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Renal function in patients with pacemaker and diabetes

Funkcja nerek u chorych z implantowanym układem elektrostymulującym serca oraz współistniejącą cukrzycą

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S u m m a r y

Introduction. The key indicators for renal function are creatinine concentration and glomerular filtration rate. Implantation of a pacemaker in patients with dysfunction of electrical conduction system and diabetes impairs renal function.

Aim. The influence of pacemaker on renal function in patients with diabetes.

Material and methods. 92 patients were enrolled in the study, among whom 11 had diabetes. Each person was examined before the procedure of pacemaker implantation, 24 hours and 48 hours after the procedure. Out of 92 patients 60 had implanted DDD pacemakers, 2 patients had VDD pacemakers and 30 patients had VVI pacemakers. All patients had GFR estimated with MDRD equation. After 24 and 48 hours the assessment of renal function was repeated.

Results. GFR was not statistically significant after 24 hours after the procedure in patients with diabetes -5.09 ± 20.77 ($p = 0.435$ vs. values before the procedure) and 48 hours after the procedure -5.18 ± 16.73 ($p = 0.328$ vs. values before the procedure). Similarly, no significant change concerned GFR in patients without diabetes 24 hours and 48 hours after the procedure, and amounted to -1.17 ± 17.61 ($p = 0.551$ vs. values before the procedure) and -1.37 ± 17.22 ($p = 0.476$ vs. values before the procedure), respectively.

Conclusions. Patients with diabetes and arrhythmias qualified for pacemaker implantation did not present with significant increase of glomerular filtration rate within 48 hours after the procedure in comparison with the values before the procedure. Both groups with and without diabetes did not present with significant increase of glomerular filtration rate in comparison with the values before the procedure.

Key words: diabetes, pacemaker, glomerular filtration

S t r e s z c z e n i e

Wprowadzenie. Najważniejszymi wartościami wykładniczymi funkcji nerek są stężenie kreatyniny i wielkość filtracji kłębuszkowej. U chorych z współistniejącą cukrzycą dysfunkcja układu bodźcotwórczo przewodzącego prowadzi często do implantacji układu elektrostymulującego serca zaburzając jednocześnie funkcję samych nerek.

Cel. Wpływ implantacji układu stymulującego serca na funkcję nerek u pacjentów ze współistniejącą cukrzycą.

Materiały i metody. Grupa badana zawierała 92 osoby. Wśród badanych znajdowało się 11 osób z cukrzycą. Każda osoba była badana przed zabiegiem wszczepienia stymulatora, po 24 godzinach od wszczepienia oraz 48 godzin od wszczepienia stymulatora serca. W grupie badanej wszczepiono 60 stymulatorów DDD, 2 stymulatory VDD oraz 30 stymulatorów VVI. U wszystkich pacjentów przed zabiegiem oznaczono wartość GFR ze wzoru MDRD. Po 24 i 48 godzinach badania powtórzono ocenę funkcji nerek.

Wyniki. W grupie chorych z współistniejącą cukrzycą wartości GFR nie była znamienna po 24 godzinach od implantacji stymulatora -5,09 ± 20,77 ($p = 0,435$ vs. wartość przed zabiegiem) i po 48 godzinach od zabiegu -5,18 ± 16,73 ($p = 0,328$ vs. wartość przed zabiegiem). Analogiczny brak znamiennej zmiany dotyczył wartości GFR u pacjentów bez współistniejącej cukrzycy który po 24 godzinach od implantacji wynosił -1,17±17,61 ($p = 0,551$ vs.wartość przed zabiegiem) a po 48 godzinach od zabiegu wynosił -1,37 ± 17,22 ($p = 0,476$ vs. wartość przed zabiegiem).

Wnioski. Pacjenci z zaburzeniami rytmu zakwalifikowani do wszczepienia stymulatora serca u których stwierdzono współistniejącą cukrzycę w ciągu 48 po leczeniu zabiegowym nie uzyskali istotnego zwiększenia filtracji kłębuszkowej w porównaniu z wartością przed zabiegiem.

Obie podgrupy badane z cukrzycą i bez tej choroby współtowarzyszącej w sposób porównywalny nie uzyskały istotnego wzrostu wartości filtracji kłębuszkowej w porównaniu z wartością przed zabiegiem.

Słowa kluczowe: cukrzyca, stymulator, filtracja kłębuszkowa

INTRODUCTION

According to the newest data of Polish Diabetes Association about 6% of the Polish population suffer from diabetes. This number has increased by 2 percentage points over the last decade. Diabetes is the main risk factor for ischaemic heart disease, renal insufficiency, stroke, sight loss and the main reason for lower extremities amputation. It reduces life span by 5-10 years (1, 2). Diabetes is concerned as a group of metabolic disorders with one common factor – hyperglycemia (3). Hyperglycemia leads to microangiopathies (retinopathy, nephropathy) and macroangiopathies. Diabetes is based upon autoimmunological processes leading to the destruction of β cells of the Langerhans islets with the participation of autoantibodies to islet cells (ICA), antibodies to insulin (IAA), and glutamic acid decarboxylase autoantibodies (GAD). Other factors predisposing to the development of autoimmunological processes are viral infections (viruses: rubella, CMV infection, Coxackie B4), short period of breastfeeding, administration of nitrites, stress. The main cause of diabetes is impaired tissue sensitivity to insulin. Age, lipid disorders, hypertension are risk factors for diabetes. Diabetes of known aethiology includes genetic disorders of the pancreatic β cells (MODY), exocrine pancreatic diseases such as acute and chronic pancreatitis, pancreatectomy, pancreatic cancer and cystic fibrosis (4, 5). Diabetic nephropathy in diabetic patients is defined as chronic kidney disease in the absence of non-diabetic background. Around 40% of diabetic patients are particularly prone to renal complications. These are either GFR < 60 ml/min/1.73 m^2 for more than 3 months and/or structural kidney disorders. Diabetic nephropathy comprises 5 stages depending on the glomerular filtration rates corresponding with chronic kidney disease. Stages of the chronic kidney disease correlate with glomerular filtration rates in the following way: stage 1 – GFR > 90 ml/min with albuminuria, stage 2 – GFR 90-60 ml/min with albuminuria and latent kidney disease, stage 3 – GFR 60-30 ml/min compensated chronic kidney disease, stage 4 – GFR 30-15 ml/min non-compensated chronic kidney disease, stage 5 – GFR < 15 ml/min defines uraemia (6, 7).

Pacemaker protects from life-threatening arrhythmias such as bradyarrhythmias. Since fifty years it has enabled ensuring imposed heart rate supporting synchronous work of cardiac muscle (8). The indications for pacemakers include cardiac muscle diseases and disorders which lead to secondary dysfunction of electrical conduction system of the heart. Chronic kidney disease intensifies arteriosclerosis and influences the prevalence of cardiovascular complications, e.g. bradyarrhythmias. The aim of the study was the assessment of renal function in patients with bradyarrhythmias and coexisting diabetes before pacemaker implantation and 24 and 48 hours after the procedure.

MATERIAL AND METHODS

92 patients (45 women and 47 men) with arrhythmias and indications for permanent pacing treated in the Departament of Cardiology of the J. Śniadecki Regional Specialist Hospital in Białystok were enrolled in the study. Each patient was examined before the procedure of pacemaker implantation. 60 patients had DDD pacemaker, 2 patients had VDD pacemaker and 30 patients had VVI pacemaker. Before the procedure patients had GFR calculated with MDRD equation. Renal assessment was repeated after 24 and 48 hours. Glomerular filtration rates were calculated with simplified MDRD equation (modification of diet in renal disease) (9) which comprised serum creatinine concentration, age and gender (10, 11). The precision of MDRD results increased with age in patients with diabetes, in men (in comparison to women), and in slim patients (12).

Normally distributed data was assessed with Shapiro-Wilk test. Comparisons between the groups were performed with t-Student test, whereas data not compatible with this distribution was assessed with U Mann-Whitney test. Periodical assessment was performed with t-Student test for pairs or Wilcoxon test for pairs; $p < 0.05$ was considered statistically significant. Calculations were performed with SPSS statistical package.

RESULTS

The group of patients without diabetes had GFR amounting to 67.41. GFR of patients with diabetes was 65.91 (tab. 1). The difference in GFR in patients without diabetes was not significant 24 hours after pacemaker implantation -1.17 ± 17.61 ($p = 0.551$ vs. value before the procedure) and 48 hours after the procedure -1.37 ± 17.22 ($p = 0.47$ vs. values before the procedure) (tab. 2). No significant difference was also presented by patients with diabetes and amounted to -5.09 ± 20.77 24 hours after the procedure ($p = 0.435$ vs. values before the procedure) and -5.18 ± 16.73 48 hours after the procedure ($p = 0.328$ vs. values before the procedure) (tab. 3). The lack of GFR significance comparable in both study groups before the procedure, 24 hours, and 48 hours after the implantation of pacemaker is presented in figures 1-3.

Table 1. Mean values of the assessed parameter – both subgroups.

Diabetes		N	Mean	SD	p
GFR	1.00	11	65.91	15.93	0.842
	0.00	81	67.41	24.14	
GFR 24	1.00	11	71.00	26.50	0.796
	0.00	81	68.58	29.33	
GFR 48	1.00	11	71.09	19.55	0.778
	0.00	81	68.78	26.14	

Table 2. Pair measurements with statistical significance – patients without diabetes.

		N	Mean	SD	p
Pair 1	GFR – GFR 24	81	-1.17	17.61	0.551
Pair 2	GFR – GFR 48	81	-1.37	17.22	0.476
Pair 3	GFR 24 – GFR 48	81	-0.20	16.36	0.914

Table 3. Pair measurements with statistical significance – patients with diabetes.

		N	Mean	SD	P
Pair 1	GFR – GFR 24	11	-5.09	20.77	0.435
Pair 2	GFR – GFR 48	11	-5.18	16.73	0.328
Pair 3	GFR 24 – GFR 48	11	-0.09	23.40	0.990

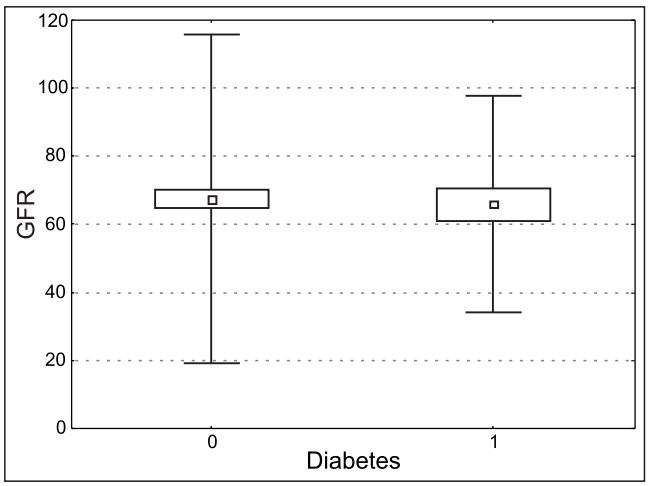

Fig. 1. GFR before the procedure in the compared groups.

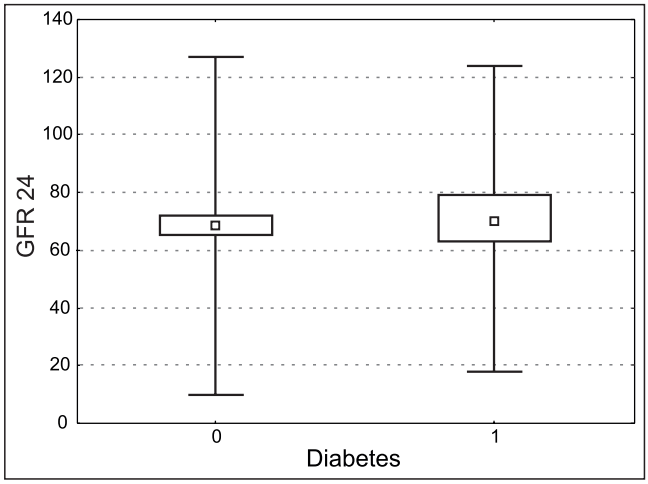

Fig. 2. GFR 24 hours after the procedure in the compared groups.

DISCUSSION

Up to date there are virtually no data on kidney function after implantation of the peacemakers, therefore we tried to assess kidney function by means of serum creatinine and estimated GFR 24 and 48 hours after peacemaker implantation. In our study we showed that pacemaker implantation did not have significant influence on glomerular filtration rate in both study groups. However, our data are of retrospective origin. GFR was necessary to define the degree of progression of renal remodeling and to assess renal function in study groups with electrical conduction system dysfunction and coexisting diabetes (13). Taking into consideration the results, patients with diabetes had amean eGFRof 65.91, which indirectly suggests well controlled diabetes with further confirmation by comparable mean GFR values in the study group without diabetes, equal to 67.41. In patients with GFR > 60 ml/min creatinine clearance is stable with its very slow increase. It intensifies only after it overruns certain value. Hence eGFR plays a key role in chronic kidney disease monitoring (14). The results of this study allow to draw conclusions that indicators for renal functions after pacemaker implantation in patients with chronic kidney disease and relatively well-controlled diabetes relative to patients without diabetes remain at similar level. Prospective studies should be designed to assess kidney function in patients undergoing peacemaker implantation to study the effects of improvement of heart function on serum creatinine. Long-term follow up is also needed to study.

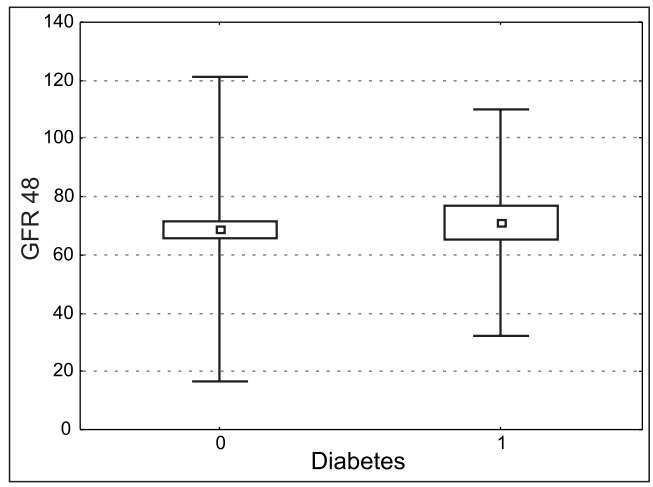

Fig. 3. GFR 48 hours after the procedure in the compared groups.

CONCLUSIONS

Patients with arrhythmias and coexisting diabetes and indications for pacemaker implantation did not present with significant increase of glomerular filtration rate 48 hours after the procedure in comparison with the value before the procedure.

Both study groups with and without diabetes did not reach the significant increase of glomerular filtration rates in comparison to the values before the procedure.

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received/otrzymano: 04.01.2013
accepted/zaakceptowano: 15.02.2013

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