General Surgery Training and One Year of COVID-19. What Has Been the Impact on Residents' Operating Room Surgical Activity? A Report From an Italian Academic Hospital

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ABSTRACT

BACKGROUND: In the last year and a half, the COVID-19 pandemic has put great pressure on the healthcare systems of many countries, Italy included, leading to a reorganization of hospital activities and a dramatic reduction in surgical activity. Our study aimed to evaluate, from a quantitative and qualitative perspective, the impact of this reduction on the formation of surgery residents at the Academic Hospital of Udine.

METHODS: We compared the resident's surgical activity during the pandemic year (March 2020–2021) with the one during the pre-pandemic year, declining the surgical procedures by timing, type, and complexity and categorizing the residents by postgraduate year (PGY) and surgical role.

RESULTS: Our analysis highlighted how the main reductions occurred in the elective and medium complexity surgery due to the procrastination of benign pathologies such as hernias, cholelithiasis, and hemorrhoids, which also appeared to be the more frequent cases where the residents are first operators. On the other hand, the residents of the last PGY still maintained a good exposure to neoplasm and high complexity interventions, which are cardinal aspects in the last year of formation.

CONCLUSIONS: These results mostly confirmed the critical points noted by the resident surgeons themselves, highlighting however the specific impact on different PGY and surgical activities, offering a starting point to better understand how to challenge the negative effect that the COVID-19 pandemic has had on the surgical resident formation.

KEYWORDS: COVID-19, surgical resident, teaching hospital, surgical training

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Introduction

The COVID-19 pandemic severely impacted all healthcare activities, particularly surgical residency training.

Italy was the first Western country to be severely affected by COVID-19. The first cases were identified in 2 Chinese tourists and confirmed by the Superior Institute of Health on January 30, 2020. However, the first indigenous case was recognized on February 21, 2020, in Lombardia in the north of Italy.[1]

With the rapid worsening of the pandemic situation, the council of ministers emanated a series of decrees-laws containing restrictive and increasing measures until the definition of the nation lockdown in date 9 March further reinforced with the following decree of 22 March 2020.[2,3] In the following months, there was a phase of relaxation of restrictive measures starting from the end of May and throughout the summer (phase 2) which was followed by a new restrictive phase in October due to a recrudescence of the pandemic situation.[4,5] This period lasted until May 2021 when the vaccine campaign began to have its first effects, with a significant decrease in cases of infections and deaths.

Until the beginning of the pandemic period, the national health system undertook a series of structural actions to respond to the incredible criticality related to the spread of COVID-19. Specifically in the surgical field, in the absence of certain recommendations or guidelines, already in the first weeks after the start of the epidemic were a series of empirical decisions that, corrected and implemented in the following months, have defined the surgical care activities in our surgical department of the Academic Hospital of Udine but in general throughout all the country.

As reported in a previous report, the decisions taken in our department have concerned the safety of surgical staff and patients, the redefinition of care pathways, the indications for surgery, and the management of the operating room.[6]

In general, the main effect of these decisions was a dramatic reduction in surgical activity throughout the first year of the pandemic.

At the same time, the University of Udine, as well as those in the rest of Italy, has suspended all in-person activities, replacing them with remote training. In detail, all university frontal training activities in the medical and health field have been blocked, with a concurrent (sometimes complete) restriction on the attendance of teaching hospitals. Only postgraduates have continued to attend their clinical training programs. Also, from this point of view, these arrangements are extended throughout the first year of the pandemic.

This study aims to evaluate, with quantitative and qualitative methods, the impact of the first year of the pandemic COVID-19 on general surgery residents' training at the Academic Hospital of Udine. The main outcome evaluated is the amount of loss in surgical activity during the first year of the COVID-19 pandemic as compared to the previous year.

Methods

Surgical procedures performed by residents in training at the Unit of general surgery at Udine Hospital in the first year of the pandemic COVID-19 (March 9, 2020, to March 8, 2021) were reviewed using the institutional electronic database. The same was done for the previous year (March 9, 2019, to March 8, 2020) to have a comparison with a temporally similar period but representative of the pre-pandemic phase. ln Italy, until this year, the residency training program was structured over 5 years.

Table 1. Comparison of surgical activity and its features (type of operator, admission, pathology, and complexity) between the pre-COVID and COVID period for all the residents.

All PGYs	Pre-COVID-19 Mean ± SD	COVID-19 Mean ± SD	*P* *t*-test
Number of procedures	347.6 (97.7)	144.6 (60.6)	.0001
First operator	100.6 (29.2)	32.4 (15.2)	.0001
Second operator	154.1 (41.0)	64.6 (30.2)	.0001
Other operator	91.4 (54.0)	47.6 (23.8)	.0125
Elective procedures	295.1 (86.5)	118.3 (49.1)	.0001
Urgency procedures	45.2 (21.4)	26.4 (16.0)	.0143
Benign pathology	204.8 (75.1)	66.5 (27.8)	.0001
Malign pathology	142.6 (69.1)	78.1 (36.8)	.0059
High complexity	71.9 (29.0)	35.8 (12.7)	.0005
Medium complexity	125.4 (36.6)	52.7 (26.1)	.0001
Low complexity	150.1 (53.6)	46.9 (26.5)	.0001

PGY: postgraduate year.

Each PGY corresponds to a job description that identifies the degree of autonomy and the type of procedures that the trainee surgeon can perform. The autonomy and complexity of procedures increase each year, ensuring a high degree of security.[7] In our program, the first PGY is mainly of clinical type regarding the management of the surgical patient while in PGY 3 and 4, the residents carry out their clinical/surgical activity at the different hospitals of the regional network. In the first pandemic year, this was disregarded due to the inability to move from one hospital to another.

To have homogeneous data, we considered, as inclusion criteria, the total surgical activity carried out by residents of all years in the 2 periods analyzed and then that performed only by residents of PGYs 2 and 5, excluding that referred to PGYs 1 and 3-4 for the reasons mentioned above. Surgical procedures were declined by timing (election or emergency), type of pathology (benign or malignant), and complexity (low, medium, and high). The latter was described using the classification of Gelmini-Saviano, nationally referenced for general surgery residency programs.[8] The same surgical procedure was attributed to all residents present in the surgical team about their role. Residents were categorized according to the role they played in each procedure: first operator (performed the procedure), second operator (helped the attending or another resident), and another operator (scrubbed on the operating table as a third or fourth surgeon).

As regards the ethical aspects, all methods were carried out by the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. We specify that this study did not require our Institutional Review Board approval or patient informed consent because no patient data has been collected and it has been conducted as an internal analysis of the General Surgery Department and Simulation Center performance.

Statistical analysis

Data collected from institutional databases were included in an Excel spreadsheet anonymously and in aggregate form. All analyses were performed with the statistical software SPSS, V.20. To describe the surgery training activity of the residents before and during the period of the COVID-19 emergency, and mean and standard deviations were calculated for each variable under study. Subsequently, the *t*-test was used to compare the variables' averages of the 2 periods (pre- and post-COVID-19). Statistical significance was set at a P value $\leq .05$.

Results

In the pandemic period examined, the trainee physicians present in the general surgery unit of the Academic Hospital of Udine were assigned to 2281 procedures compared with

5248 in the previous year (in a total of 1545 vs 989 surgical procedures performed in our department, respectively). The residents present were a total of 14 in the pandemic restriction year and 15 in the index year, while in the 2 PGYs (2 and 5) considered there were 4 for each year in both periods. The comparison of the activity performed by all residents present in the COVID-19 and Pre-COVID-19 period, declined by several interventions, the surgical role of the individual resident, type of intervention, type of pathology, and complexity of the procedure is shown in Table 1. The same data for the 2 years considered, PGY 2 and 5, are collected in Tables 2 and 3, respectively. We have not considered in differentiating between open and minimally invasive (MIS) procedures because of the related high risk of bias due to the large variety of surgical activities included in the study.

Discussion

This study aims to estimate the impact of the first year of the pandemic COVID-19 on the surgical activity of general surgery residents at the Academic Hospital of Udine. As major limitations, we have to report the impossibility to perform a sample size/power analysis in this study and the still present individual variability in each resident surgical activity.

The drastic decrease in hospitalizations, the cancellation of elective nonurgent cases, and the simultaneous reduction of patients presenting in an emergency are typical aspects of the surgical field. These factors, in the first year of the COVID-19 pandemic, have negatively and significantly affected the surgical activity of trainees. This evidence confirms the data of a national survey, where respectively 61% and 34% of physicians in postgraduate training declared a significant reduction or the complete interruption of surgical activities.[9] Until now, this trend has been mainly investigated qualitatively, without really quantifying its impact on residents' surgical activity.[10–13] Many of the contributors also privileged speculation regarding the impact of the pandemic on the mental state of trainees by remarking on their state of anxiety, apprehension at being infected, or failure to obtain the necessary skills for acquiring a future job position.[9,14,15]

Regarding the complexity of the interventions, in this study, the greatest reduction has involved the ones of low and medium complexity. These interventions have been usually related to benign pathologies (hernias, cholelithiasis, and hemorrhoids) and have been more frequent in cases where the resident has been the first operator. The negative impact of the pandemic on the exposure to surgery of benign pathologies of trainees is one of the critical points noted by the resident surgeons themselves.[16]

The continuous reduction of surgical cases, related to the COVID-19 emergency, should be a starting point of reflection on how to improve the surgical learning curve of residents. This would be fundamental to ensure their required degree of autonomy at the end of the program. Chief residents who came out in the pandemic year had already reached the number of surgeries needed to finish the program, but this would be more complex for early-year trainers who do not yet have a large case mix. However, it is interesting to observe that the residents of the last year of specialty training still maintained a good exposure (not statistically significant compared to the previous year) to

Table 2. Comparison of surgical activity and its features (type of operator, admission, pathology, and complexity) between the pre-COVID and COVID period for PGY 2 residents.

PGY 2	Pre-COVID-19 Mean ± SD	COVID-19 Mean ± SD	*P* *t*-test
Number of procedures	462.3 (16.5)	209.0 (12.4)	.0001
First operator	110.0 (7.0)	43.5 (9.9)	.0001
Second operator	197.8 (14.3)	95.8 (7.4)	.0001
Other operator	154.8 (7.6)	69.8 (4.3)	.0001
Elective procedures	397.5 (18.6)	168.5 (11.8)	.0001
Urgency procedures	64.3 (4.1)	40.5 (5.1)	.0004
Benign pathology	245.8 (23.1)	90.5 (13.7)	.0001
Malign pathology	216.0 (12.5)	118.5 (17.9)	.0002
High complexity	96.0 (11.2)	36.0 (9.1)	.0002
Medium complexity	169.8 (13.5)	76.8 (7.0)	.0001
Low complexity	196.0 (24.5)	63.8 (37.9)	.0019

PGY: postgraduate year.

Table 3. Comparison of surgical activity and its features (type of operator, admission, pathology, and complexity) between the pre-COVID and COVID period for PGY 5 residents.

PGY 5	Pre-COVID-19 Mean ± SD	COVID-19 Mean ± SD	*P* *t*-test
Number of procedures	295.3 (93.7)	87.0 (50.1)	.0132
First operator	116.0 (48.5)	28.8 (21.3)	.0290
Second operator	141.5 (50.4)	36.0 (21.2)	.0179
Other operator	38.0 (9.4)	22.3 (11.8)	.0849
Elective procedures	229.8 (90.2)	76.3 (48.2)	.0335
Urgency procedures	40.5 (7.0)	10.8 (6.4)	.0008
Benign pathology	232.5 (88.1)	40.0 (25.9)	.0180
Malign pathology	62.8 (27.9)	47.0 (28.5)	.4599
High complexity	45.0 (20.4)	27.0 (15.3)	.2116
Medium complexity	104.0 (29.5)	26.8 (18.5)	.0066
Low complexity	146.3 (71.2)	33.3 (24.7)	.0595

PGY: postgraduate year.

neoplasm and high complexity interventions, which are the cardinal aspects of this year's resident training. This underlined the intent on the part of the academic body in seeking to specialize surgeons with the necessary skills to acquire a working position, even at the risk of a further reduction of younger residents' activity. All of this is in the hope of a normalization of the health care system in the coming months and thus a recovery of the activities not done by the junior residents of the early years.

In the absence of guidelines or specific recommendations regarding how to reorganize postgraduate surgical education, efforts have been made to maintain a high quality of surgical education while respecting the safety of learners, educators, and patients.[17]

The negative effect on postgraduate surgical training is not only related to the reduction of surgical activity but also the reduction of working hours with significant decreases in clinical activity in the department and ambulatory. In our department, the residents have been involved in a weekly schedule with a reduction of about 30% of their working time, in agreement with the academic staff, motivated by the reduction of activity and to reduce their exposure to COVID-19. At the same time, the possibility of rotation in different hospitals was canceled. Also, the limitation of access to operating rooms to only essential staff, in particular for the trainees, was a further limitation to attending, observing, and assisting.[18] The suspension of face-to-face meetings, lectures, and scientific congresses has been quick, at least in part, replaced by the use of online educational meetings on virtual platforms (conferences, webinars, and journal clubs) as already described in other surgical disciplines.[19,20] Certainly, a modality that has revealed many positive potentials and that can be useful also in the future.[21]

Regarding possible bias in this study, we have to mention the difficulty in comparing the surgical training of 2 subsequent PGYs due to the differences in resident group number and due to the subsequent variation in the daily organization of the activities. However, this confounding factor has been minimized by selecting 2 index PGYs with almost the same characteristics in the 2 years. Another aspect is that our academic context cannot be perfectly compared to other surgical schools (in terms of the number of residents, type of access to the OR, timetable organization, etc), given the fact that each academic hospital has its particularities.

Conversely, in the next future, training programs will need to take into account the reduced acquisition of skills by physicians in training due to the training deficit caused by pandemic restrictions, modifying existing curricula, and implementing operating room activity to maintain the high quality of training programs.[22,23]

An alternative method of training, normally complementary to the activity in the operating room, is the use of simulation that, in our institution, we have implemented during the pandemic period in all surgical training programs.[24] Simulation in surgery is very useful in particular for novices for the acquisition of basic skills for both traditional and laparoscopic surgery. In this regard, as it has been well documented, in the first year of the pandemic there was a reduction of laparoscopic surgery both as a consequence of the cancellation of many cases of benign pathology but also because, especially at the beginning, it was considered at high risk due to the possible contamination by aerosols.[6] This has resulted in additional difficulty for residents to build up a case mix in minimally invasive surgery.

The training activity in the cadaver lab, when present, is valuable training support for residents with advanced skills. In these months of the pandemic, at the simulation center of our university, the possibility to develop an activity of preoperative surgical planning using software with 3D reconstructions from CT and MRI and 3D printing has increased. On one hand, it's an activity with a strong educational result while on the other hand, It has a safety impact on the patient. Certainly, the pandemic period has increased the awareness of the role that technology, teleconferences, telemedicine but also augmented reality, and mixed reality, can have in the immediate and future in surgical training, especially in case of reduction of activity or you have to observe rules of distancing.[25,26] Interesting in this regard is the concept of surgical kits, simple trainers to use at home to develop or maintain some basic skills for junior residents, or the development of operating room simulation platforms always accessible from home to progress more advanced skills.[27,28] In our Institution, we have concentrated our work in re-establishing quick and safe access to our Simulation Center, in order to provide a continuous standard to the training program.[29]

Conclusion

The first year of the COVID-19 pandemic has certainly had an important and negative impact on the surgical activity of general surgery residents, both from a qualitative and a quantitative point of view. Since it was impossible to give a univocal answer at the national and international level to this situation, the single academic boards have tried to ensure their valid training path despite the large reduction of surgery cases and the variability of the pathologies to be treated. Ensuring attendance on the ward and in the operating room, even if with significant reductions in hours, raising the level of safety for residents to reduce contaminations, and introducing new forms of learning such as simulation and activation of distance education platforms have generally been the common steps in the different academic contexts. Shortly, hoping for a return to normality supported by vaccination plans, a revision of postgraduate training paths shared among the various scientific societies of reference is probably desirable. The use and enhancement of new training strategies based on the use of new technologies, whose introduction has been accelerated by the critical issues related to the pandemic, cannot be abandoned for a return to

the past. Simulation, smart education, web platforms, and augmented and immersive reality will not be able to replace learning in the operating room but will be complementary to it in a new postgraduate general surgery training curriculum.

Abbreviations

PGY: postgraduate year
CT: computed tomography
MRI: magnetic resonance imaging

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Author's Contribution

VB, PPB, DM, and RQ have provided the same contribution in terms of conceptualization, data curation, data analysis, investigation, methodology, writing, and reviewing. All authors have read and approved the manuscript.

Ethics Approval and Consent to Participate

This study did not require our Institutional Review Board approval or patient consent because no patient data has been collected and it has been conducted as an internal analysis of the General Surgery Department and Simulation Center performance. All methods were carried out by relevant guidelines and regulations.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets generated during and/or analyzed during the current study are available on specific and motivated request to the corresponding author and will be provided from the G2 Clinico® repository by Insiel® (no permanent online link available).

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