

Surgical and Critical Inpatients' Management for Upcoming Pandemic Waves

Sergio Perez-Holanda*

Medical Deputy Director (Health Care Area IV, Oviedo), Central University Hospital of Asturias, Principality of Asturias, Spain

***Corresponding Author:** Sergio Perez-Holanda, Medical Deputy Director (Health Care Area IV, Oviedo), Central University Hospital of Asturias, Principality of Asturias, Spain.

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Abstract

Introduction: The emergency situation, caused by COVID-19, gave rise to the adoption of a series of measures to face these extraordinary circumstances. In Principality of Asturias (a Region in Northern Spain) during the fourth wave, the month in which our healthcare structures were most stressed was last July '21.

Objective: The objective of this work is to review the different organizational aspects, focusing on inpatients' management, who required surgical intervention at our hospital during that month.

Methods: This is a retrospective and descriptive of consecutive cases, which studies surgical activity during July '21 contrasting with activity performed in previous pandemic waves, as well as the one performed in July '19 (prior to pandemic).

Results: Epidemiological indicators were increasing in each pandemic wave, as well as hospital occupancy in conventional beds. But nevertheless, critical bed occupancies were lower than in previous waves. There was a temporal coincidence between reaching 70% of the population vaccinated, and the abrupt decrease in the epidemiological indicators of the pandemic. The temporary postponement of scheduled surgical interventions was anecdotal. Donation and transplantation activity was maintained under normal conditions, without any restrictions by the effect of the pandemic. Scheduled surgical activity decreased by - 11.9% compared to July '19 (without pandemic). In the regional registry, this activity did not reduce the number of patients waiting for surgery, nor their waiting time.

Conclusions: Despite the limitations of our study, we can prudently deduce that vaccination seemed to represent a factor that could have modified the impact of the disease, and so, the stress suffered by the organization appeared to be less compared to previous pandemic waves.

Keywords: COVID-19 Pandemic; SARS-CoV-2 Infection; Safety Management; Surgery; Vaccination

Abbreviations

COVID-19: SARS-Cov-2 Virus; In Reference to Patients Infected with this Virus; PCR: Viral Antigen Detection for COVID-19 By Polymerase Chain Reaction Test in Nasopharyngeal Smear

Introduction

The SARS-CoV-2 (hereinafter, COVID-19) virus pandemic caused the postponement of some scheduled interventions in different volumes [1-3] since its declaration in March '20.

Our Region (Principality of Asturias, Northern Spain) is divided into 8 Healthcare Areas, depending on the number of population, and their distribution. In our Healthcare Area IV (Oviedo), the last regional census of the population was 331.717 inhabitants, and 1.018.784 inhabitants as reference centre in the Region [4]. The Healthcare Provision has already been described previously [1,2]. The maximum capacity in Intensive Care Units and Surgical Resuscitation Units (hereinafter, critical beds), once all the available spaces were conditioned, increased from 128 beds to 162 beds since the third pandemic wave [3], maintaining 1135 beds for admitted inpatients (hereinafter, conventional beds).

The proportion of PCR positivity was 1.6% during the first wave [1]; it reached a peak around 10.5% during the second wave [2], while it was around 12.9% during the third one [3], which ended on May 2, 2021, when the proportion of detection for COVID-19 polymerase chain reaction test (hereinafter, PCR) positivity kept constantly below 5.0% [5]. Since then, surgical activity was progressively normalized in our hospital. Nevertheless, both a hospitalization unit and an intensive care unit were kept open for COVID-19 infected inpatients.

In the previous pandemic waves, some restrictions were decreed by the Regional Government [6], which included the maintenance of regional confinement [7], the capacity of meetings and celebrations restricted to 6 people maximum, or, thus, a limitation of time zones mobility by night. Along July '21, only the following recommendations remained active: a) The mandatory use of a mask, b) social distancing, c) hand hygiene; and, d) the suspension of mass events (burials, sports, cultural, or folkloric activities and competitions, among others) [8].

Since December 18th, 2020, when the peak of accumulated incidence rate per 100.000 inhabitants in the last 14 days was 195.3 cases, hospital occupancy was still decreasing very slowly, due to the finishing of the second pandemic wave [2]. During the third wave, this rate increased progressively with a peak of 658.73 cases on February 2nd [4].

On June 24th, the proportion of PCR positivity was 5.44% [5], beginning a new pandemic wave: the fourth one in our Region.

Aim of the Study

When comparing the different trends in hospital occupancies depending on the circumstances into each pandemic wave, it seems that the paradigm would have changed, regarding the strategic approach and the different organizational aspects needed for inpatients' care, who required surgical and critical cares.

Methods

This is a retrospective, descriptive study of consecutive cases, which studies surgical activity both in quantity and quality. It focuses on the epidemiological indicators in terms of the maintenance and adaptation of the measures taken in the last wave of the COVID-19 pandemic.

For this purpose, the activity and measures carried out in the month of greatest stress in the hospital organization (July '21) are studied, and contrasted with the first three previous pandemic waves [1-3], as well as with the same month prior to pandemic (July '19).

The following exclusion criteria were established: 1) Patients with a non-surgical profile (co-infected or not) who have been treated in the critical care units are excluded from this review. 2) Reducing the duration of the pandemic to one month (where the indicators peaks occurred) in order to establish more homogeneous groups of cases and controls, led to the rest of months being excluded. 3) On the other hand, the month of June '21 had a behaviour of extreme activity compared to the summer months (July, August, and September), so it was excluded from the study. 4) The description of the activity with a status of "non-surgical" was not part of the scope of this study. 5) Furthermore, some clinical criteria were not reviewed, such as: a) Clinical parameters or biological markers to differentiate systemic affectation or sepsis of abdominal origin, such as the presence of digestive symptoms or the different analytical studies required in the

diagnosis of patients. b) Approach, and the use of minimally invasive approaches, or precaution in the use of the pneumoperitoneum, or the use of electric scalpel, or the discouragement of endoanal type interventions. c) Treatment for COVID-19 patients requiring pharmaceutical measures, as well as types of antiviral medication, side effects and contraindications, use of oxygen therapy or steroids or non-steroidal anti-inflammatory drugs, or even the testing of interactions in the case of antiviral use. d) The individual actions carried out by the Occupational Risk Prevention Department were not described in this study, or the assessment of the indication for post-exposure prophylaxis by the workers.

Both the scope, care circuits, and protocols of action for patients in the surgical area have been described previously [1,2], as well as some issues regarding ethical aspects, including those related to patients, workers, or the handling of information to patients and their families.

During this new pandemic wave, there were periodic screening PCR tests among professionals and users [3], in addition to having performed them on suspected cases [1,2].

Results

The accumulated incidence rates in the population, hospital occupancies, coverage of vaccination, and the most relevant events that have occurred during the new pandemic wave are described in table 1 [4-5].

According to each pandemic waves, hospital occupancies in conventional beds were: 58.3%, 81.6%, 83.5%, and 87.9% respectively.

Care indicators comparing to the same periods in presence (years 2020 and 2021) and absence (year 2019) of COVID-19 pandemic are presented in table 2 [9], and these data complemented those presented in previous pandemic waves [1-2].

On June 24th, 2021, the proportion of PCR positivity was 5.44%, and throughout July 2021 [5] it was increasing until it reached a peak of 16.22% on July 30th. On August 27th, the first value below 5.0% in PCR positivity was observed [5].

Regarding the accumulated incidence, it began to increase suddenly, since July 5th, until it reached a peak around 684,54 cases, on July 20th [4] (Table 1).

Week	Average of Accumulated Incidence Rate Per 100.000 Inhabitants in the Last 14 Days	Proportion of PCR Positivity Test in Our Region (%)	University Hospital Occupancy for Covid-19 Patients in Conventional Beds, in Number (%)	University Hospital Occupancy for Covid-19 Patients in Critical Beds in Number (%)	Regional Hospital Occupancy for Covid-19 Patients in Conventional Beds, in Number (%)	Regional Hospital Occupancy for Covid-19 Patients in Critical Beds in Number (%)	Number of Operating Rooms Scheduled Morning + Afternoon (Average)	Proportion of Vaccinated Population (One Dose At Least, %)	Events
June 14, 2021	67.75	2.35%	7.21%	5.50%	2.04%	7.21%	27 + 11,3	35.29%	- No Perimeter closure, and no control of time zones.

June 21, 2021	71.02	2.58%	5.57%	2.05%	1.70%	5.57%	27,2 + 11,3	38.95%	<ul style="list-style-type: none"> - Continuing vaccination campaign to people depending on their group. - Continuing of admission of critical patients coming from others Healthcare Areas. - Maintaining 1 Surgical Committee meetings per week. PCR positivity 5,44%, on June 24th. - Maintaining 2 Critical Committee meetings per week
June 28, 2021	74.75	3.39%	4.03%	1.47%	1.22%	4.03%	26,7 + 10,7	44.36%	- Similar actions to previous week.
July 5, 2021	196.64	11.27%	4.36%	2.04%	1.80%	4.36%	18,5 + 4,0	50.32%	- Critics unit ICU-7 (4 boxes) closed.
July 12, 2021	474.37	13.17%	5.03%	2.38%	2.12%	5.06%	19,0 + 5,5	57.43%	<ul style="list-style-type: none"> - Income/ discharge Balance: +1,5 patients daily. - Increasing from 2 to 3 Critical Committee meetings per week. - Availability of conventional beds outside the Healthcare Area.

July 19, 2021	660.65	14.00%	6.71%	3.57%	3.26%	6.71%	19,2 + 4,5	62.91%	<ul style="list-style-type: none"> - Progressive increase of Ratio Income/discharge Balance: +6.0 patients daily. - Peak of accumulated incidence rate of 684,54 cases on July 20th. - Availability of critical beds outside the Healthcare Area.
July 26, 2021	620.74	11.19% (Peak = 16,22%)	9.40%	5.51%	5.14%	9.40%	19,0 + 5,25	65.55%	<ul style="list-style-type: none"> - Income/discharge Balance of +4,5 patients daily. - Postponement of delayable activity since July 28th. - Appearance of first epidemic outbreaks in nursing homes. - Hospital occupancy in conventional beds peak was 5,67% on July 29th. - No need to opening "Intensive Care Unit -8" (formerly, locker) as on February 4, 2021 - PCR positivity was 16.22% on July 30th. - Start of vaccination campaign to people below <30 years old.

August 2, 2021	462.61	8.81%	11.07%	5.51%	5.07%	11.07%	18,2 + 4,5	67.11%	<ul style="list-style-type: none"> - Maintenance of Major Ambulatory Surgery Unit activity in normal conditions - Maintaining of Postponement of delayable activity.
August 9, 2021	319.2	6.65%	11.74%	4.46%	3.75%	11.74%	18,6 + 3,8	68.77%	<ul style="list-style-type: none"> - No perimeter closure of any municipalities in the Region, on the contrary to previous waves - "Intensive Care Unit-8" (formerly, locker room) used as observatory unit on the contrary to previous pandemic wave. - Hospital occupancy in critical beds peak was 11,74% on August 5th to 10th, 2021 - No need to opening "Intensive Care Unit -9" (formerly, gym) as on February 4th, 2021

August 16, 2021	211.23	5.55%	9.40%	3.70%	3.14%	9.40%	18,3 + 3,7	71.42%	- Ratio Income/discharge Balance: +2.0 patients daily. - Decreasing from 3 to 2 Critical Committee meetings per week.
August 23, 2021	139.87	5.06%	7.38%	2.79%	2.79%	7.38%	18,4 + 4,3	82.29%	- First PCR positivity value below 5.0% on August 27 th (finishing the fourth wave)
August 30, 2021	94.03	2.95%	7.05%	2.13%	2.13%	7.05%	18,5 + 4,5	93.92%	- Income/discharge Balance of 0-1 patients daily. - Open vaccination campaign for any unvaccinated people over 11 years old.

Table 1: The accumulated incidence rates, hospitals occupancies, proportion of vaccinated population, and the most relevant events that have occurred during this last pandemic wave.

In previous waves [1-3], the hospital occupancies reached maximums of up to 20% of the total beds installed in conventional hospitalization, or almost 60% of the total number of beds installed for critical patients. In this wave, the peak of conventional beds occupancy was 5,67% on July 29th, and the peak of critical beds occupancy was 11,74% since August 5th to 10th (Table 1). More over, twenty-six critical beds (coming from the second wave) were already occupied by COVID-19 inpatients when the third wave began (which meant 16.1% of the maximum capacity), while in June 24th, 4.3% of critical beds were occupied (coming from the third wave) when the fourth wave began [4].

In our Region, vaccination campaign began on December 27th, 2020 [5], following the different risk criteria periodically updated by Health Authorities [10]. Vaccination coverage with at least one dose in the whole population including children under 12 years old, reached around 50% on July 5th, and 75% on July 30th, 2021 [5]. The evolution of vaccination coverage in the population are presented in table 1 [4-5], in comparison with some other indicators and events occurred.

In terms of activity, delayable and non-preferent patients [11] were postponed in different volumes (from -17,7% to - 76,0%) during others pandemic waves [1-3], while in this last wave, surgical activity recovered amounts slightly lower to years prior to pandemic (-11,3%; Table 2).

	2019	2020	2021
Hospital occupancy (%)	85.00	73.9	87.90
Maximum of accumulated incidence rate per 100.000 inhabitants in the last 14 days	-	8.54	684.54
Maximum Number of critical beds occupied for COVID-19 patients (%)	-	22.27	9.40
Average of number of working beds daily	904.60	845.10	876.50
Average of overall hospital stay per patient (in days)	8.65	8.30	8.77
Hospital mortality index (%)	4.60	5.20	5.50
Index of deaths in Surgical Services out of number of discharges (%)	1.50	2.30	1.70
Total number of available operating rooms per working day	19	18	18
Number of specific operating rooms available for COVID-19 patients per day	-	4	2
Number of available emergency operating rooms per day	2	2	2
Number of scheduled patients operated on	1,024	910	908
Number of emergent and urgent patients operated on	403	306	386
Total number of patients operated on	1,427	1,216	1,294
Ratio of scheduled ambulatory / admitted interventions (%)	41.50	42.40	39.40
Number of total transplants performed (including renal, hepatic and cardiac)	17	7	7
Scheduled surgical performance (morning and afternoon, %)	77.80	71.30	74.52
Surgical suspensions (%)	3.80	3.00	3.30
Number of patients in Surgical Waiting List registry (last day of the month)	7,074	7,699	7,973
Average of delay to be operated on (last day of the month, in days)	82.39	82.09	97.31
Number of patients waiting for operation more than 180 days (last day of the month)	453	845	1,066

Table 2: Activity data in July, comparing 2019, 2020, and 2021.

In the surgical waiting list registry related to July 2021, 667 out of 908 scheduled patients operated on (73,5%) had a priority less than or equal to 2 (preferential and urgent patients; data not shown).

The overall accumulated mortality rate was 5.5% in July '21, while it was 5.6%, 5.3%, and 7.4% in the first, second, and third pandemic waves respectively. While, regarding the total of inpatients' deaths in Surgical Services were 1.70% in July '21, while it was 1.60%, 0.8%, and 0.01% respectively [9].

Discussion

In a previous manuscript [12], it was hypothesized about a possible paradigm shift in the indicators used to predict the availability of hospital resources. The aim of this study is to carry out a more in-depth analysis about some predictive indicators during this last pandemic wave, along July '21.

All the previous restrictions decreed by Health Authorities [6,7] could not be established for reasons of a legal nature [8], after having ended the State of Alarm that preserved them. In fact, the mandatory use of a mask, social distancing, and hand hygiene could remain active only.

In our Region, we dated the beginning of the new pandemic wave (so-called, the fourth wave) on June 24th, 2021, based on the proportion of PCR positivity greater than 5%, and progressively [5]. This wave was ended on August 27th. As shown in table 1, in each pandemic wave

[1-3] the peak of the proportion of PCR positivity was increasing, and it reached its peak on July 20th [5]. However, the highest proportion found this time did not trigger the expected impact on the postponement of surgical activity.

So, this indicator did not seem to have too much influence on the normal surgical activity either. In fact, hospital occupancy and others indicators seemed to reach similar parameters to 2019 (without a pandemic; Table 2).

Due to the lack of professionals available in the public employment applicants exchanges, all the available spaces into the hospital could not have been converted into functional critical care units. So, our theoretical maximum capacity of 162 critical beds could not have been reached. Fortunately, this measure was never necessary (Table 1).

Despite the stock of applicants for public employment was exhausted since the second wave [2], this fact had no influence on the activity carried out, and no outbreaks among health personnel were observed also. As in previous waves, the collaboration of personnel were established from the first moment, both belonging to critical care services (anaesthesia, pediatrics, intensive care, or cardiologists, among others), and conventional hospitalization units (internal medicine doctors, pneumologists, cardiac surgeons, or rehabilitation doctors, among others). Moreover, the surgical activity was adjusted to the available professionals, due to summer vacation absences, and this issue could explain the slightly lower scheduled surgical activity compared to years without a pandemic (Table 2).

Patients registered with a priority type 3 (delayable, not oncological) [11], and with a type of medium/long hospital occupancy [13] were selected to be postponed, as in previous waves [3] since July 28th (coinciding with the peak of epidemiological indicators), but its influence on the results was anecdotal, so the average of surgical inpatients' stay did not change (6,6 days; data not shown).

When studying the surgical waiting list outputs registry [11], a low percentage of patients were registered with priority 3 (p.e. allows delay), with speaks in favour of safety and diligence in the way of scheduling by the Heads of all Surgical Services. Despite the number of scheduled patients operated on were nearly similar to those carried out in years without a pandemic, this fact has not led to a significant reduction both in the average of delay to be operated on (in days), or in the number of patients waiting for operation more than 180 days. This behaviour may be explained by the effect of the 3 overlapping pandemic waves suffered from November 2020 to July 2021 [14], in which the number of patients awaiting was proportionally and cumulatively higher than the number of patients who left the registry.

During this wave, the expected impact on hospital occupancies both in conventional and critical beds was not observed [1-3], despite the rebound in epidemiological indicators. A slightly increase in the number of deaths was observed among infected inpatients. This behaviour was possibly related to the effect of the 3 overlapping pandemic waves suffered also. Although it may be explained by the trend of a greater number of interventions performed [14].

In our Region, the vaccination strategy against COVID-19 pandemic began on December 27th, 2020 [5], depending on the different risk criteria of the population, and according to the protocol established by the Health Authorities [10]. In this new wave, the impact of vaccination became apparent some days prior to pandemic peak, when the incidence of infection among people under 30 years of age was doubled in three days only [15]. Subsequently, some calls were made by Authorities to obtain more population response to vaccination [16]. Vaccination coverage with at least one dose reached 70% of the total regional population (including children under 12 years old) on July 20th [5]. In fact, during the second wave, it had already been suggested [2] the intriguing proportion of PCR positivity registered in the age range under 15 years compared to the total samples analyzed and registered in our Health care Area (10.4% versus 4.3%). This hypothesis seems to have become more apparent during this last wave.

At the beginning of the fourth wave, it was speculated to achieve the so-called herd immunity with 50% of vaccinated population, but recently, Tony Kirby, ex-Chief of the Press Office of the scientific journal *The Lancet*, speculated that the level of the success of herd immunity was around 80% of the vaccinated population [17]. Our vaccination coverage in the population was around 75% on July 30th

(Table 1). In any case, the percentage of vaccination that allows obtaining herd immunity is still under debate, but this hypothesis allows us to explain that our care indicators had lower impact on our hospital resources.

In fact, this greater availability of hospital resources guided us towards getting closer to normalizing surgical activity (Table 2).

Taking all these issues together, the decision-making process that concerned both surgical and critical patients changed during the fourth wave. In fact, the evolution of proportion of vaccinated population, in comparison with epidemiological and care indicators, allows us to deduce that, vaccination seemed to represent a factor that would have modified the impact of the pandemic.

Several limitations in this study force us to be very cautious about its conclusion: Some of them related to the sample studied, and the heterogeneity of the groups to compare (which did not allow statistical analysis between them); and, other limitations related to limiting the duration of the pandemic to the month when peaks in accumulated incidence rate or percentage of PCR positivity were observed. More over, the bias in the activity carried out could also be reduced, as the peak of the pandemic corresponded to a month of summer vacation. Clinical parameters have not been studied in this study, or diagnostic questions (sepsis, among others), or surgical techniques (minimally invasive access, among others), or treatments prescribed in these patients (corticosteroids, among others). So, care indicators (such as mortality, among others) may be more complex to explain. Finally, aspects related to the health status of the staff, which may have reduced the activity, have not been detailed.

Conclusion

Despite the limitations of our study, we can prudently deduce that vaccination seemed to represent a factor that could have modified the impact of the disease, and so, the stress suffered by the organization appeared to be less compared to previous pandemic waves.

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