Common themes in geriatric emergency general surgery: a narrative review

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Abstract

Population aging is a growing phenomenon. The geriatric patient is defined by physical, psychological, and social characteristics associated with aging that make him or her more fragile and susceptible. An older patient is usually fragile: frailty has a linear, if not unambiguous, relationship with age. With this background, the concept of futility emerges in emergency surgery, which refers to having a goal but being almost certain of failure in achieving it. A narrative review of the literature was carried out using PubMed, Google Scholar, and Cochrane to identify pertinent publications. Inclusion criteria included: i) an emergency setting in geriatric general surgery, ii) frailty in emergency surgery, and iii) futility in emergency surgery. The study identified valid assessment scores for older and frail patients, as well as imaging tools that may aid in the evaluation of frailty, demonstrating the potential futility of surgical treatment. The review addressed the most common acute surgical situations that affect geriatric patients. Older patients are more fragile and vulnerable than the general population, even though geriatric age does not always correlate with frailty. Several fragility scores have been developed to perform an accurate preoperative assessment of the urgent elderly surgical patient, to estimate treatment futility and perioperative risk, and to guide the surgeon to the most appropriate therapeutic or palliative action.

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Introduction

Population aging is a constantly increasing phenomenon. The geriatric patient (conventionally defined as a person over 65 years of age) is characterized by physical, psychological, and social traits that make him or her more fragile and vulnerable compared to the general population. Advanced age is associated with an increased risk of comorbidities and loss of autonomy, as well as a reduced life-expectancy. Aging refers to the inevitable and irreversible organ malfunction with time, regardless of the absence of acute organ damage, disease, or unbalanced lifestyles. Typical signs of aging can be summarized as a reduced ability to maintain homeostasis in response to stressful events and therefore a limited proper reaction to acute events, with subsequent increased risks of morbidity, loss of independence during ADLs (Activities of Daily Living), and mortality. The concept of "geriatric age", however, must take into account not only the patient's chronological age, but also social, economic, and cultural factors, including the patient's functional status. For this reason, it would be more appropriate, in the overall assessment of a patient, to speak of "frailty" instead of geriatric age.

Frailty is defined as a reduced physiological reserve associated with an increased vulnerability due to the gradual loss of physical, cognitive, social, and psychological functions, that leads to a higher susceptibility to adverse events, disability, and death.[1,] Frailty displays a linear, though not univocal, trend with age. In surgery, frailty is related to an increased risk of all complications (clinical and surgical) and death: the patient's diminished resources cause an inadequate ability to promptly respond to surgery, and the presence of comorbidities raises the risk of complications and death in the postoperative period, as well as dampen the patient's abilities and autonomy. Even though in elective surgery it's feasible to perform a multidimensional assessment of the geriatric patient and adequately prepare him to face the surgical stress through pre-operative-habilitation programs, this is very complicated and often not possible in urgent or emergent situations.

As a matter of fact, in an emergent surgery setting, the patient's assessment and treatment choice must be as hasty as possible, but the critically ill patient might have a physical or sensory impairment, and his/her family members may not be immediately avail-

able; this may make it difficult to carry out an overall assessment of the patient and the risks connected with a possible surgical treatment. At least 50 different scores have been suggested and are currently being used in surgical emergencies in frail patients, but an adequate pre-operative assessment in these cases is often very complex.

Thus the concept of futility in emergency surgery. Futility is the lack of effectiveness; it consists of setting a goal and carrying out the action(s) aimed at achieving it, but with the awareness that the aforementioned action(s) will be useless and unsuccessful.

This notion is corroborated by the acknowledgment of the inherent risk in a clinical case where uncertainty and the danger of morbidity and death are extreme. The evaluation of futility in emergency surgery unfolds several considerations, from the strictly clinical ones (e.g. the overall risks for the patient in question) to the psychological and social ones (e.g. the loss of autonomy in daily activities, or the worsening in the quality of life), and to the ethical ones (e.g. the decision not to proceed surgically as it would be 'futile'). It is in such a complex and multifactorial background that it was mandatory to examine several different variables and develop the tools to shape a patient's global assessment as objectively as possible.

This literature review aims to analyze and discuss what might be the best approach for the emergency and urgent surgeon in assessing the geriatric and fragile patient and therefore in deciding whether or not a particular surgical act is useful.

Materials and Methods

Literature research was performed using PubMed, Google Scholar, and Cochrane to identify relevant publications, using "emergency" AND "general surgery" AND "geriatric" as search terms. The search was limited to publications written in English, rejecting duplicates and selecting a total of 98 publications (Figure 1). Abstracts were screened for inclusivity and full articles were reviewed to identify all potentially relevant studies. The inclusion criteria were: i) emergency in geriatric general surgery, ii) frailty in emergency surgery, and iii) futility in emergency surgery. Studies dealing with frailty in disciplines other than general surgery and with emergency surgery in the non-geriatric patient setting were excluded.

It was not possible to develop a systematic literature review with meta-analysis because of the heterogeneity of the studies, the outcomes currently under review, and the ample variability of approach to the different outcomes in the analyzed publications.

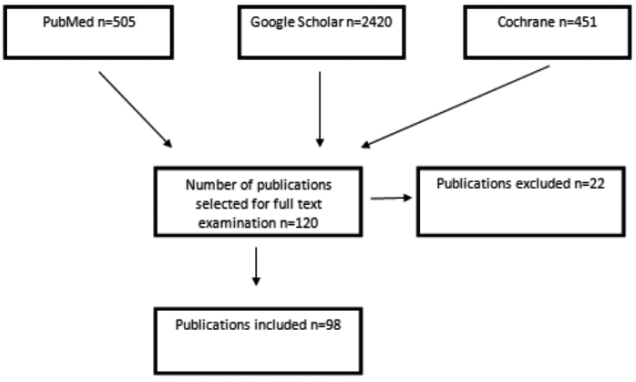

Figure 1. Publications selection.

Futility

The concept of futility consists of setting a goal and carrying out the actions and activities aimed at achieving that goal, but with the virtual assurance that the aforementioned actions will fail to achieve it.[3,4] Futility is associated with an intrinsic risk in an event where the danger and uncertainty for the patient's outcomes are extreme. Although risk evaluation is vital even in elective surgery settings, it becomes crucial in emergency contexts as these are associated with an increased complexity of the patient's global assessment related to the need for swift decisions, often made late at night, a narrower window for adequate multidisciplinary discussion, and possible lack of family support to guide the surgical decision.

The concept of futility can be described as i) quantitative: *i.e.,* as the statistical probability of surviving a specific procedure, or as the probability of success of a treatment;[5,6] ii) qualitative: *i.e.,* as the benefit that the procedure may bring regarding the patient's quality of life (e.g. the presence of a permanent ostomy, or the need for palliative therapy in oncology).[5,6]

The analysis of both these traits can guide the discussion and risk stratification in clinical decision-making. Several parameters help predict the futility of a surgical procedure: advanced age, serum lactates, renal function, patient's comorbidities, state of consciousness, and the presence or absence of septic status. The quantitative feature of futility is the one that predominantly leads the clinical decision, however, it may not always be easily understood or acknowledged by the patient or his/her family, as the qualitative aspects related to the procedure may often be more meaningful for the patient and his/her family than the risk of death itself. To exemplify, for patients it's easier to understand the risk of being discharged with a permanent ostomy or the need for home support than the risk of death related to their clinical condition.[7]

These considerations clarify the extreme controversy of the term futility in the decision-making process and the need for an equilibrium between the urgent nature of the surgical act and its associated risk, as emergency surgery increases the risk of surgery without gross benefits (*i.e.,* death within 48-72 hours after surgery).

The overall management of these complex scenarios can turn out to be pretty difficult for the surgeon, thus leading to emotional stress, depression, and burnout.[8] The first step should be to balance the surgical risk using objective scores combined with the patient's values and perception. The complementary assessment of the risks, benefits, and therapeutic alternatives can then guide the conversation to a decision. A multidimensional assessment between the anesthetist, the surgeon, and the patient's physician, if possible, could be valuable, as it would provide the patient and his family a wide overview of potential surgical benefits, associated risks of morbidity and mortality, potential loss of autonomy in daily activities, and possible non-operative alternatives.[9]

Geriatric patient evaluation

Geriatric age conventionally begins at 65 years of age, but some patients may require earlier geriatric expertise because of underlying conditions and comorbidities that make them frail. Aging refers to the inevitable and irreversible organ decline with the passing of years, even in the absence of acute damage, diseases, environmental hazards, or unbalanced lifestyles. The first sign of aging corresponds to a reduced ability to maintain homeostasis under stress, underlying thus frailty in the elderly. Frailty indeed shows a linear, though not univocal, trend with age: it is reckoned that frailty is present in 10-

20% of patients older than 65 years of age, and this percentage increases up to 40% in patients older than 80 years of age.[10] Disease interferes with natural aging and triggers specific geriatric complications, known as geriatric syndromes (*i.e.,* delirium, incontinence, falls, visual and hearing impairments, and weight loss).[11]

Emergency general surgery in older patients is associated with increased mortality, and higher rates of short- and long-term complications (*i.e.*, in emergency cholecystectomy, complications can reach up to 27% in 65-79 year-older patients, and up to 38% in patients aged 80 years or older),[12] loss of independence and autonomy. The need to compute risk stratification, throughout common scores, also applied in elective surgery (ASA, APACHE II, P-POSSUM, etc),[13] frailty assessment, and presence/absence of sarcopenia are hence vital.

ASA-score (American Society of Anesthesiologists Physical Classification System)

This scale is effective in establishing how fit the patient is for a surgical procedure. It classifies comorbidities, but lacks information on operative risk, as it should be merged with information about frailty, type of surgery, and available medical facilities. Moreover, it does not consider age and physical status, as well as other comorbidities such as cancer, and may be biased towards the clinician's subjective judgment. In an emergency setting in a geriatric patient, the score appears adequate for predicting mortality, but less suitable for estimating short-term complications.[14-17]

APACHE II scoring system (Acute Physiology and Chronic Health Assessment)

It is a measuring system based on current physiologic measurements, age, and previous health conditions, often used in the ICU setting, determines disease severity in critically ill patients within the first 24 hours of intensive care hospitalization. In an emergency surgery setting in the elderly, this score is both inadequate in predicting short-term and long-term complications as well as time-consuming and onerous to perform.[12,14,17,18]

CFS (Clinical Frailty Scale)

It is a simple and quickly validated scale to assess patients' frailty and fitness, tailored for patients aged 65 years or older, administered on triage admission and then 2 weeks later. It labels the population into 9 groups based on comorbidities, physical activity, and autonomy in activities of daily living. It's reliable in predicting short- and long-term mortality, but not in estimating short-term surgical complications.[14,17,19-25]

ACS-NSQIP risk calculator (American College of Surgeons National Surgical Quality Improvement Program)

This is an online calculator that takes into account the patient's age, comorbidities (obesity, diabetes, cardiovascular disease, dyspnea, hepatopathy, renal failure, advanced neoplasm), medication use (*i.e.*, corticosteroids or antihypertensive drugs), the patient's lifestyle (smoker, drinker), and the type of surgery planned. These data are enriched with information about the geriatric patient's independence status. It measures the risk of complications within the first 30 days after surgery and thus allows an accurate prediction of short-term complications and death risks; it may be useful guidance in the surgical-decision making.[14]

P-POSSUM score (Porthsmout Physiological Operative Severity Score for enUmeration of Mortality and morbidity)

It is a verified score that allows a projection of morbidity and mortality risks in the surgical patient based on objective physiological and operative criteria; it is therefore a great assessment tool for the frail patient even in the emergency setting.[12,17,26]

NELA Risk calculator

It provides an estimate of the risk of death within 30 days of emergency abdominal surgery. It has been developed using the data gathered from patients admitted into the National Emergency Laparotomy Audit between December 2016 and November 2019. This tool reviews each procedure's risks and patient's information. In the UK it has proved its superior accuracy over the P-POSSUM score for patients undergoing emergency laparotomy.[36]

Comprehensive geriatric assessment

Preoperative patient stratification may be difficult in an emergency setting; risk assessment in older patients in emergency surgery is however cardinal for a more appropriate intraoperative physiological control and optimal post-operative management. The concept of Comprehensive Geriatric Assessment (CGA) is increasingly emphasized in current literature as the standard key for improving outcomes in elderly patients in elective surgery.[34-37] The CGA consists of a global evaluation of the geriatric patient, taking into account age, comorbidities, degree of autonomy in ADLs, psychological cognitive and social status, and family support, thus allowing not only to rate his or her surgical risk, but also to organize postoperative recovery through a targeted physiotherapy program, to adequately plan hospital discharge (towards home or care facilities), and, in case of home discharge, to guide family members in the overall assistance and management of any presides. This assessment should be managed by a multidisciplinary team (composed usually of a geriatrician, a nurse, and a social worker) so that all areas of concern can be suitably and accurately determined. Other figures, such as a psychiatrist or psychologist, may be involved. Predefined questionnaires are employed to inquire about the ability to perform functional actions and the possible need for assistance, history of falls, presence of urinary and/or fecal incontinence, pain, available social support, depressive symptoms, vision or hearing impairment, nutritional status, comorbidities, and polypharmacotherapy. Following the analysis of these parameters, the multidisciplinary team then defines the most appropriate setting for the patient (home, a long-term care facility, a hospital ward) and any necessary supplies. In a surgical urgency/emergency setting, a preoperative multidisciplinary evaluation of the patient is impractical due to the acute nature of the situation; it would be desirable however to perform it routinely both in the post-operative period and in case of conservative palliative treatment.

Frailty evaluation

Frailty is defined as a condition of reduced physiological reserve associated with enhanced vulnerability, due to a loss of physical, cognitive, social, and psychological functioning, leading to a raised susceptibility to adverse events, disability, and death.[1,2] Frailty, in the surgical setting, is related to an increased rate of all

complications and death:[37] frail patients' limited resources result in a decreased ability to respond adequately to surgery; moreover, potential comorbidities are linked with a higher risk of postoperative complications.[12,39,40] The frail surgical patient has indeed, compared with the non-frail patient, an increased risk of developing complications, both surgical and medical (e.g., wound infections, reintervention, pneumonia, renal failure), as well as an amplified postoperative disability and mortality,[11,19,34,41] longer length of hospital stay, increased institutionalization, and higher rates of hospital readmission.

Frailty is not an absolute contraindication to surgery, but it is related to an increased intra and postoperative risk;[2,42] risk stratification can therefore be convenient in predicting outcomes and optimizing patients when faced with surgical stress while trying to avoid the patient's functional decline, prevent or manage appropriately early postoperative complications, plan the post-surgical course and proper setting after hospital discharge.[39,40] Plentiful scores have been developed to optimize the frail patient's assessment in an urgent/emergent surgical setting. There are around fifty such scores, a few examples of those most commonly used in an emergency/emergency setting are the CFS (Clinical Frailty Score),[12,19-25] which we have already discussed before, and the following ones.

Fried's Frailty Index

This score was issued from cardiovascular health-related studies. It examines 5 parameters: unintentional weight loss, gait slowness, easy fatigability, history of falls, and reduced strength in grasping objects. The patient is considered a frail individual when the score is greater than or equal to 3. The advantage of this score in an emergency setting appears limited, as the patient's dire condition may override the assessment.[12,44,45]

mFFC (modified Fried's Frailty Criteria)

This is a multidimensional frailty screening system, similar to the Fried Index, from which it derived, that assesses grip strength, fatigability, scant physical activity, weight loss, and exhaustion. A score of 0 identifies a robust patient, a score between 1-2 a pre-frail patient, and a score greater than or equal to 3 identifies a frail patient. Again, the worth of this index may once more be distorted in an emergency.[36]

mFI-11 (modified Frailty Index 11)

This score takes into account the patient's comorbidities for a total of 11 points: i) diabetes mellitus, ii) congestive cardiac failure, iii) medically treated hypertension, iv) history of stroke or TIA, v) partial or total dependence in ADLs, vi) history of myocardial infarction, vii) history of peripheral vascular disease, viii) history of cerebrovascular pathology with relics, ix) COPD or pneumonia, x) history of PTCA or angina, and xi) history of sensory impairments. A point is assigned to each variable: if the score is 0 the patient is considered non-fragile, if the score is 1-2 the patient is considered pre-fragile, and above 3 points the patient is considered frail. A higher score is associated with increased complications, such as wound infections, reintervention, hospital readmission after discharge, increased institutionalization, longer hospital stay, and worse preoperative mortality.[2,41]

mFI-5 (modified Frailty Index-5)

This modified score is more flexible and brief than the mFI-11, and is obtained with only 5 elements: i) presence of heart failure within 30 days of surgery, ii) diabetes mellitus, iii) COPD or pneumonia, iv) partial or total dependence in ADLs, v) treated hypertension. A score of 1-2 suggests intermediate frailty, which has a 1.5% increased risk of failure-to-rescue, postoperative complications, reintervention, and mortality; a score greater than or equal to 3 reflects severe frailty, resulting in a 4-fold increase in all-cause mortality, a 5-fold increase in perioperative complications, and a 2-fold increase in reintervention risk.[41,42]

fTRST (flamish version of the Triage Risk Screening Tool)

This is a 5-item questionnaire, with a total score ranging from 0 to 6, which allows for an overall assessment of the patient. It considers cognitive decline, autonomy in ADLs, mobility and any falls in the past 6 months, history of hospitalization in the past 3 months, and poly-pharmacotherapy (more than 5 chronic medications). A score greater than or equal to 2 correlates with enhanced short- and long-term postoperative complications, higher mortality, and longer duration of hospital stay. It's a rather simple and quick tool; [19,20,40,46]

50-RPFI (modified 50-variable Rockwood Preadmission Frailty Index)

It consists in a 50-item score that examines comorbidities, ADLs and IADLs, psychological, nutritional, and functional status, and a few blood test values. It's very useful in assessing the risk of postoperative morbidity and mortality, the main drawback is that it is quite elaborate and long to complete; [20]

TSFI (Trauma Specific Frailty Index), EGSFI (Emergency General Surgery Frailty Index), and TEGS-FI (Trauma and Emergency General Surgery Frailty Index)

TSFI[1,47] is the only model developed specifically to assess frailty in the trauma patient; its application was later extended to emergency surgery (EGSFI),[1,20,48,49] hence TEGS-FI. The score is characterized by 15 variables and examines the presence of comorbidities (neoplasm, cardiovascular disease, dementia), attitude towards health status, ADLs, and functional and nutritional status. A higher score is linked to an increased risk of complications, but its regular employment allows an overall reduction in the number of complications and institutionalization, whilst it doesn't affect mortality.[50]

MALE risk score

This score weighs up factors such as male sex (male), presence of anemia (anemic), albuminemia $\leq$ 3.5 g/dl (low albumin), age greater than or equal to 85 years (Eighty-five years old); each variable is assigned one point. This is a practical, easy-to-calculate, and accurate tool for predicting poor outcomes in elderly patients in an emergent surgery setting. Indeed, in a prospective multicenter study, Ablett *et al.*[51] imply that a higher MALE score is related to an increased 30- and 90-day mortality, new hospitalizations in patients who sustained emergent surgery, and longer length of hospital stay. The importance of hypoalbuminemia is especially emphasized: albumin values below 3.5 g/dl are associated with malnutrition states that may underlie chronic inflammatory bowel diseases, hepatopathy, neoplasms, and heart failure, thus associating with a higher rate of surgical complications, such as anastomotic dehiscences and wound infections.[51,52]

Frailty imaging

Communication with the patient and/or family members in an emergency setting may be complicated, making it challenging to apply the available scores. CT-guided radiological methods have therefore been implemented to assess patients' characteristics suggestive of a potential vulnerability to the surgical act: i) sarcopenia: a progressive and generalized skeletal muscle syndrome characterized by loss of muscle mass, reduced strength, and muscle quality; it's calculated by measuring the TPI (Total Psoas Index), comprised of the sum of the area of the right and left psoas muscle at L3 level on CT, divided by the patient's height in meters;[12,28,29] ii) osteopenia: a measurement of attenuation, in Hounsfield Units (HU), in the region of interest (ROI). A 2D ROI is assessed at the level of the anterior vertebral trabecular area on an axial projection of L3. It has proved its usefulness in predicting 30-day mortality in patients requiring emergency laparotomy;[28,30] iii) sarcopenic obesity: the total visceral and subcutaneous adipose tissue area measured in an axial projection and divided by total muscle area at L3 level. There are limited data regarding the advantage of this parameter in assessing emergency morbidity and mortality, the main field of application concerns elective gastric and pancreatic surgery;[27,31-34] iv) renal volume normalized to the patient's height; v) calcification rate of the abdominal aorta: the aorta is segmented from D12 to the lower end of L3; the calcification rate is obtained by dividing the percentage of calcification volume by the total volume of the aorta.

The adequacy of these last two parameters in assessing frailty in older patients has been hypothesized, but there are only a handful of studies available.[28]

Main emergency surgical diseases in older patients

Acute cholecystitis

The MICOL study [53] shows that age is a strong risk factor for biliary cholecystitis in both sexes: the prevalence of cholelithiasis at 70 years of age is 15% in men and 24% in women, while in nonagenarians the prevalence reaches 24% in men and 35% in women. Clinical manifestations of acute cholecystitis in geriatric patients may be altered by factors such as reduced pain perception,[54,55] altered biliary physiology,[56] and a different response to tissue damage.[57] The typical symptom of acute cholecystitis, characterized by epigastric and right hypochondrium pain, may be absent in older patients, either as an effect of aging or as a consequence of pathologies such as diabetes, known precursor to an altered nociceptive sensitivity:[13] 12% of patients with acute cholecystitis experience atypical pain, while 5% of elderly patients are pain-free,[58] with an often negative Murphy's sign. Fever is reported with inconsistent percentages within the geriatric population (36-74%), but only 6-10% reach a body temperature above 38°C.[58,59] Regarding laboratory tests, only 41-59% of elderly patients with acute cholecystitis present with neutrophilic leucocytosis.[58,60] The diagnosis of acute cholecystitis may therefore often be delayed, with a higher occurrence of severe or gangrenous acute cholecystitis.

This explains the importance of stratifying geriatric patients as a means to select the proper surgical treatment. Evidence shows that cholecystectomy remains the main treatment for acute lithiasic cholecystitis, even in older patients,[61] and that mortality is significantly lower if surgery is performed during the same hospitalization.[62] Assessment of a patient's frailty is mandatory alongside the related surgical risk, using validated scores, the mortality rates connected to surgical or conservative treatment, the probability of recurrence, and life expectancy. If a surgical approach is feasible, laparoscopic cholecystectomy appears to be the treatment of choice even in the elderly patient, as it is safe, a well-established procedure, it has low complication rates and reduced post-operative hospital stay.[63] The relatively higher rate of laparotomic conversions in older patients as reported in the literature,[64,65] is probably due to more severe cholecystitis upon admission.

If the patient is deemed "not fit" for surgery, the available alternatives are percutaneous cholecystostomy and antibiotic treatment.

Percutaneous cholecystostomy, either echo- or CT-guided, may be considered in patients over 65 years of age, with ASA scores III or IV, PF 3 or 4, or with septic shock who are considered unfit for surgery.[13] This treatment can be life-saving in emergency settings in those patients who would not tolerate immediate general anesthesia and surgery, but can also be considered as a bridge-to-surgery intervention.[66,67,68] The cholecystostomy catheter can be removed 4-6 weeks after its positioning, following a thorough study of the biliary duct with cholangiography.[69,70]

Empirical broad-spectrum antibiotic treatment may be reserved for those patients "not fit" for surgery, whose clinical, laboratory, or radiological findings are not striking enough to proceed with a percutaneous cholecystostomy.[13]

In the case of associated biliary lithiasis, the patient may undergo preoperative, intraoperative, or postoperative ERCP.[71,72]

Acute appendicitis

Acute appendicitis is typical of the youth; only 10% of cases occur in patients aged 60 years or older,[73] in whom it is linked to more complications and mortality, due to frequent diagnostic and therapeutic delays. Divergent clinical presentation is recurrent in the geriatric patient and it includes atypical symptoms, late diagnosis, perforation, and septic complications:[74,75] in older patients, the rate of perforated appendicitis reaches up to 50-70% of cases, compared to 20-30% in the young.[76,77]

Typical clinical manifestations (fever, pain in the right abdominal quadrants, and leucocytosis) occur in only 10-26% of patients past 60 years of age;[78] this is due to age itself (reduced nerve sensitivity and abdominal musculature hyposensitivity), to the patient's comorbidities (*i.e.*, diabetes or cognitive decline) and the possible intake of pain-relieving or steroid drugs for other reasons, which increases the risk of perforated appendicitis upon admission.[79] Literature documents indeed that the perforation risk is much higher in patients over 80 years of age, even compared to patients aged between 60 and 79 years; this appears to be related to the common diagnostic and therapeutic delay linked to a reduced perception of pain, loneliness, comorbidities, limited physiological reserve, differential diagnosis with other typical geriatric diseases, and a higher chance of prior abdominal surgery: all these factors increase the overall surgical risk compared to younger patients. It has been observed that surgeons are often hesitant to operate on an 80-year-old patient and tend to favor non-operative treatment until explicit clinical-laboratory worsening: this delay only worsens the risk of complicated appendicitis.[80] Moreover, this setting requires a multidimensional evaluation of the geriatric patient to discern the best clinical and operative path taking advantage of the several scores that allow risk stratification, proper communication with the patient and family members, and receiving assistance from a geriatric consultant in post-operative period to decrease complications, length of stay and rate of institutionalization.

Acute bowel obstruction

Key risk factors for the development of mechanical bowel obstruction are prior abdominal surgery (especially pelvic surgery), malignant pathology, hernias, volvulus, and recurrent diverticulitis; uncommon ones involve chronic inflammatory diseases and impacted stones. Diagnosis is based on clinical and radiological examinations, especially CT scans without and with i.v. contrast, which allows differential diagnoses.[81,82] In the literature, only a few scattered studies focus on geriatric emergency surgery due to intestinal obstruction, surgical strategies, and morbidity-mortality rates.[83] Early mortality rate (within 30 days after the surgical act) appears to be higher in older patients rather than the younger ones (9.1-23.5% in the elderly versus 0-3.2% in the young patient);[83] likewise, intra-hospital mortality was found to be around 18.2% in the geriatric patient and roughly 8.9% in the non-geriatric patient.[84] Length of stay is longer in older patients, with a greater risk of developing medical complications linked to hospitalization itself.[85] On the other hand, the resection rate, which is primarily related to vascular ischemia secondary to a protracted intestinal occlusion, has no statistically significant differences between the two groups.[84] Moreover, geriatric patients tend to be admitted to the Emergency Department at a worse and more frequently complicated stage of the pathology at issue, worsening de facto the surgical outcome compared to the non-geriatric patient, despite appropriate timing: clinical presentation delay decreases the efficiency of subsequent rehydrating treatment, electrolytes' management, and gastric decompression with a nasogastric tube, thus increasing the urgency of a surgical approach.[84] Furthermore, in geriatric patients, mechanical occlusion may have a more frequent neoplastic origin, with a higher rate of ostomy packing.[84] 30-day mortality is significantly higher in patients with mechanical occlusion of the large intestine (with evidence of intrinsic neoplastic origin in 60-70% of cases).[81,86-90]

Mesenteric ischemia

Mesenteric ischemia can affect both the small and large bowel and is characterized by a mortality rate of 20-80% in the adult population regardless of age.[91,92] The main pathogenic factors include atherosclerosis, which is the most common cause in geriatric patients,[93] cardiac arrhythmias and valvular disease, vasoconstrictor drugs, and hereditary coagulation disorders.[94,95] The appearance of acute symptoms demands a speedy treatment, proceeding with an emergency laparotomy, possible revascularisation, and potential intestinal resection if needed.[96] According to the literature, 30-day mortality is around 31.5% in patients aged 65 years or older undergoing emergency surgery for mesenteric ischemia.[97] Usual complications include difficult weaning from the ventilator (30%), post-operative septic shock (22.4%), pneumonia (19.9%), and unexpected intubation (10.8%).[97] Preoperative factors that increase mortality and the risk of post-surgical complications are preoperative septic shock,[92,97] terminal renal failure undergoing dialysis,[97] reduced respiratory function[97,98,] and a history of recent unintentional weight loss,[97,99] which can be considered as an indirect indicator of frailty and sarcopenia. It has been observed that without these risk factors mortality rate is drastically reduced, with a 30-day survival rate of 84% in patients from 65 to 80 years of age undergoing emergent surgical treatment for mesenteric ischemia.[97] Literature has demonstrated that mesenteric ischemia, even in geriatric patients, is no longer a sure death sentence, but requires individual risk stratification based on primary diagnosis, patient's age, specific preoperative comorbidities, and expected outcome.

Treatment and palliation of surgical emergencies in geriatric patients with colorectal cancer

The incidence of colorectal cancer (CRC) increases with age: the average age of diagnosis is 68 years in men and 72 years in women.[100] More than one-third of cases are diagnosed in an emergency setting,[101] especially in older patients.[102-104] Advanced age, social deprivation, and belonging to an ethnic minority are the main risk factors for an emergency ED presentation of colorectal cancer.[105] Emergency treatment of CRC is generally associated with a worse prognosis, related to the recurrent presence of occlusion, perforation, and locally advanced or metastatic disease, leading thus increased morbidity and mortality.[106]

Pre-operative assessment

The choice between palliative or radical curative treatment is crucial in the preoperative stage. The emergent nature of the situation often precludes a multidisciplinary assessment with an oncological discussion, so it is mandatory to acquire as much information as possible about the patient, his or her pathological history, lifestyle, social and family support, and associate it with clinical, laboratory, and radiological data, to estimate post-surgical morbidity and mortality, oncological prognosis and functional recovery in the medium and long term:[40] i) predicting post-surgical morbidity and mortality: in case of emergency admission for CRC, the major risk factors for adverse surgical outcomes are: proximal colon damage and/or peritonitis, being aged over 75 years old, comorbidities, advanced neoplastic stage, hemodynamic instability.[107-111] The prevailing risk factor is the patient's frailty.[19] The surgeon has many validated scores (e.g. P-POSSUM, fTRST, TEGS-FI, etc.) including the CT-scan assessed value of sarcopenia available to attain the most objective information as possible; ii) on the state of frailty and the consequent risk of postoperative morbidity and mortality;[40] iii) oncological prognosis: abdominal CT scan without and with contrast medium provides information on the patient's status (presence of perforation, peritonitis, sarcopenia, other pathologies), on the oncological stage (locoregional and distant neoplastic extension) and bowel status (dilation, possibility of endoscopic stent placement, choice of possible ostomy site).[40] The presence of perforated bowel is associated with a negative outcome and appears to expose the patient to an increased risk of peritoneal carcinosis (between 14% and 45% of cases);[112] iv) predicting functional recovery in the medium and long term and the consequences of a possible ostomy: functional recovery depends on the patient's preoperative morbidity and frailty, but also his/her social and family support. This is essential to understand what the patient's priorities and goals are, to determine what level of health status the patient would find acceptable, and to discuss palliative treatment and possible definitive ostomy placement with the patient and family members.[113]

Surgical treatment

In the case of bowel perforation the primary goal is to control sepsis and only secondarily malignancy, performing a damage-control surgery in case of a hemodynamically unstable patient with a good performance status.[40]

In case of intestinal obstruction caused by colorectal cancer, the surgical treatment is affected by the neoplasm's site: a right colon localization can be treated surgically with right hemicolectomy and possible intestinal anastomosis if the neoplasm is resectable, or alternately with a decompressive ileostomy in locally advanced disease or patient instability;[40] a rectal location should be treated with

decompression with an ostomy or, if the neoplasm appears easily resectable, with a Hartmann sigma-rectal resection (stenting in rectal cancers is more commonly associated with pain and stent migration);[40] left colon localization may be treated with endoscopic stent placement or with ostomy as a bridge to surgery if a radical resection is programmed. The timing of the second surgical act may fluctuate from 7 to 10 days within the same hospitalization, or require a new hospitalization. In the case of palliative surgery, stent placement or ostomy may be definitive in the absence of any further surgical indications.[114-118]

For stage IV tumors, in patients with good PF, a resection of the primary tumor despite the absence of resectable metastases or a bridging treatment to demolitive resection may still be taken into consideration.[119] Evidence of peritoneal carcinosis diverts the surgeon's therapeutic choice towards a non-invasive treatment or a palliative ostomy.[120]

Both in the case of palliative and radical surgery, a laparoscopic approach should be preferred, as it is associated with lower pain and faster recovery in the postoperative period.[121,122]

Post-operative management

Older patients admitted to the ED for colorectal cancer needing emergency surgery have a higher risk of post-operative morbidity and mortality than patients undergoing elective surgery.[102,123,124] Early mobilization, optimization of fluid therapy, early oral nutrition, and the use of non-opioid analgesics grant a faster patient recovery[125,126] and prevention of postoperative delirium,[127] in the meanwhile a personalized geriatric assessment after surgery can help the surgeon in the prevention and management of post-operative morbidity and in planning hospital discharge.[128]

Damage control surgery

Damage-control surgery is widely recognized as a life-saving technique in unstable trauma patients or patients with severe surgical pathology treated in an emergency setting to allow further resuscitative maneuvers before undertaking definitive surgery.[129] The basic principles of damage-control surgery are the control of hemorrhage and peritoneal contamination, with a significant reduction in operating time, and the packing of a laparostomy, so that further resuscitative maneuvers can be performed in an intensive care setting and, once the patient is stabilized, proceed with curative surgery[130] 24-48 hours later.[131] The enactment of these damage-control surgery principles in older patients has demonstrated a reduction in mortality, ostomy rate, and time-lapse before subsequent ostomy closure.[132-134] Damage-control surgery followed by reintervention within 24 and 48 hours has not highlighted any significant difference in morbidity, mortality, or abdominal-wall closure rate in elderly patients compared to regular adult ones.[135] Damage-control surgery is thus feasible and should be considered in the geriatric patient after careful preoperative assessment and patient stratification to avoid "unnecessary" surgical procedures in extremely frail and compromised patients for whom the line between necessary and inappropriate treatment may become very blurred.

ERAS in emergency surgery in the elderly

The application of ERAS (Enhanced Recovery After Surgery) ideals in addition to a laparoscopic surgical approach in emergency surgery settings has shown benefits regarding morbidity, mortality, and length of stay in post-operative care.[125] In an emergency setting the ERAS protocol is not fully applicable in its entirety, but some features, such as early mobilization, optimization of fluid therapy, early nutrition, and non-opioid analgesic therapy can be implemented in the post-operative setting to thwart complications and encourage rehabilitation.[40]

Early mobilization wards off loss of muscle mass and decreases pressure ulcers, deep vein thrombosis in the lower limbs, respiratory complications, and delirium, if supported by appropriate fall prevention protocols. Early post-operative rehabilitation programs have proven safe and effective in fending off and lowering functional decline in hospitalized acute geriatric patients, including those who have undertaken emergent abdominal surgery.[136,137]

Optimization of fluid therapy, along with a daily input/output fluid balance is crucial, especially in patients undergoing massive intraoperative liquid infusions. Geriatric patients encounter on one side a high risk of hypervolemia and congestive heart failure, paralytic ileus, and edema;[46] on the other side, dehydration is associated with acute renal failure and delirium.[138]

Nutrition plays a cardinal role in the geriatric patient's rehabilitation. These patients often present with malnutrition (5.8-50.5%)[139] due to long periods of fasting or inappetence. The combination of metabolic disorders, malnutrition, and sarcopenia relates to a limited ability to respond properly to surgical stress in the short, medium, and long term.[140,141] One of the key goals is thus to restore oral food intake as soon as possible and to potentially start supportive nutritional therapy should any surgical risks arise.[141]

Conclusions

The physical, psychological, and social characteristics of a geriatric patient depict him or her as more fragile and vulnerable. Advanced age is associated with an increased risk of comorbidity and loss of autonomy, as well as a decrease in life expectancy. Geriatric age does not necessarily correlate with frailty, which indeed has a linear, but not univocal, trend with age. Frailty is also associated with an increased risk of all complications and death, after both elective surgery and emergency surgery. Yet, despite the ability of elective surgery to assess the geriatric patient in a multidisciplinary manner and properly prepare him/her for the upcoming surgical stress, this is not feasible in acute situations, where the time factor is crucial. Therefore, several fragility scores have been developed over the years to allow a preoperative assessment of the urgent surgical patient, to estimate the risk of morbidity and mortality, and to guide the surgeon toward the proper therapeutic or palliative treatment and limit the risk of complications in the postoperative period through the adoption of measures tailored to each patient. Many studies have managed to appraise the benefits of the different scores in an emergency setting in the geriatric patient, whereas there are still only a handful of studies to have analyzed the outcomes of a specific urgent surgical procedure performed in the geriatric patient applying one or more specific scores. These considerations certainly give rise to further pondering and discussion, given the constant aging of the general population and the increase in life expectancy even in frail patients.

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