19 suspect patients, the postoperative and overall mortality rate in patients hospitalized in surgery wards, and in COVID-19-positive patients during this period.

### *2.2. Recruitment of Participants and Data Collection*

47 surgical departments, belonging to university centres and county hospitals, in 25 large cities, located in various regions of the country, responded to the request and were

included in the study. During the study period, 6/47 wards were COVID-19 support centres, intended for COVID-19-positive patients. The requirements were addressed by email to the heads of the departments, through an official address. The questionnaire included the following questions: the total number of hospitalized patients between March and August 2020, the number of COVID-19-positive patients hospitalized, the number of suspect patients operated on, the number of surgical procedures performed, from which how many emergencies, the number of postoperative deaths in total and in positive patients, as well as the causes of death in COVID-19-positive patients, recorded during this period. To be able to report comparative data from the year 2020, the number of hospitalizations and the number of deaths in the period March–August 2019 were also requested. The data were collected through electronic mail. All participating centres provided data on the number of hospitalizations and the number of surgical interventions between March and August 2020. We obtained complete responses from nine participating centres; 44/47 centres reported the number of COVID-19 suspected patients operated on, 40/47 centres reported the number of positive patients operated on, 32/47 centres reported the number of deaths during March–August 2020, 41/47 centres reported the number of postoperative deaths in positive patients. The causes of death in positive patients were reported by 3/6 COVID-19 support centres and 6/43 non-COVID-19 centres. The data were reported in the form of frequencies and percentages.

### *2.3. Definition of Variables*

The hospitalized patient was considered COVID-19 suspect if, at the time of surgery, he did not have a negative result of a PCR test for COVID-19. In the absence of these results, the patients underwent surgical intervention, in specially designated operating rooms, with personnel wearing protective suits against contamination with COVID-19.

The patient was considered COVID-19 positive if, at the time of the surgery, he had a positive result in the PCR test and the surgery was performed in a COVID-19 operating room.

The COVID-19 support hospitals were the hospitals designated by the Romanian Ministry of Health, for the admission and treatment of COVID-19-positive patients, in the period March–August 2020 [18], which were added to those located in the outbreak of COVID-19.

The non-COVID-19 hospitals were considered those that didn't receive COVID-19-positive patients, following the screening with PCR tests, and that organized epidemiological circuits for three types of patients: negative, suspect and positive.

The outbreak of COVID-19 was defined as an area with an incidence of more than 5 cases/per 1000 inhabitants, where a zonal quarantine was instituted for a while.

### *2.4. Statistical Methods*

The collected data were reported as frequencies and percentages. A detailed data set was compiled on Microsoft Excel (Microsoft Corp, Washington, DC, USA) and analyzed using IBM SPSS Statistics for Windows, Version 21.0 (Released 2012. IBM Corp, Armonk, NY, USA). In the statistical analysis, the z-test for two proportions and t-test for Equality of Means were used. Data normality was checked using the Shapiro–Wilk test and the plot of data scattering. Data homogeneity testing was done using Levene test. For all analyses, the threshold for two-sided statistical significance was set at $p < 0.05$.

## 3. Results

### *3.1. Hospitalization and Surgical Treatment in Surgical Wards*

In the period between March and August 2020, in the centres included in the study, the number of hospitalized patients was 27,666 and the number of surgical interventions was 26,653 (Table S1).

To verify hypothesis H1, we performed the following comparative analysis. Nine non-COVID-19 centres, with complete data reporting, provided comparative data: 4744 hospitalized patients in 2020–compared to 9113 hospitalizations in the same period of

2019–those in 2020 represented 52% of hospitalizations in the same period of 2019 ($p < 0.05$) (Figure 1) (Table S2).

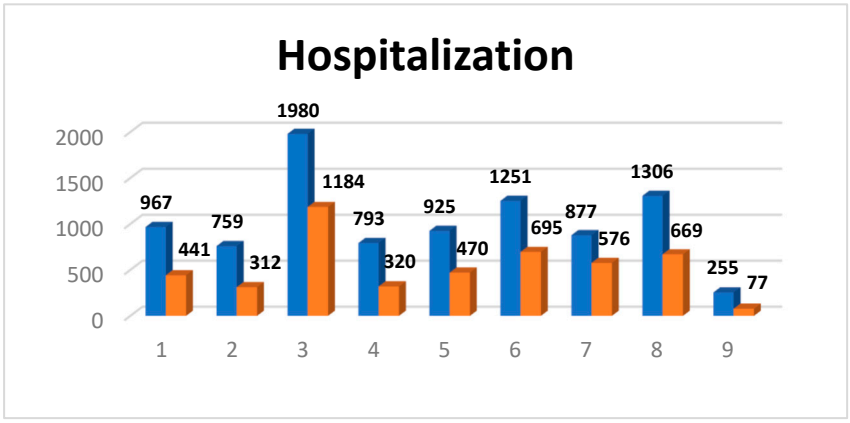


**Figure 1.** The comparative, detailed situation of hospitalized patients in the period March–August 2019 (blue) vs. March–August 2020 (red).

The total number of hospitalizations, between March and August 2020, in the non-COVID-19 hospitals included in the study, was 24,473 and the total number of surgical interventions was 24,167. To verify hypothesis H2, we performed the following comparative analysis. The proportion of surgical interventions, in patients admitted to wards, in non-COVID-19 hospitals, was 98.7%, and in COVID-19 hospitals it was 78.2% (2496/3193), ($p < 0.05$) (Table S3).

The average rate of surgical interventions, in the COVID-19 centres, was 51.8%, with limits between 5.2% (one centre) and 100% (two centres); three centres in the areas of COVID-19 outbreaks had a high rate of surgical interventions among hospitalized patients–100% in two centres and 73.2% in the third, the other three COVID-19 centres, located outside the outbreaks, had low rates of surgical interventions, between 5.2–21.3%.

Data on emergency surgical interventions, in non-COVID-19 hospitals, were provided by 29/41 non-COVID-19 centres and we found that the proportion of emergency interventions was 43.4% (7543/17,374), with limits between 0% and 100%, 14 centres reporting more than 30%, and that even the ten departments with scheduled surgery profile, recorded important rates of emergency surgery.

To verify hypothesis H3, we performed the following comparative analysis. In the six COVID-19 centres, the proportion of emergency interventions was 84.8% (2202/2596), significantly higher than that in non-COVID-19 centres ($p < 0.05$), five centres reporting almost 100% (Figure 2) (Table S3).

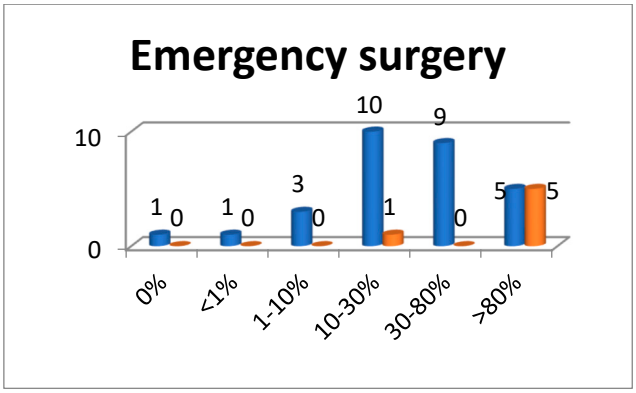


**Figure 2.** Share of emergency surgical interventions (blue—number of non—COVID—19 centres, red—number of support COVID—19 centres).

3.1.1. Surgical Treatment in the Absence of the Patient's PCR Test Result

In the absence of PCR test results for the detection of COVID-19, 5052 patients from 46 centres, including six COVID-19 support centres, underwent surgical intervention. The proportion of interventions in suspect patients, from the total of interventions performed, was 20% (5052/25,211). In the 40 non-COVID-19 centres this share was 12.6% (2874/22,715), with limits between 0% (three centres) and 100% (one centre).

In the six COVID-19 support centres, the share of operations on COVID-19 suspect patients was 87.3% (2178/2496), with limits between 0% (one centre) and 100% (two centres from the outbreak of COVID-19, who considered all operated patients suspect for COVID-19) (Figure 3).

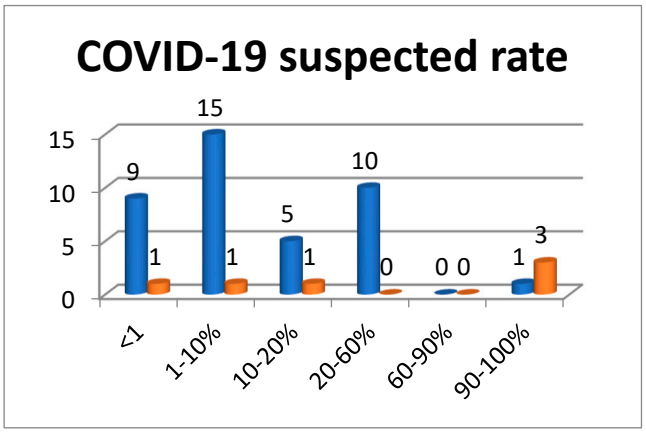


**Figure 3.** Share of patients operated on with suspected COVID-19 (blue—number of non—COVID—19 centres, red—number of COVID—19 support centres).

To verify hypothesis H4, we performed the following comparative analysis. During the studied period, from 5052 suspect patients who required surgery in 43 centres that provided data, 228 patients had positive COVID-19 tests (confirmed pre-operatively or postoperatively). In the rest of the suspected patients, the result of the PCR COVID-19 test was negative. The share of positive COVID-19 cases, from the total number of interventions with protective equipment, was reduced (4.9%); the protective measures were imposed by the lack of PCR test results at the time of the surgical intervention. In the COVID-19 support centres, the share of COVID-19-positive patients among the suspected ones was 6.1% (133/2178), and in the non-support centres 3.7% (95/2552), ($p < 0.05$) (Table S3).

3.1.2. Hospitalization of COVID-19 Positive Patients

To verify hypothesis H5, we performed the following comparative analysis. 30 centres provided data on the hospitalization of COVID-19-positive patients, 24 non-COVID-19 centres and six COVID-19 support centres. The positive patients represented a small percentage (3.3%) of the total of hospitalized patients as well as of those operated on. Among the non-COVID centres, 13 centres reported zero hospitalizations of COVID-19-positive patients, and seven centres had less than five patients; the total number of positive patients in these centres was 64 patients, representing 0.5% of hospitalized patients.

In the COVID support centres, 512 positive patients were hospitalized, and one centre, from the outbreak, reported zero positive patient hospitalizations, considering all hospitalized patients suspected of having COVID-19. In the other COVID support centres, the number of hospitalizations varied between 40 and 225 COVID-19-positive patients. The proportion of hospitalized positive patients was 16% (512/3193) (Table S1) (Figure 3) (Figure 4).

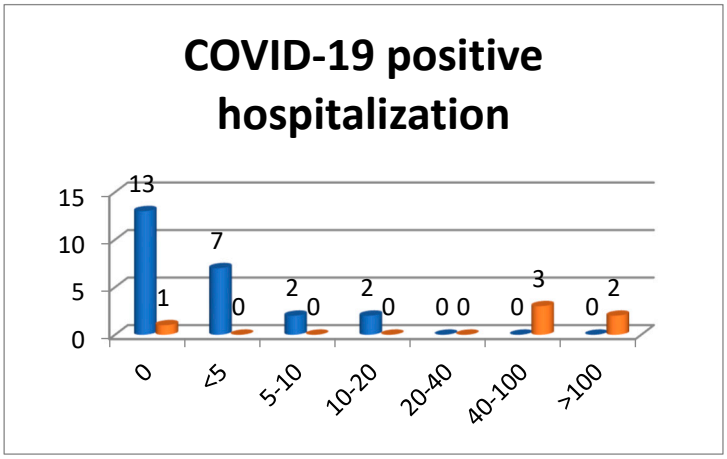


**Figure 4.** COVID-19 positive hospitalization (blue—number of non COVID—19 center, red—number of COVID—19 support center).

### *3.2. Mortality in Surgical Services*

To verify hypothesis H6, we performed the following comparative analysis. Nine centres included in the study reported data on overall mortality in a similar period in 2019. The average value of mortality in these centres in the period March–July of 2020 was 5.82%, compared to 3.28% in a similar period in 2019, ($p < 0.05$) (Table S2).

To verify hypothesis H7, we performed the following comparative analysis.32 centres reported the number of deaths during the study period, including five from the COVID support centres. The total number of postoperative deaths in the period March–August 2020 was 833, with mean postoperative mortality of 4.78% (833/17,405). The average value of postoperative mortality in the 26 reporting non-COVID-19 centres was 4.8% (787/16,407), with 25 centres reporting mortality below 10%.

In the five COVID-19 centres that provided data, the average postoperative mortality was 5% (50/998), three centres from the COVID-19 outbreak reported mortality rates between 0.9–11%; the two centres located outside the epidemiologic outbreaks reported a mortality of 25% and 80%, respectively (Figure 5).

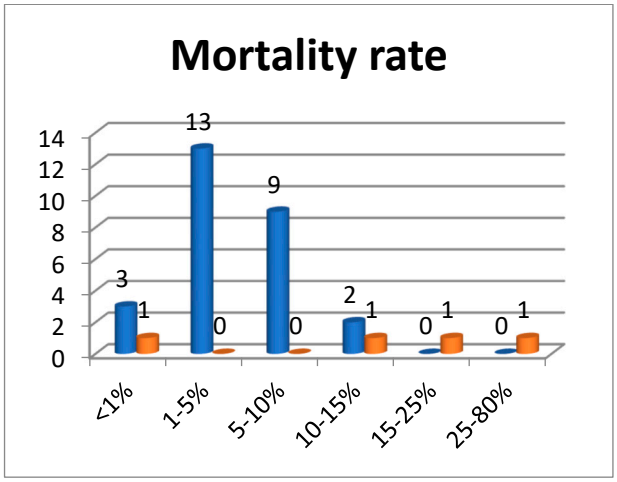


**Figure 5.** The postoperative mortality rate in the reporting centres during March–July 2020 (blue—non-COVID—19 centre, red—COVID—19 centre).

To verify hypothesis H8, we performed the following comparative analysis. Complete data on postoperative deaths and COVID-19-positive patients were provided by 30 centres. The deaths of COVID-19-positive patients operated on in this period was 42, representing

5.9% of the total number of deaths (42/714). In the non-COVID-19 centres, from the 25 centres that provided data, the proportion of deaths in COVID-19 positive patients was 2.4% (16/664), and in the 5 support centres for COVID-19 it was 46% (23/50) ($p < 0.05$) (Table S3). Because patients who did not require surgery were also hospitalized in the COVID-19 centres, we observed different mortality rates among hospitalized, operated or operated COVID-19-positive patients. Overall mortality is found between 0.9–5.3% among hospitalized patients with an average of 3.1%, postoperative mortality between 0.9–80%, with an average value of 25.1% and postoperative mortality of positive patients between 8.92–50%, with a value average of 28% (Table S1) (Figure 6).

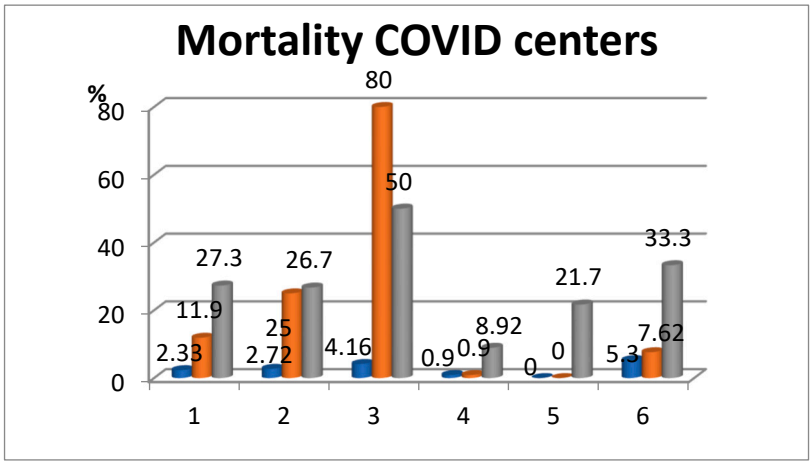


**Figure 6.** Overall mortality rates (blue), postoperative mortality rates (red) and postoperative mortality rates in COVID-19-positive patients (grey).

### *3.3. Deaths of COVID-19-Positive Patients*

Postoperative mortality, in positive patients, was 19% (42/220), with 14 patients dying in non-COVID-19 centres, and 28 patients in COVID-support centres.

All COVID-19 support centres and five non-COVID-19 centres reported the causes of death for 36 postoperative deaths in COVID-19-positive patients, but for which, a necropsy was not included. This fact determined the impossibility of accurately establishing the cause of the death.

To verify hypothesis H9, we performed the following descriptive analysis. In the COVID-19 support centres, the following causes of death were reported in positive patients: complicated malignant diseases (five patients), complicated peripheral arteriopathy (seven patients), mesenteric ischemia (two patients), multiple organ dysfunction (four patients), respiratory failure (three patients), hemoperitoneum (one patient), pancreatitis (three patients), brain trauma (one patient), and peritonitis (two patients).

Five non-COVID-19 centres reported the causes of death in COVID-19-positive patients; the eight postoperative deaths had the following causes: complicated malignant diseases (three patients), pulmonary thromboembolism (one patient), pancreatitis (one patient), intestinal occlusion (one patient), upper limb embolism (one patient) and peritonitis (one patient).

## 4. Discussion

The COVID-19 pandemic is an unprecedented situation for modern medicine, with profound implications for surgical practice.

In Romania, the creation of hospitals for the care of COVID-19 patients and the transformation of some into support centres for the treatment of positive patients helped the health system, to cope with the increased number of patients during this period.

In non-COVID hospitals, special circuits have been established to separate the green zone–confirmed negative patients, from the yellow zone–suspect patients or from the red

zone–positive patients. Asymptomatic surgical patients, with no PCR test result, were considered COVID-19 suspects, isolated in yellow zone rooms, with specially designated staff, using protective equipment. Until the PCR test result was obtained, surgical treatment was reserved for emergencies. Patients with emergency surgery, who were subsequently confirmed positive, were transferred to phase I hospitals (hospitals for infectious diseases) or phase II hospitals (COVID-19 hospitals, designated by the Ministry of Health) as soon as they no longer represented a surgical emergency [30].

Negative patients benefited from surgical treatment, with priority given to medical-surgical emergencies and oncological patients.

We found a sharp decrease in hospitalizations for surgical treatment during the studied period, (52% of the number of hospitalizations from a similar period in 2019), as a result of the reduction in the capacity of hospitals to receive patients, due to the establishment of epidemiological circuits and the application of social distancing rules. Similar aspects, of a significant reduction in the number of hospitalizations, compared to the similar period of 2019, were also reported by other authors [31].

The reduction in hospitalization capacity led to the limitation of admissions only to cases with a surgical indication (98.7%) in non-COVID-19 wards.

The surgical activity was significantly reduced, also due to the prolonged time for the decontamination of the operating room, the reduction of the available staff, by quarantining in case of positive tests, following the PCR screening for COVID-19, the reduction of the number of postoperative and Intensive Care Unit (ICU) beds, by including some ICU beds on the COVID-19 support lists [30].

A decrease in surgical activity was observed especially for scheduled surgery. In Romania also, treating patients with malignant diseases was a priority, but the decrease in the number of surgical interventions also included the oncological ones. Other studies have also noted that one of the most serious problems has been the limitation of the number of cancer operations, and have proposed to transfer patients for oncological surgery to less crowded hospitals [32].

Minimally invasive surgery has entered a major impasse during the pandemic. The main international surgical societies, dedicated to minimally invasive surgery, such as the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), the European Association of Endoscopic Surgery (EAES) and the Romanian Association of Endoscopic Surgery (RAES), have issued recommendations regarding minimally invasive treatment modalities during the COVID-19 pandemic, to create a safety framework, for both medical staff and patients, during surgical interventions [33–35].

In Romania, by using a closed exhaust system, with adequate filtration, the risk of contamination of medical personnel, through the generation of aerosols during exhalation was eliminated, as recommended by other authors [36,37].

The screening of patients admitted to surgery wards in non-COVID-19 centres was one of the priorities of the health system, an aspect also recommended by other authors [6,38].

One of the most important priorities for hospitals has been the establishment and accreditation of laboratories to identify, confirm and monitor patients with COVID-19. The implementation of the COVID-19 testing was not uniform at the national level, only some centres benefited from performing the tests on the day of admission, an aspect that led to some discrepant results–three centres did not operate on suspected patients, and one non-COVID centre operated 100% COVID-19 suspect patients.

The share of surgical interventions, in suspected patients, was significantly lower in non-COVID centres (12.6%), compared to COVID-19 centres (87.3%), as a result of the intensive preoperative PCR screening of surgical patients in the non-COVID-19 centres. However, only 4.9% of the COVID-19 suspect patients operated on proved positive–the lack of PCR test results at the time of the intervention, being responsible for the emergency treatment of a large number of negative patients as suspect COVID-19, even in epidemiological outbreaks.

Emergency surgical interventions were performed in operating rooms intended for COVID-19-positive or suspectedpatients, according to the recommendations of other authors [39].

The indications and principles of treatment were the same as in non-pandemic circumstances. However, emergency surgery respected the recommendations of other authors to be limited to interventions that are strictly necessary for the immediate saving of the patient's life, because the activity of the surgical teams was carried out in exceptional conditions: without the use of air conditioning in the operating room, special equipment protection, masks and visors with a face filter with protection level 3 (FFP3) [40,41].

The COVID support centres have adopted a flexible attitude in admitting patients, taking into account local needs. The average rate of surgical interventions was 78.2%, with a higher rate of interventions being observed in the centres of epidemiological outbreaks, between 73.2–100% of them providing surgical assistance to all patients presented to the emergency room. In the centres outside the outbreaks, the share of emergency interventions was reduced, between 5.2–21.3%, interventions being strictly limited to surgical emergencies. Some of the positive patients operated on in non-COVID-19 centres were transferred to these centres, within the limits of available beds. After the exhaustion of these beds, the non-COVID-19 hospitals proved flexibility, by continuing to care for positive patients, in the specially arranged red areas.

The flexibility of the COVID-19 and non-COVID-19 centres to adapt to the local requirements, observed in our study, was also recommended by other authors, to optimally use healthcare resources and facilitate as many patients as possible to the health system [42].

During the hospitalization of positive patients in the surgical wards, the goals of care were the surgical treatment of emergencies, and the management of complications, associated with the treatment of COVID-19, under the coordination of the infectious disease doctor to obtain a negative PCR test. After that, the patient was transferred for the continuation of surgical treatment in hospitals non-COVID-19, aspects also recommended by other studies [43].

The average overall mortality rate for hospitalized patients, in the period March–July 2020, was 5.9% compared to 3.3% in a similar period in 2019. The increased mortality was also reported by other authors [44]. Probably, it was the result of the surgical treatment of more severe diseases, compared to the general profile of the surgical department from the period preceding the pandemic.

The difficulties of accessing hospitals, the fear of infection with COVID-19 in the hospital, and the illness itself, led to the postponement of the surgery in some patients, and implicitly to the alteration of the postoperative results. Hospitalization only when the disease has reached the complicated phase (intestinal occlusion or peritonitis) or it has progressed, can explain the results obtained. But, because we do not have complete data regarding the stages of evolution or the type of interventions practiced, definitive conclusions cannot be made.

The postoperative mortality rate in the March–July 2020 period was around 5%, both in non-COVID and COVID centres. It is noteworthy that the COVID centres, located during the epidemiologic outbreak, provided surgical assistance to all patients, regardless of their epidemiologic status, and had lower mortality compared to those outside the epidemiologic outbreak. The two COVID-19 support centres, located outside the outbreaks, performed a small number of surgical interventions, 10 and 16 respectively, and reported a large number of deaths–8 and 4 respectively. In these centres, the postoperative mortality of 28%, in positive patients, more precisely reflects the effect of surgical intervention on a positive patient, results also reported by the authors [9,31,45]. Also in non-COVID-19 centres, the postoperative mortality of positive patients was increased–by 16% (14/87). Although the postoperative mortality in positive COVID-19 patients is significantly higher, compared to the global one, the lack of complementary data, such as age, the presence of comorbidities, the stage of the disease, or the type of surgical procedure, prevents obtaining definitive

conclusions regarding the direct influence of COVID-19 on postoperative mortality in positive patients.

With the finding of microvascular damage, at the level of the pulmonary circulation, and the introduction of anticoagulant drugs in a therapeutic dose, into the treatment of symptomatic positive patients, the risk of bleeding in surgical patients increased. Hemorrhagic complications were encountered in two patients, whose evolution was favourable by controlling the bleeding. The death of a patient, confirmed with COVID-19, was due to the severe evolution of a hemorrhagic complication, with hemoperitoneum due to an overdose of anticoagulant drugs. Mesenteric ischemia was recorded in 2 patients with permanent atrial fibrillation, from COVID-19 support centres and in which there may have been an impairment of the microcirculation in the context of COVID-19. And other studies support the involvement of this cause of death in the pandemic; a meta-analysis showed a postoperative mortality rate of 27% in COVD-19 positive patients with mesenteric ischemia [46].

For some of the patients, the causes of death were determined by postoperative complications. The most frequent cause of death was represented by the complications of malignant diseases in eight patients, five positive patients from COVID-19 support centres, among which two with perforated tumors and three patients from non-COVID-19 support centres. Other causes of death were necrotic-hemorrhagic pancreatitis in four patients, and complicated peripheral arteriopathy in seven patients. These aspects were also found in other studies [47].

Severe respiratory dysfunction was the initial morbid condition for the death of two positive patients, who received surgical treatment, and although pneumonia associated with COVID-19 was proven by imaging, it cannot be appreciated that this represented the main cause of death. Respiratory failure was recorded in three more patients. Other authors also observed increased mortality rates among positive patients operated on due to pulmonary complications [48].

To our knowledge, this is the first article to present the results of a national survey of surgical activity in Romanian hospitals in the period March–August 2020, under the conditions of the application of new rules imposed by the Ministry of Health due to the COVID-19 pandemic, but it is possible that some hypotheses developed in this study to be debated in other recent studies.

This study, through the results obtained, reflects the following aspects regarding the COVID-19 pandemic, in the period March–July 2022 in Romania–the reduction of surgical activity, the unequal PCR screening of surgical patients, the segregation of positive patients, with significantly increased postoperative mortality in positive patients. This study also emphasizes the importance of continuing care for positive surgical patients in centres or areas dedicated to positive patients. Although only six centres were transformed into COVID-19 support centres, most of the centres provided circuits adapted to the epidemiological situation, developed standard operating procedures in the form of segregation of care and designated medical personnel, areas dedicated to COVID-19 patients, pre-operative testing PCR, the adaptation of national and international guidelines for the continuation of patient care. This survey helped us identify several strategies to improve surgical care in the post-pandemic era and improve the delivery of medical care. The development of segregated and flexible workflow systems in terms of hospital design and staffing would enable a better response to future pandemics.

The main limitation of the study is the fact that not all the centers responded to all the questions in the survey regarding surgical activity from March to August 2020 in Romania. The second limitation was that the questionnaire included only objective data-driven queries, like other studies based on the collection of data by questionnaire [49]; no details were available regarding patient demographics, diagnosis, procedural details, postoperative outcomes, hospital policies, and complication details. Therefore, detailed conclusions could not be drawn. However, this survey highlighted the behaviour of different hospitals, in response to the COVID-19 pandemic, and provides insight into

the administrative and scientific strategies to mitigate the consequences of the pandemic, which were adopted by different hospitals in Romania, treating surgical patients. This study provides an opportunity to analyze the strategies adopted by centres that had comparatively better results and to include them in future strategies.

## 5. Conclusions

During the first waves of the pandemic, the medical and surgical teams made heroic efforts to continue their surgical activity, under particularly difficult conditions and, sometimes, had to pay a significant tribute to this deadly suffering.

The obtained results largely confirmed the formulated hypotheses. Prioritizing the safety of patients and medical personnel, during the COVID-19 pandemic, has led to a significant decrease in surgical activities, especially for scheduled operations compared to a similar period of the previous year. Surgical emergencies were the highest priority in treatment, especially in the COVID support hospitals. The centres included in the study adopted a flexible attitude regarding patient management, depending on the local epidemiological situation. The flexibility demonstrated by the centers located in the COVID outbreak led to very close global mortality results between {5%} and non-support {4.8%} COVID centers. Postoperative mortality rates were higher than in a similar period in 2019. Positive patients represented a small percentage (3.3%) of the total admissions and suspected operated patients (4.6%), but postoperative mortality was significantly higher (19%). Analyzing the postoperative mortality, a significant difference was found in the support centers, especially in the positive operated patients compared to the negative or non-operated positive ones. In our study, the causes of death in the positive patients were mainly determined by the surgical condition in complicated phases, due to the delay in the medical act induced by the restrictions imposed by the pandemic. This study is the first to present the influence of the pandemic on the mortality of patients hospitalized in surgery wards during March–August 2020 in Romania, and of course the limited value of the results requires future larger studies.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su15010237/s1, Table S1: Explanatory data included 47 centres which reported the number of hospitalized patients in the period March–July 2019, respectively 2020, the number of surgery, emergency surgery, COVID-19 suspected and positive operated patients, deaths number total and COVID-19 positive, and mortality; Table S2: Explanatory data included the statistical association between the results of the hospitalized patients and postoperative mortality in the period March–July 2020 and the similar period of 2019; Table S3: Explanatory data included the statistical association between the results in COVID-19 centres and non-COVID-19 centres; Supplementary Table S4: Explanatory data that included the statistical test for data normality; Supplementary Table S5: Explanatory data that included Levene statistical test for data homogeneity ($p$-value = 0.402); Supplementary Figure S1 Explanatory plot for data normality for hospitalized patients in period March–August 2019; Supplementary Figure S2 Explanatory plot for data normality for for hospitalized patients in period March–August 2020.

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