ORIGINAL ARTICLE

Effects of short- and long-term efficacy of percutaneous transluminal renal angioplasty with or without intravascular brachytherapy on regression of left ventricular hypertrophy in patients with renovascular hypertension

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KEY WORDS

brachytherapy, hypertension, left ventricular hypertrophy

ABSTRACT

INTRODUCTION The largest group of patients with secondary hypertension comprises individuals with renovascular hypertension resulting from renal artery stenosis that is a potentially removable condition. It is caused by atherosclerosis in 70–80% of patients.

OBJECTIVES The aim of the study was to evaluate the influence of intravascular brachytherapy (IVBT) procedure performed after percutaneous transluminal renal angioplasty (PTRA) on left ventricular (LV) function, mass regression and type of hypertrophy (LVH) determined on echocardiography during long-term follow-up.

PATIENTS AND METHODS Sixty-two patients with atherosclerotic renal artery stenosis complicated by severe hypertension were treated with PTRA and randomly assigned to group 1 (PTRA alone) or group 2 (PTRA followed by IVBT). Subsequent IVBT was performed with the PARIS® catheter and the Microselectron HDR (Nucletron™) system for peripheral arteries. Treatment outcomes during follow-up were assessed with quantitative coronary angiography. LV mass and mass index (LVM and LVMI) and functional parameters prior to PTRA and during follow-up were determined by echocardiography with regard to the type of procedure.

RESULTS The degree of renal artery stenosis was significantly different in groups 1 and 2. In both groups elevated LVMI was observed ($p = 0.94$). There were no significant differences in interventricular septum (IVS) to LV posterior wall (LVPW) ratio, relative LV wall thickness, volumetric parameters and LV ejection fraction between both groups. During follow-up the values of LVMI and IVS to LVPW ratio were significantly lower ($p = 0.021$ and $p = 0.004$, respectively) in the PTRA + IVBT group compared to the PTRA group. Analysis of the LV geometry and type of hypertrophy revealed a marked reduction in concentric LVH in the IVBT group during long-term follow-up.

CONCLUSIONS Echocardiographic evaluation comparing several LV parameters in the PTRA alone and PTRA + IVBT groups showed that PTRA with subsequent brachytherapy were associated with better control of blood pressure and greater LVM regression, especially concentric hypertrophy, during long-term follow-up.

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INTRODUCTION The largest group of patients with secondary hypertension comprises individuals with renovascular hypertension (RVH) resulting from renal artery stenosis (RAS). Its etiology is in 70–80% atherosclerotic, a potentially removable cause.[1-4] Among the complications of arterial hypertension, pathologic changes in the cardiovascular system are of utmost importance. Myocardial hypertrophy is one of the most common pathologies.[5-9] At present more attention is focused on the early diagnosis[10] and treatment of RAS-related hypertension, which could contribute to a significant reduction in organ complications, morbidity and mortality.[4] Therefore, there is a need for preventive actions to reverse harmful mechanisms leading to left ventricular (LV) hypertrophy (LVH).[7,8,11] A number of reports from the 1970s demonstrated that LVH-related hypertension regressed with appropriate antihypertensive therapy. The effect results from a reduction in blood pressure and a direct influence of drugs on myocytes.[8,12] A particular contribution of those mechanisms is difficult to estimate since it differs with regard to drugs. The milestone in the invasive treatment of RVH was the introduction of percutaneous transluminal renal artery angioplasty (PTRA). Unfortunately, despite a relatively high effectiveness of renal angioplasty followed by stent implantation, the procedure is still associated with a risk of in-stent stenosis (restenosis) and its sequelae, particularly an increase in blood pressure. Thus, numerous studies are ongoing to improve techniques which prevent restenosis, i.e. drug-eluting stent implantation, intravascular brachytherapy (IVBT) and contact radiation therapy. Both β and γ radiation inhibit cell division and contribute to apoptosis of several smooth muscle cells in the media, which prevents the 2nd and 3rd phase of restenosis.[13] Assessment of the influence of blood pressure reduction after PTRA with subsequent IVBT (with or without pharmacotherapy) can be useful in objective evaluation of the impact of hemodynamic changes in LVH.[14-19]

Patients and methods Between 2001 and 2002, consecutive patients with atherosclerotic RAS who met the inclusion criteria were enrolled in the study. The study protocol was approved by the Bioethical Committee of the Medical University of Silesia, Katowice. The inclusion criteria were as follows: age ≥40 years, atherosclerotic renal artery stenosis ≥50% diameter with clinical features of RVH refractory to pharmacological treatment, deterioration of renal function as a result of progressive ischemia with a reference diameter of the renal artery ≥3 mm. The diagnosis of the RVH was made during hospitalization in the Department of Nephrology, Endocrinology and Metabolic Diseases, the Medical University of Silesia, Katowice, Poland. All patients underwent renal angiography and subsequently scheduled for angioplasty. Subsequently, they were randomly assigned (sealed envelopes) to one of 2 groups. Follow-up angiographic assessment and quantitative measurements were performed (off-line) by 2 independent experienced interventional cardiologists randomly selected. The procedure of PTRA was performed in the Hemodynamic Laboratory of the Silesian Center of Heart Diseases, Zabrze, Poland. The γ radiation therapy was performed in the Brachytherapy Department, Comprehensive Cancer Centre, Maria Sklodowska-Curie Memorial Institute Branch, Gliwice, Poland using the Paris® Centering Catheter System and the Nucletron® microSelectron HDR™ remote afterloader. The degree of renal artery stenosis was assessed by quantitative coronary angiography (QCA). Two days before the procedure all patients received 150 mg acetylsalicylic acid orally and 300 mg clopidogrel orally. Shortly before angioplasty 10,000 IU heparin intravenously was administered. Moreover, prior antiplatelet treatment was continued. Blood pressure was monitored for 24 hours with the use of ABPM[20] before the PTRA, shortly after the procedure and during long-term follow-up.

Echocardiographic assessment Two-dimensional (2D) and M-mode echocardiography was performed in standard parasternal long axis (LAx), short axis (SAx) and apical (two- and four-chamber) views. The LV end-systolic diameter, LV end-diastolic diameter (LVEDd), thickness of the interventricular septum (IVS) and LV posterior wall (LVPW) were analyzed using M-mode. For the study mean values from 3 subsequent measurements during heart cycles were calculated. Evaluation of LV mass (LVM) was made automatically by calculation using Deveraux formula:

$$\text{LVM (g)} = 1.04 \times (\text{LVPW} + \text{IVS} + \text{LVEDd})^3 - (\text{LVEDd})^3 - 14$$

where: LVPW – left ventricular posterior wall diameter during diastole (mm), IVS – interventricular septum wall thickness (mm), LVEDd – left ventricular end-diastolic diameter (mm).

In the case of asymmetric myocardial hypertrophy, which typically occurs during long-lasting arterial hypertension, all parameters were calculated planimetrically in the SAx imaging and 2D imaging using parasternal LAx view. The ratio of LV mass index (LVMI) to the patient's body surface area (m^2) was calculated. The proportion differs with sex. The normal upper limit of the ratio is 116 g/m^2 for males and 104 g/m^2 for females. As a diagnostic criterion for LVH in both sexes, the value >125 g/m^2 was adopted. The relative wall thickness (RWT) of the LV was estimated using the formula 2LVPWd/LVEDd. The normal RWT is <0.45.

Differentiation into 4 subtypes of LVH and geometry alterations was performed on the basis of echocardiographic analysis of the mass index and RWT as follows:

1 normal LV geometry: LWMI and RWT within normal range

2 concentric remodeling: LWMI – normal, RWT above the upper normal limit

TABLE 1 Echocardiographic parameters in the study groups

	Before the procedure			Follow-up		
	PTRA + BR	PTRA	p	PRTA + BR	PTRA	p
EDV (ml)	99.7 ±23.2	96.4 ±22.8	0.59	101.8 ±24.4	97.9 ±27.5	0.56
ESV (ml)	44.3 ±12.9	43.9 ±14.5	0.92	44.2 ±13.6	44.5 ±16.4	0.94
SV (ml)	55.4 ±13.1	52.5 ±11.1	0.36	57.6 ±14.5	53.3 ±14	0.24
EF (%)	55.7 ±4.9	54.9 ±5.8	0.55	56.9 ±7.4	54.4 ±5.6	0.15
FS (%)	39.2 ±6.9	39.8 ±8.1	0.76	41.1 ±11.1	38.8 ±7.2	0.34
LVDd (cm)	5 ±0.5	5.1 ±0.4	0.71	4.9 ±0.5	5.1 ±0.4	0.17
LVDs (cm)	3.1 ±0.5	3.1 ±0.6	0.95	2.9 ±0.6	3.1 ±0.5	0.22
LVM (g)	286 ±54.5	277.9 ±49	0.53	274.7 ±58.9	294.7 ±59.5	0.20
LVMI (g/m²)	152.8 ±27.5	153.3 ±19.6	0.94	145 ±29.3	161.9 ±24.8	0.021
IVS (mm)	1.2 ±0.1	1.1 ±0.1	0.59	1.2 ±0.2	1.2 ±0.1	0.16
LVPW (mm)	1.2 ±0.1	1.2 ±0.1	0.32	1.1 ±0.1	1.2 ±0.1	0.045
2PW/LVDd	0.479 ±0.068	0.461 ±0.067	0.31	0.465 ±0.46	0.47 ±0.047	0.73
IVS/LVPW	0.983 ±0.116	0.996 ±0.113	0.66	1.097 ±0.186	0.983 ±0.094	0.004

Values are presented as mean ± standard deviation.

Abbreviations: BR – brachytherapy, EDV – end diastolic volume, EF – ejection fraction, ESV – end systolic volume, FS – fractional shortening, IVS – interventricular septum, LVDd – left ventricular diameter in diastole, LVDs – left ventricular diameter in systole, LVM – left ventricular mass, LVMI – left ventricular mass index, LVPW – left ventricular posterior wall, PTRA – percutaneous transluminal renal angioplasty, SV – stroke volume, 2PW/LVDd – posterior wall/left ventricular diameter in diastole

3 concentric hypertrophy: LWMI and RWT above the upper normal limit
4 eccentric hypertrophy: LVMI above the upper normal limit, RWT normal.

The ejection fraction (EF) was calculated using end-systolic volume and end-diastolic volume according to Simpson's rule.

Intravascular brachytherapy IVBT was performed with the Nucletron® microSelectron HDR™ remote afterloader and the γ-emitting iridium source Ir192 using the PARIS® Centering Catheter System constructed by Guidant and compatible with the equipment of the above mentioned company. According to the protocol the follow-up hospitalization was scheduled at 9 months in order to perform renal artery angiography, ECG and other non-invasive tests.

Statistical analysis The continuous data with normal distribution were expressed as mean ± standard deviation. To assess the data distribution Kolmogorov-Smirnow and Lilliefors tests were used. The differences between groups in mean values were examined using U Mann-Whitney or Student's t-tests, as appropriate. The χ^2 test was used to determine differences between the groups in categoric variables. The relationship between continuous data was determined using a non-parametric Spearman correlation. At $p < 0.05$ differences were considered statistically significant. All statistical analyses were performed using STATISTICA 6.0 software (StatSoft, Inc. USA).

RESULTS A total of 71 patients (43 male and 28 female) were randomized. The PTRA procedure was successful in 62 patients (87.3%). Nine patients (12.7%) were excluded from the study. In this subgroup vascular stents were implanted due to renal artery dissection. In group 1, consisting of 33 patients (mean age 51.8 ±7.6 years, male – 55%), PTRA followed by IVBT was performed. In 5 of them (15.2%) a catheter was inserted *via* the brachial artery prior to PTRA. Group 2 involved 28 patients at a mean age of 53.3 ±8.2 years (55% male). There were no statistically significant differences between the 2 groups with regard to echocardiographic variables prior to angioplasty (TABLE 1).

In both groups LVMI (group 1, 152.8 ±27.5 g/m² and group 2, 153.3 ±19.6 g/m², p = 0.94) was increased. Similarly LVPW was elevated (12 ±1 mm). The IVS thickness was initially greater in the IVBT group (12 ±1 mm), whereas in group 1 it was lower (11 ±1mm, p = 0.59). There were no significant differences in the ratio of IVS to LVPW. The ratio of IVS do LVPW was 0.983 ±0.12 in group 1 and 0.99 ±0.11 in group 2. No differences between both groups were observed with reference to the thickness of LV wall, and volumetric and hemodynamic LV parameters. There were no intergroup differences in blood pressure and 24-hour changes in the mean blood pressure measured by ambulatory blood pressure monitoring (ABPM) before and after PTRA. A significant reduction in systolic and diastolic blood pressure and a lower percentage of systolic and diastolic blood pressure above the normal upper limit were observed in both groups following angioplasty (TABLE 2). As a result of decreased blood pressure the number and doses of drugs were reduced. During long-term follow-up a small, but statistically significant increase in systolic and diastolic blood pressure was observed (lower in group 1).

TABLE 2 Changes in 24-hour blood pressure in the study groups

	Before the procedure 1	After the procedure 2	Follow-up 3	p 1 vs. 2	p 2 vs. 3	p 1 vs. 3
	PTRA + BR					
SBP	152 ±7	144 ±8	145 ±8	<0.001	0.039	<0.001
% of values > upper limit	89 ±10	70 ±14	71 ±15	<0.001	0.56	<0.001
DBP	108 ±4	91 ±3	93 ±3	<0.001	<0.001	<0.001
% of values > upper limit	96 ±6	65 ±16	65 ±17	<0.001	0.33	<0.001
	PTRA					
SBP	152 ±8	143 ±8	148 ±8	<0.001	<0.001	<0.001
% of values > upper limit	89 ±10	68 ±20	78 ±18	<0.001	<0.001	<0.001
DBP	108 ±5	91 ±4	95 ±5	<0.001	<0.001	<0.001
% of values > upper limit	94 ±9	64 ±16	77 ±18	<0.001	<0.001	<0.001

Values are presented as mean ± standard deviation.
Abbreviations: DBP – diastolic blood pressure, SBP – systolic blood pressure, other – see TABLE 1

TABLE 3 Total number of antihypertensive drugs in the study groups

	Before the procedure 1	After the procedure 2	Follow-up 3	p 1 vs. 2	p 2 vs. 3	p 1 vs. 3
PTRA + BR	3.2 ±0.9	1.9 ±1.1	2.1 ±1.0	<0.001	<0.001	<0.001
PTRA	3.3 ±0.9	2.0 ±0.8	2.8 ±1.3	<0.001	<0.001	0.050
P value: PTRA + BR vs. PTRA	0.63	0.66	0.038			

Values are presented as mean ± standard deviation.
Abbreviations: see TABLE 1

An increase in the doses of the prescribed medications was required in those individuals (TABLE 3).

Echocardiographic assessment during long-term follow-up During follow-up all patients underwent renal angiography (with calculation of intravascular ultrasound and QCA) after 294 ±142 days (group 1) and 319 ±165 days (group 2; p = NS). Restenosis was documented in 4 patients (12.9%) from group 1 and 9 patients (32.1%) from group 2 (p = 0.018).

During the same hospital stay echocardiography was performed. In the IVBT group, LVEF was slightly increased, while it decreased in group 2. There were no significant differences in shortening fraction between the groups before PTRA and during long-term follow-up (TABLES 1 and 4).

In the relative assessment of LV wall thickness before PTRA and during follow-up no statistically significant differences were noted between the study groups. In group 1 LVM was decreased when compared to the same variable assessed prior to PTRA (p = 0.05). In contrast, LVM in group 2 was significantly increased (p <0.01). In the brachytherapy group, LVMI was significantly lower than in patients not undergoing the procedure (145 ±29.3 g/m² vs. 161.9 ±24.8 g/m², respectively; p = 0.021). LVPW during long-term follow-up was decreased (11 ±1 mm) in group 1 compared to group 2 (12 ±1 mm, p = 0.045).

A significant intergroup difference was observed in the IVS/LVPW ratio (group 1: 1.097 ±0.186, vs. group 2: 0.983 ±0.094; p = 0.004). No other differences were noted when analyzing the remaining volumetric and hemodynamic parameters.

In patients who underwent brachytherapy there was a significant decrease in LVMI from 152.8 ±38.2 g/m² to 145 ±29.3 g/m² (p = 0.025) and a slight decrease in LVM from 286 ±54 g to 274 ±58 g, which almost reached the level of statistical significance (p = 0.066). In group 2, a small, but significant increase in LVMI (from 153.3 ±19 g/m² to 161.9 ±24.8 g/m², p = 0.024) and LVM (from 278 ±49 g to 295 ±59 g, p = 0.01) was observed during follow-up. In the brachytherapy group, the IVS thickness measured approximately 1.2 mm and did not change significantly during follow-up compared to values obtained before the procedure. The IVS thickness in group 2 increased from 1.1 ±0.1 mm before PTRA to 1.2 ±0.1 mm during long-term follow-up (p = 0.16). A significant decrease in LVPW thickness was noted in the brachytherapy group (from 1.2 ±0.1 mm to 1.1 ±0.1 mm, p = 0.024). There was such a change in the PTRA group; the LVPW measurement before and after the procedure was approximately 1.2 ±0.1 mm (p = 0.26). The IVS to LVPW ratio increased significantly in group 1 from 9.8 ±1.2 mm to 11 ±1.9 mm after PTRA (p = 0.006), which resulted from reduction in LVPW thickness during follow-up. During long-term observation, the thickness of IVS in group 2 increased while LVPW remained unaltered and therefore the IVS/LVPW ratio decreased from 1.00 ±0.11 to 0.98 ±0.09 (p = 0.50).

TABLE 4 Changes in echocardiographic parameters in the study groups

	PTRA + BR			PTRA		
	Before the procedure	Follow-up	p	Before the procedure	Follow-up	p
EDV (ml)	99.7 ±24.2	101.8 ±24.4	0.28	96.4 ±22.8	97.9 ±27.5	0.24
ESV (ml)	44.3 ±12.2	44.2 ±13.6	0.86	43.9 ±14.5	44.5 ±16.4	0.49
SV(ml)	55.4 ±13.9	57.6 ±14.5	0.21	52.5 ±11.1	53.3 ±14	0.50
EF (%)	55.7 ±4.5	56.9 ±7.4	0.24	54.9 ±5.8	54.4 ±5.6	0.57
FS (%)	39.2 ±6.9	41.1 ±11.1	0.22	39.8 ±8.1	38.8 ±7.2	0.31
LVDd (cm)	5.0 ±0.4	4.9 ±0.5	0.22	5.1 ±0.4	5.1 ±0.4	0.76
LVDs (cm)	3.1 ±0.5	2.9 ±0.6	0.090	3.1 ±0.6	3.1 ±0,5	0.32
LVM (g)	286 ±54	274 ±58	0.066	278 ±49	295 ±59	0.010
LVMI (g/m²)	152.8 ±38.2	145 ±29.3	0.025	153.3 ±19.6	161.9 ±25	0.024
IVS (mm)	1.2 ±0.1	1.2 ±0.2	0.071	1.1 ±0.1	1.2 ±0.1	0.16
LVPW (mm)	1.2 ±0.1	1.1 ±0.1	0.024	1.2 ±0.1	1.2 ±0.1	0.26
2PW/LVDd	0.48 ±0.07	0.46 ±0.46	0.30	0.46 ±0.07	0.47 ±0.05	0.41
IVS/LVPW	0.98 ±0.12	1.10 ±0.19	0.006	1.00 ±0.11	0.98 ±0.09	0.50

Values are presented as mean ± standard deviation.

Abbreviations: see TABLE 1

TABLE 5 Left ventricular hypertrophy by echocardiographic evaluation in the study groups

	Before the procedure	Follow-up
PTRA + BR	31 patients	29 patients
concentric hypertrophy	19 (61.3%)	13 (41.9%)
eccentric hypertrophy	7 (22.6%)	9 (29.0%)
concentric remodeling	3 (9.7%)	5 (16.2%)
normal	2 (6.4%)	4 (12.9%)
PTRA	29 patients	28 patients
concentric hypertrophy	17 (58.6%)	19 (67.8%)
eccentric hypertrophy	10 (34.5%)	7 (25.0%)
normal	2 (6.9%)	2 (7.2%)

Values are presented as a number of patients (%).

Abbreviations: see TABLE 1

Type of left ventricular hypertrophy Initially, a normal geometry of the LV was noted in 3 patients (5.1%) in both groups. As a result of the treatment during long-term follow-up the number increased to 6 (10.2%). Concentric LVH was observed initially in 36 (61%) subjects and, during follow-up in 32 patients (54.2%). Additionally, there was a tendency to reduce the proportion of patients with eccentric hypertrophy from 17 cases (28.8%) to 16 (27.1%). The number of individuals with concentric LV remodeling increased from 3 (5.1%) to 5 (8.5%) during long-term follow-up.

The further analysis of LVH and its types was made in subgroups of patients who underwent PTRA followed by brachytherapy and those without subsequent radiation therapy of the renal artery (TABLE 5). The proportion of patients with concentric hypertrophy prior to the procedure was similar (group 1 – 61.3% and group 2 – 58.6%). During long-term follow-up, the percentage of patients with concentric hypertrophy decreased to 41.9% in group 1 compared to group 2 in which it increased to 67.8%. With regard to eccentric hypertrophy, a rise in the percentage of patients from 22.6% to 29% in group 1 was noted. On the other hand, in group 2 a decrease from 34.5% to 25% was observed. The proportion of patients with concentric LV remodeling increased from 9.7% to 16.2% in group 1. No patient with concentric remodeling of the LV was identified in group 2. The normal geometry of the LV on the initial echocardiographic evaluation was detected in 6.4% of patients from group 1. During long-term follow-up the percentage of patients with normal LV geometry rose to 12.9%. In group 2 no such observation was made. Directly after PTRA, a reduction in absolute values of blood pressure was noted in both groups, i.e. in 70% of patients from group 1 and 72% of patients from group 2. During follow-up, a long-term outcome, defined as a normalized blood pressure or a permanent reduction in doses of antihypertensive drugs, was observed in 19 patients from group 1 and 12 individuals from group 2.

DISCUSSION LVH observed in more than 30% of patients with arterial hypertension is a strong independent risk factor for cardiovascular events. Prevalence of myocardial hypertrophy increases with age, body weight and blood pressure. Determination of the LVH has a significant impact on prognosis of each patient. The highest mortality is observed in individuals with concentric hypertrophy and a lower death rate in those with eccentric LVH. The lowest mortality refers to patients with concentric remodeling when compared to the patients with normal LV geometry. Early detection of LV hypertrophy in patients with arterial hypertension, particularly with RVH, appropriate pharmacotherapy and invasive treatment may reduce the prevalence of cardiovascular complications.

Results obtained during echocardiography following long-term follow-up demonstrate that conventionally assessed parameters, i.e. shortening fraction (SF) and EF, cannot be considered as markers of LV contractility. They do not alter despite changes in the LV myocardial mass and the antihypertensive effect of therapy. Echocardiographic assessment using the LVMI and Deveraux formula showed a significant reduction in myocardial mass and the mass index (when was indexed to a body surface area) and a higher ratio of diastolic IVS thickness to the LVPW in patients who underwent PTRA followed by IVBT compared to those treated with PTRA alone. When analyzing the type of hypertrophy and LV geometry during long-term follow-up, a significant reduction in concentric hypertrophy was observed in patients who underwent PTRA + IVBT (57.6% vs. 42%) vs. the PTRA group (62% vs. 64.3%). The incidence of eccentric hypertrophy, less common in the studied population, decreased insignificantly in both groups during long-term follow-up. In patients with concentric LV remodeling the following changes are typically observed: an increase in total peripheral resistance, a decrease in volume of circulating plasma and cardiac output.[7,8,21-23] Results obtained during a follow-up echocardiography may be partially explained by an increase in LV myocardial mass in patients who underwent only renal artery angioplasty (despite invasive treatment). This may contribute to a higher incidence of restenosis and a less permanent effect of PTRA. Similar conclusions were reported in the study by Symonides et al. who demonstrated that effective renal artery revascularization was associated with a long-lasting regression of LVH parameters.[24] No evidence of LVM reduction in patients who did not undergo IVBT may be partially explained by a lower decrease in diastolic blood pressure during follow-up when blood pressure values were compared.

Not only early employed invasive treatment, but also appropriate pharmacotherapy may prevent cardiovascular complications or reduce the risk of their occurrence in patients with hypertensive LVH.[25] Nearly all antihypertensive drugs contribute to a reduction in LV myocardial mass with the exception of vasodilatators with peripheral activity and drugs additionally stimulating sympathetic nervous system.[26,27] Drugs which dilate arterioles (hydralazine, minoxidil) increase the volume of circulating blood and consequently the LV ejection volume. Despite their antihypertensive effect, the LV myocardial mass does not decrease. Analysis of several studies performed during the previous years has shown that the most pronounced reduction in LV myocardial mass assessed by echocardiography was obtained with the use of angiotensin-converting enzyme inhibitors (ACEI), calcium channel blockers and diuretics.[26-28] Some studies reported that antihypertensive treatment contributed to a significant regression of myocardial mass, particularly in concentric LVH.[7,27,29] On the other hand, the study by Zeeler et al. demonstrated that PTRA was an independent predictor of reduction in LVH, most likely by decreased activity of the renin-angiotensin-aldosterone system, which was followed by antihypertensive effect.[30] In the current study, the total amount of agents, i.e. ACEI, calcium channel blockers and diuretics used by patients who underwent PTRA followed by brachytherapy was significantly lower when compared to patients in whom PTRA alone was performed.

Parameters evaluated on echocardiography, i.e. SF and EF, cardiac output and stroke volume, can reflect only the dynamic changes in the LV volume, without assessing the type of hypertrophy, alterations in LV geometry and rheology, particularly with reference to the body surface area.[23]

In conclusion, during long-term follow-up in patients who underwent PTRA combined with brachytherapy, echocardiography showed reduced LVM and LVH. The only factors that differ between the study groups, which may influence the LV mass, are: the type of invasive procedure performed and long-term effectiveness in terms of reduction and better control of blood pressure.

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ARTYKUŁ ORYGINALNY

Wpływ wczesnej i odległej skuteczności zabiegu przezskórnej śródnaczyniowej angioplastyki tętnicy nerkowej z następową brachyterapią i/lub bez niej na regresję przerostu mięśnia sercowego u chorych na nadciśnienie naczyniowo-nerkowe

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SŁOWA KLUCZOWE

brachyterapia, nadciśnienie tętnicze, przerost lewej komory

STRESZCZENIE

WPROWADZENIE Największą grupę chorych na wtórne nadciśnienie tętnicze stanowią chorzy na nadciśnienie naczyniowo-nerkowe (NNN) spowodowane zwężeniem tętnicy nerkowej (ZTN), czyli potencjalnie usuwalną przyczyną, w około 70–80% przypadków o etiologii miażdżycowej.

CELE Celem badania była ocena wpływu brachyterapii śródnaczyniowej (*intravascular brachytherapy* – IVBT) przeprowadzonej po zabiegu przezskórnej śródnaczyniowej angioplastyki tętnicy nerkowej (*percutaneous transluminal renal angioblasty* – PTRA) na funkcję, zmniejszenie masy i typ przerostu lewej komory (*left ventricular hypertrophy* – LVH) ocenianych echokardiograficznie w odległej obserwacji.

PACJENCI I METODY Grupę 62 pacjentów z ciężkim nadciśnieniem tętniczym wikłającym miażdżycowe zwężenie tętnicy nerkowej poddano zabiegowi PTRA. U losowo wybranych pacjentów dodatkowo wykonano IVBT, a następnie porównano grupę 1 (PTRA) z grupą 2 (PTRA + IVBT). Zabieg IVBT przeprowadzono przy użyciu cewnika PARIS® i urządzenia microSelectron HDR firmy Nucletron™ dla tętnic obwodowych. Wyniki leczenia w obserwacji odległej oceniano z użyciem angiografii ilościowej. W trakcie obserwacji ocenie echokardiograficznej poddano dane funkcjonalne przed PTRA, masę lewej komory i indeks masy w odniesieniu do typu zabiegu.

WYNIKI Stopień ZTN różnił się istotnie pomiędzy grupami. W obu grupach zaobserwowano wzrost indeksu masy mięśniowej lewej komory (*left ventricular mass index* – LVMI), $p = 0,94$. Nie zauważono istotnych różnic w relatywnej grubości ściany lewej komory, stosunku przegrody międzykomorowej (*interventricular septum* – IVS) do ściany tylnej lewej komory (*left ventricular posterior wall* – LVPW), parametrach objętościowych i frakcji wyrzutowej lewej komory (*left ventricle* – LV) pomiędzy grupami. W trakcie dalszej obserwacji LVMI oraz stosunek IVS do LVPW były znacząco niższe w grupie PTRA + IVBT w porównaniu do grupy PTRA (odpowiednio $p = 0,021$ oraz $p = 0,004$). Analiza geometrii i typu przerostu LV wykazała istotne zmniejszenie koncentrycznego przerostu LV w grupie IVBT podczas odległej obserwacji.

WNIOSKI W analizie echokardiograficznej porównującej w odległej obserwacji poszczególne parametry LV w grupach PTRA oraz PTRA + IVBT wykazano, że zabieg PTRA z następową brachyterapią związany był z lepszą kontrolą ciśnienia tętniczego i wyższym stopniem regresji masy LV, w szczególności przerostu koncentrycznego.

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