

ORIGINAL ARTICLE

Emergency surgery in the time of Coronavirus: the pandemic effect

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ABSTRACT

BACKGROUND: The COVID-19 epidemic became a challenge for Emergency Departments (ED) and a remarkable reduction in surgical emergencies has been widely noticed. The aim of the present study was to evaluate the impact of the pandemic period in the need of surgical emergencies.

METHODS: Between January 1, and May 31, 2020 all the consecutive general surgery emergencies performed by the Unit Hospital Emergency Surgery of the Careggi University (Florence, Italy) were prospectively recorded and compared to the same period of 2019. Demographic and clinical data were recorded and analyzed.

RESULTS: The number of surgical procedures decreased only in the month of March 2020 (compared to 2019), while in April the total number of emergency surgical procedures was similar. Only appendectomy, complicated hernia repair and colonic resection were significantly reduced (40%, 48% and 33% respectively). The number of small intestine excision, cholecystectomy and lysis of peritoneal adhesions remained stable throughout the entire period. No statistically significant differences were found considering age, sex, Emergency Surgery Score, mortality, ICU postoperative admission and time between admission and surgery, even when analyzed with multivariate analysis for every single surgical procedure, suggesting a comparable disease severity and comorbidity patterns. Mortality in COVID patients was 25%, compared to 7% of no-covid patients.

CONCLUSIONS: The COVID-19 pandemic has caused major changes in daily clinical practice, especially in areas such as Emergency. This has led to a temporary reduction and changes in the flow of patients to the emergency room, with implications also for emergency surgical activities.

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KEY WORDS: Emergency service, hospital; Surgical procedures, operative; COVID-19; Coronavirus; Pandemics; Appendectomy.

Since its detection in China in December 2019,¹ severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infection rapidly spread throughout the world, declared as a global health emergency by the WHO.

The Italian first case has been reported in Northern Italy on February 21 2020² starting a rapid expansion throughout the country.

On March 1, the confirmed positive cases were already more than 1600 (with 83 deaths) and on March 9 of more than 8000 (with about 500 deaths).

After the imposition of some local and regional measures for the containment of infections, on 9 March 2020 the government of Italy imposed a national quarantine, restricting the movement

of the population except for extreme necessity, work (only few exceptions as health services), and health circumstances. Additional lockdown restrictions mandated the temporary closure of non-essential shops and businesses.

After about two months of lockdown, on 26 April, the Prime Minister announced the so-called “Phase 2,” that would start from 4 May. Movements across regions were still forbidden, while the ones between municipalities were allowed only for work and health reasons as well as for visit relatives. Moreover, he allowed the re-opening of closed factories, but schools, bars, restaurants and barbers were still closed.

Concerning the field of surgery, elective procedures have been canceled in favor of emergencies or oncological non-deferrable patients.

However, emergency can be defined as a serious, sudden, unexpected, and often dangerous situation requiring immediate action, independent from general social, political or health conditions.

Although from the earliest days of the infection the COVID-19 epidemic became a challenge for Emergency Departments (ED), a remarkable reduction in surgical emergencies has been widely noticed. The aim of the present study was to evaluate the impact of the pandemic period in the need of surgical emergencies.

Materials and methods

Between January 1 and May 31, 2020 all the consecutive general surgery emergencies performed by the Unit of Emergency Surgery of the Careggi University Hospital in Florence were prospectively recorded and compared to the same period of 2019.

Careggi University hospital is a third level regional center, in the Tuscany capital city of Florence, with a Trauma Center and about 115,000 patients (pediatric population excluded) evaluated per year in the emergency department (among the five biggest in Italy).

Seven procedures are known to represent most of the activity of emergency general surgery and were chosen for this analysis.³ These procedures were identified based on their ICD-9 codes and include the following: appendectomy (47.0×), cholecystectomy (51.2×), laparotomy or lapa-

roscopy (54.1/2×), lysis of adhesions (54.5×), colonic resection (45.7×), peptic ulcer disease repair (44.4×), and small bowel resection (45.6×). Moreover, surgery for hernia complications (incisional, umbilical, inguinal, crural) was also recorded (ICD-9 code 53.xx).

Other performed procedures included: perianal abscess or fistula drainage, foreign body removal, gastrostomy/jejunostomy, management of septic subcutaneous complications, non traumatic splenectomy, management of hemorrhoidal bleeding.

Only those classified with an admission status of urgent or emergent were analyzed; cases coded as elective, or trauma admissions were excluded. To focus the analysis on the scope of practice common to emergency general surgeons, patients who underwent primarily obstetric, cardiac, vascular, endovascular, orthopedic, thoracic, radiologic, or endoscopic procedures were also excluded. Pediatric population (<18 years old) was not referred to our hospital and was excluded from the present study.

Demographic (sex, age) and clinical data (disease, COVID+, perioperative mortality, comorbidity status, time between admission and surgery, length of stay, ICU admission, reoperation) were recorded and analyzed. Preoperative status, comorbidities and risk of 30-day postoperative complication were evaluated with Emergency Surgery Score (ESS).⁴

Nasal and throat swab for COVID-19 RNA finding (with RT-PCR) and CT scan were performed in all the patients admitted in the emergency department that were suitable for emergency surgery.

Surgery was conducted according to the last national and international guidelines and to general recommendations.^{5,6}

Statistical analysis

Chi-square tests were used to compare categorical variables. Wilcoxon or Mann Whitney tests were used to compare continuous variables (dependent or independent), as appropriate. A multivariate model was used for each of the main procedures to adjust for patient factors. Covariates in this model included age, sex, ESS, mortality and COVID+. A statistical significance was considered for P value <0.05.

TABLE I.—Data about Emergency Department visits, abdominal surgical evaluation and emergency surgery procedures.

	ED visits	Surgical evaluation	P	Surgical treatment	P
Jan-Feb 2019	19023	646 (3.4%)	0.6	162 (25%)	0.4
Jan-Feb 2020	19238	669 (3.4%)		155 (23%)	
Mar-Apr 2019	20650	696 (3.4%)	0.0001	146 (21%)	0.001
Mar-Apr 2020	6984	356 (5.1%)		107 (30%)	

TABLE II.—Emergency surgical procedures performed per month.

	01/19	01/20	02/19	02/20	03/19	03/20	04/19	04/20	05/19	05/20	2019	2020
Colorectal resection 45.7×	11	5	15	15	17	5	15	9	11	15	69	49
Small intestine excision 45.6×	8	6	10	8	9	7	11	11	5	6	43	38
Cholecystectomy 51.2×	11	14	14	10	11	3	7	11	13	13	56	51
Appendectomy 47.0×	14	17	18	15	17	13	16	9	22	11	87	65
Lysis of adhesions 54.5×	7	12	11	9	6	5	3	6	5	2	32	34
Hernia 53.××	8	4	7	9	8	4	6	1	7	6	36	24
Laparotomy/laparoscopy 54.1/2	2	4	8	4	6	1	1	6	2	6	19	21
Control of GD ulcer 44.4×	5	0	2	2	0	0	3	2	0	1	10	5
Others	5	10	6	11	8	6	2	8	4	10	25	45
Total	71	72	91	83	82	44	64	63	69	70	377	332

Results

During the study period, a significant reduction of emergency department visits in the months of march and april was found, compared to January, February and May 2020 and to the previous year.

Moreover, as reported in Table I, no statistically significant differences were found in the number of surgical evaluations required for abdominal symptoms and in the number of surgical emergencies in the period Jan-Feb comparing 2019 and 2020. On the contrary, a statistically significant change was found between mar-apr 2019 and 2020 considering the whole number of ED consultations (reduced), the number of surgical evaluation (reduced), the percentage of surgical evaluation (increased) out of the total number of patients, the number of emergency surgical procedure (reduced) and the percentage of emergency surgical procedure (increased) out of the abdominal patients evaluated, suggesting a reduction in access to the ED for patients with minor symptoms, especially non-surgical ones (and the improper use of the ED services).

The number of surgical procedures decreased only in the month of March 2020 (compared to 2019), while in April the total numer of emergency surgical procedures was similar (Table II).

TABLE III.—Surgical procedures performed in the COVID period with percentage of reduction

	Mar-May 2019	Mar-May 2020	
Colorectal resection	43	29	-33%
Small intestine excision	25	24	-4%
Cholecystectomy	31	27	-13%
Appendectomy	55	33	-40*
Lysis of adhesions	14	13	-7%
Hernia	21	11	-48%

However, considering every surgical indication, in the COVID period only appendectomy, complicated hernia repair and colonic resection were significantly reduced (40%, 48% and 33% respectively). The number of small intestine excision, cholecystectomy and lysis of peritoneal adhesions remained stable throughout the entire period (Table III).

Peptic ulcer disease repair and laparotomy/laparoscopy were excluded from the analysis because the numbers were too low to give reliable information (less than a median of 5 procedures/month).

The monthly evolution of surgicl activity and each individual procedure is summarized in Figure 1.

No statistically significant differences were found considering age, sex, ESS, mortality, ICU postoperative admission and time between ad-

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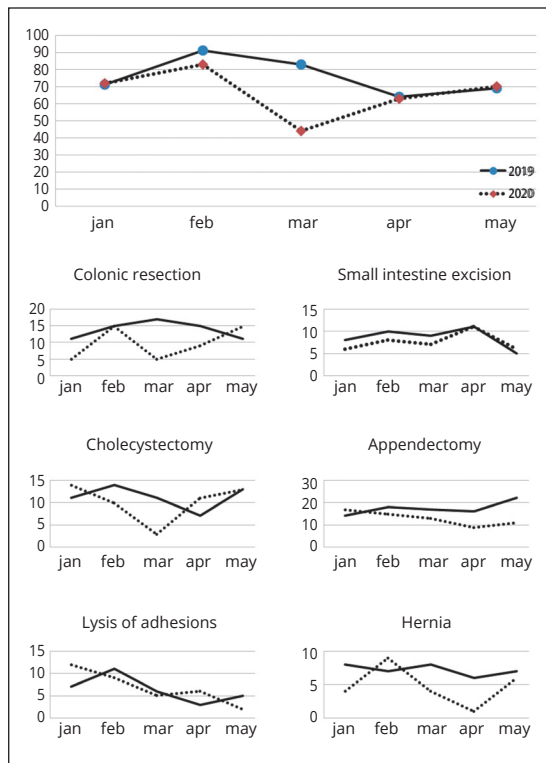


Figure 1.—Emergency surgical activity in the period January-May 2019-2020.

mission and surgery, even when analyzed with multivariate analysis for every single surgical procedure. In particular, no statistically significant differences were found in mortality (P: 0.7 and 0.1 in March and April, respectively), in Emergency Surgery score, in reoperation rate and in ICU postoperative admissions, suggesting a comparable disease severity and comorbidity patterns (Table IV).

During the study period 8 patients were COVID + (4.5%) and were treated for colonic ischemia,³ bowel obstruction (2: right colon cancer

and adhesions), abdominal abscess, laparotomy for retroperitoneal hematoma and appendectomy for acute appendicitis. Two patients (25%) of this subgroup died in the postoperative period, due to the severity of the surgical disease and the concomitant pulmonary complications. The overall mortality rate in the period January-May in no-COVID patients (2019 and 2020) was about 7%.

Discussion

The main question is: why a condition that is acute, unexpected and troubling for the patients should be significantly affected by external influences?

The idea that this could be related to a patient's choice, preferring to stay at home until further worsening of symptoms, is reductive and superficial, and it should imply the assumption that urgent/emergent condition such as bowel obstruction, incarcerated hernia, gastrointestinal bleeding, or perforation, mesenteric ischemia or cholecistitis or appendicitis can progress towards spontaneous healing, preventing the patient from having access to the healthcare system.

Contrary to the weekend or holiday effect, where the level of the outcome compared to weekdays is questioned because of the fewer professional and medical resources available, in addition to a selection of patients with more severe diseases,⁷⁻⁹ in this case the level of care services had even increased but patients were missing.

In fact, the declined number of ED patients did not result in decreased utilization of hospital staff. On the contrary, more workers were needed to provide increased protective measures, to collect patient histories in greater detail, to conduct examinations, and to relieve the high workload of ED staff.

TABLE IV.—Demographic and perioperative data.

	Mar 19	Mar 20	P	Apr 19	Apr 20	P	May 19	May 20	P
N. of patients	82	44		64	63		69	70	
Age	61.9	56.7	0.1	57.8	60.1	0.5	58.1	59.6	0.6
Sex (M/F)	37/45	20/24	1	25/39	27/36	0.7	40/29	45/25	0.4
ESS	4.9	5.3	0.6	5.4	5.7	0.5	5.2	5.1	0.9
ICU adm	11 (13%)	7 (16%)	0.7	9 (14%)	11 (17%)	0.6	8 (12%)	7 (10%)	0.7
Reoperations	3 (3%)	2 (4%)	1	4 (6%)	4 (6%)	1	0 (0%)	4 (5%)	0.1
Deaths	5 (6%)	4 (9%)	0.7	2 (3%)	6 (9%)	0.1	2 (3%)	6 (8%)	0.2
COVID +		1			3			4	

The same phenomenon was experienced in other Italian hospitals, where number of urgent interventions significantly dropped after the introduction of mobility restricting measures by the government and approximately 40% of surgeons reported an unusual delay in the presentation of nontraumatic abdominal emergencies. Delay was partially related to patient choice, preferring to stay at home until worsening of the symptoms, and partially due to the waiting list for the COVID-19 test at the emergency room.¹⁰

It seems reasonable that less critical patients were likely to avoid visits to medical centers due to the perceived risk of nosocomial virus transmission or to the government-imposed restrictive measures. In contrast, patients with emergency conditions or critical illnesses necessitating treatment were not able to avoid visiting the emergency department.

This was partially confirmed by our results, when during the march-april period a two-third reduction of the ED accesses was noted compared to the same period of the previous year, but only a 25% of reduction of surgical activity (45% in March and no reduction in April). Moreover, the percentage of patients in ED requiring surgical evaluation for abdominal symptoms raised from 3% to 5%, with an increased surgical treatment rate (30%).

The impact of viral outbreaks on the number of ED visits was previously reported for coronavirus (SARS),^{11, 12} however this was never reported about emergency surgical activity.

During the March-May 2020 study period, the amount of lysis of adhesions, small intestine excisions and cholecystectomies were only slightly (or not at all) affected by the reduction of patients, but the number of colorectal resections, appendectomies and complicated hernia repairs significantly decreased.

While this could be partially explained for appendectomies and complicated hernias, due to lockdown measurements that reduced potential risk factors such as difficult bowel management, uncontrolled diet, heavy physical activity and to potential home non operative management supervised by general practitioners, the reduction of colorectal resections (33%) remains not fully understandable. In fact, in a recent Italian survey

an increase of conservative treatment for appendicitis, cholecystitis and diverticulitis was reported.¹³ Moreover, considering appendectomies, the higher number of CT scan evaluation for potential COVID diagnosis significantly reduced the number of negative appendectomy rate.¹⁴

In our clinical practice, emergency colorectal resections were performed for bowel obstruction or perforation, colonic ischemia, acute Hinchey IV diverticulitis, complicated colorectal malignancies. It is hard to believe that the treatment of these clinical conditions can be postponed or home treated.

However, emergency colonic resections are often performed in elderly or institutionalized patients (*i.e.*, coming from nursing homes), who were also more susceptible to the effects of the coronavirus, with many deaths.

It has been reported that in the province of Bergamo (Italy), more than 600 nursing home residents, from a total capacity of 6400 beds, died between March 7 and 27, 2020.¹⁵ A similar phenomenon happened in many other Italian regions, where outbreaks of infection rapidly developed in many nursing homes. It has been reported that up 40% of deaths for COVID infection in Italy may be occurred in patients living in or coming from care homes. The same problem was reported in many other countries, where the percentage of COVID-19-related deaths among care home residents ranges from 19% in Hungary to 62% in Canada and for example, data for Germany suggests that 36% of deaths would have happened in communal establishments which, as well as care homes, also include prisons and other group living settings.¹⁶

Moreover, a percentage of indirect mortality not related to the virus but caused by the crisis of the hospital system and the fear of going to the hospital (as in the case of cardiovascular disease) might also be involved in justifying the lack of access of these patients to urgent surgical procedures (in this case colorectal resections) or ED services.

In the present paper, no differences were found in comorbidity severity score or mortality, not confirming the idea that only the most complex cases came to the ED for a surgical treatment. In this study, a higher mortality rate was noted

for COVID + compared to negative patients, but no healthcare workers involved in the surgical pathway resulted infected, confirming a good adherence to prevention measures. However, in Italy, more than 25,000 health care professionals resulted infected by coronavirus, representing more than 10% of overall positive cases.

Conclusions

The COVID-19 pandemic has caused major changes in daily clinical practice, especially in areas such as Emergency. This has led to a temporary reduction and changes in the flow of patients to the emergency room, with implications also for emergency surgical activities. However, the impact has not been significant for some surgical indication such as small intestine excision, cholecystectomy, and lysis of peritoneal adhesions. On the other hand, pathologies such as acute appendicitis or complicated hernia have suffered a drastic reduction, suggesting a possible alternative non-surgical management even during periods of normal healthcare activity. In conclusion, further studies are needed to identify in detail the factors related to the different demand for health services by patients.

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