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Preoperative diagnosis of frailty

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Abstract

The aging world population obliges physicians to establish measures to optimize and estimate the outcomes of increasingly frail patients. Thus, in the last few years there has been an increase in the application of frailty indices. Multiple scales have emerged that can be applied in the perioperative setting. Each one has demonstrated some utility, either by way of establishing postoperative prognosis or as a method for the clinical optimization of patient care. Anaesthesiologists are offered a wide choice of scales, the characteristics and appropriate management of which they are often unaware. This narrative review aims to clarify the concept of frailty, describe its importance in the perioperative setting and evaluate the different scales that are most applicable to the perioperative setting. It will also establish paths for the future optimization of patient care.

Keywords

Frailty, aged, preoperative frailty, risk assessment, scales frailty, preoperative care, geriatric assessment

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Introduction

What is frailty?

In 1994, Rockwood et al.[1] concluded that patient mortality was associated more with biological age than with chronological age.[2] Therefore, patients of the same chronological age and with identical diseases yield varying results based on their biological age. Frailty is a broader term, which as

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a biological concept can also be observed in younger people. Frailty is a complex and multifactorial syndrome that involves aging, chronic inflammation, malnutrition, physical inactivity, genetic factors, chronic conditions or diseases, polypharmaceutical and psychosocial factors.[3] Individuals of the same chronological age may vary widely in their functional status. Frailty should be distinguished from comorbidities or disabilities, although these three entities may be related.

Frailty is defined as a clinically recognizable state of increased vulnerability due to decreased physiological reserve and function. This syndrome is associated with impairment of multiple physiological systems, thus affecting the ability to adapt (reduced resilience) to stressors (acute illness, injury or psychological stress). In 2001, Fried et al. defined frailty operationally, requiring the fulfilment of three of the following five phenotypic criteria: loss of strength, unintentional weight loss, feeling of exhaustion, slow walking and low physical activity.[2–4]

The biological mechanisms causing frailty are believed to be the result of cumulative cellular damage throughout life. Although the specific pathophysiological pathways underlying this syndrome are not yet clearly understood, it is well established that inflammation is likely a clear factor in the development of frailty. Proinflammatory cytokines may influence frailty directly by promoting protein degradation or indirectly by altering metabolic processes.[5]

Frailty occurs when multiple physiological systems are impaired. The more physiological systems that are in a diminished state, the greater the likelihood of frailty. Although physiological systems lose some of their homeostatic reserve at older ages, there is a reserve buffer. However, repair mechanisms cannot maintain system homeostasis when the critical buffer threshold is exceeded.[5]

How important is frailty in the perioperative period?

Frailty increases vulnerability to external stressors, resulting in adverse outcomes such as functional impairment, institutionalization and death. In both elective and emergency surgery, frail patients experience worse outcomes compared with non-frail older people.[6]

People over 65 years of age are the fastest growing group in the western world.[7] This demographic change has led to a greater demand for surgery in older patients. The prevalence of frailty in the general population is not exactly known, although it is estimated to be between 6–10% in the general community.[8] Patients who undergo surgery, both emergency and elective, would present a higher percentage of frailty, around 25–56%. For example, the majority of adults admitted to hospital for hip fracture requiring surgery are frail.[6,9]

Assessment of the risk of experiencing an adverse surgical outcome in older adults has historically been based on biological age and pre-existing medical comorbidities.[3,6,10] Some surgical risk stratification tools are as follows: (i) the American Society of Anesthesiologists (ASA) Physical Status Classification; (ii) the Acute Physiology and Chronic Health Evaluation; (iii) the Physiological and Operative Severity Score for the enumeration of Mortality and morbidity; (iv) and the Goldman Cardiac Risk Index.[11] However, the predictive accuracy of these tools depends on multiple variables, such as the patient population to be evaluated, the surgical indication and the procedure performed. The main limitation of these risk stratification strategies may be their inability to capture the physiological

impairment present almost exclusively in older adults.[12]

Preoperative frailty in elderly patients is associated with a higher rate of postoperative complications, independent of age, surgical discipline and surgical risk. It is also associated with a significant increase in hospital stay and non-home discharges, as well as an increase in long-lasting physical and cognitive disability after surgery.[13–18] Frailty has been shown to improve the predictive power of each risk index (Lee and Eagle scores and ASA physical status).[11] These findings have been confirmed in various surgical specialties, including cardiac, thoracic, orthopaedic, digestive, otorhinolaryngological, urological and oncological surgeries.[19–25] Underlying cognitive impairment is a well-known risk factor for many different postoperative complications, including delirium. This complication is also associated with other adverse outcomes, such as discharge to a post-acute care facility and loss of independence in instrumental activities of daily life. Therefore, preoperative assessment of frailty allows for an adequate perioperative management of the resources required in order to prevent perioperative death and complications.

This narrative review aims to clarify the concept of frailty, describe its importance in the perioperative setting and evaluate the different scales that are most applicable to the perioperative setting. The review will also establish paths for the future optimization of patient care. For this review, articles published in English up to December 2023 were searched for in the PubMed® database, using the following terms: "Frailty" AND "preoperative" AND "diagnosis". This review contains mainly clinical guidelines, as well as systematic and narrative reviews. It discusses updated knowledge in order to unify and make the need to incorporate the diagnosis of frailty in the preoperative setting easily understandable. This review is guided by the scale for the assessment of narrative review articles.[26]

Frailty assessment

What should be measured in frailty?

Regardless of the frailty tool used, in order to apply it in practice, it is necessary to define it. The frailty scales evaluate indicators and characteristics that must include the evaluation of several areas, such as physical health, functional capacity, mental and emotional health, cognition, nutrition, history of falls, comorbidities or social support.[9,10,27]

How can frailty be assessed?

There are two classic models for measuring frailty. In 2001, Fried et al.[4] proposed their traditional 'phenotypic' model. In the same year, Mitnitski et al.[28] also published their 'cumulative deficit' model, which considers not only the physical components of frailty, but also psychosocial aspects. Both frailty models (phenotypic and cumulative deficit) have been validated in several populations and environments;[1,4,5] and both have been used in multiple frailty scales, separately or combined.[29] However, no scale completely evaluates all components at the same time, so there is still no consensus on which is the most appropriate. Since the different tools have different conceptual models, they are not overlapping.[30]

It could be considered that the gold standard for the evaluation of frailty would be a comprehensive geriatric assessment (CGA) carried out by expert personnel.[9] Unfortunately, it is not possible to perform this assessment routinely in the clinical setting. A CGA is a dynamic and structured diagnostic process that allows for detecting and quantifying the problems, needs and

abilities of the elderly in the clinical, functional, mental and social areas. This quantification allows for the development of an interdisciplinary strategy for intervention, treatment and long-term follow-up, to optimize resources and achieve a greater degree of independence and, consequently, a better quality of life.

What scales do we have for measuring frailty?

The most used and validated frailty scales in the perioperative period are the following:[31] (i) Fried Frailty Phenotype: Extracted from the Cardiovascular Health Study, this scale considers frailty based on the patient's physical characteristics or phenotype. It defines frailty as a biological syndrome characterized by energy depletion, such that a patient who presents three or more of the following criteria is considered frail: unintentional weight loss of at least 4.5 kg in the last year, weakness (low grip strength), feeling of exhaustion, slow walking speed and little physical activity. These five components are considered indirect measures of dysregulation in stress response and energy metabolism. In multiple epidemiological studies, this scale has been associated with adverse outcomes, including mortality. Despite its widespread use, a major factor impeding its application is the inclusion of measurements that are not routinely used for patient assessment, such as grip strength. It also does not include the psychosocial components of frailty;[4,5,29] (ii) Frailty Index or index of accumulation of deficits (FI-CD): Proposed as a way to incorporate the multidimensional nature of frailty in an operational definition, it considers 70 items extracted from the Canadian Study on Health and Aging. An index is calculated between the number of items detected and the number of items evaluated. The greater the number of deficits, the greater the frailty. FI-CD is based on the biological causal theory of 'cumulative deficit', involving the following domains: comorbidities, cognition, exhaustion, mobility, mood, nutritional status, social vulnerability, disabilities or any health deficiency. Currently, its predictive capacity is more related to the total score than with the characteristics of deficits. However, it is stated that deficits included should meet the following characteristics: to increase their incidence with age without having a limit and to reflect a variety of physiological systems. Several studies have found that FI-CD has a greater ability to predict adverse clinical events than other frailty measures in both hospital and community settings. Furthermore, it is believed that there is an upper limit (around 0.67), beyond which survival is unlikely. Despite its many positive attributes, its calculation can be time-consuming.[2]

Subsequent revisions of the FI-CD have developed new scales with a smaller number of items that may be more relevant for the surgical environment and correlate well with mortality and complications: (i) Modified Frailty Index-11 (mFI-11): After reviewing the National Surgical Quality Improvement Program Participant Use File for the years 2005–2009 for inpatient surgical patients who had undergone cardiac, general, gynaecological, neurosurgical, orthopaedic, otorhinolaryngological, plastic, general thoracic, urological and vascular surgeries, a simple 11-point frailty index was extracted. This index has been shown to correlate with both 30-day mortality and morbidity for all surgical specialties and may be applicable to other national databases and clinical practice;[32] (ii) Modified Frailty Index-5 (mFI-5): It is a concise risk stratification tool that has been shown to predict the occurrence of adverse postoperative outcomes among all surgical subspecialties.[29] The mFI-5 score is calculated based on the presence of the following five comorbidities: congestive heart failure in the 30 days before

surgery, diabetes mellitus, chronic obstructive pulmonary disease or pneumonia, high blood pressure requiring medication and degree of dependence on the time of surgery.[33] Although both Modified Frailty Index scales have been widely used, and are quick and easy, they have been criticized for the little information they provide, and their failure to use relevant variables that reflect the typical physiological dysfunction of frail patients.

Other widely used and validated frailty scales in the perioperative period include the following: (i) Edmonton Frailty Scale: This scale contains nine components: cognition, general health, self-reported health status, functional independence, social support, polypharmacy, mood, sphincter continence and functional performance. The scores of the different components are totalled to classify the severity of frailty as non-frail (0–5), apparently vulnerable (6–7), mildly frail (8–9), moderately frail (10–11) and severely frail (12–17). A unique and distinguishing feature of this scale is the assessment of the social support domain, suggesting the consideration of frailty as a dynamic state. This is a valid and reliable tool for the identification of frailty in the hospital setting and surgical population. Of note, this scale has been validated in staff without formal training in geriatric care, making it practically and clinically meaningful;[34] (ii) FRAIL Scale: Proposed by the International Association of Nutrition and Aging, this scale only requires answering five simple questions and does not require the physical attendance of the patient. It includes the following components: fatigue, endurance, ambulation, illness and weight loss. Scoring of this scale is performed by giving 1 point to each component. Finally, patients are classified according to the final score into frail (3–5), pre-frail (1–2) or robust (0) health status. This scale is considered to be clinically useful due to its simple nature and its ability to be derived from data included in the geriatric assessment of a patient. It is capable of predicting mortality in certain populations and is useful for assessing frailty in the community and hospitalization. However, it has yet to be validated in the perioperative period;[35,36] (iii) Clinical Frailty Scale (CFS): This tool is based on a clinical judgment that assesses three domains: comorbidity, function and cognition. Thus, a score from 1 to 9 is generated as follows: 1, very fit; 2, well; 3, more or less well; 4, vulnerable; 5, mildly frail; 6, moderately frail; 7, severely frail; 8, very severely frail; and 9, terminally ill. Those patients considered 'not frail' have a score of 1–3; 'pre-frail' for a score of 4 and 'frail' for a score $\geq$5. CFS can be extracted from medical records and has been validated as a predictor of adverse outcomes in hospitalized elderly and surgical populations. An increase of one CFS category predicts increased 6-year institutionalization (23.9%) and mortality (21.2%). It also correlates with increased 30-day mortality after cardiac surgery and general surgery;[14,29] (iv) Groningen Frailty Indicator: This measure of frailty is widely used in the Netherlands. It contains 15 self-reported dichotomous items, comprising physical factors (independence in shopping, walking, dressing, using the toilet, physical fitness, vision, hearing, weight loss and polypharmacy), a cognitive component (memory problems), social factors (loneliness, missing others, feeling abandoned) and a psychological component (feeling discouraged or sad, feeling nervous or anxious). This scale classifies frailty on a spectrum ranging from a score of 0 (normal activity without restrictions) to 15 (completely disabled), with scores $\geq$4 indicative of frailty. It is widely used in the field of community medicine;[37] (v) Vulnerable Elderly Survey (VES-13): This is a 13-item-based scoring system that considers age, self-assessed health, limitation in physical function and functional disabilities. It has been rated as the screening

instrument that best predicts postoperative complications after emergency abdominal surgery;[12,38] (vi) Risk Analysis Index: This is an 11-variable weighted metric designed to elucidate preoperative risk. This index is one of the most validated measures of surgical frailty, has a very good internal validity and has been applied in different surgical specialties. Its development was performed with robust methodology, calibrated to predict postoperative mortality and morbidity, using data such as patient demographics, place of residence, cognitive status, functional independence and clinical factors. The ease and speed of its application, which avoids the disruption of clinical practice, has promoted its increasing use.[39]

Other frailty tools developed are the following: (i) Osteoporotic Fracture Study Index: This index considers frailty from its phenotypic nature. Frailty is classified as the presence of more than two components out of the following three: weight loss (intentional/unintentional more than 5% in the last year), exhaustion (if the patient answers 'no' to the question 'do you feel full of energy?') and low mobility (inability to get up from a chair five times). Therefore, this scale is easy to apply, valid and reliable, and it has been shown to be a good independent predictor of adverse outcomes in non-hospitalized elderly;[5] (ii) Gérontopôle Frailty Screening Tool: is designed for early recognition of frailty in community-dwelling older people. It consists of two steps: first, a questionnaire is carried out, followed by the doctor's clinical judgment about the state of frailty. After the initial six screening questions, the clinician should answer the following question: 'Do you think your patient is frail?' It is designed to be performed on people over 65 years of age without physical disability and acute clinical illness.[40]

Individual factors underlying frailty can also be used to detect frailty as follows: (i) Gait speed: This measurement is probably the best indicator of frailty among the components that are included in the Fried scale. Gait speed is clinically applicable. However, it may overestimate frailty, and there may be difficulties in adequately measuring gait range in a clinical setting. This variable is closely associated with adverse health outcomes in older people;[29] (ii) Sarcopenia: This biological and functional marker of frailty can be objectively quantified and its assessment is independent of patients' collaboration. Quadriceps measurement by computed tomography (CT) is a good assessment of sarcopenia and frailty in the surgical setting. However, it is only clinically reasonable in those settings where the patient requires a preoperative CT scan as part of the perioperative standard of care. Recently, due to the surge in interest in the introduction of echography into clinical practice, ultrasound assessment of quadriceps thickness has been investigated to screen for sarcopenia in patients admitted to the intensive care unit (ICU). It is a cheap, fast and non-invasive method, which does not require patient collaboration, and is especially useful in emergency surgery where time or access to clinical history is lacking.[41] Table 1 summarizes some of the characteristics of several of the most frequently used scales to determine the extent of frailty.

What scale should be chosen?

What limitations do we find when it comes to measuring frailty?

As noted above, there are a wide variety of scales that assess frailty. Some barriers to the use of frailty in clinical practice have been defined that include the lack of consensus on the definition of frailty, the lack of a treatment for this entity and the few clinical studies that demonstrate a clear benefit on the optimization of the frail patient.[42] Furthermore, the main limitation

Table 1. Summary of some of the characteristics of several of the most frequently used scales to determine the extent of frailty.

	Frailty Index Cumulative Deficit	mFI-11	Edmonton Frailty Scale	FRAIL Scale	Fried Frailty Scale	Clinical Frailty Scale	Groningen Frailty Indicator	Gait speed	Sarcopenia
Frailty model									
Phenotypic	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cumulative deficit	Yes	Yes	Yes	Yes	No	No	No	No	No
Length									
Long	Yes	No	Yes	No	Yes	No	No	No	No
Short	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Staff training required	Yes	No	Yes	No	Yes	No	No	No	Yes
Equipment required	None	None	Chronometer/ drawing materials	None	Dynamometer	None	None	Chronometer/ space	Ultrasound
Need for patient collaboration	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Target									
Risk estimation	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes
Diagnosis	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

mFI-11, modified Frailty Index-11.

when choosing a specific scale is that most of them have been established from the retrospective analysis of large databases, but more evidence is still needed to validate their consistency and reliability. The perfect scale would be one that adapts to the specific physiological situation of the patient and that can be applied quickly at the point of care. Although many authors consider a CGA as the standard, there is no fully validated tool to evaluate frailty in the perioperative environment. So, the ability of each tool to diagnose a frail patient cannot be calculated with acceptable sensitivity and specificity values in this setting. Among the main limitations in choosing a scale as the only one include the following:[5] (i) lack of consistency, validity and reliability of scales. The different scales have been designed and validated for certain types of patients, making it difficult to extrapolate them to other populations. When attempting to create a correspondence between different frailty scales, it has been concluded that some frailty tools categorize more individuals as frail than others despite assessing similar domains.[43] Even if similar risk stratification thresholds could be established between frailty indices, the intersection of patients identified as frail is complex and does not completely overlap. Despite this lack of correlation among the different scales, most of them are capable of predicting mortality and long-term institutionalization in the non-surgical population;[30] (ii) some scales require collaboration from patients when they are unable to do so. Cognitive or physical alterations, as well as the highly stressful situation, can make it difficult for patients in the perioperative setting to collaborate on certain scales, which cause an overestimation of frailty; (iii) others take a long time to perform the measurement. In addition, some require specific equipment, such as a grip strength dynamometer. Moreover, some scales must be carried out by trained personnel; (iv) lack of awareness by hospital management concerning the importance of frailty in the perioperative environment, as well as the lack of sufficient preoperative planning to carry out an assessment of perioperative frailty that allows for their optimization prior to surgical intervention.

Numerous guidelines recommend routinely assessing frailty preoperatively, recognizing its important role in predicting the postoperative outcome of elderly surgical patients. These statements come from multidisciplinary and international societies, such as: (i) recommendations for preoperative management of frailty from the Society for Perioperative Assessment and Quality Improvement; (ii) the Centre for Perioperative Care and the British Geriatrics Society have worked together to develop the Guideline for Perioperative Care for People Living with Frailty Undergoing Elective and Emergency Surgery; (iii) peri-operative care of the elderly 2014: Association of Anaesthetists of Great Britain and Ireland; (iv) American Geriatrics Society (New York) and American College of Surgeons, the Association of Anaesthetists of Great Britain guidelines on perioperative care of older people in Ireland (London, United Kingdom) and the Society for Perioperative Assessment and Quality Improvement guidelines on perioperative management of frailty.[27,44] As it has been highlighted above, there are multiple barriers to instituting routine preoperative frailty assessment. In addition, although evidence suggests that it is not yet part of the routine preoperative practice in most settings,[45] efforts are being made to incorporate preoperative frailty diagnosis to optimize the patient through prehabilitation programmes.[46]

Based on limited but consistent data, the CFS seems to be the most feasible instrument among those commonly studied, as it does not require additional tools or physical subdomain scoring measurements. Furthermore, this scale is significantly

faster than the Fried Frailty Phenotype.[45] In the urgent surgical setting, the assessment of frailty is even more difficult. However, both the VES-13 and mFI-11 scales seem to be useful in predicting morbidity and mortality 30 days postoperatively, with acceptable sensitivity and predictive values.[12,46] In non-cooperative patients (with cognitive impairment or immobility), some studies suggest that there is an association between ultrasound measurement of the quadriceps muscle and the postoperative outcomes.[41] Therefore, this can be a useful complementary test for the detection of frailty because it is rapid, non-invasive and applicable at the patient's bedside without his or her collaboration.

Preoperative consultation provides a great opportunity to detect and evaluate frailty. The scale to be chosen in this situation should be adapted to the type of surgery, the population and the available resources, as well as the objective pursued (evaluate the risk of mortality, disability, ICU admissions or delirium). Thus, several preoperative strategies have been proposed from the application of a single tool or simple measure, to the use of somewhat more elaborate algorithms that include an initial screening tool, and subsequently a tool for a more complete assessment. This approach should be optimally carried out through multidisciplinary teamwork that manage the different domains of frailty throughout the perioperative period.[47]

Since 2014, the British Geriatrics Society has developed a guideline to manage surgical patients living with frailty (Guideline for the care of people living with frailty undergoing elective and emergency surgery that encompasses the whole perioperative pathway). The following strong recommendations are included in this guideline;[27,44] (i) all patients over 65 years and those younger at risk of frailty referred for elective or emergency surgery should have their frailty status documented using the CFS at the time of referral, preoperative evaluation and admission; (ii) all patients living with frailty (CFS > 5) should undergo a CGA and optimization prior to surgery, adapted to the available time; (iii) all patients with CFS > 5 should have a documented preoperative cognitive assessment using a validated tool; (iv) all hospitals should have a perioperative frailty team with CGA experience providing clinical care throughout the process; (v) all hospitals should designate a clinical lead for perioperative frailty.

Subsequently, in 2021, the Guideline for Perioperative Care for People Living with Frailty Undergoing Elective and Emergency Surgery was published, which recommended performing a comprehensive geriatric assessment for adequate frailty assessment and provided further recommendations on perioperative planning of frail patients.[44]

In 2019, the American College of Surgeons partnered with the John A. Hartford Foundation to develop a Geriatric Surgery Verification Program, which recommends the implementation of 32 evidence-based standards. These standards address the entire perioperative period, focusing on organizational issues, equipment, personnel, patient care protocols (preoperative, postoperative and transition of care), data monitoring, quality improvement, professional and community outreach and research.[48] This programme was developed to support hospitals in seeking to provide better, safer and more equitable care to all patients, regardless of their age. Thus, it has the potential to transform clinical practice in all surgical specialties.[49]

The Veterans Health Affairs "Surgical Pause" Program also systematized preoperative frailty screening. Patients selected for this programme were not scheduled for surgery until a team performed a risk assessment and clarified goals of care. Physicians from Orthopaedic Surgery, General Surgery and Traumatology, Critical Care

Medicine, Palliative Care and Hospitalization communicated with each other to reach consensus on expected clinical outcomes with different management options, including surgical and nonsurgical management. This consensus should be reached in less than 24 h. Then, a team member meets with the patient to describe these options, learn about his or her goals and values, and identifies the therapeutic path that is best aligned with those goals and values.[50]

What most of the recommendations have in common is that multidisciplinary teams should be established for preoperative evaluation and optimization of frailty, as well as for patients with cognitive disorders and multimorbidity. This would allow for establishing the prognosis, making shared decisions, planning preoperative physical and nutritional conditioning, optimizing management of postoperative complications, planning care in advance, as well as postoperative rehabilitation, and establishing reasonable goals or predicting the appropriate destination after hospital discharge.[44]

Conclusion

Despite advances in perioperative frailty assessment, there are still multiple challenges in this field. Standardization of assessment tools and effective integration of frailty information into clinical decision making require further research and should be a priority. Furthermore, understanding how to address and mitigate risks associated with frailty remains an evolving topic.

Perioperative frailty assessment is a valuable tool to identify patients at risk of suffering from postoperative complications and personalize their surgical care. Frailty evaluation and management strategies have a wide margin for improving and optimizing the perioperative results. Structuring personalized care to detect, evaluate and manage this syndrome in the perioperative period will provide significant progress for these patients and will improve the resource consumption of health institutions. Furthermore, standardizing frailty assessment in clinical practice may provide a means to identify and manage this syndrome in the early stages and perhaps slow its progression.

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