Article

Emergency Surgery in the Elderly: Could Laparoscopy Be Useful in Frailty? A Single-Center Prospective 2-Year Follow-Up in 120 Consecutive Patients

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Abstract: Background: the general population is aging across the world. Therefore, even surgical interventions in the elderly—in particular those involving emergency surgical admissions—are becoming more frequent. The elderly population is often frail (in multiple physiological systems, this is often defined as age-related cumulative decline). This study involved a 2-year follow-up evaluation of frail elderly patients treated with urgent surgical intervention at Santa Maria Regina della Misericordia Hospital, General Surgery Department, in Adria (Italy). Method: a prospective, single-center, 2-year follow-up study of 120 patients >65 years old, treated at our department for surgical abdominal emergencies. We considered co-morbidities (ASA—American Society of Anesthesiologists Physical Status Classification System—score), type of surgery (laparoscopy, laparotomy or converted), frailty score, mortality, and complications at 30 days and at 2 years. Conclusions: 70 (58.4%) patients had laparoscopy, 49 (40.8) had laparotomy, and in 1 (0.8%) case, surgery was converted from laparoscopy to laparotomy. Mortality strictly depends on the type of surgery (laparotomy vs. laparoscopy), complications during recovery, and a lower Fried frailty criteria score, on average. The long-term follow-up can be a useful tool to highlight a safer surgical approach, such as laparoscopy, in frail elderly patients. We consider the laparoscopic approach feasible in emergency situations, with similar or better outcomes than laparotomy, especially in frail elderly patients.

Keywords: laparoscopy; urgent surgery; elderly; frailty

1. Aim

The global population is aging [1]. The number of people worldwide >65 years of age is estimated to increase from 524 million in 2010 to 1.5 billion in 2050. Consequently, the rate of surgical procedures in older populations is rising [2]. In the United States, 15% of the population is >65 years of age, but this group accounts for >35% of surgical operations. In Italy, according to the Italian National Institute for Statistics (Istituto Nazionale di Statistica, ISTAT), there were approximately 13.5 million people aged 65 and older in 2016, representing 22.3% of inhabitants [3,4], and this value will continue to grow in the following years. Recovery, particularly for surgical emergencies, is considered complicated in the elderly [5–7], who tend to have longer hospital stays [7–9] (this is related to comorbidities, an elevated number of drugs taken, and reduced physical and mental reserves) [3,5,8,9]. Not all patients of the same age have the same risks or frailty issues (in

multiple physiological systems, this is defined as age-related cumulative decline, and is considered a better predictor of mortality and morbidity than chronological age in the elderly). In the surgical field, the most frequent emergency diagnoses in the elderly are acute incarcerated hernia, cholecystitis, bowel obstruction and/or infarction, colic obstruction, and acute appendicitis [6]. Frailty assessment could facilitate identification of vulnerable surgical patients and, consequently, identify the appropriate surgical and anesthetic management [2]. However, currently there is no a standardized method of evaluation in emergency admissions [2,10]. Despite the urgent need for knowledge in treating elderly and/or frail surgical patients, especially in emergency situations, there are surprisingly few population-based studies [9,11–16] that involve long-term follow-ups. For this reason, our Santa Maria Regina della Misericordia Hospital, General Surgery Department, in Adria (Italy) participated in a study dubbed frailty and emergency surgery in the elderly: protocol of a prospective, multicenter study in Italy for evaluating perioperative outcome (FRAILE-SEL) [3]. Our evaluation started with a standardized evaluation of urgent admissions for surgical interventions in elderly, consequently we considered the Fried frailty score criteria at recovery. We followed-up at 30 days and at 2-years. Thus, this study was a prospective follow-up in the elderly (>65 years of age). We considered patients treated with urgent surgical laparoscopy or laparotomy interventions at our Department, and evaluated Frailty Score criteria at the time of recovery, at 30 days, and at 2 years, regardless of comorbidities and type of surgical procedure.

2. Methods

This is a prospective observational single-center study that includes 120 consecutive patients over 65 years old, treated for surgical abdominal emergencies at our Department between July 2016 and October 2017 (totally 15 months), and enrolled during the FRAILE-SEL study period of enlistment. Inclusion criteria are patients >65 years of age, regardless of co-morbidities, and surgically treated for urgent–emergent abdominal pathology with laparoscopy or laparotomy. Exclusion criteria are patients <65 years of age and/or elective and re-operations. Every patient recovered has been surgically treated by our general surgeons. We followed-up patients for 2 years. Date of last contact was 31 October, 2019. Source data include co-morbidities, type of surgery (laparoscopy, laparotomy, or converted), length of stay, complications of surgery (Clavien Dindo classification [17]), and follow-up (at 30 days and at 2 years). We scanned our data with Perioperative Mortality Rate (POMR) [16] and the following Frailty Fried Scale criteria [18,19] (Figure 1): energy balance and nutrition (considering weight loss in the previous 3 months > 10%), active mobilization (lowest quintile of kilocalories of physical activity during the past week), endurance (poor endurance and energy), weakness (hand grip strength in the lowest 20% quintile adjusted for sex and body mass index), slowness (walking speed under the lowest quintile adjusted for sex and height) at recovery and at 2 years (when possible). We compared these data with admittance diagnosis, (ASA - American Society of Anesthesiologists Physical Status Classification System - score) [20] complications, and mortality during hospitalization, at 30 days and at 2 years, to evaluate how frailty can impact in the follow up of urgent–emergency surgery admissions in elderly. We divided patients according to cause of death: medical or surgical complications during recovery and at 30 days, cardiovascular pathologies at 2 years, or the evolution of co-morbidities. We analyzed our data with statistical univariate analysis Chi-square, considering $p < 0.05$ as significant value, and with linear regression, with 95% confidence interval, using SPSS Program® for Linux.
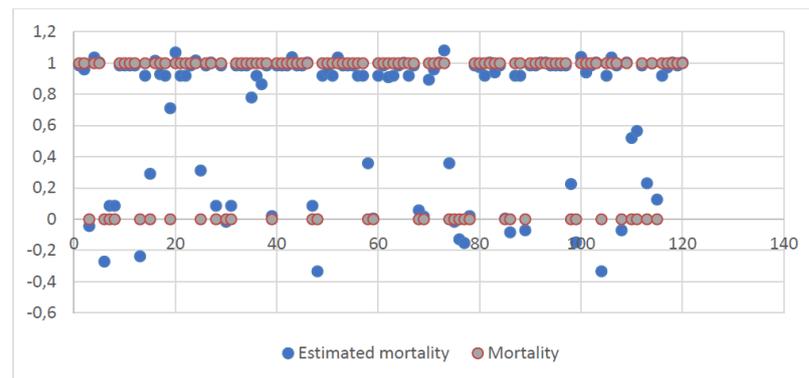
Figure 1. Results of linear regression between frailty criteria at recovery and after 2 years, and type of surgery, with estimated mortality.

3. Results

The study includes 120 patients (males 70, 58.3%, females 50, 41.7%), average age 79 years old, (range 65–98, median 79). Average BMI is 26.2 kg/m^2 (range 13-40 kg/m^2, median 25.3 13–40 kg/m^2). Median length of stay is 11 days (range 1–41, median 9). Comorbidities are presented in Table 1. ASA score is related to mortality ($p<0.0005$): 22.5% of patients are ASA 3, 4.2% are ASA 2, and 1.7% are ASA 4. We admitted 43 patients with cholecystitis (35.8%), 32 with colic obstruction (26.7%), 19 with ileal obstruction or infarction (15.8%), 13 with inguinal hernia obstruction (10.8%), 10 with appendicitis (8.4%), and 3 with incarcerated abdominal wall hernia (2.5%). In 70 (58.4%) cases, patients were treated with laparoscopic approach, in 49 (40.8%) with laparotomic approach, and in 1 (0.8%) case, surgery was converted from laparoscopy to open. In 4 (3.3%) cases, an ileostomy was performed and in 12 (10%) cases, a colostomy was made. During recovery, 6 patients died (5%). At 2 years, 86 (71.7%) patients were alive and 28 (23.3%) dead: 24 (70.6%) were males and 10 (29.4%) females. Table 2 presents the causes of death for every ASA score, without finding a statistical connection, even considering relationship between cause of death and laparoscopic or open intervention (Table 3). We found intra-recovery complications in 19 (15.8%) patients: 7 patients were treated with laparoscopic approach and 12 with open one (comparing the non-complicated approaches— 63 laparoscopic, 37 open, and 1 converted). So there is statistical relationship between mortality and laparotomic approach (Table 4) (respectively, $p < 0.04$ and $p < 0.03$). Therefore, mortality is linked to intrahospital complications, just as the laparoscopic approach has proven to be burdened by fewer complications and a lower mortality rate. Clavien Dindo Classification [17] and relationship with intra-recovery mortality is reported in Table 5. In Table 6, we relate abdominal surgery with type of surgery and total rate of mortality for the different surgeries. Laparoscopy is associated with lower mortality (Table 7) ($p < 0.02$). Frailty Score criteria at recovery (120 patients) and after 2 years (86 patients) are reported in Table 8. The linear regression between frailty criteria at recovery and after 2 years, and type of surgery, with estimated mortality, shows a lower worsening of frailty rating in the elderly patient from hospitalization to 2 years ($p < 0.0005$). Considering linear regression, we analyzed the type of surgery and complications to estimate patient mortality with that predicted by the regression model (R < 0.009). The evaluation of Frailty criteria at recovery and after 2 years strictly shows correlation with mortality, real and estimated (Table 9, Figure 1).

Table 1. Comorbidities.

Co-Morbidities	N	% on 120
Heart attack (<6 months)	1	0.8
Heart failure (<30 days)	5	4.2
Chronic heart failure	48	40
Previous coronary by-pass	26	21.7
Hypertension	93	77.5
Cerebrovascular diseases	30	25
Peripheral chronic obstructive arterial disease	18	15
Use of oral anticoagulant	28	23.3
Pulmonary diseases	26	21.7
Metastatic cancer	6	5
Non-metastatic cancer	21	17.5
Renal diseases	20	16.7
Diabetes	37	30.8
Use of immunosuppressant drugs	8	6.7
Actual smoker	8	6.7
Previous smoker	37	30.8

Table 2. Causes of death (*N*), ASA score, % on total deaths and % on ASA score, and *p* (0.05).

Causes of Death	N	% on 34	ASA Score	% ASA Scores on 34	*p (0.05)*
Medical/surgical during recovery	6	17.6	ASA 1: 0 ASA 2: 0 ASA 3: 5 ASA 4: 1	0 0 14.7 2.9	0.68
Medical/surgical < 30 days	13	38.2	ASA 1: 0 ASA 2: 5 ASA 3: 8 ASA 4: 0	0 14.7 23.5 0	
Cardiovascular diseases < 2 years ∞	8	23.5	ASA 1: 0 ASA 2: 0 ASA 3: 8 ASA 4: 0	0 0 23.5 0	
Evolution of comorbidities—other	7	20.7	ASA 1: 0 ASA 2: 0 ASA 3: 6 ASA 4: 1	0 5.9 17.6 2.9	

∞ in 2 cases cardiovascular diseases were not present at recovery.

Table 3. Causes of death (N), type of surgery, % on total deaths (% on 34), and *p* (0.05).

Causes of Death	N	Type of Surgery (% on 34)	*p (0.05)*
Medical/surgical during recovery	6	Laparoscopic: 0 (0) Open: 6 (17.6) Converted: 0 (0)	0.5
Medical/surgical < 30 days	13	Laparoscopic: 4 (11.8) Open: 8 (23.5) Converted: 1 (2.9)	
Cardiovascular diseases < 2 years ∞	8	Laparoscopic: 3 (8.9) Open: 5 (14.7) Converted: 0 (0)	

∞ in 2 cases cardiovascular diseases were not present at recovery.

Table 4. Complications and their %, mortality and its %, type of surgery and its %, and *p* (0.05).

Complications (% on 120)	Death (% on 120)	*p* (0.05)	Type of Surgery (% on 120)	*p* (0.05)
yes: 19 (15.8)	9 (7.5)	0.04	Laparoscopic: 7 (5.8) Open: 12 (10) Converted: 0 (0)	0.03
no: 101 (84.2)	25 (20.8)		Laparoscopic: 63 (52.5) Open: 37 (30.9) Converted: 1 (0.8)	

Table 5. Clavien Dindo Complications and their %, mortality and its %, and *p* (0.05).

Clavien Dindo	N (% on 120)	Death (% on 120)	*p* (0.05)
1	4 (3.3)	0 (0)	0.8
2	0 (0)	0 (0)	
3a	3 (2.5)	1 (0.8)	
3b	4 (3.3)	1 (0.8)	
4a	3 (2.5)	2 (1.6)	
4b	0 (0)	0 (0)	
5	5 (4.2)	5 (4.2)	

Table 6. Abdominal surgery (*N*) and % on 120, type of surgery (% on 120), mortality (% on 120), death in the different types of surgery (% on 120), and *p* (0.05).

Abdominal Surgery	N (% on 120)	Type of Surgery (% on 120)	*p* (0.05)	N of Death (% on 120)	*p* (0.05)	Type of Surgery–Death (% on 120)	*p* (0.05)
Cholecystectomy	43 (35.8)	Laparoscopic: 41 (34.2) Open: 2 (1.6) Converted: 0 (0)	<0.001	7 (5.8)	<0.04	Laparoscopic: 6 (5) Open: 1 (0.8) Converted: 0 (0)	<0.03
Appendectomy	10 (8.4)	Laparoscopic: 9 (7.5) Open: 1 (0.8) Converted: 0 (0)		2 (1.7)		Laparoscopic: 2 (1.7) Open: 0 (0) Converted: 0 (0)	
Ileal resection	19 (15.8)	Laparoscopic: 2 (1.6) Open: 17 (14.2) Converted: 0 (0)		6 (5)		Laparoscopic: 0 (0) Open: 6 (5) Converted: 0 (0)	
Colic resection	32 (26.7)	Laparoscopic: 15 (12.5) Open: 16 (13.3) Converted: 1 (0.8)		16 (13.3)		Laparoscopic: 6 (5) Open: 9 (7.5) Converted: 1 (0.8)	
Inguinal hernia reparation	13 (10.8)	Laparoscopic: 1 (0.8) Open: 12 (10) Converted: 0 (0)		3 (2.5)		Laparoscopic: 0 (0) Open: 3 (2.5) Converted: 0 (0)	
Incarcerated abdominal wall hernia reparation	3 (2.5)	Laparoscopic: 2 (1.6) Open: 1 (0.8) Converted: 0 (0)		0 (0)		Laparoscopic: 0 (0) Open: 0 (0) Converted: 0 (0)	

Table 7. Type of surgery (% on 120), mortality and *p* (0.05).

Type of Surgery	Mortality N (% on 120)	*p* (0.05)
Laparoscopy	14 (11.7)	0.02
Open	19 (15.8)	
Converted	1 (0.8)	

Table 8. Frailty score criteria at recovery (*N* 120 and % on 120), at 2 years (*N* 86 and % on 86), type of surgery at recovery (*N* 120 and % on 120), at 2 years (*N* 86 and % on 86) and *p* (0.05).

Frailty Score Criteria	Weight Loss in the Previous 3 Months (>10%)	Active Mobilization	Endurance	Weakness	Slowness
N (120) at recovery (% on 120)	4 (3.3)	71 (59.2)	17 (14.2)	22 (18.3)	112 (93.3)
N (86) at 2 years (% on 86)	8 (9.3)	60 (69.8)	10 (11.6)	22 (25.6)	85 (98.9)
p (0.05)	0.44				
Type of surgery at recovery					
Laparoscopy	1 (0.8)	47 (39.2)	5 (4.2)	6 (5)	67 (55.8)
Laparotomy	1 (0.8)	23 (19.2)	12 (10)	16 (13.3)	44 (36.7)
Converted	0 (0)	1 (0.8)	0 (0)	0 (0)	1 (0.8)
Type of surgery *N* (86) at 2 years (% on 86)					
Laparoscopy	2 (2.3)	40 (46.5)	4 (4.7)	11 (12.8)	55 (64)
Laparotomy	6 (7)	20 (23.2)	6 (7)	11 (12.8)	30 (34.9)
Converted	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
p (0.05)	0.0005				

Table 9. Results of linear regression between frailty criteria at recovery and after 2 years, and type of surgery, with estimated mortality.

Statistical Regression	
Multiple R	0.950090474
R^2	0.902671908
Adjusted R^2	0.891756608
Standard error	0.148876201
Observations	120

4. Discussion

In the early 2000s, Fried et al. [18,21] decided to re-define a concept that was introduced in the 1990s by Rockwood et al. [19,22], about frailty. Fried designated the so-called Frailty Phenotype, which used objective diagnostic criteria to define fragility, consequently differencing it from disability and co-morbidity. At this point, it became possible to identify different phenotypes: "frail" (with three or more criteria), "pre-frail" (one or two criteria), or "robust" (none of them). Therefore, it became feasible to rigorously differentiate, at least during the elective treatment of illnesses, frail elderly patients [19,21,22]. The majority of patients undergoing emergency laparotomy have potentially life-threatening conditions that require prompt investigation and treatment. Unlike elective surgery, there is often limited time to carry out investigations, especially in the elderly [23–27]. In literature [28–30], it is confirmed that older patients undergoing surgery have a higher risk of both mortality and complications compared to younger patients. An elevated ASA score and multiple co-morbidities increase mortality during post-operatory. ASA class 3 or higher predict a worse follow-up [9]. Moreover, hospitalization for older surgical patients is often complicated by physiologic decompensation, pre-existing co-morbidities, and prolonged length of stay [31,32]. These combined effects mean that aging populations pose new challenges for the dispensation of healthcare. In 2011, the National Emergency Laparotomy Audit (NELA), founded by NHS (National Health Service) England and the Welsh government, started collecting comparative information from all hospitals in England and Wales where emergency laparotomies were performed, to improve the care

of patients. It was established in response to the comparatively high death rate after emergency laparotomy, and the substantial variation in this rate among hospitals [27]. Data from the fifth NELA report showed that 45% of emergency surgeries concerned patients >75 years, while in 55%, the ASA score was ≥3. Although NELA was created with the aim of comparing emergency laparotomies, the fifth report even considered bower emergent laparoscopy. It reports that the average mortality rate after emergency laparotomy remains static at 9.6% (in our study, it is about 15.8%) and that 22.7% of patients do not have their preoperative mortality risk documented. NELA demonstrates that an assessment of frailty is not routinely performed. Frailty is associated with a greater risk of postoperative mortality and morbidity, which is independent of the risk associated with age. For patients over 65, frailty assessment used alongside clinical risk assessment, plus specialist geriatric input for the older frail patients, is likely to improve their outcomes. Other studies confirm that for patients undergoing laparoscopic surgery, the 30-day mortality is 3.5% compared to 10% via an open approach. The median length of stay for patients undergoing laparoscopic surgery is 6 days compared with 11 days for those who had an open emergency laparotomy [26,27]. Recent guidelines [33–36] recommend the laparoscopic approach in all patients, even in the elderly. A recent meta-analysis [37] shows that laparoscopy is associated with an earlier return to home with a satisfactory quality of life. In our study, and according to the literature [37–39], it is worthwhile to note that most emergency interventions are laparoscopic. According to the research in [24,25], the use of supraglottic airway devices is also associated with a more rapid return to spontaneous breathing. This is obviously more feasible, considering a laparoscopic and less invasive approach. We can reasonably say that the laparoscopic approach is safer than the laparotomic one; this is true especially with a skilled surgical team. In references [23,26], the authors reported that, in the short term, results related to conversion from laparoscopy to laparotomy were not worse than the direct laparotomic approach. We just had one case, so we do not have a rating parameter. The only case that was converted (for an incarcerated hernia) died after 1 year because of a metastatic sigmoid cancer. Consequently, we cannot consider it significative. Our study is burdened with many biases. First, the comparison of different severities in surgical interventions (from low to high risk), and subsequently, the non-comparisons between comorbidities and type of surgery. We are also aware that most "major" surgeries have been set up with a laparotomic approach without attempting laparoscopy. This is related to individual surgical skills. Finally, we did not compare the baseline characteristic (age, comorbidities, frailty, and ASA score) of the two populations. We even decided to evaluate clinical observation at 2 years to verify the long-term effects of emergency surgery in the elderly, attempting to fill the gap present in the literature. The purpose of our study, with all of its limitations, is to focus on the need to systematically implement a frailty assessment in elderly patients, and attempt to increase the routine use of the laparoscopic approach, even in emergency surgeries in the elderly, as well as provide inspiration for improvement.

We agree with the literature [2,17,28–31] that more research, regarding frailty and its impacts on surgical patients in acute settings, is needed. This tool must be efficient and suitable for application at the bedside, in every situation, and in daily moments. A more widespread application of the frailty score, in our opinion, can be useful in creating a long-term evaluative follow-up in frail patients; moreover, it can likely help with determining the right surgical approach for every patient (according to the skills of the operative surgical team). We must not only consider surgical intervention, but also anesthesiological intervention, using alternative procedures at intubation, such as supraglottic devices.

5. Conclusions

Our study could be a starting point to identify the most useful scores to establish, in a simple and rapid way, the risk classes of elderly and frail patients undergoing urgent surgery. We need the use of various criteria, and above all, a long follow-up that allows us to identify mortality and quality of life at a distance. Choosing the perfect surgery in the

right patient is a great challenge. In fact, the NELA study began by only considering the laparotomy approach, while in subsequent reports, it opened its boundaries even to the most pioneering laparoscopy. Our study can be a starting point to study elderly patients in emergency settings, in its entirely (considering co-morbidities and fragility), at the recovery, and in the following years. We believe that a more logical approach to elderly patients can bring a more rational return to a satisfactory quality of life.

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