INTRODUCTION

Chronic heart failure (HF) is one of the most serious challenges of cardiology in the 21st century. At present, the prevalence of HF in the general population is estimated at between 1% and 2% [1]. Thus, this condition affects between 6.5 and 10 million Europeans (including 600–700 thousand people in Poland) and over 5 million citizens of the United States [2, 3]. The prognosis is frequently unfavourable and at the same time difficult to assess precisely. The continuous search for factors significantly influencing the prognosis of patients with HF is of considerable importance, especially given the ageing population as well as a clear relationship between age and an increase in incidence of HF [1]. A paradoxical impact of obesity on the prognosis of HF patients has been observed for many years. Obesity increases the risk of HF occurrence, but at the same time, if HF is diagnosed, obesity appears to be a factor improving the prognosis [4–6]. Obesity is seldom an isolated abnormality, more frequently being part of metabolic syndrome (MS) — the coincidence of obesity, hypertension, dyslipidaemia, and carbohydrate metabolism disorders. The importance of MS coexistence for the prognosis of patients with HF remains unclear.

The aim of the study was to analyse the influence of MS on the one-year surveillance of HF patients without atrial fibrillation (AF).

METHODS

The study was a post hoc analysis of data concerning 893 patients included in the pilot survey for the Heart Failure Registry, carried out in Polish medical centres for the European Society of Cardiology. In this study we presented the results of subgroup analysis of patients without diagnosed AF. For statistical analysis, it was assumed that a patient with MS was a patient with simultaneous occurrence of diabetes, hypertension, and obesity. Detailed information about the methods and limitations of the study are presented in the Appendix (see journal website).

Statistical analysis

The analysis was performed using STATISTICA 12 PL software. The comparative analysis of the survival was performed by log-rank test, showing Kaplan-Meier survival curves and presenting hazard ratio (HR) values. The impact of individual qualitative factors on the survival was assessed by main effect or one-way analysis of variance (ANOVA), and factor interactions were evaluated by ANOVA interaction analysis.

RESULTS

Characteristics of the studied population

The study group consisted of 893 patients, 339 of whom had no history of any form of AF (men: 223, 69%). The mean
The age of the study population was 63.6 ± 13.5 years, mean blood pressure was 133.4 ± 28.9/79.8 ± 15.8 mmHg, mean heart rate 78.7 ± 17.4 bpm, left ventricular ejection fraction 40.2% ± 13.9, and mean body mass index (BMI) 28.4 ± 5.3 kg/m². As far as comorbidities are concerned, 61% (n = 208) of the group had previously diagnosed coronary artery disease, 54% (n = 187) were previously hospitalised due to HF, and approximately 63% of patients received antihypertensive treatment. Diabetes was diagnosed in 33% (n = 114), arterial hypertension in 62% (n = 212), BMI > 30 kg/m² in 36% (n = 121), dyslipidaemia in 75% (n = 255), and MS in 13% (n = 45) of patients.

**Survival analysis**

During the 12-month follow-up study, 7.8% of patients without and 17.8% of patients with MS died (HR 0.44; log-rank test p = 0.03). The Kaplan-Meier survival curve depending on the coexistence of MS is presented in Figure 1A. Interaction ANOVA analysis demonstrated that the adverse influence of MS on the prognosis of HF patients without AF was caused by the coexistence of hypertension and diabetes (p < 0.002 for interaction). The negative prognostic effect of the coexistence of these two conditions was independent of obesity (lack of the obesity paradox), as shown in Figure 1B.

**DISCUSSION**

The significance of MS in assessing the prognosis of patients with HF remains a difficult and controversial issue. We experience the obesity paradox described in the introduction and at the same time, also in a paradoxical context, the lack of clinical benefit from intensive treatment of dyslipidaemia. It may be assumed that hypertension and diabetes become the crucial elements of MS in this context. The existing research on this matter provides conflicting information. Tamariz et al. [7] showed that the coexistence of MS (defined by the National Cholesterol Education Programme — Adult Treatment Panel III criteria) was associated with a 50% increase in the relative risk of death [7]. Yoon et al. [8], however, observed lower mortality in patients with MS than in patients without MS (4.9% vs. 8.3%, p < 0.001). By contrast, Tadaki et al. [9] observed a 28% (HR 1.28, 95% confidence interval 1.06–1.54, p = 0.011) increased risk of death or cardiovascular event in the case of coexisting HF and MS, but only in men. Perrone-Filardi et al. [10] observed comparable survival in patients without MS and diabetes and in those with MS and coexisting diabetes. They indicated that the influence of MS on a prognosis may be related to whether the method used implies the presence of diabetes as a sine qua non condition for diagnosing MS [10]. Furthermore, Yamauchi et al. [11] demonstrated that the occurrence of a new AF episode in patients with HF significantly increases mortality risk.

Based on these and other studies, it can be assumed that the negative impact of AF on the prognosis of patients with HF has been confirmed [12]. In light of the abovementioned studies, the definition of MS used in the present study, and the fact that it separately analysed patients without AF, allows
us to obtain new data on the impact of MS on the prognosis of patients with HF.

Similarly to the study by Perrone-Filardi et al. [10], and in contrast to the study by Tamariz et al. [7], in the presented analysis obesity was a sine qua non condition for MS. In turn, as opposed to the study by Perrone-Filardi et al. [10], diabetes was also a prerequisite for the diagnosis of MS. In our study, as far as patients without AF were concerned, coexistence of MS was related to a 56% higher relative risk of death. This observation remains consistent with the previously presented results of the studies by Tamariz et al. [7] and Tadaki et al. [9], but simultaneously appears to contradict the results of Perrone-Filardi et al. [10]. Interaction analysis, however, showed that the negative impact of MS on the survival of HF patients without AF resulted primarily from the coexistence of diabetes and hypertension. This is, in fact, consistent with the observations of Italian researchers, and, at the same time, provides additional information on the importance of coexisting diabetes for the prognosis of patients with HF. The negative impact of diabetes and hypertension is so strong that it can eliminate the phenomenon of the obesity paradox. It is worth noting that the negative influence of MS on the survival of patients in this group was independent of sex in the study population.

In conclusion, the coexistence of MS worsens the prognosis of HF patients without AF. The worsening of the prognosis is primarily caused by the coexistence of diabetes and hypertension, and the occurrence of obesity has no influence on the prognosis (lack of the obesity paradox).

**Conflict of interest:** none declared

**References**


