



## Research article

## Impact of COVID-19 pandemic in surgical training of Junior Residents in general surgery

García-Quijada García Javier<sup>a,\*</sup>, Sanz Muñoz Paloma<sup>a</sup>, Salazar Carrasco Andrea<sup>a</sup>, Corral Pazos de Provens Octavio<sup>b</sup>, Delgado Millán Miguel Ángel<sup>a</sup><sup>a</sup> General Surgery Department, Getafe University Hospital, Carr. Madrid - Toledo, Km 12,500, 28905 Getafe, Madrid, Spain<sup>b</sup> Health Science Faculty, UNIR (La Rioja International University), v. de la Paz, 137, 26006 Logroño, La Rioja, Spain

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## ABSTRACT

**Background:** The pandemic caused by SARS-CoV2 has had a huge impact on our health system. Due to both cancellation of elective surgery and restructuring in departments at most medical centers, surgical residents face a potential training deficit in their specialty.

This study aims to objectively analyze and quantify the impact of the pandemic on the surgical activity of residents, in the setting of emergency and elective surgery, to assess whether this period has really supposed a training deficit.

**Material and methods:** A descriptive analysis is proposed, comparing the number of procedures performed by residents of our department during the year prior to the pandemic and during the pandemic, clustering them into different subgroups.

**Results:** The results give an optimistic outlook. In the first place, in elective surgery, despite the lower procedures performed in absolute numbers, the proportional participation of residents in the scheduled surgeries increased in all the subgroups analyzed, finding statistically significant differences and finally approaching the total number of procedures in both periods, without relevant differences in the comparison. As for emergency surgery, residents also increased their proportional participation in most subgroups, in this case reaching more total procedures, even in absolute numbers.

**Conclusion:** Therefore, the results seem to indicate that the teaching effort made by staff surgeons of the department has managed to palliate, in most of the subgroups analyzed, the decrease in surgical activity that the pandemic has produced, so, at least in the area of surgical practice, the impact of the pandemic has probably been reduced comparing to previous expectations.

## 1. Introduction

The pandemic caused by SARS-CoV2 has had a huge impact on our health system [1], directly or indirectly causing millions of victims. The restructuring of departments and medical units has led to the transfer of multiple specialists, in order to support the most overwhelmed services. This situation has also affected surgical residents, who during the pandemic, have joined medical services, such as Geriatrics, Intensive Care, Emergencies or Internal Medicine. On the other hand, in most hospitals, the scheduled surgical activity has been reduced [2], even being discontinued in some centers, performing only emergency surgeries.

These events have inevitably caused a decline in the surgical and care activity of surgical residents in their own field. We wonder if the care

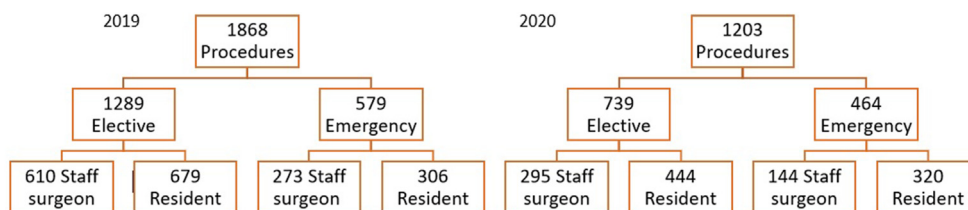
deficit suffered during this year will have a significant impact on the training of residents. For this reason, and as a first step for subsequent studies, we have carried out a descriptive analysis to quantify the impact of the pandemic, mainly on the surgical activity of the residents of our service, with the aim of objectively demonstrating whether this year has really meant a training deficit that may have had an impact on the acquisition of skills or abilities of surgical practice in residents.

## 2. Material and methods

Two periods were established, the year of the pandemic (2020), which we consider from April 2020 to April 2021, and the previous year (2019), from April 2019, to April 2020. Despite the fact that the

\* Corresponding author.

E-mail address: [gquijada.javier@gmail.com](mailto:gquijada.javier@gmail.com) (G.-Q.G. Javier).



**Figure 1.** The total number of procedures performed in both periods (2019 and 2020) is illustrated, breaking down by number of scheduled and emergency procedures, and how many of these were performed by residents or staff surgeons of the department.

pandemic state was declared almost a month earlier (March 11, 2020), elective surgical activity was not affected until several weeks later. At the beginning of April, the accumulation of infected patients in the medical and intensive care services had already forced the restructuring of services and the suspension of elective procedures.

From here, the total number of surgeries performed by 10 residents of General Surgery from the University Hospital of Getafe were collected through the Hospital's informatic department, either participating as a main surgeon or as an assistant surgeon.

With these data, we performed a descriptive analysis to compare the total number of surgeries performed as the main surgeon at a global level and breaking down by subgroups in the two periods described.

The data were collected using the Microsoft Excel® Software and subsequently a descriptive statistical analysis was carried out by means of the SPSS Statics® software, using descriptive statistics and "Chi-square" hypothesis contrast test for the comparisons between both time periods. An approval by an ethical committee was not required as our research doesn't include experimentation on human subjects or biological samples.

In the first instance, the subgroups of elective surgery and emergency surgery were taken into account, considering elective surgery, all that performed on a patient who comes on a scheduled basis, either for an outpatient intervention or for one that required admission. Regarding emergency surgery, all procedures performed in the operating room by the staff designated to assist urgent patients were included (Figure 1).

In the elective surgery group, we considered the subgroups of pathologies that residents intervene with the most frequency or proportion, including cholecystectomies, endocrine surgery (total thyroidectomies, hemithyroidectomy and parathyroidectomy), breast surgery (including mastectomies, breast-conserving surgeries, sentinel lymph node biopsies and axillary lymphadenectomies), colorectal surgery (including total or subtotal colectomies, right and left colectomies, sigmoidectomies and

rectal resections), proctologic surgery (including fistulotomies, flaps, laser cauterizations, draining seton placements, hemorrhoidectomies, and sphincterotomies), abdominal wall surgery (considering inguino-crural, umbilical, epigastric hernias, and eventrations), gastric surgery (including bariatric surgery, total, subtotal or atypical gastrectomy, esophagectomies, gastroesophageal reflux surgeries, hiatal hernias, and gastroenteric anastomosis), and outpatient surgery (considering excision of soft tissue lesions, nail lesions or nerve, muscle or vascular biopsies).

Regarding the emergency surgery group, the following subgroups were taken into account: appendectomies, urgent cholecystectomies, wall surgeries (due to inguino-crural, umbilical, epigastric hernias or complicated eventrations), urgent proctologic surgeries (mainly drainage of abscesses, seton draining placements and sphincterotomies), urgent intestinal resections (including resections of the colon or small intestine mainly due to perforation, obstruction or sepsis) and emergency gastric surgeries (considering simple sutures in perforated gastroduodenal ulcers, surgical hemostasis in bleeding gastroduodenal ulcers, and bariatric and esophago-gastric revisional surgeries).

### 3. Results

All data were collected (Tables 1 and 2); with a total of 1868 surgeries in 2019 and 1203 surgeries in 2020, the overall activity of the service decreased by 35.6%. Thus, 985 of 1868 surgeries were performed by residents in 2019, and 764 of 1203 surgeries in 2020. This represents a 22.4% decrease in the number of surgeries performed by residents. However, taking into account the total number of surgeries of the service, residents went from performing 52.73% of the surgeries in the department in 2019 to performing 63.5% of surgeries in 2020, which implies a relative increase of 20.43% in the surgical activity of residents.

Regarding elective surgery (Table 1), in 2019 a total of 1289 procedures were performed, while in 2020 only 739 procedures were

**Table 1.** The data collected in the subgroups established for "elective surgery" are illustrated.

	2019			2020			Increment (%) in global residents participation	Global surgical volume (%)	P value
	Procedures performed by residents	Total procedures	Residents participation (%)	Procedures performed by residents	Total Procedures	Residents participation (%)			
<b>Global (Elective and emergency surgery)</b>	985	1868	52.73	764	1203	63.51	20.44	-35.60	<b>0.000</b>
<b>Elective surgery</b>	679	1289	52.68	444	739	60.08	14.06	-42.67	<b>0.001</b>
Outpatient surgery	552	801	68.91	341	513	66.47	-3.54	-35.96	0.355
Cholecystectomy	21	83	25.30	27	48	56.25	122.32	-42.17	<b>0.000</b>
Endocrine surgery	6	61	9.84	15	36	41.67	326.61	-40.98	<b>0.000</b>
Breast surgery	57	108	52.78	46	77	59.74	13.19	-28.70	0.347
Colorectal surgery	21	104	20.19	15	62	24.19	19.81	-40.38	0.545
Proctologic surgery	18	59	30.51	10	19	52.63	75.51	-67.80	0.08
Abdominal wall surgery	66	141	46.81	19	28	67.86	44.97	-80.14	<b>0.042</b>
Gastric surgery	9	54	16.67	1	5	20	20	-90.74	0.849

Bold in "P value" means  $p < 0.005$  (statistically significant differences).

**Table 2.** The data collected in the subgroups established for "emergency surgery" are illustrated.

	2019			2020			Increment (%) in global residents participation	Global surgical volume (%)	P value
	Procedures performed by residents	Total procedures	Residents participation (%)	Procedures performed by residents	Total procedures	Residents participation (%)			
<b>Global (Elective and emergency surgery)</b>	985	1868	52.73	764	1203	63.51	20.44	-35.60	<b>0.000</b>
<b>Emergency surgery</b>	306	579	52.85	320	464	68.97	30.49	-19.86	<b>0.000</b>
Appendectomy	132	218	60.55	109	148	73.64	21.63	-32.11	<b>0.01</b>
Cholecystectomy	35	67	52.23	37	55	67.27	28.78	-17.91	0.093
Abdominal wall surgery	17	36	47.22	19	27	70.37	49.02	-25	0.066
Proctologic surgery	21	42	50	24	33	72.73	45.45	-21.42	<b>0.046</b>
Intestinal resection surgery	18	40	45	25	36	69.44	54.32	-10	<b>0.032</b>
Gastric surgery	6	10	60	7	9	77.78	29.63	-10	0.405

Bold in "P value" means  $p < 0.005$  (statistically significant differences).

performed, which represents a decrease in scheduled activity of 42.67%. Residents performed 679 of 1289 procedures in 2019 and 444 of 739 procedures in 2020, representing a 34.6% decrease in the total number of scheduled procedures performed by residents. However, residents went from performing 52.68% of the total elective procedures in 2019 to performing 60.08% in 2020, assuming a relative increase of 14.05% in scheduled surgical activity, reaching statistically significant differences ( $p < 0.05$ ). Excluding outpatient surgery, which accounts for 62.14% of elective procedures, in which resident participation remained constant, (performing 68.91% in 2019 and 66.47% in 2020), residents went from performing 26.02% of scheduled procedures in 2019 to performing 45.57% in 2020.

In the emergency field (Table 2), 579 surgeries were performed in 2019 and 464 surgeries in 2020, with an urgent surgical activity decreasing by 19.86%. Residents operated on 306 of 579 urgent surgeries in 2019 and 320 of 464 urgent surgeries in 2020, increasing the total number of urgent procedures by 4.57%, going from performing 52.85% out all emergency procedures in 2019 to perform 68.97%, which represents a relative increase of 30.49%, also founding statistically significant differences.

Within the elective procedures (Table 1), considering by subgroups, the total number of cholecystectomies performed by residents increased, going from 21 cholecystectomies in 2019 to 27 cholecystectomies in 2020, operating 25.30% of the total scheduled cholecystectomies in 2019 and 56.25% in 2020. In endocrine surgery it occurred in a similar way, performing 6 procedures in 2019, going on to perform 15 procedures in 2020, increasing from 9.84% of total endocrine surgeries in 2019, to 41.67% of endocrine surgeries in 2020, reaching in both cholecystectomies and endocrine surgery statistically significant differences. In breast surgery, despite performing fewer procedures in absolute numbers (57 procedures in 2019 versus 46 procedures in 2020), residents went from intervening in 52.78% of breast surgery procedures in 2019 to intervening in 59.74% of procedures in 2020. In colorectal surgery, residents also performed fewer procedures in total numbers, performing 21 procedures in 2019 and 15 procedures in 2020, but their relative participation increased, going from performing 20.19% of scheduled colorectal surgery procedures in 2019 to performing 24.19% of procedures in 2020. In proctologic surgery, residents also performed fewer procedures in absolute numbers, 18 procedures in 2019 versus 10 procedures in 2020, although their relative participation increased, going from performing 30.51% of elective proctologic procedures in 2019 to intervening 52.63% of procedures in 2020. In abdominal wall surgery, residents also performed fewer scheduled procedures during the pandemic, going from performing 66 surgeries in 2019 to 19 surgeries in 2020. Proportionally, residents went from intervening in 46.8% of scheduled abdominal wall surgeries to intervening 67.85% in 2020, with

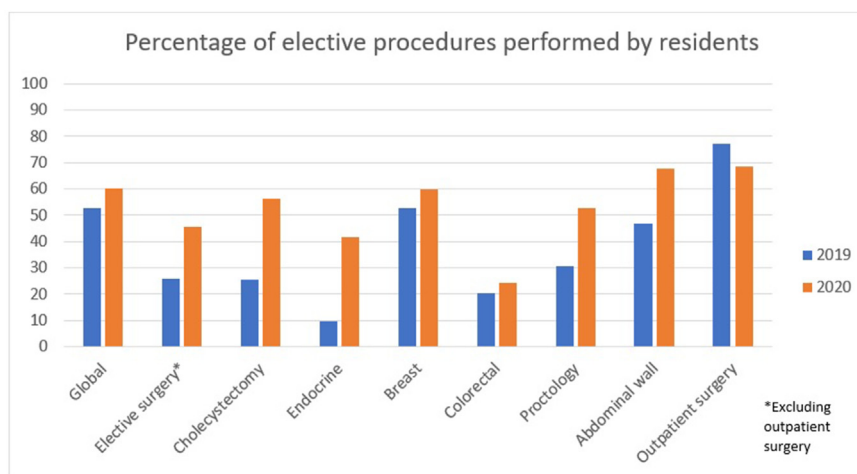
statistically significant differences. Finally, in gastric surgery, residents also performed fewer elective procedures in 2020, dropping from 9 procedures in 2019 to a single procedure in 2020, performing 16.67% of procedures in 2019 and 20% in 2020.

Breaking down emergency surgeries (Table 2) we find in the following subgroups that; residents performed fewer appendectomies during the pandemic (132 appendectomies in 2019 and 109 appendectomies in 2020), but went from operating 60.55% of appendectomies to operate 73.64% of them in 2020, with statistically significant differences. Residents performed more emergency cholecystectomies during the pandemic, 35 cholecystectomies in 2019 and 37 in 2020, with proportional participation also increasing, performing 52.23% of emergency cholecystectomies in 2019 and 67.27% in 2020. As for emergency abdominal wall pathology, residents performed 17 procedures in 2019 and 19 in 2020, going from intervening 47.22% of emergency abdominal wall procedures in 2019 to intervene 70.37% in 2020. In emergency proctology the results are similar; residents performed 21 procedures in 2020 and 24 in 2020, increasing the proportion of surgeries performed by residents, going from 50% in 2019 to performing 72.73% of emergency proctology procedures in 2020, founding statistically significant differences. As for intestine or colonic resection surgery, residents performed 18 procedures in 2019 and 25 in 2020, increasing the proportion of interventions performed by residents in this area from 45% of interventions in 2019 to 69.44% in 2020, also associated with statistically significant differences. Finally, in emergency gastric surgery, the number of procedures performed by residents remained practically constant (6 surgeries performed in 2019 and 7 surgeries in 2020), going from performing 60% of urgent gastric surgeries to intervening 77.78% of them in 2020.

#### 4. Discussion

The coronavirus pandemic has had serious repercussions in teaching area on surgical residents. Multiple studies have already evaluated the impact of the pandemic [3] on issues of work stress, anxiety, future prospects, general knowledge of the specialty or surgical activity, mainly through surveys [4, 5, 6, 7] whose purpose is to assess the subjective perception of residents. The aim of our study has been, on the contrary, to objectively evaluate how the pandemic has affected surgical activity, exclusively in general surgery residents technical skills training, at the in-hospital level.

In the first instance, it is obvious the impact that the pandemic has produced on the global surgical activity in our service, observing a decrease in activity, mainly elective surgery, from 28.70% in breast surgery, which are mainly oncological surgeries (therefore less affected by cancellations), to almost an 80% decrease in elective abdominal wall



**Figure 2.** The proportion of procedures performed by residents is illustrated, over the overall elective surgeries performed in our service in both periods, divided into subgroups.

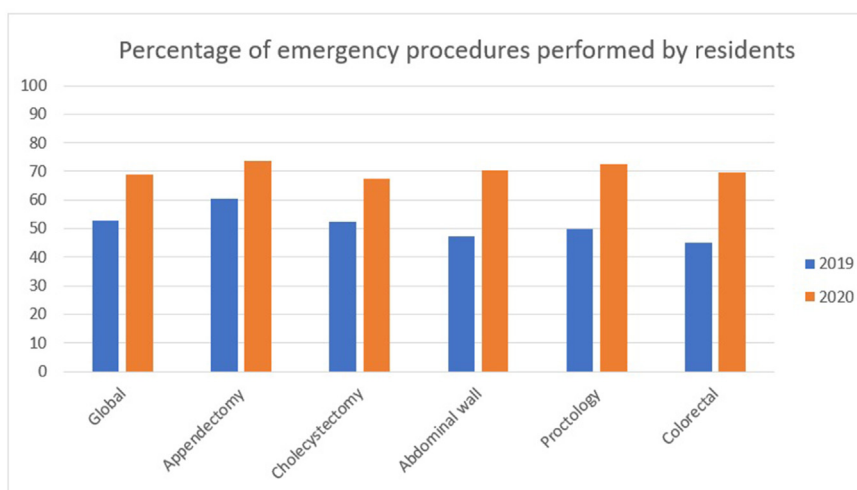
pathology, which shows a huge impact, whose repercussions on issues of morbidity and mortality added by the delay of waiting lists will have to be analyzed in future studies. On the other hand, in emergency surgery, activity has also been affected, although at lower levels, with decreases ranging from 10% to 32.11%. This could be partially explained by multiple causes; for example, a higher rate of conservative management on certain patients, whom under normal circumstances would be subjected to an emergency surgery. The anesthetic contraindication due to respiratory infections by coronavirus that were considered to decisively increase the surgical risk could be one possible explanation. For example, shortage of human or material resources in the surgical area during the critical period might be affected surgical indication too, and finally participating in the reduced number of surgical emergencies performed during this period of pandemic.

In general terms, it can be seen that in several subgroups residents have undergone a smaller number of procedures compared to the previous year, as expected with the data we obtained in terms of overall surgical activity. However, a striking fact is that, in all subgroups, excluding local outpatient surgery, the proportional participation of the resident increased (Figures 2 and 3), reaching practically double in some of them, mainly in elective surgery.

This fact could mean that, despite the significant decrease in the surgical activity of the service, procedures performed by the residents have not been as affected as one might expect given the situation. In fact, in some subgroups, such as elective or emergency cholecystectomies, scheduled endocrine surgery, emergency abdominal wall surgery, proctologic and bowel resection surgery, residents have ended up performing more procedures than in previous years, despite the decline in global activity.

The reason for these results cannot be totally explained by staff restructuring or a redistribution at the department, since, both in elective and urgent surgery, there is always participation of a specialized surgeon, regardless of the presence of a surgical resident. This demonstrates the department's effort to compensate for the deficit of surgical activity and limit the loss of training of residents, who have finally ended up intervening practically the same procedures as the year before the pandemic.

Elective gastric surgery has suffered a very significant reduction, of 90.74%, mainly due to the total interruption of bariatric procedures, which represent a significant volume of gastric surgeries in our center. However, because they are complex procedures and less frequently performed by residents of the department, the percentage of participation of residents has remained constant.



**Figure 3.** The proportion of procedures performed by residents is illustrated, over the total of emergency surgeries performed in our service in both periods, divided into subgroups.

Elective proctologic surgery and abdominal wall surgery, fundamentally benign pathologies, are the subgroups most affected by the pandemic. The reduction in the number of total procedures at a global level was very important, decreasing the activity by 67.8% and 80.14% respectively. In these cases, it is where compensation has been most difficult, and the surgical training of residents has been most affected.

## 5. Conclusion

The pandemic has led to a learning deficit in many areas for surgical residents. We've observed a significant decrease in elective surgical activity at our center. However, the results present a positive outlook and demonstrate the department's effort to maintain standards in teaching, focusing exclusively in technical skills training of the residents.

The relative participation of the resident increased in all the subgroups analyzed, exceeding in absolute numbers the previous year's in cholecystectomies and endocrine surgery. In the emergency area, except for the total number of urgent appendectomies, where the differences are not very relevant, residents have ended up performing more procedures during the pandemic, even in absolute numbers. This shows that, despite the deficit caused in other learning areas, the impact of the pandemic in the field of surgical activity of residents, at least in our center, is probably lesser than expected.

The hardest hit areas in our center were elective proctology, gastric surgery and abdominal wall surgery, which, coincidentally, were the most severely affected by the suspensions of elective surgeries.

## Declarations

### Author contribution statement

Javier García-Quijada García: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Paloma Sanz Muñoz and Miguel Ángel Delgado Millán: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data.

Andrea Salazar Carrasco and Octavio Corral Pazos de Provens: Analyzed and interpreted the data; Wrote the paper.

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### Data availability statement

Data included in article/supp. material/referenced in article.

### Declaration of interest's statement

The authors declare no conflict of interest.

### Additional information

No additional information is available for this paper.

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