Kardiologia Polska 2014; 72, 7: 646–653; DOI: 10.5603/KP.a2014.0047 ISSN 0022–9032

Dyspnoea related to pre-excitation during sinus rhythm as a new indication for catheter ablation

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Abstract

Background: Patients with pre-excitation without arrhythmic symptoms are diagnosed as Wolff-Parkinson-White (WPW) pattern.

Aim: To evaluate the efficacy of radiofrequency ablation (RFA) in patients with a WPW pattern and reported dyspnoea.

Methods: Five patients (four adults and one adolescent, all female, age 33 ± 15 years) with a WPW pattern were referred due to dyspnoea and exercise intolerance. None had a history of paroxysmal syncope, pre-syncope, dizziness or palpitation. Before and after RFA, additional tests were used to exclude organic diseases of the pulmonary vessels, heart and lung, as well as bronchial hyperreactivity and metabolic diseases. Cardiopulmonary exercise test (CPET), echocardiography, time of forced expiration, baseline dyspnoea index (BDI), and transition dyspnoea index (TDI) were included into an objective evaluation of breath pattern.

Results: In all investigated patients, no arrhythmia was inducible during the electrophysiology study. The time of forced expiration increased immediately after RFA from 15.8 ± 2.9 to 29.2 ± 4.4 s ($p < 0.001$). The BDI score before RFA was 6.7 ± 1.9 and the TDI score after RFA showed a significant improvement: 8.0 ± 1.2 ($p < 0.05$). CPET revealed significant improvement in cardiopulmonary capacity after RFA in all cases: peak oxygen consumption [mL/kg/min]: 31.1 ± 7 vs. 42.6 ± 9.6 ($p = 0.014$); peak exercise minute ventilation [L/min]: 60.0 ± 19.9 vs. 82.0 ± 27 ($p = 0.006$); peak exercise tidal volume [L]: 1.56 ± 0.25 vs. 2.04 ± 0.24 ($p = 0.002$); ratio dead space/tidal volume at the end of exercise: 28 ± 2.6 vs. 25 ± 2.3 ($p = 0.005$).

Conclusions: Dyspnoea during sinus rhythm in women with pre-excitation may be considered to be an evaluation criterion before RFA.

Key words: WPW syndrome, accessory pathway, dyspnoea, cardiopulmonary exercise test, ablation

Kardiol Pol 2014; 72, 7: 646–653

INTRODUCTION

The diagnosis of Wolff-Parkinson-White (WPW) syndrome is reserved for patients who have ventricular pre-excitation and symptoms related to paroxysmal tachycardia, such as paroxysmal palpitations, dizziness, or syncope [1, 2]. Patients with pre-excitation without arrhythmic symptoms are usually diagnosed as having a WPW pattern or asymptomatic pre-excitation [1].

Radiofrequency catheter ablation (RFA) has become an established mode of therapy for symptomatic patients. However, the management of WPW pattern is controversial [1–5]. Some studies and case reports have associated a WPW pattern

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Received: 30.05.2013 **Accepted:** 16.01.2014 **Available as AoP:** 10.02.2014

with interventricular dyssynchrony and even the development of cardiomyopathy [6–10]. An association between pre-excitation and reduced cardiopulmonary performance in a patient with WPW syndrome has been reported [11].

In this report, we present a series of patients with chronic unexplained dyspnoea coexisting with a WPW pattern. Disappearance of resting and exertional dyspnoea and improvement in cardiopulmonary performance was noted immediately after successful RFA of the accessory pathway.

METHODS

Study group

All consecutive patients with pre-excitation referred for electrophysiologic consultation and invasive treatment from October 2007 to November 2008 in a single Electrophysiology Laboratory were screened. From the referred group of 43 patients with manifest pre-excitation, seven patients were found to have no documented episodes or symptoms of palpitation or other paroxysmal symptoms suggesting paroxysmal arrhythmic events. Five of these seven patients reported a history of resting and exertional dyspnoea and limited respiratory performance, which was confirmed by abnormal spirometry and cardiopulmonary exercise test (CPET; see below). The excluded two patients had normal results of spirometry and CPET; all their parameters obtained during these tests were above predicted values.

The included five patients with a history of resting dyspnoea and exercise intolerance were diagnosed as 'unexplained dyspnoea' coexisting with a WPW pattern.

Clinical evaluation

The protocol of investigation comprised: detailed questionnaire regarding symptoms with a special focus on resting and exertional dyspnoea symptoms; the baseline dyspnoea index and transition dyspnoea index (BDI-TDI) [12, 13].

24-h Holter monitoring was used to investigate potentially arrhythmic events. Two-dimensional (2D) echocardiography and 64-row computed tomography was performed to exclude organic heart and lung diseases, any morphological changes in the pulmonary vessels or stenosis in the coronary arteries. Metabolic, rheumatoid, endocrinological and haematological diseases were excluded by specific blood tests.

Patients underwent clinical evaluation seven days before and within two weeks after RFA. In all cases, investigations before ablation were undertaken with manifest pre-excitation.

Expiratory test

The expiratory test consisted of electrocardiography (ECG) monitoring for manifest pre-excitation and forced continuous counting by the patient (patients looked at a watch and counted the numbers appearing at a rate of one per second). After maximal expiration followed by maximal inspiration, patients were asked to start counting continuously with audible pronunciation of successive numerals (1, 2, 3… etc.) without inspiration as long as possible. Patients were carefully observed and instructed not to inhale and to keep appropriate speed during counting. When a patient tried to breathe in during counting, the test ended. The expiratory test was repeated up to three times and the maximal time of expiration was taken for analysis. The expiratory test was then repeated before ablation (in the Electrophysiology Laboratory) in the resting position and immediately after successful RFA.

Resting lung function

Spirometry was used to obtain values for forced vital capacity (FVC) and forced expiratory volume in the first second (FEV_1) [14]. Bronchial hyperreactivity was excluded by a negative spirometric dilation test and a negative methacholine inhalation test. Body plethysmography and measurement of carbon monoxide diffusing capacity (DLCO) were used for the exclusion of parenchymal lung diseases.

CPET

CPET was carried out on a treadmill using standard equipment and conditions (ZAN 680, Oberthulba, Germany and Spire Health, Longmont, CO, USA). All patients exercised to maximum tolerance with the use of a progressively increasing work rate according to the ramp protocol [15, 16].

Gas exchange analyses were undertaken on a breath-by-breath basis. The following parameters were analysed during CPET: oxygen consumption at peak exercise (VO_2peak [mL/kg/min]); oxygen consumption at anaerobe threshold (VO_2 at AT [mL/kg/min]); total time of exercise [s]; respiratory exchange ratio (RER = VCO_2/VO_2); heart rate (HR [bpm]); oxygen consumption per heart rate (O_2 pulse [L/beat]); minute ventilation (VE [L/min]); tidal volume (VT [L]); equivalent ventilation for O_2 (VE/VO_2); equivalent ventilation for CO_2 (VE/VCO_2); end-tidal pressure of CO_2 (Pet CO_2 [mm Hg]); and ratio between dead space and tidal volume in the lungs (VD/VT [%]) [16].

Furthermore, Wasserman's criteria (corrected for age and sex) for VO_2peak, VEpeak and VTpeak were used to evaluate the prognostic impact of the CPET to identifypatients with suspected symptomatic pre-excitation during sinus rhythm [17–20].

Echocardiography and ventricular dyssynchrony

Interventricular dyssynchrony was evaluated by measuring two standard echocardiographic parameters: interventricular mechanical delay and septal to posterior wall motion delay.

Electrophysiology study and RFA

Patients were investigated in the fasting state without sedation and without drugs that could influence cardiac and pulmonary performance. The electrophysiology study and RFA was undertaken using ablation catheter and a decapolar mapping catheter inserted via femoral access into the coro-

nary sinus. Standard, classic mapping was undertaken under fluoroscopic guidance and intracardiac ECGs were recorded and analysed in an electrophysiology system (EP-Tracer, CardioTek, Maastricht, the Netherlands). A stimulation study was done within 20 min after successful RFA.

Ethical approval of the study protocol

The study protocols were accepted by the Ethics Committees (Silesian Medical University no. 24/II/08 and Warsaw Medical University no. KB 143/2007). All patients provided written informed consent to be included in the study.

Statistical analyses

We used the two-tailed paired *t*-test for comparisons for coupled data. Threshold with $p < 0.05$ was considered as significant. Continuous variables were expressed as mean ± standard deviation. STATISTICA software 7.0 (Statsoft, Tulsa, OK, USA) was used for all calculations.

RESULTS

The study group consisted of five patients (five females, mean age 33 ± 15 years, mean body mass index 24.7 ± 5.4 kg/m^2) who reported a history of chronic resting and exertional dyspnoea. All possible diseases that may influence cardiopulmonary performance were excluded. Nobody was a smoker or had a history of paroxysmal syncope, pre-syncope, dizziness or palpitation. Only three of the five patients were seeking medical attention due to resting dyspnoea. The others had considered their limited cardiopulmonary performance as a typical chronic condition despite active participation in sport (n = 2, weightlifting, swimming). The baseline electrophysiological characteristics of the patients are presented in Table 1.

The main symptoms that disappeared immediately after RFA were: resting dyspnoea (n = 5), shallow breath (n = 4), and exertional dyspnoea (n = 5). The other reported symptoms that disappeared after RFA were: inability to sing or talk out loud (n = 4), chronic fatigue (n = 3), and frequent yawning (n = 2).

During the electrophysiology study, arrhythmia was not inducible in all five patients. Therefore those patients were classified as low risk WPW pattern excluding high risk for arrhythmias and sudden cardiac death.

Pre-excitation during sinus rhythm was associated with an expiratory time < 20 s in all cases. The expiratory time evaluated in the electrophysiology laboratory increased immediately after successful RF application from 15.8 ± 2.9 s to 29.2 ± 4.4 s ($p < 0.001$). In two patients after successful RF application, early recurrence of conduction throughout the accessory pathway was noted within the observation period. The recurrence of pre-excitation decreased the expiratory time to the baseline value. Additional RFA applications with complete elimination of accessory-pathway conduction resulted in permanent improvement in the expiratory time

Table 1. Electrophysiological (EP) characteristics of patients with dyspnoea coexisting with pre-excitation during sinus rhythm

EP parameters of accessory pathway: presentation, refractoriness and ventriculo-atrial (VA) conduction prior (pre) and after (post) radiofrequency ablation (RFA)	
Right midseptal	Permanent, 250 ms, VA (+) post RFA
Right posteroseptal	Permanent, 320 ms, VA (+) post RFA
Left inferior	Permanent, 240 ms, VA (–) post RFA
Left postero-inferior	Intermittent, 280 ms, VA (–) pre and post RFA
Left postero-inferior	Intermittent, 350 ms, VA (–) pre and post RFA

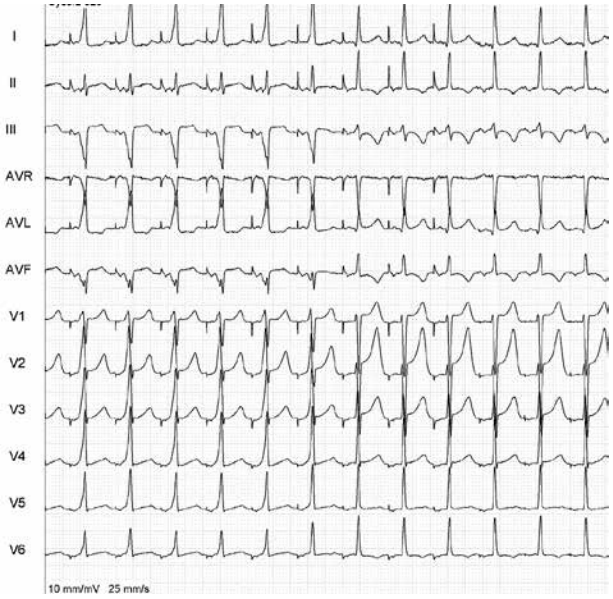

Figure 1. 12-lead electrocardiogram during atrial pacing and radiofrequency ablation in a patient with symptomatic pre-excitation during sinus rhythm. After sixth QRS complex, the disappearance of pre-excitation was noted

(Fig. 1). There were no complications associated with RFA, and one patient required a second procedure to permanently eliminate an the accessory pathway.

BDI-TDI

The BDI score evaluated before RFA was 6.7 ± 1.9 (range 5–10). The TDI score evaluated after RFA showed a very significant improvement in symptoms (8.0 ± 1.2; range 6–9; $p < 0.05$).

Spirometry

None of the five patients with pre-excitation during sinus rhythm could carry out maximum exhalations during baseline spirometry. The curves of flow-volume and volume-time had a normal configuration at the beginning, but the duration

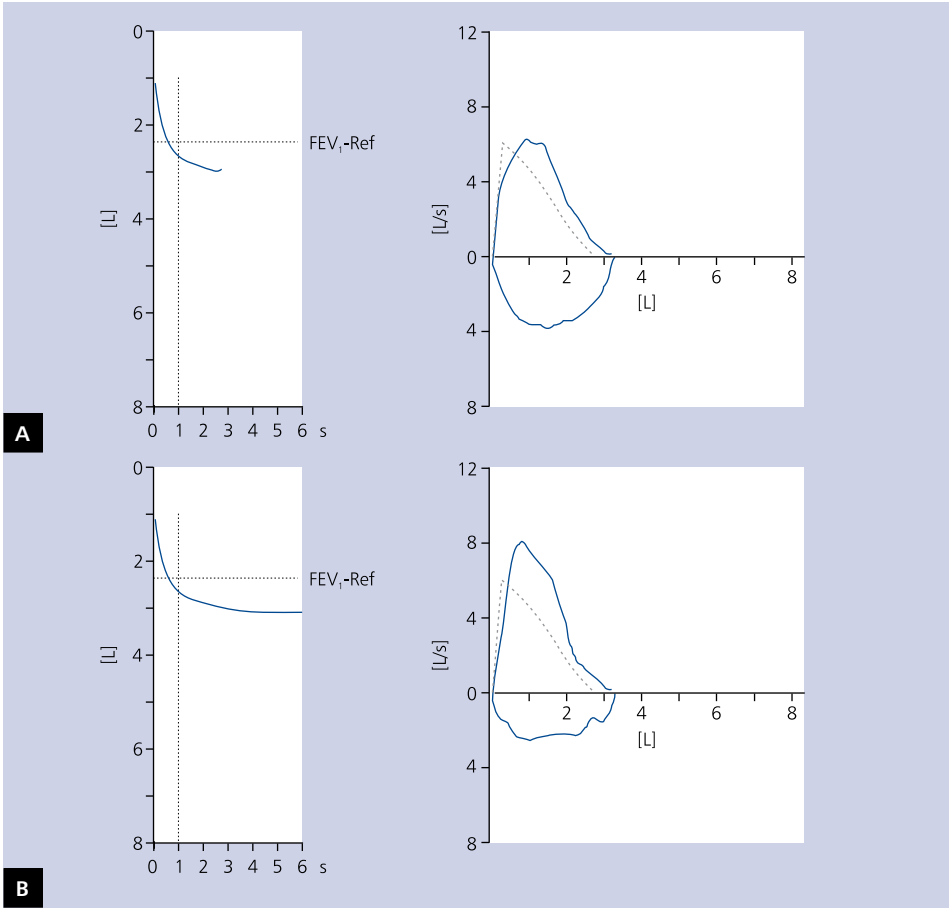

Figure 2. Typical results of standard spirometry in a patient with dyspnoea and pre-excitation during sinus rhythm. Flow/Volume (right) and Volume/Time (left) curves before and after ablation. There is essential change to the duration of the expiratory phase (3 s before vs. 6 s after radiofrequency ablation [RFA]). **A**. Test before RFA and with manifest pre-excitation; **B**. Test after RFA without pre-excitation; FEV_1 — forced expiratory volume in the first second

of exhalation was only in the range of 3–4 s. FEV_1 and FVC were normal. After RFA, the time of exhalation was at least 6 s in all cases, which was in accordance with standard values [14]. Examples of changes during spirometry are shown in Figures 2A, B.

CPET

All patients had permanent pre-excitation during the baseline CPET, and no patient had sudden block of the accessory pathway during exercise. All patients achieved maximum effort.

CPET revealed significant improvement in cardiopulmonary capacity after RFA in all five cases. The individual parameters of CPET before and after RFA are shown in Table 2. Significant differences in cardiac parameter and VO_2peak were recorded. Most importantly, lung function-related parameters such as VE and VT improved more significantly. Successful RFA with elimination of shallow breathing and dyspnoea as reported by patients was associated with significant changes in the VD/VT. Successful RFA of the accessory pathway resulted in changes in the pattern of ventilation.

There were VEpeak < 80% and VTpeak < 85% of the normal values for age and sex in the baseline CPET in all patients with pre-excitation during sinus rhythm. These findings may be understood as positive predictive points for successful RFA of the accessory pathway, because VEpeak and VTpeak improved significantly (Table 2).

Echocardiography and ventricular dyssynchrony

Prior to ablation, all patients had normal dimensions and organic heart disease was excluded. In all patients, interventricular (except one case) and intraventricular dyssynchrony was reported prior to RFA. After ablation, intraventricular dyssynchrony normalised in all patients but interventricular dyssynchrony normalised in four patients (Table 2). Therefore an improvement in cardiopulmonary performance seems to be associated with remission of intraventricular dyssynchrony.

Follow-up

Between 2008 and 2012, regular follow-up did not reveal recurrence of pre-excitation and symptoms of dyspnoea. Holter

Table 2. Results of spirometry, cardiopulmonary exercise test and echocardiography before and after radiofrequency ablation in patients with dyspnoea coexisting with pre-excitation during sinus rhythm. All tests before successful ablation were performed with manifest pre-excitation

	Patient 1 I		Patient 2 K		Patient 3 C		Patient 4 S		Patient 5 M		TOTAL group	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Age [years]	26		31		52		41		14		33 ± 15	
BMI	20.7	20.7	24.2	24.2	31.2	31.2	29	29	18.3	18.3	24.7 ± 5.4	24.7 ± 5.4
FVC	4.39 (116%)	4.43 (117%)	4.11 (124%)	4.19 (127%)	3.30 (97%)	3.80 (112%)	3.29 (115%)	3.42 (121%)	5.63 (104%)	5.77 (106%)	4.1 ± 0.97	4.28 ± 0.88
FEV_1	3.95 (119%)	4.01 (121%)	3.4 (119%)	3.38 (118%)	2.94 (100%)	3.44 (117%)	2.44 (101%)	2.58 (108%)	4.71 (103%)	4.63 (101%)	3.49 ± 0.88	3.61 ± 0.77
Total time of exercise [s]*	627	813	555	730	675	666	413	573	604	789	575 ± 100	714 ± 97*
RER	0.98	1.04	0.98	1.00	1.04	1.01	0.96	0.92	0.99	0.98	0.99 ± 0.03	0.99 ± 0.04
VO_2peak*	2.08	2.77	1.84	2.66	2.23	2.32	1.43	2.32	3.22	4.77	2.16 ± 0.67	2.97 ± 1.03*
VO_2peak/kg*	34.3	46.6	26.9	38.9	34.1	35.8	21.2	34.4	38.8	57.5	31.1 ± 7	42.6 ± 9.6*
VO_2 %N*	88	117	86	124	89	93	80	129	81	120	85 ± 4	117 ± 14*
VO_2 at AT	16.3	14.8	13.8	11.8	18.2	19.2	13.0	17.6	17.4	22.8	15.7 ± 2.3	17.2 ± 4.2
HRpeak	161	173	153	158	177	172	159	149	172	174	164 ± 10	165 ± 11
VEpeak*	58 (72%)	89 (111%)	58 (68%)	84 (99%)	51 (64%)	63 (79%)	40 (51%)	52 (66%)	93 (70%)	122 (93%)	60.0 ± 19.9	82.0 ± 27*
VTpeak*	1.58 (79%)	2.28 (114%)	1.79 (83%)	2.20 (102%)	1.56 (81%)	1.87 (97%)	1.15 (55%)	1.71 (81%)	1.74 (60%)	2.13 (74%)	1.56 ± 0.25	2.04 ± 0.24*
VE/VO_2 at AT	21.7	21.8	18.6	16.9	16.8	16.1	17.9	17.7	15.4	17.5	18.1 ± 2.4	18.0 ± 2.2
VE/VO_2peak	27.9	32.1	31.5	31.6	22.9	27.1	28.0	22.4	28.9	25.6	27.8 ± 3.1	27.8 ± 4.1
VE/VCO_2 at AT	27.7	29.6	30.9	27.9	23.4	23.6	28.8	23.6	23.7	21.4	26.9 ± 3.3	25.2 ± 3.4
VE/VCO_2peak	28.5	30.8	32.1	31.7	22.0	26.7	29.3	24.4	29.2	26	28.2 ± 3.7	27.9 ± 3.2
$PetCO_2$	35	32	31	31	35	36	34	41	33	37	33.6 ± 1.7	35.4 ± 4
VD/VT*	29	24	27	24	27	25	32	29	25	23	28 ± 2.6	25 ± 2.3*
IVMD*	70	30	55	35	50	20	80	35	70	50	65 ± 12	34 ± 11*
IVSPWMD*	145	30	163	84	155	45	153	35	190	76	161 ± 17	54 ± 25*

Cardiopulmonary exercise test was performed on treadmill according to ramp protocol; *significant improvements of parameters ($p < 0.05$); BMI — body mass index [kg/m^2]; FVC — forced vital capacity [L]; FEV_1 — forced expiratory volume in the first second [L]; VO_2peak — absolute value of oxygen consumption at peak exercise [L/min]; VO_2peak/kg — value of oxygen consumption at peak exercise related to body weight [mL/kg/min]; VO_2 %N — oxygen consumption at peak exercise related to predicted value for age and sex; VO_2 at AT — oxygen consumption at anaerobic threshold [mL/kg/min]; RER = VCO_2/VO_2 — respiratory exchange ratio; HR — heart rate [bpm]; VE — minute ventilation [L/min]; VT — tidal volume [L]; VE/VO_2 — equivalent ventilation for O_2; VE/VCO_2 — equivalent ventilation for CO_2; $PetCO_2$ — end tidal pressure of CO_2 [mm Hg] at the end of exercise; VD/VT — ratio between dead space and tidal volume in the lungs at the end of exercise; 'peak' — at peak of exercise; 'at AT' — at anaerobic threshold; % — related to norm for age and sex (pulmonologist's criteria); IVMD — interventricular mechanical delay; IVSPWMD — intraventricular septal to posterior wall motion delay; parameters of inter- and intraventricular dyssynchrony: IVMD > 40 ms, IVSPWMD > 140 ms

monitoring was performed after one, six, and 12 months after ablation, and then annually. In 2012, all patients (after a mean 36 month follow-up) were asked about symptoms of dyspnoea as a high probability of recurrence of pre-excitation. If it would be confirmed, all patients declared their willingness to undergo a second procedure to get rid of dyspnoea associated with the recurrence of pre-excitation.

DISCUSSION

The present study found a new phenomenon associated with ventricular pre-excitation. The indentified clinical findings may change the definition of symptomatic pre-excitation. Future research will decide if dyspnoea may be considered either as a new symptom associated with pre-excitation, or an additional indication for catheter ablation.

Simple tools such as the expiratory test and spirometry may identify patients with persistent dyspnoea which increased during activity requiring prolonged or forced exhalation (singing, talking out loud). It is true that the proposed expiratory test has not been evidenced and validated in medicine, but it is very simple to perform and it may help quickly to find patients with a WPW pattern and abnormal breathing (short time of expiration). Spirometry can confirm this diagnosis. CPET may be useful to exclude other causes of chronic dyspnoea and to predict the positive response to treatment. RFA of the accessory pathway immediately eliminated dyspnoea and improved the parameters of cardiopulmonary performance.

Chronic dyspnoea is associated with various disorders and diseases that can have a significant impact on quality of life and treatment. The diagnosis and evaluation of dyspnoea may be complex because various cardiovascular, respiratory and systemic diseases may share a similar presentation and symptoms [1, 12, 17, 21–23]. It is true that dyspnoea coexisting with pre-excitation during sinus rhythm requires further evaluation, but patients with such phenomena may achieve significant clinical benefit after RFA of the accessory pathway.

Evaluation of the BDI score before RFA showed that patients had dyspnoea scores similar to patients with moderate chronic obstructive pulmonary disease (COPD) or interstitial lung diseases [13, 23]. The significant improvement in the TDI by one unit is difficult to achieve during optimisation of treatment in patients with COPD [12, 13, 21]. Therefore, the change in the TDI score observed in our study population seems to be worthy of awards.

The time of forced expiration is a new and simply developed parameter of respiratory performance that could be evaluated in the electrophysiology laboratory just before and early after RFA. Immediate changes in the time of forced expiration could be used as a marker of successful RFA.

Although the present study evaluated only patients with a WPW pattern, the results are consistent with our previous observations in patients with the WPW syndrome [11]. Therefore, the complex symptoms associated with chronic dyspnoea and limited cardiopulmonary performance may be observed in all patients with manifest pre-excitation. This diagnosis may be challenging in patients with intermittent pre-excitation, because all tests should be undertaken with manifest pre-excitation. A new syndrome related to WPW pattern could be confirmed if all possible known causes of dyspnoea could be excluded. CPET can usually be used to identify de-conditioning or determine causes of dyspnoea including psychogenic aetiology [16, 20, 21].

There was no relationship between anxiety and the changes in VD/VT. Patients who are depressed or anxious may have high VE/VCO_2 at rest, but without mismatch of VD/VT and $PetCO_2$ during exercise [16, 20, 21]. Our patients had normal values of VE/VCO_2 and VE/VO_2 without significant differences before and after RFA. The significant changes in the pattern of ventilation and the significant trend of increasing tidal volume after RFA in patients who do not carry out physical exercise could be related to other unknown mechanisms.

Elimination of pre-excitation itself may be a sufficient indication for RFA to improve quality-of-life and cardiopulmonary performance. Some studies have shown that RFA may have an impact on the parameters of ventricular dyssynchrony, remission of cardiomyopathy and improvement in cardiac function [6–10, 24]. Therefore, the definition of 'asymptomatic pre-excitation' and its benign effect on cardiopulmonary performance should be validated [1, 2].

The mechanism of dyspnoea related to pre-excitation during sinus rhythm remains complex and incompletely understood. Our preliminary observations suggest that a reflex mechanism associated with ventricular dyssynchrony and probably cardiopulmonary receptors may be responsible for the symptoms of dyspnoea and exercise intolerance [9–11, 24].

The consistency of the results from history-taking and symptom evaluation, clinical observations, spirometry, echocardiography and CPET confirmed that dyspnoea coexisting with pre-excitation during sinus rhythm needs further investigation and consideration in a large group of patients diagnosed as having a WPW pattern.

Limitations of the study

This was only a preliminary report; a small number of patients were studied and the follow-up was relatively short. The present study is one single electrophysiology centre experience that documented a new syndrome in five women. No control group was studied. It is too early to determine the clinical impact of the described results, and it is unknown how many and which patients could experience dyspnoea related to ventricular pre-excitation without arrhythmias. It is theoretically possible that the presented syndrome applies only to women, but it seems unlikely that everything depends on women's emotional sensitivity, because CPET was used for objective evaluation of the breathing pattern.

Our preliminary findings need further multicentre investigation in a large control group using other invasive and non-invasive approaches to confirm the prevalence, clinical importance, and mechanism of dyspnoea related to pre-excitation during sinus rhythm in various populations of patients with a WPW pattern. Moreover, screening tools need further validation to become reliable in daily practice and clinical decision-making.

CONCLUSIONS

It seems that chronic resting dyspnoea and exertional intolerance during sinus rhythm in women with pre-excitation may be considered to be an evaluation criterion before RFA. It is suggested that an additional group of patients may be identified for catheter ablation despite the lack of typical arrhythmic symptoms.

Conflict of interest: *none declared*

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Duszność w zespole preekscytacji bez zaburzeń rytmu serca jako nowe kryterium oceny chorego kwalifikowanego do ablacji

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Streszczenie

Wstęp: Pacjenci z rejestrowaną falą delta w standardowym EKG i bez wywiadu objawów arytmicznych są klasyfikowani jako chorzy z bezobjawową preekscytacją (WPW *pattern or asymptomatic pre-excitation*).

Cel: Głównym celem badania było obiektywne pokazanie ustępowania objawów duszności u chorych z WPW po udanym zabiegu ablacji.

Metody: Badaniem objęto 5 kobiet w wieku 35 ± 15 lat, z rozpoznanym zespołem preekscytacji i objawami duszności oraz obniżonej tolerancji wysiłku. Żadna z chorych nie miała nigdy rozpoznawanych zaburzeń rytmu serca, nigdy nie doświadczyła omdleń, nigdy nie odczuwała kołatań serca. Przed i po ablacji przeprowadzono badania obrazowe wykluczające chorobę serca, płuc, naczyń płucnych, wykluczono nadreaktywność oskrzeli i choroby metaboliczne. Ergospirometria, echokardiografia, czas natężonego wydechu, wskaźniki BDI (*baseline dyspnea index*) oraz TDI (*transition dyspnea index*) wykorzystano w celu obiektywnej oceny zgłaszanej duszności.

Wyniki: Podczas badania elektrofizjologicznego u żadnej z pacjentek nie zaobserwowano zaburzeń rytmu serca, mimo że odczuwały duszność. Po udanej ablacji czas natężonego wydechu natychmiast się wydłużył z 15,8 ± 2,9 do 29,2 ± 4,4 s ($p < 0{,}001$). Wskaźnik BDI przed ablacją wynosił 6,7 ± 1,9, natomiast wskaźnik TDI po ablacji istotnie się poprawił: 8,0 ± 1,2 ($p < 0{,}05$). Ergospirometria wykazała znamienną poprawę wydolności sercowo-płucnej u wszystkich chorych: szczytowe pochłanianie tlenu [ml/kg/min]: 31,1 ± 7 *vs*. 42,6 ± 9,6 ($p = 0{,}014$); szczytowa wentylacja minutowa [l/min]: 60,0 ± 19,9 *vs*. 82,0 ± 27 ($p = 0{,}006$); szczytowa objętość oddechowa [l]: 1,56 ± 0,25 *vs*. 2,04 ± 0,24 ($p = 0{,}002$); wskaźnik przestrzeń martwa płuc/objętość oddechowa na szczycie wysiłku: 28 ± 2,6 *vs*. 25 ± 2,3 ($p = 0{,}005$).

Wnioski: Duszność może być traktowana jako objaw zespołu preekscytacji i przy braku zaburzeń rytmu serca może stanowić dodatkowe kryterium oceny pacjenta przy kwalifikacji do zabiegu ablacji. Ergospirometria wydaje się badaniem przydatnym w diagnostyce duszności wynikającej z obecności dodatkowej drogi przewodzenia przedsionkowo-komorowego.

Słowa kluczowe: zespół WPW, droga dodatkowa, duszność, ergospirometria, ablacja

Kardiol Pol 2014; 72, 7: 646–653

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Praca wpłynęła: 30.05.2013 r. **Zaakceptowana do druku:** 16.01.2014 r. **Data publikacji AoP:** 10.02.2014 r.