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Impact of obesity on electrical cardioversion efficacy in patients with persistent atrial fibrillation

Wpływ otyłości na skuteczność kardiowersji elektrycznej u pacjentów z przetrwałym migotaniem przedsionków

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Abstract

Introduction. Obesity's influence on the effectiveness of electrical cardioversion (CVE) still requires more studies. The study aimed to evaluate the impact of obesity on the efficacy of CVE in atrial fibrillation (AF).

Material and methods. Eighty-nine patients [female/male (F/M): 33/56; mean age: 64.66 ± 9.7 years) with persistent symptomatic AF qualified for CVE were prospectively enrolled in the study. CVE efficacy was analyzed immediately after the procedure and in a one-month follow-up. Patients with immediately efficient CVE were divided into obese group [OG; body mass index (BMI) ≥ 30 kg/m^2, 49 patients, F/M: 21/28, mean age: 64 ± 10 y.] and non-obese group (NOG; BMI < 30 kg/m^2, 33 patients, F/M: 9/24, mean age: 66 ± 10 y.).

Results. Immediate CVE efficacy was 92%. Sinus rhythm restoration was not BMI-dependent, but BMI had an impact on the amount of energy needed for sinus rhythm restoration (150 J in NOG vs. 200 J in OG, $p < 0.05$). One-month CVE efficacy was 47%: 38.8% in OG and 60.6% in NOG ($p < 0.05$). Patients in OG had greater left atrium (LA) and left ventricle (LV) diameters ($p < 0.05$) and lower LV ejection fraction (EF) ($p < 0.05$) as compared to NOG subjects. Logistic regression analysis revealed LV EF (odds ratio: 1.107, 95% CI: 1.015–1.207, $p < 0.05$] as a factor influencing one-month CVE efficacy.

Conclusions. Immediate high efficacy of CVE in persistent AF seems to be independent of coexisting obesity, however, obesity has an impact on the amount of energy needed for sinus rhythm restoration. One-month efficacy of CVE is low and modified by coexisting obesity.

Key words: obesity, atrial fibrillation, electrical cardioversion, sinus rhythm restoration, electrical cardioversion energy

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Introduction

Despite growing consciousness of the issue, the prevalence of obesity has doubled in more than 70 countries during the last 30 years [1].

Obesity is a well-known risk factor for cardiovascular diseases including atrial hypertension, dyslipidemia, diabetes, stroke, coronary artery disease and arrhythmias [2].

Constant low-grade inflammation, structural remodelling including enlargement, fibrosis and fatty infiltration of the atrium observed in obesity are the main mechanisms of atrial fibrillation (AF) pathogenesis in this group of patients [3].

The impact of obesity on electrical cardioversion (CVE) outcomes, which is a method of choice in symptomatic patients, is uncertain. Some studies suggest lower CVE efficacy in obese patients and a higher risk of AF recurrence after sinus rhythm restoration [4]. Structural changes including left ventricular hypertrophy and left atrium enlargement, observed in the previous studies, could play an important role in that issue. On the other hand, fatty tissue reduction itself probably could reduce the AF recurrence rate [5].

Taking into account the increasing number of obese patients with AF, the study aimed to evaluate the impact of obesity on the efficacy of CVE.

Material and methods

Eighty-nine patients with persistent symptomatic AF who had been qualified for electrical cardioversion were prospectively enrolled in the study. The presence of the symptomatic AF documented by an electrocardiogram (ECG) was the main inclusion criterion for the study. The primary endpoint of the study was the presence of AF in the ECG performed immediately after CVE or sinus rhythm absence at a one-month follow-up. Patients on antiarrhythmic treatment with amiodarone, with active inflammatory disease, chronic kidney disease with estimated glomerular filtration rate < 30 mL/min/1.73 m^2, severe valvular heart disease, left ventricle ejection fraction < 40%, cardiomyopathy, diabetes mellitus demanding insulin therapy and patients with morbid obesity [body mass index (BMI) ≥ 40 kg/m^2) were excluded from the study.

On the day of CVE, patients underwent clinical examination, including the collection of anthropometric data, laboratory testing, ECG and echocardiography (ECHO).

Patients without sinus rhythm restoration were no longer observed, while those with successful CVE took part in a one-month follow-up. Body mass index, which constituted a discriminating factor for the study groups, was ≥ 30 kg/m^2 in the obesity group (OG) and < 30 kg/m^2 in the non-obese group (NOG).

The study has been approved by the ethics committee (Bioethical Committee, Medical University of Silesia; No KNW/022/KB1/159/16/17, 31.01.2017) and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Patients qualified for the study gave their informed consent prior to their inclusion.

Body measurements

Every patient underwent weight measurements on a balanced beam scale and height measurements with a stadiometer. Waist circumference was measured at a level midway between lower rib margin and the iliac crest, while hip circumference was measured as maximal circumference over the buttocks. BMI was calculated by dividing patients' weight in kilograms by height in meters squared, while body surface area (BSA) was obtained by Mostellar formula. The waist-to-hip ratio (WHR) was obtained by dividing waist circumference by hip circumference.

Laboratory testing

On admission, all of the patients qualified for CVE underwent basing laboratory testing. Blood samples for the laboratory testing were collected from the antecubital vein.

Echocardiography

All of the patients underwent transthoracic echocardiography before CVE by a single experienced investigator using an Epiq 7G (Philips, Andover, MA, USA) with a 2.5-MHz probe in 2D, M and Doppler modes.

Definitions

AF was defined by arrhythmia lasting at least 30 seconds with a typical pattern of irregular RR intervals and no discernible, distinct P waves observed in ECG [6]. Arterial hypertension was defined as newly recognised hypertension based on two separate measurements that exceeded 140/90 mm Hg during the hospitalisation, a previous hypertension diagnosis or any antihypertensive drug use [7]. Diabetes mellitus was defined as the fasting blood glucose levels over 125 mg/dL in two separate measurements or in the case of the use of hypoglycaemic agents. Impaired fasting glucose and impaired glucose tolerance were analysed jointly with diabetes mellitus [8]. Estimated glomerular filtration rate (eGFR) calculated according to the Cockcroft-Gault formula including the creatinine level, patient age, sex and weight was used to represent patients' kidney function.

Electrical cardioversion procedure

Every patient qualified for CVE was administered vitamin K agonist or new oral anticoagulant for at least three weeks. CVE was performed by an experienced physician in short-term intravenous anaesthesia until sinus rhythm restoration with an increasing amount of energy starting from 150 J using paddles. Antero-lateral position of paddles was

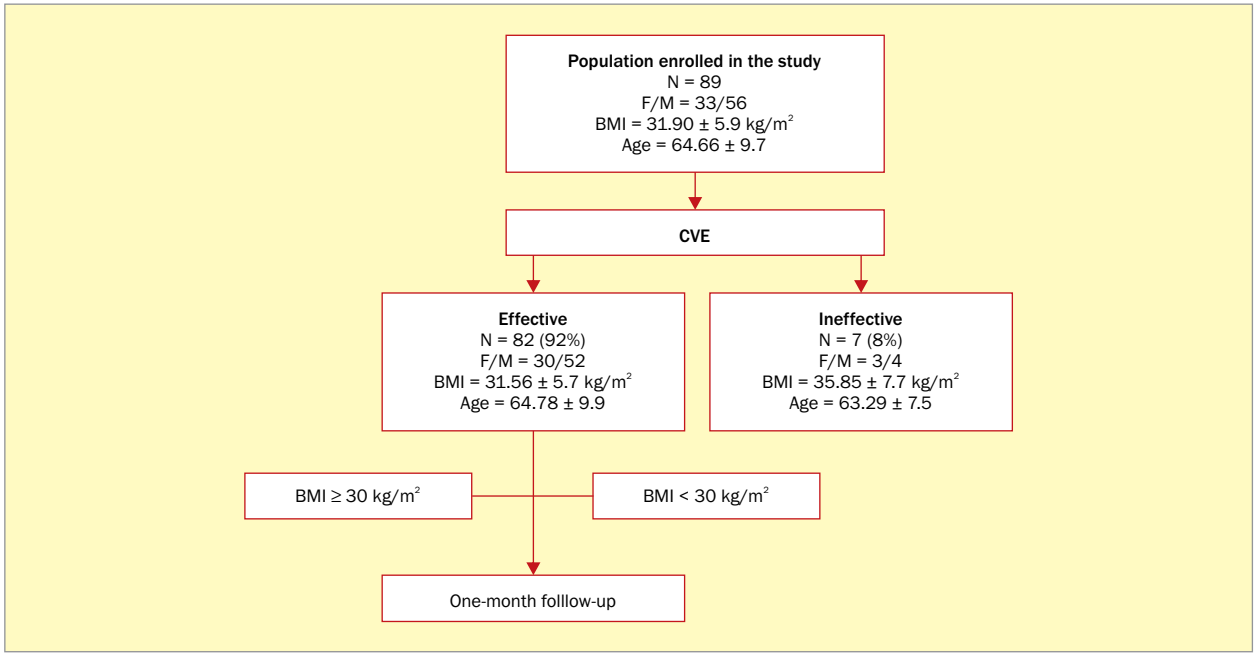

Figure 1. A diagram representing a course of the study; F — female; M — male; BMI — body mass index; CVE — electrical cardioversion

used both in first and in subsequent shocks with no change to antero-posterior position after unsuccessful shock. The performing physician decided on the energy of subsequent shocks taking into account patients clinical characteristics (BMI, FA duration). If CVE was not successful after three attempts the procedure was ended.

Before termination of hospitalization, the changes required from previous treatment were made.

Statistical analysis

Statistical analysis was performed by Statistica 13.0 (TIBCO Software Inc., Palo Alto, CA, U.S.) and StataSE 13.0 (StataCorp LP, TX, U.S.) software. Statistical significance was set at a p value below 0.05. All tests were two-tailed. Variables were presented as mean value ± standard deviation (SD) in case of normal data distribution or median with lower and upper quartile for other distributions or as a number and percentage for data in nominal and ordinal scale. The distribution of variables was evaluated by the Anderson-Darling test and the quantile-quantile (Q-Q) plot. The homogeneity of variances was assessed by the Levene test. The *t*-Student's test was performed to compare two independent groups (according to BMI ≥ 30 kg/m^2 and below) for normally distributed data and in case of non-normal distribution, the U Mann-Whitney test was used. For nonparametric data χ^2 test was performed. Logistic regression was used to calculate risk factors of higher energy used for effective CVE (> 200 J) and to assess CVE efficiency. Results were presented as odds ratios with 95% confidence intervals (CI) and corresponding p-value.

Results

Demographic and clinical characteristics of the population qualified for CVE

The study group consisted of eighty-nine patients.

Immediate CVE efficacy reached 82 subjects, only in 7 individuals, the procedure did not restore sinus rhythm. The group of patients with inefficient CVE did not significantly differ in BMI or age from the group with a successful procedure outcome (Figure 1).

Demographic and clinical characteristics of patients with effective CVE

The OG consisted of 49 individuals, while 33 subjects were included in the NOG.

Both OG and NOG were symptomatic (median EHRA score: 2 in OG and NOG), with a moderate risk of thromboembolism (median CHA_2DS_2-VASc: 3 in OG and NOG). The most prevalent comorbidities in both groups were atrial hypertension (92%), hyperlipidemia (52%), diabetes mellitus (33%) and coronary artery disease (28%). Nearly 14% of the patients had already experienced a stroke or TIA episode.

More than half of the participants were taking angiotensin-converting enzyme (ACE) inhibitors, beta-blockers, statins and diuretics. Dabigatran was the most frequently used anticoagulant drug (40% vs. 34% for rivaroxaban, 20% for acenocoumarin, 3% for warfarin and apixaban). Despite implemented therapy blood pressure exceeding the norm was observed in 22% of patients during hospitalization.

Table S1. Baseline clinical characteristics of obese group (OG) and non-obese group (NOG) — laboratory testing

Variable	Absolute count and percentage or median (25–75 percentile) or mean (standard deviation)		p
	OG N = 49	NOG N = 33	
Platelet count [×1000/mm^3]	217.5 (59.1)	224.7 (47.1)	0.69
Hemoglobin concentration [g/dL]	14.3 (1.3)	14.6 (1.6)	0.35
White blood cells [×1000/mm^3]	7.1 (1.9)	6.9 (1.8)	0.69
Serum creatinine concentration [mg/dL]	0.98 (0.18)	0.94 (0.15)	0.35
eGFR [mL/min/1.73 m^2]	75.4 (11.4)	78.8 (9.4)	0.16
Glucose [mg/dL]	108.0 (98.0–124.8)	100.0 (92.0–114.0)	0.06
Total cholesterol [mg/dL]	163.8 (44.9)	176.6 (43.5)	0.21
Low-density lipoprotein (LDL) [mg/dL]	86.4 (39.1)	96.2 (38.3)	0.28
High-density lipoprotein (HDL) [mg/dL]	50.7 (15)	54.2 (15.7)	0.32
Triglycerides [mg/dL]	129 (100–151)	109 (83–157)	0.88

eGFR — estimated glomerular filtration rate

Table S2. Baseline clinical characteristics of obese group (OG) and non-obese group (NOG) — echocardiography

Variable	Absolute count and percentage or median (25–75 percentile) or mean (standard deviation)		p
	OG N = 49	NOG N = 33	
LA antero-posterior diameter [mm]	44.8 (4.9)	42.4 (5.2)	**< 0.05**
LA area [cm^2]	26.1 (4.2)	24.2 (4.1)	**< 0.05**
LA volume [mL]	83.9 (18.1)	75.2 (20.9)	**< 0.05**
LV EF [%]	54.8 (5.4)	57.7 (5.8)	**< 0.05**
LV EDD [mm]	51.9 (5.4)	48.9 (4.4)	**< 0.01**
LV ESD [mm]	33.2 (5.7)	30.4 (4.5)	**< 0.05**
LV EDV [mL]	133.8 (36.5)	110.3 (27.5)	**< 0.01**
LV ESV [mL]	60.1 (19.9)	47.5 (14.8)	**< 0.01**

LA — left atrial; LV — left ventricle; EF — ejection fraction; EDD — end-diastolic diameter; ESD — end-systolic diameter; EDV — end-diastolic volume; ESV — end-systolic volume

Only 9% of patients admitted to smoking cigarettes and 1% to abuse alcohol.

In the study, CVE turned out to be safety a safety procedure. None of the adverse events including skin burns and embolic complications was observed.

Anthropometric measurements

OG and NOG differed significantly not only in weight and BMI (33.4 kg/m^2 vs. 27.1 kg/m^2) but also in BSA and waist circumference.

Laboratory testing

Laboratory tests showed no significant differences in measured parameters between groups. Measured levels of glucose were exceeding recommended values in both of the study groups (Table S1).

Echocardiography

Left ventricle end-diastolic diameter (LV EDD), LV end--systolic diameter (LV ESD), but also LV end-diastolic and end-systolic volumes (LV EDV, LV ESV) were significantly different between the study groups ($p < 0.05$). The study revealed that left atrial antero-posterior diameter (LA) as well as left atrial area (LA area) and left atrial volume (LA volume) had greater values in OG comparing to NOG ($p < 0.05$) (Table S2).

Patients in OG had significantly lower LV ejection fraction (LV EF) comparing to NOG patient ($p < 0.05$).

The study groups did not differ in other diastolic function markers like E/E', deceleration time (DT) or isovolumetric relaxation time (IVRT) measured in ECHO. Also, the frequency of the mitral valve regurgitation was similar in both groups.

Energy used for effective CVE

The study showed significantly higher energy needed for sinus rhythm restoration in OG (median: 200 J vs. 150 J) (Table 1).

The logistic regression model revealed that higher BMI, BSA and waist circumference had an impact on the amount of energy needed for efficient CVE (Table S3). Echocardiographic parameters including left heart dimensions, presence

Table 1. Demographic and clinical characteristics of obese and non-obese group of patients with effective sinus rhythm restoration

Variable	Absolute count and percentage or median and 25–75 percentile or mean ± standard deviation		p
	BMI ≥ 30 kg/m^2 N = 49	BMI < 30 kg/m^2 N = 33	
Age [years]	64 (10)	66 (10)	0.02
Sex (F/M)	21/28	9/24	0.15
Weight [kg]	97 (89–108)	80 (69–85)	**< 0.001**
Height [cm]	1.69 (10)	1.7 (8)	0.2
BMI [kg/cm^2]	33.4 (31.9–36.8)	27.1 (24.2–28.7)	**< 0.001**
BSA [m^2]	2.26 (0.25)	1.91 (0.17)	**< 0.001**
Waist circumference [cm]	113.2 (12.7)	96.3 (11.6)	**< 0.001**
WHR	0.98 (0.9–1.06)	0.96 (0.87–1.02)	0.44
CHA_2DS_2-VASc (pts)	3.0 (1.6)	3.0 (1.7)	0.94
EHRA score	2 (2–2)	2 (2–2)	0.77
Beta-blockers therapy before CVE	42 (85.7%)	23 (69.7%)	0.09
Non-amiodaron antiarrhythmic therapy before CVE			
Sotalol therapy	2 (4.8%)	5 (15%)	0.1
Propafenone therapy	2 (4.1%)	3 (9.1%)	0.39
CVE immediate efficacy	49 (89%)	33 (97%)	0.8
Energy used for effective CVE [J]	200 (200–200)	150 (150–200)	**< 0.001**
Beta-blockers therapy after CVE	41 (83%)	21 (63%)	0.07
Non-amiodaron antiarrhythmic therapy after CVE			
Sotalol therapy after CVE	2 (4.8%)	5 (15%)	0.1
Propafenone therapy after CVE	2 (4.1%)	3 (9.1%)	1.0
CVE efficacy in one-month follow-up	19 (38.8%)	20 (60.6%)	**< 0.05**

BMI — body mass index; F — female; M — male; BSA — body surface area; WHR — waist-to-hip ratio; EHRA — European Heart Rhythm Association; CVE — electrical cardioversion

Table S3. Energy used to sinus rhythm restoration and clinical characteristics of the study group

Variable	OR	–95% CI	+95% CI	p
Age (years)	0.963	0.915	1.014	0.15
BSA [m^2]	1.555	1.192	2.030	**< 0.001**
BMI [kg/m^2]	1.458	1.221	1.740	**< 0.001**
WHR	1.049	0.683	1.611	0.83
Waist circumference [cm]	1.082	1.034	1.132	**< 0.01**
LA [mm]	1.086	0.986	1.197	0.09
LA area [cm^2]	1.013	0.906	1.132	0.22
LA vol [mL]	1.013	0.988	1.039	0.29
LAVI [ml/m^2]	0.986	0.941	1.033	0.57
E/E'	0.029	0.001	39.505	0.34
Mitral insufficiency grade	2.000	0.733	5.453	0.18

OR — odds ratio; CI — confidence interval; BSA — body surface area; BMI — body mass index; WHR — waist-to-hip ratio; LA — left atrium; vol — volume; LAVI — left atrial volume index; E/E' — mitral peak velocity of early filling to early diastolic mitral annular velocity

Table 2. Logistic regression of clinical characteristics and echocardiographic parameters influencing immediate and one-month electrical cardioversion (CVE) efficacy

Variable	Immediate CVE efficacy				One-month CVE efficacy			
	OR	–95% CI	+95% CI	p	OR	–95% CI	+95% CI	p
Age [years]	1.015	0.940	1.097	0.7	1.036	0.990	1.035	0.13
BSA [m^2]	0.276	0.014	5.274	0.39	0.406	0.68	2.401	0.32
BMI [kg/m^2]	0.908	0.815	1.012	0.08	0.961	0.888	1.041	0.33
WHR	1.349	0.625	2.907	0.44	0.858	0.575	1.281	0.46
Waist circumference [cm]	0.967	0.920	1.015	0.18	0.983	0.954	1.014	0.28
LA [mm]	0.942	0.809	1.096	0.44	0.912	0.831	1.001	0.052
LA area [cm^2]	0.991	0.828	1.186	0.92	0.947	0.853	1.051	0.31
LA vol [mL]	0.983	0.945	1.022	0.39	0.979	0.956	1.022	0.08
LAVI [ml/m^2]	0.982	0.910	1.059	0.64	0.973	0.930	1.017	0.23
LV EF [%]	1.114	0.980	1.267	0.1	1.107	1.015	1.207	**< 0.05**
E/E'	1.657	0.180	15.271	0.66	1.687	0.529	5.382	0.38
Mitral insufficiency grade	0.396	0.45	3.467	0.4	1.141	0.438	2.989	0.79

OR — odds ratio; CI — confidence interval; BSA — body surface area; BMI — body mass index; WHR — waist-to-hip ratio; LA — left atrium; vol — volume; LAVI — left atrial volume index; LV EF — left ventricular ejection fraction; E/E' — mitral peak velocity of early filling to early diastolic mitral annular velocity

of mitral valve regurgitation and other markers of diastolic function had no influence on energy used for effective CVE.

One-month follow-up results

At the one-month follow up only 47.5% of patients who experienced a successful sinus rhythm restoration remained free of arrhythmia. One-month CVE efficacy was 38.8% in OG and 60.6% in NOG with ($p < 0.05$).

Blood pressure exceeding over 140/90 mm Hg was still observed in 17% of patients during physical examination. Despite the recommendation only 4 patients (5%) managed to reduce weight, the rest maintained or even gained weight. There were no patients who managed to give up smoking in the whole observed population.

CVE efficacy — logistic regression analysis

Logistic regression analysis revealed that clinical characteristics and echocardiographic parameters have no significant impact on immediate CVE efficacy. The BMI values showed a favourable trend to influence immediate CVE efficacy (Table 2).

Logistic regression analysis revealed that LV EF influences one-month CVE efficacy (Table 2).

There were no independent factors related to immediate and one-month CVE efficacy.

Discussion

While the impact of obesity on AF pathogenesis is well known, the influence of the excessive fatty tissue on antiarrhythmic treatment with CVE both immediate and long-term is uncertain. In our study, immediate procedure efficacy in patients qualified for CVE reached 92% and was not BMI dependent. The results of our study stay in opposition to the previous research.

In the multicenter prospective trial ENSURE-AF by Lip et al. [9] clinical factors affecting CVE efficacy as well as adverse events of anticoagulation therapy were analyzed. In ENSURE-AF 2,199 patients were randomized to endoxaban or enoxaparin- warfarin group. CVE was successful in 1,578 patients (72%), in 355 individuals procedure did not restore sinus rhythm. Patients with inefficient CVE were characterized by higher BMI as well as higher body weight compared to the patients with successful rhythm restoration. Male sex, coronary artery disease, acetylsalicylic acid and statin therapy were also more common in patients with inefficient CVE. Multivariate analysis revealed BMI, weight and gender as an independent predictor of successful CVE. In our study, immediate CVE efficacy was independent of BMI.

All of the patients enrolled in the study underwent a CVE procedure with shocks delivered by paddles. Many medical centres prefer using patches as a modality of CVE due to convenience. However, this could result in lower immediate CVE efficacy especially in the obese population.

While CVE is a highly efficient procedure for most patients, in the obese population, there are some technical aspects of the intervention that should be taken into consideration. Deposits of the excessive fatty tissue, resulting in higher transthoracic impedance, are the reason why some modifications of techniques need to be implemented. In obese patients, the choice between using adhesive patches and handheld paddles, which apply pressure to the chest wall properly, prove that choosing the most efficient shock vector and the adjustment of energy delivered play an invaluable role.

In the study by Voskoboinik et al. [10] energy used for CVE in patients with BMI ≥ 30 kg/m^2 and modality (patches and paddles) were analyzed. The energy used for the first shock was 100 J and 200 J for the second shock if needed. If the two shocks failed, patients underwent a third shock using alternative modality and 200 J energy. CVE was efficient in the first (100 J) or second (200 J) shock in 90.3% while using paddles and only in 68.2% with patches. There were 20 crossovers from patches to paddles and six from paddles to patches. In the whole obese population, CVE with paddles was effective in 82.9%, while with patches only in 66.7%.

In the study by Kang et al. [11] more than one-third of patients enrolled in the study experienced AF recurrence in follow-up after ablation. Patients with efficient ablation were characterized by lower BMI, shorter duration of AF and lower prevalence of diabetes mellitus. What's more total number of shocks during CVE preceding ablation, total energy and the highest shock energy were lower in patients maintaining sinus rhythm in follow-up. These observations suggest that CVE energy parameters may be related to the electroanatomical remodelling of AF and could predict AF recurrence after ablation.

According to the previous observations, obesity is the main risk factor for LA enlargement [12]. In our study, OG was characterized by greater LA measurements observed by echocardiography comparing to the NOG. This data is in agreement with well-recognized observations that obesity may be a cause of LA dilatation.

In the study by Stritzke et al. [13] over 1200 participants were observed for 10 years to find out which factor has the strongest impact on LA volume, focusing especially on obesity and atrial hypertension. Follow-up revealed that both high BMI and hypertension results in LA enlargement, but obesity impact was the greatest.

Association between obesity and left ventricle hypertrophy had already been described in various publications. In the study issued in "Hypertension", BMI was a predictor of left ventricle enlargement and myocardial dysfunction expressed in decreased midwall fractional shortening without significant impact on ejection fraction [14].

In contrast to some previous publications [15], our study showed that patients with BMI ≥ 30 kg/m^2 were characterized by lower ejection fraction comparing to NOG.

In the study by Morricone et al. [16], obese patients not only had significantly larger left ventricular diameters, but also thicker end-diastolic septum and posterior wall coupled with impaired diastolic function. However, in our study, there were no significant differences in diastolic function markers.

The study revealed that the average energy needed for effective cardioversion in OG was higher than in NOG. While the median energy value for patients with BMI ≥ 30 kg/m^2 reached 200 J, patients with lower BMI needed only 150 J. In the logistic regression model, not only BMI but also BSA and waist circumference were related to the necessity to use higher energies.

To limit a potent amiodaron influence on CVE efficacy patients on antiarrhythmic therapy with amiodaron were excluded from the study. Some of the patients were receiving other antiarrhythmic drugs (sotalol, propafenone) before CVE and the therapy was maintained after the procedure.

Obesity influence on long-term CVE outcomes still requires continued study. What we can prove is constant low-grade inflammation, insulin resistance and maladaptive immune responses are responsible for higher cardiovascular risk observed in obese patients.

In the study by Guglin et al. [4], the effect of obesity on AF recurrence was analyzed using data from the Atrial Fibrillation Follow-Up Investigation of Rhythm Management (AFFIRM) study. Higher BMI was associated with a higher number of cardioversions (OR 1.017 for a BMI increase of 1 kg/m^2) but also with a higher risk of being in AF on follow-up. Also, LA measurements and history of hypertension were the risk factors of AF recurrence. However, the multivariate analysis revealed that LA size but not BMI was an independent predictor of AF recurrence. According to previous publications covering this subject, the effect of obesity on AF efficiency was related to the greater LA measurements in patients with higher BMIs. This finding is consistent with the results of our study.

The discussion should take into consideration data on the implementation of lifestyle modification. It is emphasized in many publications that the role of weight management is not only in AF recurrence rate [17–19] but also in relieving the symptoms. In the study published in "JAMA", patients randomized to a weight management group showed a significantly greater reduction in the number of AF episodes, but also in syndrome severity scores than the control group. Furthermore, patients in the weight management group had lost weight more effectively than the group which received only general lifestyle advice. Additionally, weight reduction was associated with reverse cardiac remodelling. Reduction in intraventricular septal thickness and left atrial area was observed only in the intervention group [5].

The limited number of enrolled patients combined with the measurement error in anthropometry and echocardiography were the main limitations of the study. Assessment of some of the technical differences, for example, the pressure applied to the chest wall during the CVE procedure was practically impossible.

Conclusions

Proper qualification for CVE and careful course of procedure resulted in high immediate efficacy of intervention even in obese patients. While higher energy usage could

be necessary, greater amounts of delivered shocks should be taken into consideration.

A Long-term efficacy of CVE is still insufficient and seems to be worse in obese patients.

The borderline influence of BMI on immediate CVE efficacy and low one-month CVE efficacy in obese subjects suggest that further studies are necessary. BMI impact on the amount of energy needed for sinus rhythm restoration and bigger LA diameters in obese patients constitute the next argument in the discussion regarding obesity and sinus rhythm restoration.

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Conflict of interest

The authors declare no conflict of interest.

Streszczenie

Wstęp. Znaczenie otyłości dla efektywności procedur przywracających rytm zatokowy nie zostało nadal jednoznacznie określone. Celem przeprowadzonego badania była ocena wpływu otyłości na skuteczność kardiowersji elektrycznej (CVE) w migotaniu przedsionków (AF).

Materiały i metody. Do badania włączono 89 pacjentów zakwalifikowanych do CVE z powodu objawowego przetrwałego AF. Pacjentów, u których przywrócono rytm zatokowy, podzielono na 2 grupy, uwzględniając ich wskaźnik masy ciała (BMI): grupę z otyłością (OG: BMI ≥ 30 kg/m^2) i bez otyłości (NOG: BMI < 30 kg/m^2). W obu grupach ponownie oceniono skuteczność CVE po miesiącu obserwacji.

Wyniki. Natychmiastowa skuteczność CVE wyniosła 92% i była niezależna od BMI. Otyłość miała jednak wpływ na ilość energii potrzebnej do przywrócenia rytmu zatokowego (150 J w NOG *vs.* 200 J w OG; p < 0,05). Skuteczność CVE oceniania po miesiącu wyniosła 47%: 38,8% w OG i 60,6% w NOG (p < 0,05). Pacjenci w OG charakteryzowali się większymi wymiarami lewego przedsionka, lewej komory i niższą frakcją wyrzutową lewej komory (LVEF) w porównaniu z NOG (p < 0,05). Analiza regresji wykazała, że LVEF istotnie wpływa na skuteczność CVE ocenianej po miesiącu obserwacji (iloraz szans: 1,107, 95% CI: 1,015–1,207; p < 0,05).

Wnioski. Otyłość wydaje się nie wpływać na natychmiastową skuteczność CVE, jednak rzutuje na wartość energii koniecznej do przywrócenia rytmu zatokowego. Skuteczność CVE oceniania po miesiącu jest niska, a współistnienie otyłości dodatkowo zmniejsza szanse na utrzymanie rytmu zatokowego.

Słowa kluczowe: otyłość, migotanie przedsionków, kardiowersja elektryczna, przywrócenie rytmu zatokowego, energia kardiowersji elektrycznej

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