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Impact of COVID-19 pandemic on emergency and elective surgery. A retrospective observational analysis in Apulia, southern Italy

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Parole chiave: SARS-CoV-2; assistenza sanitaria; procedure chirurgiche; standard di cura; gestione; risorse

Abstract

Introduction. *In Italy, at the beginning of the COVID19 pandemic, only emergency and life-saving elective surgical procedures were allowed with obvious limitations in terms of numbers of operable cases. The aim of our study is to evaluate the performance of surgical activities by Apulian healthcare facilities (Southern Italy) under the pandemic emergency pressure.*
Methods. *The surgical procedures in study were identified via the Apulian regional archive of hospital discharge forms. We used the ICD9 codes in order to define the elective and urgency surgeries in analysis, and we extended our search to all procedures performed from 2019 to 2021.*
Results. *The number of all procedures decreased from 2019 to 2020; the reduction was higher for elective surgery (-43.7%) than urgency surgery (-15.5%). In 2021, an increase compared to 2020 was recorded for all procedures; nevertheless, elective surgeries registered a further slightly decrease compared to 2019 (-12.4%), while a slightly increase was observed for urgency surgeries (+3.5%). No particular variation was observed considering sex and age at surgery of the patients, and days of hospitalization from 2019 to 2021.*
Conclusions. *The impact of COVID19 on Apulian regional health system has been extremely shocked and has required the implementation of strategies aimed at containing the infection and guaranteeing health services as far as possible. A new paradigm of hospital care for SARS-COV-2 patients in the post-emergency phase in Italy is needed, in order to optimize the resources available and to guarantee high standards of quality and efficiency for citizens.*

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Introduction

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) was first identified in late 2019 in the city of Wuhan (Hubei province of China). Subsequently, the World Health Organization (WHO) declared that the SARS-CoV-2 disease (COVID-19) had reached a pandemic state on March 11th, 2020 (1).

In Italy, at the beginning of the pandemic, hospital facilities were strengthened by applying the Italian Ministry of Health recommendations for COVID-19 patients, to assist the increasing numbers of affected patients who needed intensive support therapy (2). Nonurgent procedures were stopped and delayed to reallocate the healthcare personnel (especially nurses and anesthesiologists) to deal with the COVID-19 emergency situation. This measure freed ventilators and other instruments and converted surgical theatres into additional intensive care unit beds as needed; several surgical departments were closed and converted into COVID-19 medical wards. Moreover, surgeons were requested to help medical personnel in the COVID-19 elective and emergency wards. In this setting, only emergency and life-saving elective surgical procedures were allowed with obvious limitations in terms of numbers of operable cases (2). A 2020 survey (3) investigated the current practice of emergency surgery in Italy during the first weeks of the pandemic; 71 Italian general surgery units practicing emergency surgery were interviewed, showing that 74% of surgeons operated only on urgent cases, and the number of interventions significantly dropped, with over 40% of non-traumatic abdominal emergency cases that had an unusual delayed treatment.

Apulia (Southern Italy, 4,000,000 inhabitants) is the second biggest Region in Southern Italy. At the start of the pandemic, the hospitals' framework was rearranged and some "Covid Hospitals", entirely dedicated to SARS-CoV-2-positive patients, were designed. In particular, the total number of beds dedicated to COVID patients was 3,062, with 263 beds in COVID intensive care units. In other hospitals, the wards were separated into areas dedicated to SARS-CoV-2-positive patients and areas reserved for SARS-CoV-2-negative subjects. These sectors were separated from one another either functionally or physically. Most anesthesiologists and surgeons were reallocated in support of clinical and intensive-care activities, and several surgical wards and surgical equipment were used in support of COVID19 patients' treatment. Therefore, surgical activities were greatly reduced, guaranteeing only emergency operations and life-saving elective surgical procedures. In 2021, additional COVID-dedicated settings were obtained in the form of emergency facilities, often located in fair centers, such as the so-called Large Emergency Unit in Bari's Eastern Fair exhibition space (4). The hiring of new staff, the reorganization of spaces and healthcare personnel, and the start of the vaccination campaign have allowed for a normalization of surgical activities, with the aim of a return to pre-pandemic performances.

In this context, our study aims to evaluate the performance of surgical activities of Apulian hospital facilities under the pandemic emergency pressure. We compared four elective and four emergency surgeries during three years (2019, 2020, and 2021), to define the trend of procedures and the characteristics of the patients in the pre- and post-pandemic period.

Material and Methods

This is a retrospective observational study.

The surgical procedures in study were identified via the procedures analyzed by the Italian National Program Outcomes 2022 (5). The Apulian regional archive of hospital discharge forms, an online database containing all information regarding hospital and inpatient procedures carried out in Apulian hospital facilities, was used to define the procedures; we used the ICD9 codes (6) in order to describe four elective and four emergency surgeries as follow:

• Elective surgery

- Prostatectomy (ICD9 codes: 60.21, 60.29, 60.62, 60.69, 60.99, 60.5)
- Thyroidectomy (ICD9 codes: 06.2, 06.31, 06.39, 06.4, 06.50, 06.51, 06.52, 06.98)
- Cardiac valvuloplasty (ICD9 codes: 35.11, 35.12, 35.14, 35.21, 35.22, 35.23, 35.24, 35.26, 35.28, 96)
- Laparoscopic cholecystectomy (ICD9 codes: 51.22, 51.23)

• Emergency surgery

- Appendicectomy (ICD9 code: 47.01)
- Crude reduction of fracture of the femur (ICD9 codes: 79.25, 79.35)
- Percutaneous transluminal coronary angioplasty (ICD9 code: 00.66)
- Endovascular removal of obstruction from head and neck vessels (ICD9 code: 39.74).

We extended our search to all procedures performed from 2019 to 2021. The selection of these surgical interventions is not random; rather, it stems from a

preliminary analysis of the pre-pandemic years, where they emerged as the most numerous and representative procedures within their respective categories.

The final dataset was created as an Excel spreadsheet that included information on sex, age at surgery, and days of hospitalization of patients. An anonymized data analysis was performed using STATA MP17 software.

Continuous variables are reported as the mean ± standard deviation and range, and categorical variables as proportions. The hospitalization rate was defined as the number of hospitalizations divided by the Apulian population, extracted (only the male population was considered for prostatectomy) from the archives of the National Institute of Statistics (ISTAT). The t-student's test for independent data was used to compare continuous variables between the years under analysis, while the chi-square test was employed to compare categorical variables across the same time frame. A p-value < 0.05 was considered statistically significant for all tests.

Results

Table 1 describes the trend of elective and emergency procedures from 2019 to 2021; for all procedures, a decrease from 2019 to 2020 was observed, more marked for elective surgery (on average - 43.7%) than emergency surgery (on average - 15.5%). In 2021, an increase compared to 2020 was recorded for all procedures; nevertheless, elective surgeries registered a further slightly decrease compared to 2019 (-12.4%), while a slightly increase was observed for emergency surgeries (+3.5%).

Figures 1 and 2 describe the hospitalization rates per semester; the greatest rate fluctuations are observed in the second semester for elective procedures, while the first semesters seem to impact more on emergency surgery. The statistical comparison of the hospitalization rates between years under analysis is described in Table 2.

The characteristics of the patients undergoing surgery are described in Table 3. No statistically

Table 1 - Number of procedures and percentage change between the years under analysis.

Procedure	2019	2020	2021	Δ% 2020-2019	Δ% 2021-2020	Δ% 2021-2019
Elective surgery						
Prostatectomy	3,723	2,057	3,227	-44.7%	56.9%	-13.3%
Thyroidectomy	1,885	1,255	1,637	-33.4%	30.4%	-13.2%
Cardiac valvuloplasty	1,711	794	1,636	-53.6%	106.0%	-4.4%
Laparoscopic cholecystectomy	5,213	2,972	4,243	-43.0%	42.8%	-18.6%
Emergency surgery						
Appendicectomy	1,373	1,060	1,303	-22.8%	22.9%	-5.1%
Crude reduction of fracture of the femur	3,923	3,477	3,970	-11.4%	14.2%	1.2%
Percutaneous transluminal coronary angioplasty	5,475	3,980	5,044	-27.3%	26.7%	-7.9%
Endovascular removal of obstruction from head and neck vessels	162	161	204	-0.6%	26.7%	25.9%

Table 2 - Statistical comparison of hospitalization rates between years.

Procedure	2019 vs. 2020	2019 vs. 2021	2020 vs. 2021
Elective surgery			
Prostatectomy	<0.0001	<0.0001	0.526
Thyroidectomy	0.001	0.890	0.007
Cardiac valvuloplasty	<0.0001	<0.0001	0.107
Laparoscopic cholecystectomy	<0.0001	<0.0001	0.962
Emergency surgery			
Appendicectomy	0.007	0.207	0.156
Crude reduction of fracture of the femur	0.008	0.021	0.737
Percutaneous transluminal coronary angioplasty	0.062	0.012	0.521
Endovascular removal of obstruction from head and neck vessels	<0.0001	0.510	0.224

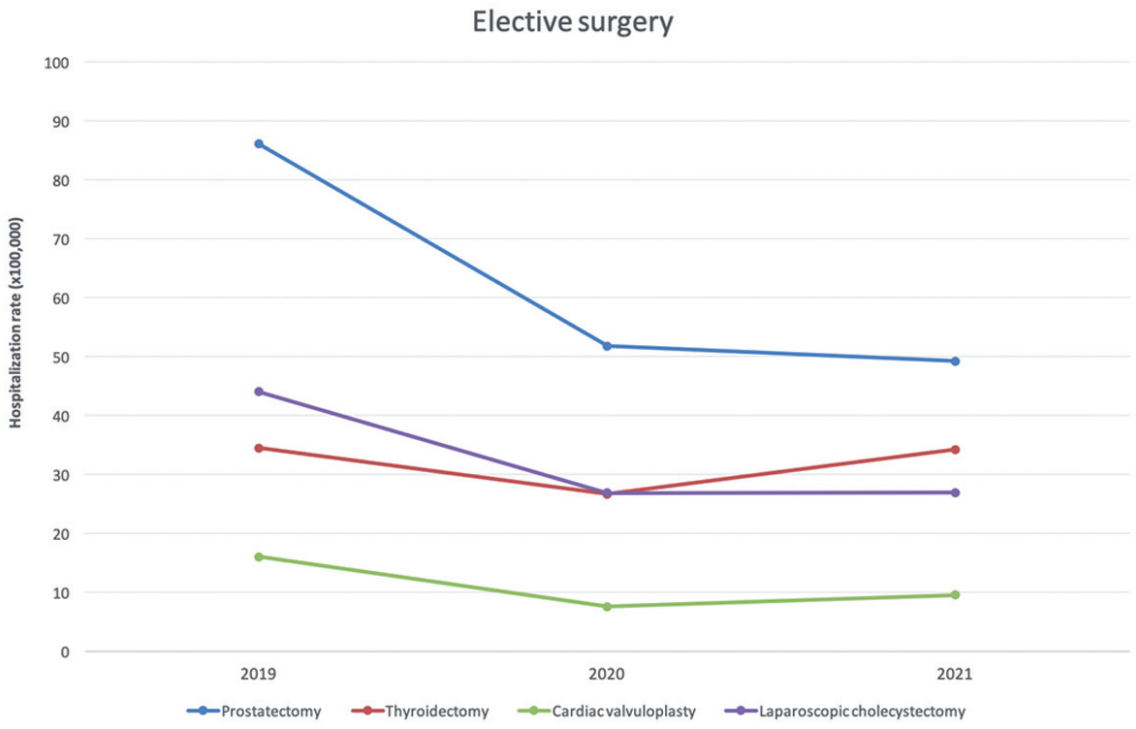

Figure 1 - Hospitalization rates for elective surgery. Years 2019-2021.

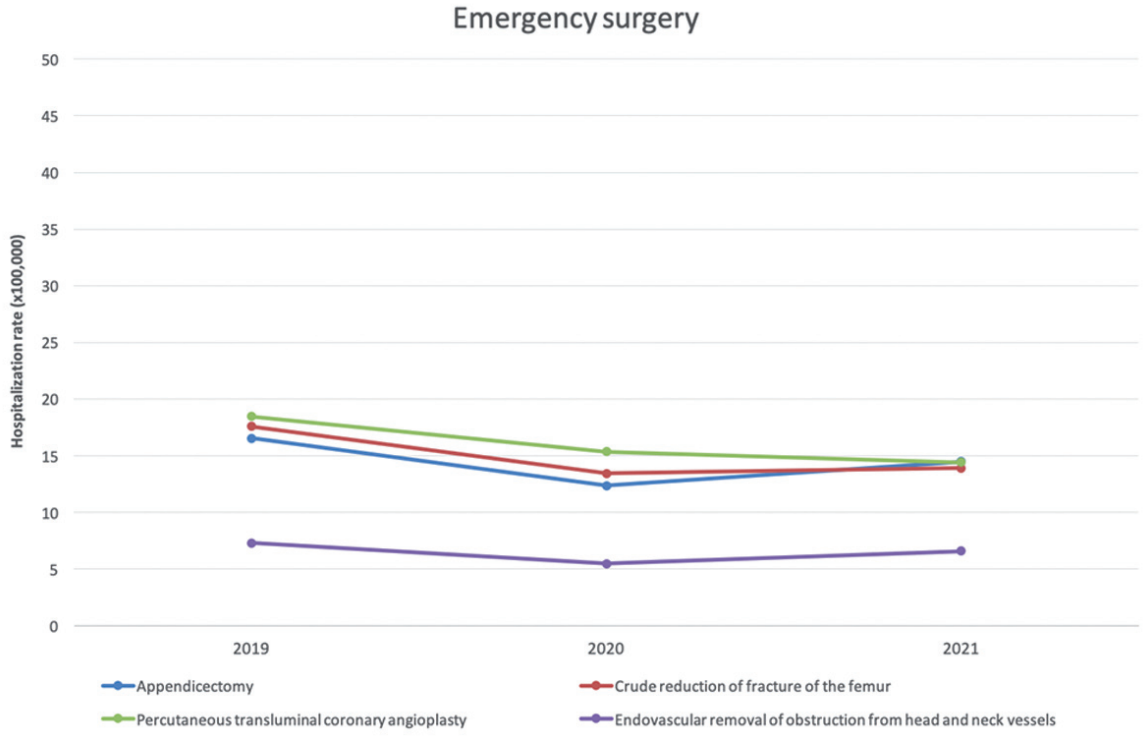

Figure 2 - Hospitalization rates for emergency surgery. Years 2019-2021.

Table 3 - Characteristics of the patients undergoing surgery. Years 2019-2021.

Procedure		Male sex; n (%)			Age at surgery mean±SD			Days of hospitalization mean±SD		
		2019	2020	2021	2019	2020	2021	2019	2020	2021
Emergency	Appendicectomy	750 (54.6)	627 (59.2)	651 (53.6)	30.6±19.4 (3-94)	28.5±19.8 (2-89)	33.7±20.0 (2-98)	5.7±3.1 (0-36)	6.3±4.0 (1-40)	5.0±3.2 (0-50)
	Crude reduction of fracture of the femur	1,037 (26.4)	912 (26.2)	1,019 (26.1)	79.4±14.0 (0-106)	79.5±15.0 (4-103)	79.3±15.0 (5-106)	9.7±5.8 (1-69)	8.5±5.1 (1-52)	9.3±5.9 (0-115)
	Percutaneous transluminal coronary angioplasty	4,117 (75.2)	2,998 (75.3)	3,861 (76.6)	68.6±12.3 (34-94)	68.3±12.0 (16-101)	67.8±12.2 (26-99)	8.1±7.0 (0-122)	7.6±6.0 (0-54)	7.9±6.5 (0-102)
	Endovascular removal of obstruction from head and neck vessels	60 (37.0)	72 (44.7)	89 (43.6)	74.2±13.0 (37-93)	72.2±10.9 (47-88)	74.3±12.0 (24-96)	12.1±8.5 (1-37)	16.3±11.7 (0-65)	13.6±24.8 (0-339)
Elective	Prostatectomy	3,723 (100.0)	2,057 (100.0)	3,227 (100.0)	67.7±8.2 (40-94)	68.3±7.8 (25-87)	68.1±8.1 (24-95)	4.9±2.2 (1-28)	4.7±3.0 (1-43)	5.6±3.3 (0-58)
	Thyroidectomy	450 (23.9)	304 (24.2)	396 (24.4)	52.6±14.2 (12-84)	51.6±13.7 (18-90)	53.1±14.1 (12-87)	3.5±6.4 (0-146)	3.4±3.0 (0-38)	3.6±3.6 (0-92)
	Cardiac valvuloplasty	946 (55.3)	415 (52.3)	926 (56.6)	70.1±12.1 (14-92)	68.2±11.5 (24-88)	71.0±12.3 (17-97)	14.8±11.7 (1-124)	13.3±6.9 (3-43)	14.4±11.3 (1-160)
	Laparoscopic cholecystectomy	1,968 (37.8)	1,147 (38.6)	1,649 (38.9)	56.7±15.0 (6-93)	57.6±13.9 (5-92)	56.2±14.6 (12-94)	4.0±5.3 (1-70)	4.1±5.3 (1-44)	3.5±3.6 (0-57)

significant variations were observed considering sex, age at surgery, and days of hospitalization from 2019 to 2021 ($p>0.05$).

Conclusions

The results of our survey show how the measures implemented by Apulian Health Government to deal with COVID19 were able to guarantee urgent surgical procedures even in the most critical phases of the pandemic. This evidence is confirmed by other experiences in Italy, as reported in the literature. Bonalumi et al. (7) described the re-organization of cardiovascular surgery activities in Lombardy (Northern Italy, 10,000,000 inhabitants); a hub-and-spoke system was introduced that efficiently safeguarded access to the heart and vascular surgical services for patients who required non-deferrable, urgent and emergency treatments. Nevertheless, a slight decrease was observed in 2021 for appendicectomy and percutaneous transluminal coronary angioplasty; the various population lockdowns required to restrain the virus may have reduced the injuries and traumatic accidents, as well as the excess of mortality due to COVID19 may have reduced the number of at-risk subjects for cardiac and neurology stroke.

As expected, a decrease in the elective procedures was observed; this has also been described by a 2020 Italian survey (2), that was designed to elucidate the impact of the first 5 weeks of COVID-19 emergency on elective surgery for oncological disease in Italy; the questionnaire was sent to 54 oncological surgical Units from 36 Italian hospitals, showing that these Units reduced their hospital beds, surgical activities, had less availability of intensive care unit beds, and had a reduction of outpatient clinics. The number of surgical procedures decreased, ranging from a median number of 3.8 per week before COVID-19 to 2.6 later on. Similar evidence was observed in a 2022 retrospective study (8); the Authors investigated the monthly number of hospitalizations for colorectal and breast cancers in Abruzzo in the year 2020, comparing them with the admissions that occurred in the years 2018-2019. A reduction of elective oncological surgery for colorectal cancer by 35.71% and for breast cancer by 10.36% was found. In 2021 we observed an increase in elective procedures, but a return to pre-pandemic levels was observed only for valvuloplasty surgery; the reason could have been that, in addition, the pandemic has also led to the reduction of other services, including instrumental examinations and

investigations for early diagnosis. Indeed, several experiences in the literature reported a decrease in oncological activities (9), and diagnostic procedures (10). Therefore, an underdiagnosis of prostate, thyroid, and gallbladder diseases could explain the decrease in related surgical procedures. On the other hand, Valnieri et al. (11) reported prostatectomies and cholecystectomies among the elective procedures more likely to be inappropriate; in this light, their decrease may be also interpreted as a reorganization by surgical wards to manage procedures with high potential for inappropriateness. Specific investigations are needed to clarify this point.

The strength of our study is the analysis of three years and the comparison between the pre- and post-pandemic period; moreover, the comparison between emergency and elective procedures allows us to evaluate the response of the Regional Health Service to the adaptation of the services and resources available due to the pandemic situation. The main limitation is the restricted choice of the surgical interventions selected, although other studies in the literature investigated our topic for comparable procedures (5, 11-13). Moreover, the results of Apulia are not generalizable to all Italian Regions; nevertheless, Apulia is the second most populated region in southern Italy, and therefore its management impacts a large portion of the population of southern Italy, including at least the territories of Basilicata (Southern Italy, 560,000 inhabitants), Molise (Southern Italy, 300,000 inhabitants), and part of Campania (Southern Italy, 5,800,000 inhabitants) and Calabria (Southern Italy, 2,000,000 inhabitants). Future studies will evaluate the trend of surgical procedures also in 2022 and the years to come, to evaluate the strategies implemented to guarantee surgical services in the context of circulation of SARS-CoV-2.

Currently, a new paradigm of hospital care for SARS-COV-2 patients in the post-emergency phase in Italy has been proposed, with the distinction of COVID19 patients into: (i) hospitalized *because of* COVID19 (patients with clinical, laboratory, and radiographic signs of lower airway involvement); and: (ii) hospitalized *with* COVID19 (patients without clinical, radiographic and laboratory signs of lung involvement, whose hospitalization was determined by other causes); a new organizational model that approaches hospitalized patients according to their COVID status is required, guaranteeing the best possible functioning of the hospital supply (4). Its implementation at the Bari Policlinico General-University hospital, the biggest hospital in Apulia, allowed more rational management of COVID19 patients and available resources.

One of the next challenges for public health institutions will be to manage one of the consequences of the decreased number of services offered during the pandemic emergency phase, i.e. the recovery of the waiting lists that have arisen. In this light, the Apulian Region Government in July 2022 provided for a budget change to allocate a waiting list disposal plan through the funding of shifts in additional performance to the health personnel of public and private hospital facilities (14). The results of this regulation will be seen in 2023 and the following years, but the real challenge will be to reorganize the services to optimize the resources available and to guarantee high standards of quality and efficiency for the citizens.

The study did not receive any found.
The Authors have no competing interests to declare.
The manuscript has not been presented at any meeting.

Riassunto

Impatto della pandemia COVID-19 sulla chirurgia d'urgenza e programmata. Un'analisi osservazionale retrospettiva in Puglia, Italia meridionale

Introduzione. In Italia, all'inizio della pandemia di COVID-19, sono state consentite solo procedure chirurgiche di emergenza e salvavita, con ovvie limitazioni in termini di numeri di casi operabili. L'obiettivo del nostro studio è valutare le prestazioni chirurgiche nelle strutture sanitarie pugliesi (Italia meridionale) sotto la pressione dell'emergenza pandemica.

Metodi. Le procedure chirurgiche in studio sono state identificate tramite l'archivio regionale pugliese delle schede di dimissione ospedaliera (SDO). Sono stati utilizzati i codici ICD9 per definire le chirurgie programmate e d'urgenza in analisi, estendendo la nostra ricerca a tutte le procedure effettuate dal 2019 al 2021.

Risultati. Il numero delle procedure in analisi è diminuito dal 2019 al 2020; la riduzione è stata maggiore per la chirurgia programmata (-43,7%) rispetto a quella d'urgenza (-15,5%). Nel 2021 è stato registrato un aumento rispetto al 2020 per tutte le procedure; tuttavia, gli interventi programmati hanno registrato un ulteriore lieve calo rispetto al 2019 (-12,4%), mentre si è osservato un leggero aumento per gli interventi in urgenza (+3,5%). Non è stata osservata alcuna variazione significativa considerando sesso e età al momento dell'intervento dei pazienti e i giorni di degenza dal 2019 al 2021.

Conclusioni. L'impatto del COVID-19 sul sistema sanitario regionale pugliese è stato estremamente rilevante e ha richiesto l'attuazione di strategie finalizzate a contenere l'infezione e garantire i servizi sanitari. È necessario un nuovo paradigma di assistenza ospedaliera per i pazienti con SARS-COV-2 nella fase post-emergenza in Italia, al fine di ottimizzare le risorse disponibili e garantire elevati standard di qualità ed efficienza per i cittadini.

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