The role of geriatric multidimensional assessment in elderly patients with severe aortic stenosis and candidates for transcatheter aortic valve implantation

Rosa Stranieri,[1] Anna Belfiore[2]

[1]Specialization School in Geriatrics, University of Bari "Aldo Moro"; [2]Internal Medicine Unit "A. Murri", Policlinico di Bari, Italy

Abstract

Severe aortic stenosis (AS) is a prevalent valvular condition among older adults, primarily resulting from the calcification and fibrosis of the aortic valve. Surgical aortic valve replacement and transcatheter aortic valve implantation (TAVI) are the main therapeutic options. TAVI has emerged as the preferred approach for elderly and frail patients deemed unsuitable for conventional surgery. This study highlights the critical role of Comprehensive Geriatric Assessment, including frailty evaluation, in identifying elderly patients best suited for TAVI. Tools such as the Essential Frailty Toolset, Clinical Frailty Scale, and the Multidimensional Prognostic Index have demonstrated efficacy in predicting postoperative mortality and disability. Multidimensional assessments, encompassing functional tests such as the 6-Minute Walking Test, enable enhanced risk stratification and personalized care planning. The findings emphasize the importance of a multidisciplinary approach in optimizing outcomes for geriatric patients with severe AS, focusing on improving clinical results and quality of life.

Correspondence: Rosa Stranieri, Specialization School in Geriatrics, University of Bari "Aldo Moro", Piazzale Giulio Cesare 11, 70124 Bari, Italy.
Tel: 080 5593123.
E-mail: rosystranieri91@gmail.com

Key words: aging, frailty, multidimensional assessments, severe aortic stenosis, transcatheter aortic valve implantation.

Contributions: both authors made a substantial intellectual contribution, read and approved the final version of the manuscript, and agreed to be accountable for all aspects of the work.

Conflict of interest: the authors declare no potential conflict of interest.

Ethics approval and consent to participate: not applicable.

Informed consent: not applicable.

Patient consent for publication: not applicable.

Availability of data and materials: not applicable.

Funding: none.

Received: 24 February 2025.
Accepted: 6 May 2025.

Geriatric Care 2025; 11:13768
doi:10.4081/gc.2025.13768

Introduction

Aortic stenosis (AS) is a common valve disease of old age, with a 2-3% incidence >65 years, due to the aging process of the valve, subject to fibrosis and calcification of the valve cusps and/or annulus, or less commonly as a result of congenital abnormalities (*e.g.*, bicuspid valve) or structural changes associated with rheumatic disease.[1] When the stenosis becomes severe, definitive interventions include surgical replacement of the aortic valve (SAVR) or a less invasive approaches such as transcatheter implantation of a biological valve prosthesis over the native valve (TAVI). A significant proportion of elderly patients with severe AS are frequently unsuitable for cardiac surgery, largely due to their advanced age, frailty, and multiple comorbidities. Consequently, valve replacement by TAVI represents the primary treatment option.[2] Elderly patients with severe AS may present with different physical and cognitive conditions, and clinical management should therefore require different approaches and attention. Geriatric multidimensional assessment may be the standard of care to best manage frail elderly patients with severe AS. A multidisciplinary clinical approach (cardiologists, cardiac surgeons, anesthetists, and geriatricians) allows an individualized assessment to identify patients for whom TAVI may be useful or, on the contrary, useless (estimated life expectancy less than 1 year) and to prevent possible complications or post-procedural outcomes.[3]

Severe aortic stenosis

The diagnosis of severe AS is based on an integrated clinical approach that includes an assessment of symptoms, most commonly dyspnea, angor, syncope or lipotimia, and persistent asthenia, as well as an echocardiographic study aimed at measuring precise parameters, namely the trans-valvular pressure gradient (PG) (mean PG≥40 mmHg). Additionally, trans-valvular flow velocity (velocity max ≥4 m/sec), valve area (planimetric AVA<1 cm^2, AVA index <0.6 cm^2/m^2, AVA Eq. of continuity cut-off 1 cm^2), left ventricular morphology, and contractility must be considered.[4] It is important to consider the possibility of "grey" conditions (low flow-low gradient), in which aortic valve measurements indicate a moderate degree of stenosis in a heart with fractional flow reserve (FFR) <50% and/or a reduced ejection volume [stroke volume index (SVI) < 35 mL/m^2]. Because velocities and gradients are flow dependent, some patients with low volume flow across the aortic valve [*e.g*., SVI<35 mL/m^2] may have severe AS with only a small AVA, and not a high velocity or mean gradient. When left ventricular systolic dysfunction with reduced stroke volume co-exists with severe AS, the AS velocity and gradient may be low, despite a small AVA.[4] Another condition is low-flow, low-gradient AS with preserved ejection fraction (EF) (≥50%); in clinical practice, an AVA of < 1 cm^2 is associated with a peak velocity of <4 m/s and a mean PG<40 mmHg despite normal left ventricular ejection fraction (LVEF). The entity of "paradoxical" low-flow, low-gradient AS with preserved EF has been introduced in this setting and refers to patients with hypertrophied, small ventricles, resulting in reduced trans-valvular flow (SVI<35 mL/m^2) even with normal FFR.[5]

Additionally, it should be noted that severe aortic valve stenosis may not always be symptomatic and may be incidentally discovered.

What is transcatheter aortic valve implantation?

The inaugural clinical application of TAVI can be traced back to 2002 with the implantation of the inaugural generation of devices, which were associated with a higher rate of procedural complications. Subsequently, because of technological developments that occurred concurrently with procedural refinements and increased operator experience, this method has been able to achieve significant results in terms of effectiveness and safety.[6] Indeed, recent evidence has demonstrated that TAVI is comparable to conventional surgery not only in patients with high or prohibitive surgical risk but also in those with intermediate and low risk, leading to its increased utilization as an aortic valve replacement strategy, particularly in the elderly. Following the prevailing guidelines, the age threshold for TAVI consideration is 75 years in Europe and 65 years in the United States.[7-9] Echocardiography (transthoracic and transesophageal, especially 3D echocardiography) plays a pivotal role in the diagnosis of severe AS, offering invaluable insights into systolic and diastolic left ventricular function, the presence of additional valvular pathologies, indications of pulmonary hypertension or right ventricular dysfunction. These data provide crucial prognostic information that should be considered by the cardiology team when determining the most appropriate interventional approach, given the severity of AS.[10] Another instrumental tool in the assessment of TAVI feasibility is cardiac computed tomography (CT) (with and without contrast agent). This enables precise measurement of the aortic ring, the aortic root, the distance from the aortic ring to the coronary artery ostium, as well as the valve morphology, the degree of calcification, and the tortuosity of the valve and arterial accesses used for the procedure, through a synchronized electrocardiogram (ECG) method.[11] The data facilitate the appropriate selection of the most suitable prosthesis size and assist in the reduction of the risk of complications, including significant regurgitation or paravalvular leak, ring rupture, and coronary ostium obstruction. The presence and location of calcifications on the aortic valve, valve ring, and aortic root also provide valuable prognostic information regarding the risk of developing paravalvular leaks. In particular, CT mapping of the arterial vascular system, including the assessment of calcifications at the aortic bifurcation and iliac arteries, vessel tortuosity, and measurements of vascular diameters, is crucial for identifying the optimal vascular access site for bioprosthetic insertion and placement.[12] For these reasons, angio-CT has become the standard imaging modality for the effective assessment of the feasibility of TAVI. In the case of patients with severe chronic kidney disease, transesophageal echocardiography can be employed as an alternative to the contrast medium study, given that studies have demonstrated a high degree of concordance between the data obtained from cardiac CT and transesophageal echocardiography, particularly in 3D imaging. The choice of vascular access site is determined by several factors, with the femoral artery being the preferred option. Alternatively, other sites may be considered, including the trans-axillary, trans-apical, trans-caval, or trans-aortic approaches. To select the optimal site, angiography or vascular color Doppler ultrasound can be employed.[11,12]

In patients with an estimated life expectancy of less than 1 year due to severe comorbidities and extreme frailty, aortic valve replacement surgery is deferred, and palliative care is indicated.

Why choose transcatheter aortic valve implantation?

Following the completion of the requisite anatomo-functional studies, the patient is presented at a heart team meeting, which includes interventional cardiologists, cardiac surgeons, anesthetists, and a TAVI nurse coordinator. At this meeting, the decision between SAVR and TAVI is made on a case-by-case basis. In light of the potential risks associated with surgical intervention, the patient's age, degree of frailty, pre-existing comorbidities, and estimated life expectancy, as well as the presence of specific anatomical and procedural characteristics that may favor the TAVI approach (such as feasible transfemoral access, porcelain aorta, previous thoracic radiotherapy, severe thoracic deformity, presence of a coronary graft passing behind the sternum or a high probability of severe patient-prosthesis discrepancy) or SAVR (aortic ring size unsuitable for TAVI, high risk of coronary artery obstruction due to coronary ostia implantation <10 mm from the ring, heavy calcifications of the valve leaflet, presence of bicuspid aortic valve, *etc*.).[12]

Among the few randomized clinical trials, we report those with a larger cohort and interesting results that support the use of TAVI as the treatment of choice in geriatric patients. In addition, its use seems to be increasing in patients with less frailty and lower surgical risk (Table 1).[13,14]

Techniques and complications associated with transcatheter aortic valve implantation

A technical description of the TAVI procedure reveals the existence of two distinct types of aortic valve prostheses: balloon-expandable and self-expandable.[15] At the end of the procedure, the patient is transferred to the intensive care unit to be monitored for an average of 24-48 hours, as needed, and to undergo transthoracic echocardiography to assess the functionality of the prosthesis and the possible occurrence of cardiac complications. The incidence of complications following TAVI has been markedly reduced because of enhanced experience, the utilization of cardiac CT as the primary imaging modality in the selection of patients and valve type, and the considerable technological advancements in bio-prosthesis design.

Paravalvular regurgitation

These have decreased statistically in recent decades with pre-procedural assessment but show a higher incidence with TAVI than with SAVR, particularly with self-expanding valves.[9]

Table 1. Randomized clinical trials: transcatheter aortic valve implantation *vs.* surgical replacement of the aortic valve.

Author	Total patients	TAVI (n)	SAVR (n)	Age	Male (%)	1-year mortality (from any cause) (%)	Death from cardiovascular cause (1-year) (%)	2-year mortality (from any cause) (%)
Leon *et al.* (13)	358	179	179	83.1±8.6 TAVI 83.2±8.3 SAVR	82 (45.8) TAVI 84 (46.9) SAVR	55 (30.7) TAVI 89 (49.7) SAVR	35 (19.6) TAVI 75 (41.9) SAVR	- -
Kodali *et al.* (14)	699	348	351	83.6±6.8 TAVI 84.5±6.4 SAVR	201 (57.8) TAVI 198 (56.7) SAVR	84 (24.3) TAVI 89 (26.8) SAVR	47 (14.3) TAVI 40 (13) SAVR	116 (33.9) TAVI 114 (35) SAVR

TAVI, transcatheter aortic valve implantation; SAVR, surgical replacement of the aortic valve.

Left bundle-branch block and pacemaker implantation

Despite a decline in the incidence of new intracardiac conduction abnormalities and pacemaker implantation over recent years, most studies continue to indicate a higher prevalence of conduction abnormalities following transcatheter implantation compared to cardiac valve replacement. In particular, the incidence of new left bundle branch block was higher with balloon-expandable valves.[13,16] The risk of conduction abnormalities and the necessity for pacemaker implantation is higher in the first 2 days following TAVI, and it is significantly increased in patients presenting with baseline right bundle branch block and severe annular calcifications. It is recommended that patients who have developed a left bundle branch block and who present with a QRS duration of >150ms and a prolonged PR interval of >240ms be monitored closely. In addition, continuous ECG monitoring or electrophysiological testing may be considered to guide the decision regarding eventual implantation of a definitive pacemaker.[11]

Stroke

The risk of stroke related to TAVI has remained relatively stable at an incidence of approximately 2%. However, this event is slightly less common with the newer generation of valves, occurring at a rate of between 1.1 and 1.2%. Stroke is associated with an elevated mortality rate and increased patient frailty, which manifests as cognitive impairment and a reduction or loss of functional capacity. These outcomes have significant social consequences and result in high management costs.[16] Strokes associated with TAVI are primarily caused by embolization of debris from the valve or vascular circulation. Less frequently, they are related to arrhythmia (atrial fibrillation). The size and number of emboli have a significant impact on the extent of brain damage and, consequently, on stroke outcomes. Therefore, it is of paramount importance to initiate antiplatelet therapy to prevent thrombus formation. Several studies have demonstrated that the risk of stroke is elevated in women compared to men. Additionally, it has been noted that the ischemic risk associated with balloon-expandable valves is marginally lower than that observed with self-expandable valves.[16]

Bleeding and pseudoaneurysms

Complications related to vascular access, such as bleeding and pseudoaneurysms, are prevalent in this population due to the utilization of large catheters in a fragile vascular heritage.[16] Fortunately, dissections are uncommon.

Acute coronary syndrome

Studies have shown that around 10% of patients undergoing TAVI experience acute coronary syndrome in the first 2 years after the procedure, which is associated with high mortality, so maintaining a good coronary access with completely free ostia is particularly important. The incidence of unsuccessful coronary angioplasty after TAVI surgery is reported to be between 3 and 7% in scientific results. However, in real-world registry data, the risk is as high as 35% for patients undergoing TAVI-in-TAVI procedures.[17]

Delirium

Post-procedural delirium is a relatively common occurrence, and some prospective observational studies have indicated that it may be associated with an increased risk of mortality. General anesthesia, non-transfemoral arterial access, and a longer procedural time are significantly associated with post-TAVI delirium.[18] Furthermore, the 1-year survival rate appears to be lower among patients who have undergone this complication.

Acute renal failure

It should be noted that both CT scans and coronary angiography require the administration of a contrast agent, which may cause acute renal damage and contribute to short-term mortality in elderly or frail patients.[15]

Geriatric multidimensional assessment and frailty tools

When talking about older people, it is natural to think of frailty as a predominantly geriatric, but not exclusive, syndrome; it is recognizable in patients characterized by a loss of physiological reserve with increased vulnerability to adverse events such as falls, disability, institutionalization, and death.[10] Frailty screening requires the assessment of several domains: physical, cognitive and mood, nutritional, and social vulnerability (Table 2).

Frailty indices used in cardiology in patients with severe aortic stenosis: scientific evidence

When discussing the elderly, it is common to consider frailty as a predominant but not exclusive syndrome. Frailty is associated with adverse outcomes related to cardiac procedures. Consequently, it has been proposed that the frailty score should be included in the preoperative evaluation of patients undergoing aortic valve replacement. The frailty score may now be used as a predictive parameter for the prognosis of patients with severe AS undergoing corrective treatment, as it has been demonstrated to reduce functional recovery post-procedure.[9] The current, widely used risk scores for cardiac surgical procedures involving the aortic valve include the Society of Thoracic Surgeons (STS) risk score and the European System for Cardiac Operative Risk Evaluation (EuroSCORE). Both scores were developed in the SAVR population. These scores appear to be poorly correlated with post-TAVI mortality and thus with the prognosis of elderly patients. Indeed, neither the STS nor the EuroSCORE scores include an objective measure of frailty. Consequently, there has been a move towards the development of newer, more specific risk scales for TAVI.[18,19] One such tool is the Essential Frailty Toolset (EFT), which was developed relatively recently and has demonstrated statistical significance in predicting mortality and worsening disability at 1 year. As a result, it has become a widely used frailty tool in the cardiology setting.[20] In the FRAILTY-AVR study, which compared the prognostic performance of seven different frailty instruments in 1020 elderly individuals undergoing TAVI or SAVR, the EFT scale demonstrated superior efficacy compared to the other assessment instruments. In particular, an EFT score of 3 or above is significantly associated with an increased risk of mortality or worsening disability within the first year. The EFT scale employs a scoring system ranging from 0 to 5, with a score of 0 indicating robust health, a score of 1-2 indicating pre-fragility, and a score of 3-5 indicating frailty. The EFT score is attributed by considering four items: muscle weakness of the lower limbs, defined as a time of ≥15 seconds or inability to complete five repetitions from sitting to standing without using the arms; pre-procedural anemia; hypoalbuminemia; and cognitive impairment, defined as a score of ≤24 on the Mini-Mental State Examination test.[21] Another applied scale is the Rockwood Clinical Frailty Scale (CFS), which was developed in 2005 by Rockwood *et al*. This scale is a semi-quantitative measure of patient symptoms, mobility, inactivity, and disability for basic activities of daily living (BADL) and instrumental activities of daily living (IADL) (Figure 1).[22] This scale

Table 2. The domains of frailty and tools for their assessment.

Domain	Assessment Tool	Key items/measures
Functional autonomy	Instrumental activities of daily living Basic activities of daily living	Evaluation of the ability to perform 8 instrumental daily activities Assessment of dependency in 6 basic daily activities
Cognitive impairmentand mood	Short Portable Mental Status Questionnaire Mini Mental State Examination Geriatric Depression Scale	Cognitive status assessed through 10-item questionnaire Cognitive status assessed through 30-item questionnaire Mood assessed through 15-item questionnaire
Comorbidity	Cumulative Illness Rating Scale	Comprehensive review of 13 organ systems for chronic and acute illnesses
Nutritional Status	Mini Nutritional Assessment ALBUMIN	Evaluation based on 6 items to assess nutritional risk
Dentition	Oral exam	Quality of mastication
Sarcopenia	Short Physical Performance Battery (19)	Gait speed; sit-to-stand time; ability to stand 10s with the feet in tandem or side by side
Social Support	Social Status and Living Arrangements	Evaluation of living conditions and available social support
Medications	Medications review	Drugs taken by the patient and appropriateness of the prescription
Physical frailty	6-Minute Walk Test	Assesses how far a person can walk in 6 min

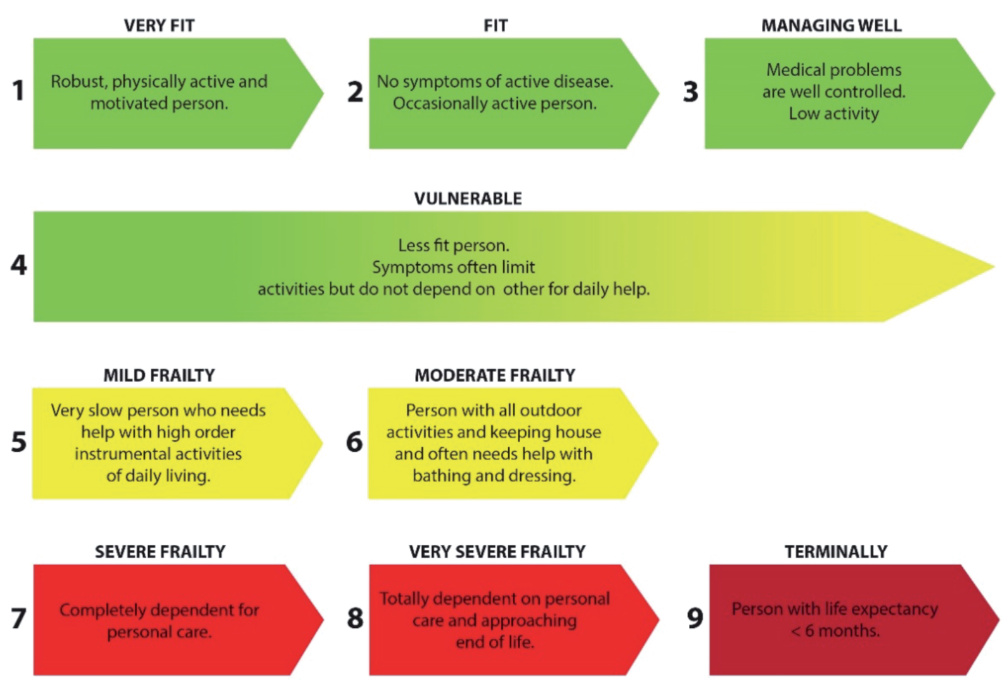

Figure 1. The Clinical Frailty Scale is used to assess the degree of frailty in older adults.

largely reflects the patient's functional capacity and is predictive of fatal or disabling outcomes post-TAVI (Table 3).[23]

This is evidenced by several observational studies, including a Japanese study that used the multicenter OCEAN registry to examine data from 1215 patients undergoing transcatheter aortic valve replacement. The patients with AS were divided into five groups according to the stages of fragility, as follows: CFS 1-3 (stages 1, 2, and 3 together), CFS 4, CFS 5, CFS 6, and CFS ≥7. Subsequently, an investigation was conducted to ascertain the relationship between CFS classification and other indicators, including body mass index (BMI), serum albumin, gait speed, and mean hand grip. Furthermore, the differences between the five groups in terms of initial characteristics, procedural outcomes, and early and mid-term mortality were also considered. In conclusion, the results demonstrated a significant correlation between the degree of CFS and several other factors, including BMI (≤20), albumin (<3.5 g/dL), gait speed, and grip strength (low). Furthermore, the data indicated that the 1-year cumulative mortality rate increased with an increase in the degree of CFS, with rates of 7.2%, 8.6%, 15.7%, 16.9%, and 44.1%, respectively ($p<0.001$) (Figure 2).[24]

The role of frailty scores, CFS, and EFT is twofold. Firstly, they are useful in predicting which patients are at high risk of complications. Secondly, they can be employed to identify which patients the procedure might be clinically unnecessary for, despite technical success. Indeed, TAVI is recommended for patients with a life expectancy of greater than 1 year, who are expected to improve their quality of life in terms of global, physical, and psychological well-being.[24] Nevertheless, although objective assessment of preoperative frailty is strongly recommended, its use in clinical practice remains limited due to the lack of a clear and agreed-upon assessment, the occurrence of sometimes divergent results in different studies, and the lack of obvious reproducibility among less experienced assessors.

The clinical implications derived from these rating scales are highly congruent with those obtained from the Multidimensional Prognostic Index (MPI).

Table 3. Frailty assessment tools more commonly used in transcatheter aortic valve implantation candidates.

Frailty Scales	Components	Definition of frailty
CFS	Subjective semiquantitative assessment of activity, mobility, exhaustion and disability for BADLs and IADLs	Classification 1 to 9 (Figure 1)
EFT	1. Sit-to-stand 2. Cognition 3. Anemia 4. Serum albumin	Range 0-5; score ≥3 (high)
MPI	8 domains from the Comprehensive Geriatric Assessment; score of 0 (no problems), 0.5 (minor problems), 1 (major problems) assigned to each of the eight domains	Range 0-1; ≤0.33 low risk; 0.34-0.66 moderate risk; ≥0.67 severe risk

CFS, Clinical Frailty Scale; EFT, Essential Frailty Toolset; MPI, Multidimensional Prognostic Index; BADLs, basic activities of daily living; IADLs, instrumental activities of daily living.

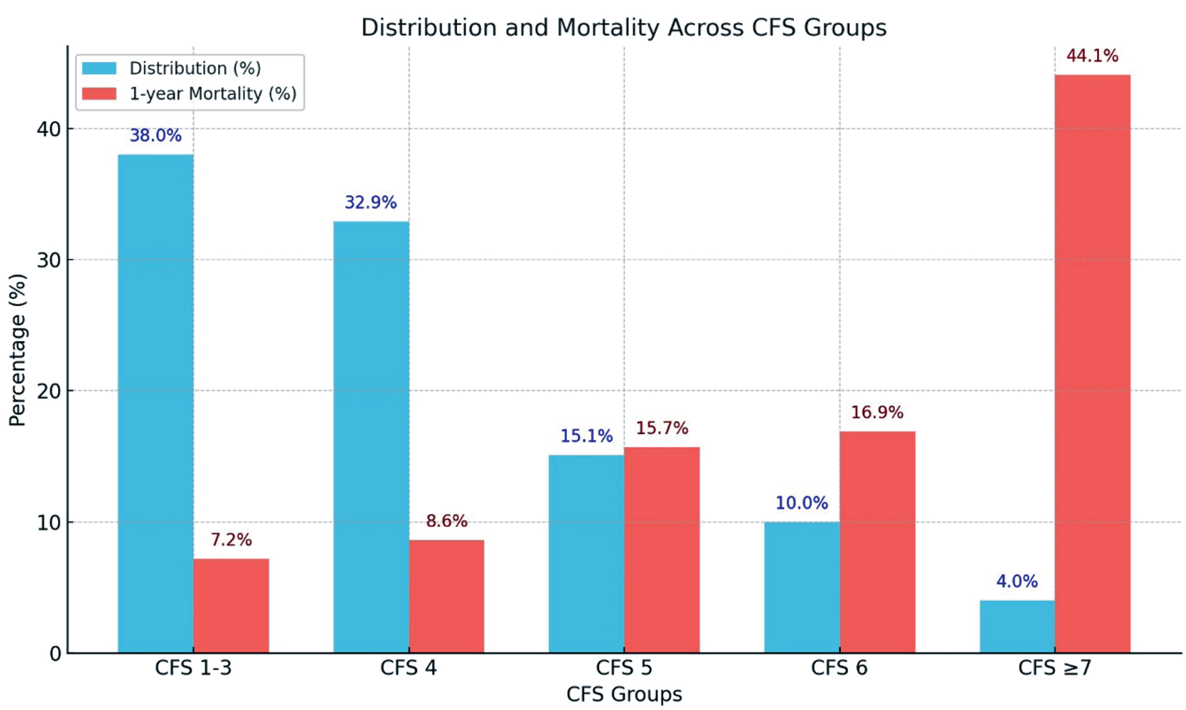

Figure 2. Representation of the OCEAN study. Data from Shimura *et al.*, 2017.[24] CFS, Clinical Frailty Scale.

Multidimensional frailty assessment in elderly patients who are candidates for transcatheter aortic valve implantation: Multidimensional Prognostic Index

In conjunction with frailty in the elderly, there is a derivative of the Comprehensive Geriatric Assessment (CGA), namely the MPI. This is a multidimensional assessment tool that has been specifically designed and validated for use in the elderly population. This index has been demonstrated to be a predictor of mortality in patients aged 65 and above who are afflicted with a range of acute and chronic illnesses, including cardiovascular disorders. A comprehensive longitudinal and multicenter study demonstrated that MPI is an effective predictive index of all-cause mortality at 1 year and of adverse health outcomes in elderly hospitalized patients. The results of recent studies conducted on relatively small groups of frail patients with severe AS indicate that MPI is a predictor of death and cerebrovascular accidents up to 3 months after TAVI.[25,26] Furthermore, the MPI has also been identified as a predictor of overall mortality up to 1 year after valve implantation. The geriatric multidimensional assessment thus comprises the application of the MPI, which is constituted of eight domains. The following variables are included in the geriatric multidimensional assessment: BADL, IADL, Cumulative Illness Rating Scale, Short Portable Mental Status Questionnaire, Exton-Smith Scale, Mini Nutritional Assessment-short form, living status, and number of medications taken (Table 4). Once the calculation is complete, the prognostic value for 1-year mortality is assigned based on the overall score. MPI-1 (0-0.33) is indicative of low risk; MPI-2 (0.34-0.66) is indicative of medium risk; MPI-3 (0.67-1.0) is indicative of high risk.[25]

The identification of elderly patients who may derive the greatest benefit from TAVI remains a significant challenge. However, some studies have indicated that the MPI tool may prove valuable in decision-making processes, and the incorporation of frailty may offer an additional prognostic role.[27] From a clinical perspective, this assessment may provide supplementary data regarding the risk of prevalent complications, such as delirium, prolonged hospitalization, and the potential for nosocomial infections. Additionally, it may offer insight into the likelihood of functional decline and the possibility of predicting the extent to which a patient's quality of life may be enhanced.[28]

In the scenario of the hospitalized patient with severe AS, the MPI can guide the clinician not only on prognosis but also on future quality of life.

Table 4. Domain of the Multidimensional Prognostic Index.

Domain	Tool	Item
Functional autonomy	IADLs	8
Dependency level	BADLs	6
Cognitive impairment	SPMSQ	10
Comorbidity	CIRS	13
Nutritional status	MNA-short form	6
Risk of pressure sores	ESS	5
Polypharmacy		1
Social support		1

BADLs, basic activities of daily living; IADLs, instrumental activities of daily living; SPMSQ, short portable mental status questionnaire; CIRS, Cumulative Illness Rating Scale; MNA, Mini Nutritional Assessment; ESS, Exton Smith Scale.

Functional capacity of transcatheter aortic valve implantation candidates: the 6-Minute Walking Test

As part of the multidimensional assessment and the concept of the fragile phenotype, it is important to explore the domain of physicality, which is reflected in the functional status (activities of daily living and IADL) but also includes the patient's physical abilities, which can be assessed using certain tests, including the 6-Minute Walking Test (6-MWT). The 6-MWT has also been considered in the guidelines in 2002 for the assessment of cardiorespiratory problems, and it represents a good submaximal test compared to other similar functional tests because it is easy to perform and more similar to activities of daily living. The 6-MWT is used to measure patient outcome before and after medical therapy, mainly in the cardiopulmonary field [*e.g.*, heart failure and chronic obstructive pulmonary disease (COPD)] but also as a stratification and prognostic tool in the surgical field, *i.e.*, in elderly patients undergoing arthroplasty and transcatheter valve replacement surgery.[29] A multicenter study published in 2011 showed that the 10th percentile of healthy male and female subjects aged 70-80 years walked >400 m in 6 minutes, indicating a kind of physical standard.[30] The multicenter, prospective, randomized PARTNER trial showed that the functional capacity of TAVI candidates, as assessed by the 6-MWT, did not predict procedural outcomes but did predict long-term all-cause mortality. Among the 484 elderly patients undergoing TAVI, three groups were selected: those unable to walk (n=218), slow walkers (n=133) with a 6-MWT below the median (128.5 m), and fast walkers (n=133) with a 6-MWT >128.5 m. At 12 months, fast walkers had a decreased 6-MWT of 44±148 m ($p<0.02$ compared to baseline), whereas slow walkers had an improved 6-MWT of 58±126 metres ($p<0.001$ compared to baseline). Similarly, those who were unable to walk increased their 6-MWT by 66±109 m ($p<0.001$ compared to baseline). There were no differences in outcomes at 30 days between the three groups, while at 2 years, the rate of death from all causes was 42.5% in the ambulatory patients, 31.2% in the slow walkers, and 28.8% in the fast walkers ($p=0.02$), mainly based on differences in non-cardiovascular death.[31]

Therefore, in the overall assessment of the elderly patient undergoing TAVI, it is interesting to consider the physical performance in the presence of severe AS, without neglecting the additional pathologies that may affect the patient's physical performance, such as COPD and arthropathies, so that the distance walked on the 6-MWT may be an expression of a multi-system alteration and could be considered a "marker" of frailty.

Our experience

Our single-center experience, based on a clinical registry of 62 geriatric patients followed and treated for severe AS (67-95 years; females > males), confirmed the efficacy and safety of TAVI as a treatment option for elderly and frail patients with severe AS.

From this observational study, results showed that 56.5% of patients tolerated the procedure well, while 43.5% developed post-procedural complications, mainly electrical conduction abnormalities with subsequent pacemaker implantation. Six deaths were recorded during the study period, three of which were directly related to the procedure.

Analysis of frailty factors showed that a high MPI, a high CFS, and reduced physical performance at 6-MWT were associated with an increased risk of complications/outcomes. However, in multivariate analysis, only LVEF% remained an independent predictor, suggesting the protective role of good cardiac function.

Patients with shorter hospital stays (<4 days) appeared to be in a better overall condition (less frailty, better functional and cognitive abilities) than those with longer hospital stays (>5 days). This highlights the importance of early intervention and proactive management to reduce hospital length of stay and improve long-term outcomes.

CFS for high scores (≥5) was a fair negative predictor of walking ability in the medium term (30 days after TAVI), but lacks accuracy. In contrast, meters walked at 6-MWT before TAVI emerged as a strong predictor of medium-term physical performance, and in particular, being able to walk at least 110 m at baseline predicted walking ability 30 days after TAVI, with good sensitivity (94 %) and fair specificity (59 %). It should be noted that these results have not been the subject of publication.

Durability of transcatheter aortic valve implantation: the latest scientific evidence

Long-term durability of bioprosthetic valves is a major goal of TAVI, as this procedure is being considered for younger and less fragile populations. Structural valve deterioration (SVD) is the main factor limiting the durability of all bioprosthetic valves used in TAVI or SAVR, but non-structural bioprosthetic valve dysfunction, such as prosthesis-patient mismatch and paravalvular regurgitation, as well as thrombosis or valve endocarditis, can also lead to valve failure (BVF). The incidence of BVF due to SVD or other causes is low (<5%) at mid-term follow-up (5 to 8 years) and compares favorably with conventional surgery. Long-term follow-up data (up to 10 years) from randomized trials of early-generation transcatheter heart valves also suggest similar valve durability with TAVI compared with SAVR at 10 years, but these studies suffer from significant survival bias.[32,33] Therefore, the long-term durability of the bioprosthesis with TAVI needs to be confirmed by analysis of TAVI trials in low-risk patients compared with SAVR at 10 years postoperatively.[32]

Conclusions and future directions

With the expected increase in the elderly population over the coming decades, and consequently in all age-related diseases, including AS, it has become important to be able to identify those elderly patients who are potentially more likely to benefit from TAVI ("survival with benefit") and to minimize peri- and post-procedural complications.

The measurement of frailty and the geriatric multidimensional assessment can ideally be placed in a "modern" vision of the heart team, in which the fundamental geriatric aspects, such as functional and cognitive deficits, frailty, disability and multicomorbidity, are given the same value as angiographic, echocardiographic and anesthesiological data, to delineate the most appropriate cardiovascular risk profile and thus decision-making in elderly patients who are candidates for TAVI, but more generally for the various complex cardiovascular procedures.

Therefore, a multidisciplinary clinical approach, including preoperative geriatric assessment, may lead to optimal and safer management of the elderly patient, especially in the setting of moderate to severe frailty. Geriatric multidimensional assessment may become the standard of care to best manage elderly and frail patients with severe AS.

Several doubts remain about which instrument is best for assessing frailty in older patients who are candidates for interventional procedures, and further validation and comparison studies between different frailty scales and instruments are needed.

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