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Frailty of patients scheduled for cardiac surgery — a pilot study

Kruchość chorych kierowanych na operacje kardiochirurgiczne — badanie pilotażowe

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Abstract

Introduction. Frailty has been recently approved in many surgical fields as the acknowledged preoperative predictor of adverse postoperative complications. Several methods are available to assess frailty assessment which focus on different patient-related data. The aims of the study were: 1) to verify whether frailty may predict early postoperative complications in cardiac surgery; and 2) to investigate the agreement between objective and subjective assessment of frailty.

Material and methods. This prospective study included 54 consecutive patients (32 men; median age 75 years) hospitalized between December 2015 and February 2016. Frailty was assessed using the Edmonton Frail Scale (EFS, subjective tool) and the Modified Frailty Index (MFI, objective tool). Complications were evaluated based on medical records.

Results. The median EFS was 6 (IQR 5–7) points. Frailty was observed in 15% and vulnerability in 49% of subjects. The median MFI was 0.45 (IQR 0.36–0.56). We found a weak correlation between frailty and the length of hospital stay (EFS: r = 0.22; P = 0.1; MFI: r = 0.324; P = 0.02). Neither tools could predict the occurrence of postoperative complications (EFS: AUROC = 0.602; 95% CI 0.459–0.732; P = 0.2; MFI: AUROC = 0.532; 95% CI 0.389–0.670; P = 0.2). We found no correlation between EFS and MFI (r = 0.05, P = 0.7).

Conclusions. Although many elderly cardiac surgical patients are at risk of frailty, none of the evaluated methods could predict postoperative complications. Available diagnostic tools to assess frailty cannot be used interchangeably. Subjective assessment (by a patient) should be verified by objective evaluation (by a treating physician) and conclusions should be drawn based on the overall clinical picture.

Key words: frailty, elderly, Edmonton Frailty Scale, Modified Frailty Index, cardiac surgery

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Introduction

Frailty is a geriatric clinical syndrome characterized by an increased susceptibility to acute and chronic stressors due to impaired responses of organs and systems of the aging body [1]. The definition of frailty describes a concern for impaired homeostasis, or a biological, mental, and social well-being [2], with a reduction in physiological reserves.

The risk of frailty increases with age [3]. International studies indicate that the criteria of frailty are met by as many as half of all subjects above 85 years of age. These persons are at a much increased risk of trauma (mostly due to falls), disability, and dependence, with a need for long-term care at home or in nursing care facilities [2]. Frailty often coexists with comorbidities (often expressed as the number of concomitant conditions) but these are not synonymous terms [4]. Quality of life of frail subjects is not satisfactory [2].

Of note, the diagnosis of frailty is not limited to a measurement of function of a single organ or even an organ system but involves global analysis of daily patient functioning. Thus, frailty is often assessed using the Frailty Index (FI) calculated using various algorithms and selected tools which may be more objective or subjective [5, 6].

Frailty is a condition associated with an impaired recovery following an action of a stressor such as surgery or its adverse consequences (postoperative complications, immobility, pain, isolation). Thus, complications increase frailty but frailty itself predisposes to complications. This results in a vicious circle which may prove fatal for the patient. Increasing evidence indicate the importance of this problem in cardiac surgery [7, 8].

The aims of the study were: 1) to verify whether frailty may predict early postoperative complications in cardiac surgery; and 2) to investigate the agreement between objective and subjective assessment of frailty.

Material and methods

We studied 54 consecutive patients aged ≥ 65 years who were hospitalized between December 2015 and February 2016 in the Silesian Centre for Heart Disease, Zabrze, Poland. Our study included patients scheduled for elective cardiac surgery (coronary artery bypass grafting: N = 25; aortic valve replacement: N = 14; mitral valve replacement: N = 11; thoracic aortic aneurysm surgery: N = 4).

For subjective assessment of frailty, we used a standardized Polish version of the Edmonton Frail Scale (EFS) [9] which evaluates nine domains of frailty including cognition, general health status, functional independence, social support, medication use, nutrition, mood, continence, and functional performance. The questionnaire included 11 questions, including six scored 0–2 and five scored 0–1. Depending on the overall score, study subjects were categorized as not frail (overall score 0–5), vulnerable (score 6–7), mildly frail (8–9), moderately frail (10–11), or severely frail (12–17).

The patients were then objectively evaluated for frailty based on their medical records and the Modified Frailty Index (MFI) criteria [10] that included 11 items related to the overall health status and concomitant conditions. Patients were scored 1 for each criterion, and the total score was divided by 11. This yielded the score range from 0.09 to 1, corresponding to the degree of frailty.

We prospectively evaluated the duration of hospital stay and occurrence of complications in the immediate postoperative period, divided into four categories: cardiovascular (low cardiac output syndrome requiring pharmacological or mechanical hemodynamic support, cardiac arrhythmia and/or conduction disturbances; N = 29), respiratory (mechanical ventilatory support for > 24 hours, airway bleeding; N = 10), renal (acute kidney injury treated with drug therapy or renal replacement therapy; N = 13), and bleeding requiring transfusion of > 2 units of packed red blood cells and/or surgical revision (N = 23).

The exclusion criteria were lack of consent for study participation (N = 0) and disability that precluded filling in the EFS questionnaire by the patient (N = 0).

Statistical analysis was performed using procedures available in the licensed MedCalc (v14) software. Quantitative variables were reported as median values and interquartile ranges (IQR) and qualitative variables were reported as absolute values and percentages. Correlations were evaluated using the Spearman rank correlation coefficient. Intergroup differences in quantitative variables were evaluated using the Mann-Whitney U test, and differences in qualitative variables were evaluated using the chi-square test or the exact Fisher test. The ability to predict complications using EFS and MFI was evaluated based on the receiver-operating characteristic (ROC) curves. Statistical significance was set at $P < 0.05$.

Results

The study group included 54 patients (31 men [58%] and 23 women [42%]) with the median age of 75 years (IQR 71–78 years). The median EFS score was 6 (IQR 5–7). Nineteen patients (36%) were categorized as not frail, 27 (49%) as vulnerable, and 8 (15%) as frail. We found no correlation between the EFS score and the patient age ($r = 0.09$; $P = 0.5$). The EFS score was similar in men and women ($P = 0.2$). The median MFI was 0.45 (IQR 0.36–0.56). We found no correlation between MFI and the patient age ($r = 0.237$; $P = 0.1$). MFI did not differ between men and women ($P = 0.9$).

The median duration of hospital stay was 8 days (IQR 6–9). We found weak correlation between frailty indexes and the duration of hospital stay (EFS: $r = 0.22$; $P = 0.1$;

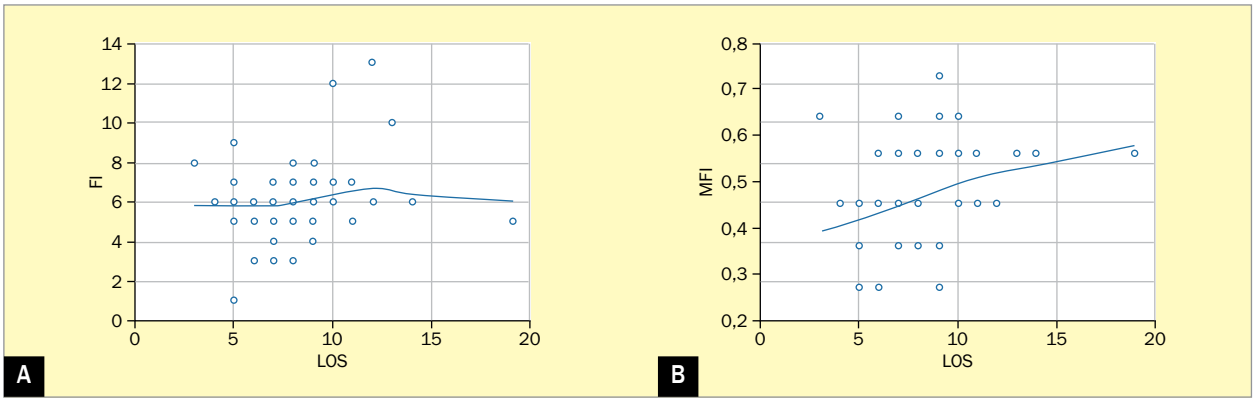

Figure 1A. Correlation between subjective assessment of frailty and the length of hospital stay; **B.** Correlation between objective assessment of frailty and the length of hospital stay

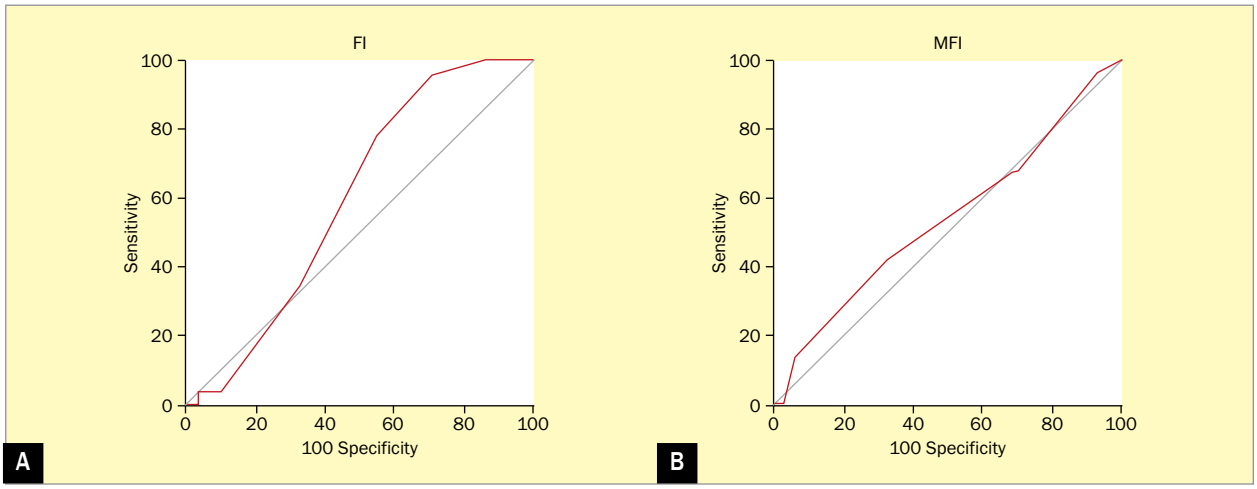

Figure 2A. ROC curve for the relation between subjective assessment of frailty and occurrence of complications; **B.** ROC curve for the relation between objective assessment of frailty and occurrence of complications

MFI: r = 0.324; P = 0.02) (Figure 1). Overall, we noted 75 events considered postoperative complications which occurred in 23 patients (43%). Both subjective and objective frailty indexes did not predict the risk of complications (EFS: AUROC = 0.602; 95% CI 0.459–0.732; P = 0.2; MFI: AUROC = 0.532; 95% CI 0.389–0.670; P = 0.2) (Figure 2).

Patients categorized as not frail by EFS had similar MFI values to those categorized as vulnerable) (median MFI 0.45; IQR 0.36–0.56), while frail patients by EFS had higher MFI values (median MFI 0.56; IQR 0.43–0.63) (P = 0.4) (Figure 3). We found no correlation between EFS and MFI (r = 0.05; P = 0.7) (Figure 4).

Discussion

More than 20 different tools to evaluate frailty [6] and help stratify the risk of serious complications and health risks have been reported in the available literature. Each of

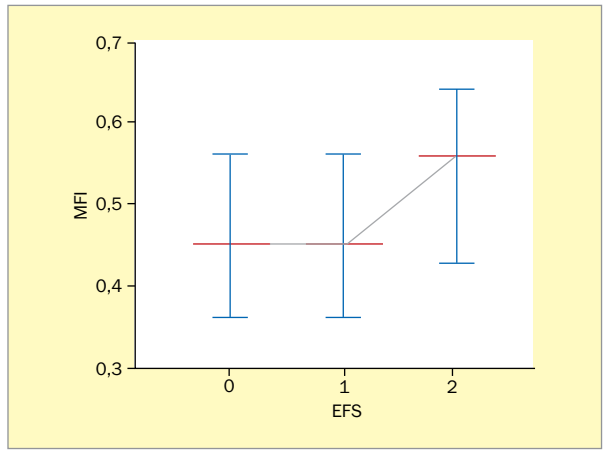

Figure 3. Comparison of the two methods to evaluate frailty: median MFI values in various EFS categories; EFS scores: 0 — no frailty: median MFI 0.45 (IQR 0.36–0.56); 1 — vulnerable: median MFI 0.45 (IQR 0.36–0.56); 2 — frailty: median MFI 0.56 (IQR 0.43–0.64)

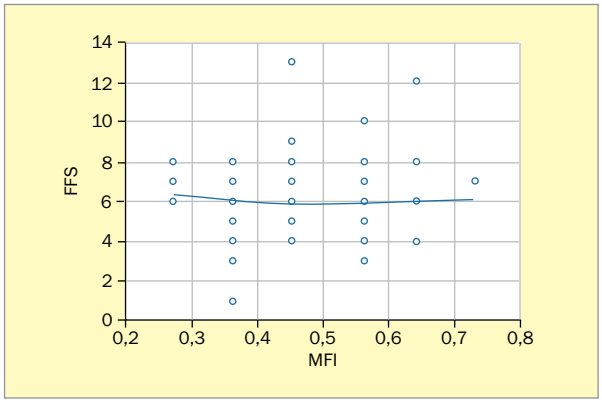

Figure 4. Correlation between frailty assessment by EFS and MFI

these methods evaluates several domains describing the health status and functional reserves of an elderly subject, which finally allows the physician to assign the patient to a specific risk group. These numerous domains include nutrition, physical activity, mobility and independent ambulation, level of vitality and life energy, endurance, cognitive function, mood, presence of or need for social support [6], concomitant conditions, presence of geriatric syndromes (e.g., falls, impaired handgrip, slow walking), and external evidence of frailty (social isolation, lack of nearest relatives, living alone, no social support) [11].

It is also interesting to consider frailty within 7 domains, each of which is also a readily available tool to evaluate it. These 7 features of frailty and threshold values that define it are as follows: the Timed Up and Go test to evaluate functional reserves, lower limb strength and gait (≥ 15 s), the Katz index of independence in activities of daily living (≤ 5 activities), the Mini-Cog test to evaluate cognitive function (score ≤ 3), the Charlson Comorbidity Index test to evaluate 19 concomitant conditions (≥ 3 comorbidities), chronic anaemia (haematocrit < 35%), malnutrition (albumin level < 3.4 g/dL), and geriatric fall syndrome (≥ 1 fall within 6 months) [12].

The above mentioned components of frailty and tools to evaluate them are well reflected in the frailty scores we used in our study. EFS includes questions related to most of these domains, and MFI also includes concomitant conditions that may adversely affect postoperative recovery and patient functioning. In line with the holistic approach to evaluate frailty, the cited literature [6–12] supports our hypothesis of the need to combine information obtained by objective (MFI) and subjective (EFS) evaluation of frailty.

Of note, with the multitude of available methods designed to evaluate frailty, it is difficult to select the optimal score that would be most precise and reproducible [6]. In clinical practice, simple and short questionnaires are usually used that cannot give a comprehensive insight into the health status and are too general (e.g., the Katz index) but their strength is ready applicability during routine preoperative evaluation. In contrast, use of such comprehensive (but reliable) questionnaires as the Frailty Index (40 questions) is often not feasible in hospital settings. In this context, combining EFS and MFI seems an optimal balance between simplicity and reliability.

Our findings indicating no relation between frailty and the risk of postoperative complications are discordant with the results of previous international studies [10–13]. A systematic review published in 2014 showed that frailty was associated with a nearly 5-fold increase in the risk of serious cardiac and cerebrovascular events (odds ratio 4.89), and this association was stronger in older patients undergoing transcatheter aortic valve replacement (TAVR) (odds ratio 3.31 to 4.89) compared to younger patients scheduled for bypass grafting or valve surgery (odds ratio 1.10 to 3.16) [8]. Of note, however, our findings are in agreement with data indicating discordance between chronological age and individual physiologic reserves [1, 4]. This indicates that although age is a risk factor for mortality and postoperative complications, it is not a direct determinant of outcomes among the elderly but rather a correlate of comorbidities [14]. In our study, all the oldest patients (i.e., ≥ 80 years of age) were categorized as not frail or vulnerable, while the highest EFS scores (≥ 8) were seen in patients at the mean age of 73 years, and the highest MFI scores (≥ 0.64) in those at the mean age of 78 years.

Many physicians are able to intuitively distinguish between frail and non-frail patients at the same chronological age based on history and physical examination [14]. Separation of age from other determinants of frailty helps avoid overestimating perioperative risk in the elderly patients in a good mental and physical condition, and underestimating this risk in younger patients with more comorbidities [2]. Epigenetic variation plays a major role in this regard [2].

Explaining discordance between our findings and literature data is difficult. We may only speculate that patient answers to the EFS items were related to their well-being at the time of filling in the questionnaire and did not reflect the actual level of frailty. Hospital admission is a significant emotional burden for the elderly, and when combined with concerns for safety and surgery outcomes, it may limit their ability to rationally assess their health status and well-being. In addition, patients often tend to overestimate when answering questions regarding their mood or self-assessment of the overall health status, and may be reluctant to answer affirmatively to questions related to the need for help during activities of daily living, or problems with walking or continence.

Discordance related to the objective tool (MFI) is difficult to explain. It may have been a chance finding or may have reflected imprecision of the test used. Of note, however, our study was based on determining frailty as a collection of pathophysiological and geriatric abnormalities in specific

domains, which is in agreement with one of the two current approaches to define frailty [4].

As noted above, our study had some limitations. First, the sample was small, and thus these findings should be extended to a larger group of seniors to allow more precise conclusions. However, we consider our findings interesting enough to be presented as a pilot study. Second, we studied a heterogeneous group of patients undergoing different types of cardiac surgery. Perhaps further analyses should be limited to more uniform patient populations (e.g., only coronary artery bypass grafting patients). Third, we arbitrarily selected two from many tools available in the literature. Although they are among the best studied and most commonly used worldwide, their precision has not been validated among cardiac surgical patients in Poland. Finally, complications were evaluated without taking into account their severity, which may have affected our findings. It cannot be excluded, however, that frailty may contribute only to selected complications.

Conclusions

Although many elderly patients undergoing cardiac surgery are at risk of frailty, none of the evaluated methods could predict postoperative complications. Of note, available diagnostic tools to assess frailty cannot be used interchangeably. Thus, it seems that subjective assessment (by a patient) should be verified by objective evaluation (by a treating physician) and conclusions should be drawn based on the overall clinical picture.

Conflict of interest(s)

The authors report no conflicts of interests.

Streszczenie

Wstęp. Wskaźnik kruchości stosuje się w wielu obszarach chirurgii jako predyktor wystąpienia powikłań pooperacyjnych. Istnieje kilka metod oceny kruchości osób starszych. Koncentrują się one na różnych danych i informacjach dotyczących pacjentów. Celem pracy były: 1) weryfikacja hipotezy, że kruchość może się przyczynić do wystąpienia wczesnych powikłań pooperacyjnych w kardiochirurgii oraz 2) sprawdzenie, czy istnieje zgodność między wynikami uzyskanymi metodą obiektywnej i subiektywnej oceny kruchości.

Materiały i metody. Badaniem prospektywnym objęto 54 chorych (31 mężczyzn; mediana wieku 75 lat) hospitalizowanych w od grudnia 2015 roku do lutego 2016 roku. Do oceny występowania kruchości wykorzystano subiektywną Skalę Kruchości Edmonton (EFS) oraz metodę obiektywną — *Modified Frailty Index* (MFI). Występowanie powikłań oceniano na podstawie dokumentacji medycznej.

Wyniki. Mediana punktów EFS wynosiła 6 (IQR 5–7). Jako podatnych na kruchość zakwalifikowano 27 (49%) pacjentów, 8 (15%) spełniało kryteria kruchości. Mediana MFI wynosiła 0,45 (IQR 0,36–0,56). Występowała słaba korelacja między kruchością a okresem hospitalizacji (EFS: R = 0,22; p = 0,1; MFI: R = 0,324; p = 0,02). Kruchość nie przyczyniała się w istotny sposób do wystąpienia powikłań pooperacyjnych (EFS: AUROC = 0,602; 95-proc.przedział ufności [CI] 0,459–0,732; p = 0,2; MFI: AUROC = 0,532; 95%CI 0,389–0,670; p = 0,2). Nie stwierdzono korelacji między wynikami w skali EFS a wynikami w MFI (R = 0,05; p = 0,7).

Wnioski. Choć wielu starszych chorych kierowanych na operacje kardiochirurgiczne było objętych ryzykiem kruchości, to żadna z ocenianych metod nie pozwalała ocenić ryzyka wystąpienia powikłań pooperacyjnych. Narzędzia do oceny kruchości nie mogą być używane zamiennie. Wydaje się zatem, że subiektywna ocena kruchości (przez pacjenta) powinna być weryfikowana za pomocą obiektywnego narzędzia (przez lekarza), a wnioski powinny być wyciągane na podstawie całokształtu obrazu klinicznego.

Słowa kluczowe: kruchość, osoby starsze, Skala Kruchości Edmonton, *Modified Frailty Index*, kardiochirurgia

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