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Instruments for geriatric assessment: new multidimensional assessment approaches

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Abstract

During the last century the considerable increase in life expectancy has led to important demographic changes and, consequently, to new clinical scenarios. Nowadays, chronic conditions, comorbidities and socio-economic factors constitute a relevant health management issue. In particular, the definition of frail elderly individuals has proven to have a strong role in the identification of high-risk patients, their clinical management and prognosis. Reorganization of the medical system has been associated with the development of new instruments for clinical assessment, focused on clinical and socio-economic issues, resulting in a multidimensional geriatric assessment.
A large number of approaches have been validated in different clinical settings and populations, until the development of multidimensional instruments demonstrated to have a crucial role in the identification of frail individuals and in their clinical management. Interestingly, some of these, such as the Multidimensional Prognostic Index (MPI), proved to play a relevant role in mortality risk stratification even in particular clinical settings such as chronic kidney disease.

Key words: *Comorbidity, Elderly, Frailty, Multidimensional assessment*

Introduction

During the last century the considerable increase in life expectancy has led to important demographic changes and, consequently, to new clinical scenarios. Nowadays, chronic conditions, comorbidities, and socio-economic factors constitute a relevant issue for health management. In particular, the definition of frail elderly individuals has proven to play a strong role in the identification of high risk patients, their clinical management, and prognosis. The reorganization of the medical system has been associated with the development of new instruments for clinical assessment, focused on clinical and socio-economic issues, resulting in a multidimensional geriatric assessment.

A large number of approaches have been validated in different clinical settings and populations, until the development of multidimensional instruments was proven to play a crucial role in the identification of frail individuals and their clinical management. Interestingly, some of them, such as the Multidimensional Prognostic Index (MPI), proved to play a relevant role in mortality risk stratification even in specific clinical settings, such as chronic kidney disease.

During the 20th century the demographic revolution of industrialized countries, resulted in an increased life expectancy, achieving a mean-life up to 78 years for men and 84 years for women. The demographic changes lead to a higher incidence of chronic conditions, multiple pathologies, and disabilities with elevated risk of rapid deterioration in health and functional status requiring long-term care needs.

In the past 50 years, chronic disease replaced acute disease as the dominant health problem. Nowadays, chronic diseases are the principal cause of disability and use of health services, consuming 80% of health expenditure. Chronic disease dramatically transformed the role of the caregiver, no less than the role of the patient and its family, turning medical intervention from a predominantly clinical to a multidisciplinary approach (1).

Indeed, advanced age is characterized by a higher prevalence of comorbidities, since the frequency of chronic conditions is age-related (2). Consequently, it is difficult to diagnose and categorize each pathology, which often do not present in a typical manner as they are atypical responses to very common illnesses.

Comorbidity is defined by the concurrent presence of two or more medically diagnosed diseases in the same individual, but both the coexistence of multiple pathologies in the same organ (the so called target-organ comorbidity), and the presence of different pathologies involving different organs and apparatus in the same patient (multi organ comorbidity) can be observed.

The high prevalence of comorbidities in elderly patients is associated with functional impairment resulting in different levels of disability induced by the gradual loss of physiologic reserve (vulnerability) especially present in octogenarians: in this regard, the contribution of evident clinical comorbidity (active comorbidity) when compared to clinically silent comorbidity (passive comorbidity) is prevalent.

The frail elderly

In 1974 the 'Federal Council on The Aging' introduced the term 'frail elderly' to describe people with a high level of disability and critical socio-economic conditions (3). So far, the term 'frail' was occasionally used in scientific literature (4, 5), and, in the eighties, Woodhouse, Buchner and Brocklehurst (6-8) provided a more exhaustive and complete definition. In clinical practice, disabled elderly people are often reported interchangeably as dependent, comorbid, or frail. All these terms describe the most physically vulnerable subset of the elderly population needing enhanced care.

Consequently, the clinical practice of the 20th century had to deal with different typology of patients, where the close interrelationships between frailty, comorbidity, and disability had to be contextualized in the socio-economic setting of each patient. Moreover, comorbidity often means polypharmacy which in turn is responsible for more adverse effects and iatrogenic damage.

Intuitively, the main issue is to identify those high risk patients who present increased vulnerability to stressors, decreased physiologic reserves and multi-system dysregulation, limited capacity to maintain homeostasis and to respond to internal and external stresses. Frailty, disability, and comorbidity are interrelated, since frailty and comorbidity predict subsequent disability; disability may lead to frailty and worsen comorbidity, and frailty could contribute to the progression of chronic diseases (Fig. 1).

The Health and Social System therefore had to provide adequate responses to the demographic changes, aiming to achieve continuous assistance in the services offered to elderly people based on a functional integration between local health units, hospital structures, and social services.

The reorganization of the medical system was based on both therapeutic and rehabilitative issues in order to optimize medical offer and economical expenses. To implement such a policy, an appropriate network of local services, managed by adequately trained and specialized professionals, was created.

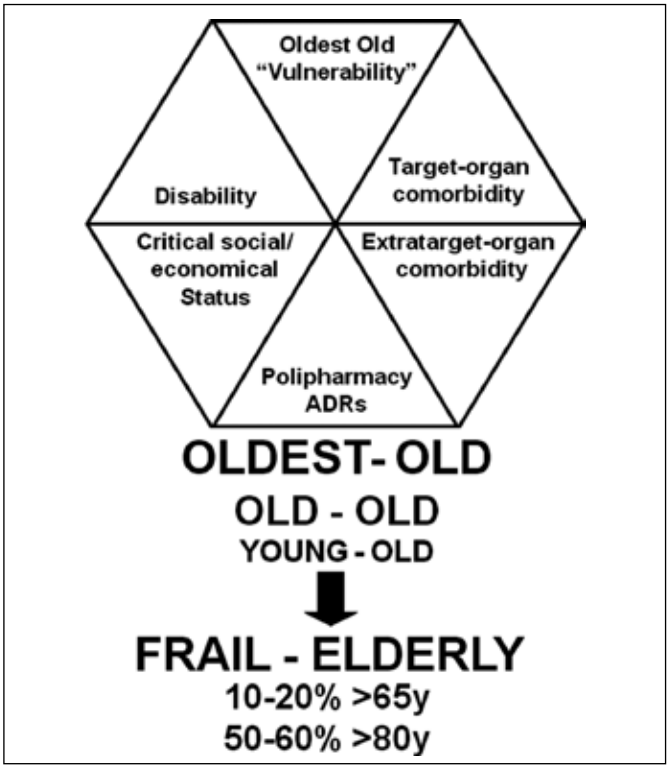

Fig. 1 - Characteristics and prevalence of frailty in the elderly population.

As regards the complexity of the medical approach, it was evident that traditional clinical assessment needed to be integrated with a comprehensive geriatric assessment. Consequently, after the clinical validation by the 'Crichton Royal Behavioural Rating Scale' (9), Fried et al (10) suggested a definition of the term 'frail' based on prespecified clinical parameters, and subsequently identified a schematic approach to define the 'frailty phenotype' (11).

Multidimensional instruments

Since then, researchers identified different multidimensional instruments to identify frailty considering the complexity of the geriatric patient, especially cognitive ability, body function, general mood, and social and economic conditions.

The 'first generation' instruments had specific targets, and was applied to specific elderly populations. In particular, they aimed to identify and stratify the risk in predetermined clinical settings, such as patients with depression, cognitive impairment, physical disability, etc.

Functional ability was determined looking at activities of daily living (ADL) and instrumental activities of daily living (IADL). ADL are self-care activities a person performs daily, while IADL are activities needed to live independently. Two indices have been prepared for an objective assessment of functional ability: the Katz index (12) for ADL and the Lawton index (13) for IADL.

As regards depression, cognition, and mental health, several instruments have been developed, such as the Geriatric Depression Scale (14), the Mini-Mental State Examination (15), etc.

Subsequently, new multidimensional instruments have been introduced, creating global scores including several items that permitted exploring several different aspects of different pathologies and reassuming them in a single, standardized, and simple score, such as the Functional Independence Measure (FIM), Canadian Study of Health and Aging (CSHA), Clinical Frailty Scale, CSHA Frailty Index, MPI; etc.

FIM was introduced in 1983 and represents one of the first and more diffused 2nd generation instruments. The main purpose was to create a generic measure that could be administered by clinicians to assess patients in all age groups with a wide variety of diagnoses and to measure the patient's progress and assess rehabilitation outcomes (16). FIM assesses physical and cognitive disability taking into account 18 items scored on the level of assistance required to perform activities of daily living. The motor subscale (13 items) collects information involving self-care, sphincter control, transfer, and locomotion, while the cognitive subscale (five items) focuses on communication and social cognition. Each item is scored from one to seven, where one represents total dependence and seven indicates complete independence. FIM is the major source of functional status and has clinical and administrative repercussions.

On the one hand, a high score at the time of admission reveals an improper indication at hospitalization, while very low scores identify patients that still need in-patient intensive care and are not yet susceptible to rehabilitation. On the other hand, an incremented FIM score at the time of discharge identifies successful rehabilitation. Moreover, the relationship between improvement in FIM score and days of hospitalization detects clinical efficiency (16).

Subsequently, Fried et al (10), in a study performed on 5317 individuals from the Cardiovascular Health Study, identified the characteristics able to detect the frailty phenotype, that were then combined into the frailty phenotype index (PFI); in particular, they assembled a multidimensional assessment comprised of five simple items: slow walking speed, impaired grip strength, self-reports of declining activity levels, exhaustion, and unintended weight loss. People with three or more of these deficits were defined as frail and those with none were said to be robust, while the presence of only one or two of these deficits identified a "pre-frail" status. Frailty phenotype predicted adverse outcomes such as: falls, hospitalizations, disability, and death. In the population of this study the prevalence of frailty was 7% and the overlap, in the presence of both frailty, comorbidity, and disability was just 21.5%. Indeed, such an instrument could be adopted univocally in a preclinical setting, being untrustworthy in hospitalized patients in whom the active pathology is strongly associated with prognosis.

In 1987, in USA, the Nursing Home Reform Act introduced the RAI-MDS (Resident Assessment Instrument Minimum Data Set) (17) a new multidimensional instrument ideated to guide admission to and residence in nursing homes. It was validated and became obligatory in 1991. The key role of RAI-MDS is to adequately plan the extra hospital assistance of elderly people. The same system, renamed VAOR, was then adopted in Europe where it was implemented with new items, selected based on clinical setting, resulting in a more complete and appropriate instrument.

Consequently, this third generation instrument turns out to be suitable for both intensive care units, rehabilitation units, and residential and nursing homes. The extreme adaptability of this instrument is given by the fact that it is comprised of a core of fixed items (almost 70%) and another part (almost 30%) that varies in dependence of the clinical setting. There are many different types of VAOR, all of them containing a proportion of common items intended to facilitate communication across multiple health care settings.

After being extensively studied and validated by the international literature, nowadays VAOR is the more complete instrument, having a large number of applications including care planning, outcome measurement, and quality indicators.

A different approach to identify frailty has been reported by Rockwood et al (18) who drew up a frailty index and assessed this in a population of 2305 elderly patients in the Canadian Study of Health and Aging. The frailty index was comprised of seventy different items. It included the presence and severity of current diseases, ability in activities of daily living, and physical and neurologic signs from the clinical examinations. Results were then combined in a scale, from one to seven, assigning the score of one to very fit individuals and the score of seven to severely frail subjects. The frailty scale turned out to be highly correlated with the frailty index; and each category increment of the scale significantly increased the medium-term risk of death and entry into an institutional facility.

Searle et al (19) reported a standard procedure for constructing a frailty index. They selected 40 health deficits

fulfilling the following criteria: associated with health status, age-related, not too early saturation in the selected population. Deficit scores were combined in an index from 0 to 40. This systematic procedure for creating a frailty index turned out to be reproducible and a good predictor of mortality.

Pilotto et al (20) introduced the MPI, a one-year mortality index from a comprehensive geriatric assessment, validated on hospitalized elderly patients. This index included clinical, cognitive, functional, nutritional, and social parameters for a total of 63 items. In particular, functional status is assessed by ADL and IADL indices; cognitive status by the 'short portable mental status questionnaire' (21); comorbidity by the Cumulative Illness Rating Scale (CIRS) (22); Nutritional status by the Mini Nutritional Assessment (MNA) (23); the risk of developing pressure sores by the Exton-Smith Scale (ESS) (24). Number of drugs and medication use, and social aspects are also defined by this index. Three grades of MPI were identified: low risk, 0.0–0.33; moderate risk, 0.34–0.66; and severe risk, 0.67–1.0. Higher MPI scores were significantly associated with older age, female sex, lower educational level, and higher mortality. Interestingly, there was agreement between the estimated and the observed mortality after both six months and one year of follow-up.

Interestingly, in a recent multicenter one year follow-up study (25) the predictive accuracy of four frailty instruments was compared in a large population of hospitalized patients and MPI demonstrated a significantly higher mortality predictive power than others both after a short and long follow-up.

It is important to underline that frailty estimates, provided by all the instruments cited above, are not equivalent since the scales utilized are quite different. Moreover, two recently published reviews (26, 27), were not able to demonstrate the accuracy of any of these indices in predicting mortality; thus, further validations to assess their clinical usefulness are still required.

Kulminsky et al (28) compared the predictive prognostic value of "phenotypic frailty index" (PFI) and "deficit index" (DI) based on 48 elderly deficits (signs, symptoms, impairments, diseases). These instruments enabled categorizing subjects as robust, pre-frail, and frail. The authors found that, with the use of PFI the risk of death was underestimated in 720 persons, while using DI the mortality risk was underestimated in 134 persons. The authors concluded that, especially among the most vulnerable part of the elderly, both approaches are very helpful for discrimination of the risk of mortality; both are frailty related even if DI has more power for discriminating frail individuals on the basis of their death susceptibility. Noteworthy, in most cases, there was no correspondence between robust, pre-frail, and frail categories.

Assessment of the older patient in specific clinical settings. Patients with kidney disease

Noteworthy, the usefulness of all existing instruments for comprehensive geriatric assessment is independent of the target organ disease and associated comorbidities. However, these measures cannot be considered as substitutes for the traditional functional and anatomic assessment of single organs or apparatus. In this regard, this issue is even more important in the presence of kidney disease in elders who show significant age-related structural and functional renal modifications. In fact, a serum creatinine concentration of 1 mg/dL reflects a glomerular filtration rate (GFR) of 120 mL/min in a 20-year-old person and 60 mL/min in an 80-year-old (29). Consequently, serum creatinine is an unreliable indicator of GFR in elderly people, particularly in those with alterations to body composition, including weight loss and sarcopenia (30). An accurate estimation of GFR in the elderly can be achieved with the Modification of Diet in Renal Disease (MDRD) (31) and the Cockcroft-Gault equations (32).

Decreased GFR, vascular dysautonomia, altered tubular handling of creatinine, reduction in sodium reabsorption and potassium secretion, and diminished renal reserve are described as physiologic impairment of the renal system (33, 34). Furthermore, a decreased function of atrial natriuretic factor because of an age-related renal resistance has been reported (35).

Thus, in the elderly population, GFR values lower than that reported in the adult group, not necessarily associated with the presence of those abnormalities commonly recognized in chronic renal failure, such as impaired proximal tubular function, altered urea serum levels, serum levels and fractional excretion of magnesium, calcium, phosphorus, and abnormal normal urinalysis (36, 37), etc.

The prevalence of chronic kidney disease in patients aged over 70 is elevated (38).

The functional and structural changes of the aging kidney can hinder the identification of subclinical disease and the prognosis stratification in patients with impaired renal function. Moreover, GFR, which is very relevant clinically, may fail in predicting the mortality risk (39). In fact, the prognosis of elderly people with chronic kidney disease is related to functional and cognitive issues, nutrition, etc (40). Furthermore, patients on chronic hemodialysis have a higher incidence of comorbidities, altered functional and metabolic status (41), abnormal body composition, frequently assume multi drug therapy, and are more susceptible to side effects (42). Consequently, multidimensional diagnostic tools have been developed in order to identity high risk old patients in the different clinical settings (43-45).

A comprehensive geriatric assessment in patients with kidney disease can integrate the clinical assessment and improve its power in the prediction of prognosis.
The usefulness of MPI in the prediction of mortality in older patients hospitalized for chronic kidney disease has been assessed in a population of 786 patients, with moderate to severe chronic kidney disease (46). In this study, according to MPI scores, authors divided the population into three groups with low, moderate, and severe risk of mortality.
Higher MPI values were associated with higher mortality after one year. Interestingly, MPI revealed greater discriminatory power than the common organ-specific prognostic indices; furthermore, MPI had a higher prognostic accuracy than GFR assessed by ROC curves.
The prognostic addictive value of MPI in patients with kidney disease has been recently reconfirmed by Pilotto et al (47) in a study comparing the prognostic accuracy of MPI and GFR estimated by MDRD in which they concluded that adding MPI information to the eGFR markedly improve the prediction of two-year all-cause mortality.
These data underline the importance of a comprehensive geriatric assessment in the chronic kidney disease setting, suggesting that a multidimensional assessment, in addition to disease-specific parameters, is fundamental for accurate stratification of patients based on mortality risk.
Analogous findings have been reported in other specific clinical settings such as older patients with heart failure (48), pneumonia (49), gastrointestinal bleeding, and cirrhosis (50).
In conclusion, several data confirm that the integration of common clinical parameters with multidimensional geriatric instruments improves the management of older patients either during the diagnostic and therapeutic phase, where the traditional clinical assessment is enlaced, in addition to the prognostic power of the clinical relevant indexes.

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