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The relevance of junctional rhythm during neurocardiogenic reaction provoked by tilt testing

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Abstract

Background: During neurocardiogenic reaction provoked by tilt testing (TT), different arrhythmias such as sinus bradycardia, sinus arrest, atrioventricular block or junctional rhythm or beats (JR) may occur. The characteristics of the JR during neurocardiogenic reaction have not yet been systematically assessed. It is not known whether the presence of JR during neurocardiogenic reaction is related to clinical characteristics of syncopal patients or the outcome of TT.

Aim: To assess whether clinical outcome of TT and clinical data are related to the presence of JR during TT.

Methods: The study group consisted of 532 patients aged 43.3 ± 18.2 years with positive TT, divided into four groups on the basis of the presence of JR and/or a ventricular pause (VP) during neurocardiogenic reaction: group VP(–)/JR(+) — JR present and VP absent, group VP(+)/JR(+) — both JR and VP present, group VP(+)/JR(–) — JR absent and VP present, and group VP(–)/JR(–) — both JR and VP absent. The control group consisted of 53 patients with no history of syncope or presyncope, including 46 patients with negative TT and seven patients with false positive TT.

Results: Total loss of consciousness during TT occurred in group VP(–)/JR(+) less frequently than in groups VP(+)/JR(+) and VP(+)/JR(–), and more frequently than in group VP(–)/JR(–) (80% *vs* 96% *vs* 94% *vs* 62%; $p < 0.05$ for both comparisons). Group VP(–)/JR(+) was significantly younger than group VP(–)/JR(–) (37.3 ± 16.3 years *vs* 45.8 ± 18.9 years; $p < 0.05$) and had a lower number of syncopal events than group VP(+)/JR(+) and VP(+)/JR(–) (median [IQ]: 2.5 (1–6) *vs* 4 (2–12) and 4 (2–10), respectively; $p < 0.05$) and lower rate of traumatic injuries than group VP(+)/JR(+) and VP(+)/JR(–) (22% *vs* 45% and 39%, respectively; $p < 0.05$). Logistic regression analysis revealed that the presence of JR was associated with younger age, male gender, history of blood-instrumentation-injection phobia and higher number of syncopal spells in medical history. The ROC curve analysis revealed that a junctional rate of no more than 49 bpm was related to the total loss of consciousness during TT ($p < 0.05$).

Conclusions: 1. JR frequently occurs during positive TT and in no subjects with negative TT. 2. Among patients with JR, two groups may be chosen on the basis of a VP occurrence, and these groups differ in respect to clinical characteristics and TT outcome. 3. Relatively rapid JR without VP is related to consciousness preservation during neurocardiogenic reaction at TT and fewer syncopal spells as well as syncope associated with injury in the past. 4. In patients with JR and VP, the JR is slower, of shorter duration, and more frequently single or pairs of junctional beats occur, which indicates high parasympathetic activity, whereas relatively rapid and stable JR may be the symptom of simultaneously increased sympathetic and parasympathetic activity.

Key words: vasovagal syncope, junctional rhythm during neurocardiogenic reaction provoked by tilt testing

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INTRODUCTION

The occurrence of junctional rhythm (JR) during neurocardiogenic reaction provoked by tilt testing (TT) has been reported in a few studies [1–3]. Some authors have described its presence during negative TT with isoproterenol (ISO) provocation and during positive TT with either ISO or nitroglycerin (NTG provocation both in false positive and true positive tests [1–5]. During positive TT, a ventricular pause (VP) during neurocardiogenic reaction may be preceded or/and followed by JR [2, 4]. Junctional escape beats after VP have been reported not only during neurocardiogenic reaction induced by TT, but also during spontaneous events [6]. In two small studies in syncopal patients, the symptom-rhythm correlation during implantable loop recorder (ILR) monitoring revealed slow junctional escape rhythm in one of 14 and one of 12 patients [7, 8]. The occurrence of JR is related to sinus rate slowing, acceleration of the spontaneous depolarisation of the subsidiary cells located in the atrioventricular junction, or both mechanisms; which occurrence depends on sympathoparasympathetic balance.

The characteristics of the JR during neurocardiogenic reaction have not yet been systematically assessed. It is not known whether the presence of JR during neurocardiogenic reaction is related to clinical characteristics of syncopal patients or the outcome of TT.

The aim of our study was to assess whether the presence of JR and its occurrence with or without VP during TT is related to the demographic and clinical characteristics of patients and the clinical outcome of TT (presyncope or syncope).

METHODS

The study group consisted of 532 vasovagal patients (348 women and 184 men) aged 43.3 ± 18.2 years with positive TT. The control group consisted of 53 subjects with no syncope or presyncope in their medical history including 46 subjects (26 women and 20 men) aged 38.9 ± 13.9 years with negative TT (control negative group) and seven subjects (three women and four men) aged 38.0 ± 13.8 years with positive TT (false positive group).

Tilt testing was performed according to the Italian protocol (20 min passive tilting at 60 degrees, 0.4 mg NTG administered if necessary and 15 min of tilting thereafter) [9]. The ECG Holter monitoring using Optima Jet Oxford system and BP monitoring with the oscillometric method with a cardiomonitor were provided. The TT was terminated at syncope or presyncope provocation or after completion of the whole protocol. The presyncope was a reason for TT termination when the presyncopal symptoms with concomitant abrupt decrease in blood pressure below 90 mm Hg and/or heart rate occurred for an unacceptably long period for the patient or for the physician. For each patient, the outcome of TT — presyncope or syncope — was recorded. The type of provoked neurocardiogenic reaction was determined according to the VASIS classification as cardioinhibitory, mixed, or vasodepressive [10].

The JR was defined as at least three consecutive junctional beats; in the case of a single or a pair of junctional beats (even repetitive after sinus beat) the term 'junctional beat' was used. The JR abbreviation denoted both junctional rhythm and junctional beats occurrence. The longest R-R interval during TT or after TT termination was measured. A VP was defined as an R-R interval lasting > 3 s. The mean R-R interval during 15 min before TT was calculated for each patient.

The study group was divided into four subgroups based on the rhythm during neurocardiogenic reaction. The JR were present in the VP(–)/JR(+) and VP(+)/JR(+) group, VP were present in the VP(+)/JR(+) and VP(+)/JR(–) group, whereas in the VP(–)/JR(–) group, neither JR nor VP were present. The representative ECG strips are presented in Figures 1 and 2.

In all patients, full medical history was taken, including the total number of syncopal spells, injuries related to syncope, syncope related to emotional distress (instrumentation-injection-blood phobia), concomitant diseases and treatment. Clinical examination and resting ECG were performed in each patient.

Statistical analysis

The variables are presented as mean ± SD for the continuous variables with the normal distribution or median and interquartile range (IQR) in the case of a lack of normal distribution. The discrete variables are presented as numbers and percentages.

The significance of differences between studied variables was assessed with ANOVA, Kruskal-Wallis test (non-parametric ANOVA); Student's t-test, Mann-Whitney U test and χ^2 test with or without Yates correction as appropriate. For the statistical analysis, the number of syncopal spells in history was dichotomised into at least three *vs* more than three events according to the median number of syncopal spells. The logistic regression analysis was performed to find association between the occurrence of JR and age, gender, number of syncopal spells, blood-instrumentation-injection phobia and traumatic injuries related to syncope in history. Logistic regression analysis was performed to find an association between the occurrence of syncope during TT in patients with positive TT and age, the syncope number in the medical history (also after dichotomic classification and categorised as follows: 1) — no syncope, 2) — one syncope, 3) — from two to five syncopes, 4) from six to nine syncopes, 5) at least ten syncopes) as well as the JR occurrence, VP presence and NTG provocation.

Multiple regression analysis was performed to examine the association between JR rate and age, gender, number of syncopal spells in history, the history of blood-instrumenta-

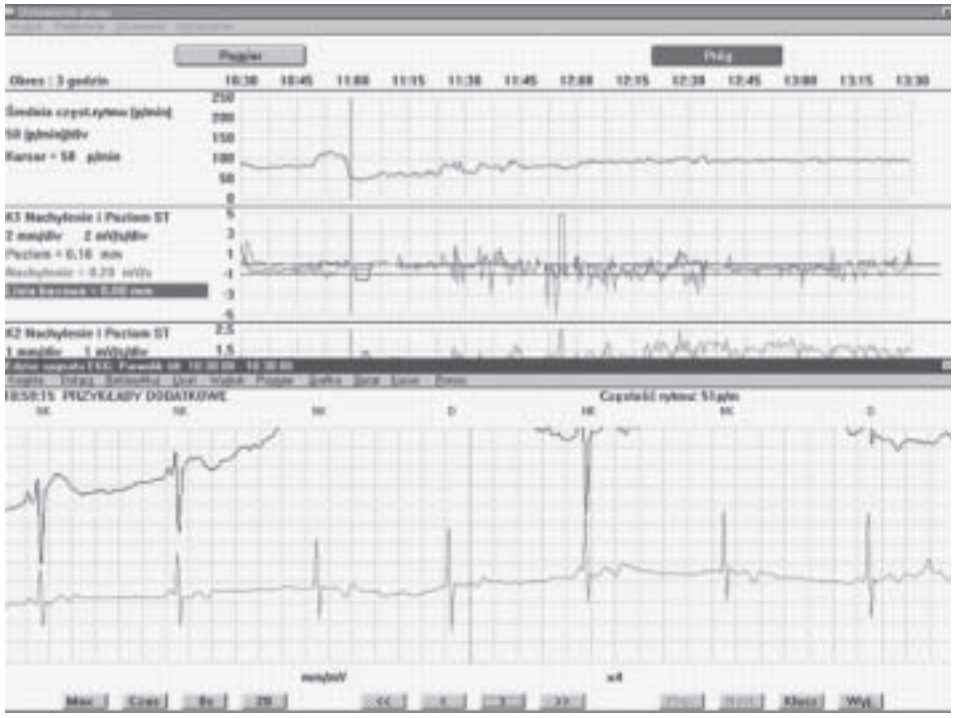

Figure 1. A representative ECG strip from a VP(–)/JR(+) group patient. Junctional rhythm during neurocardiogenic reaction provoked by tilt testing

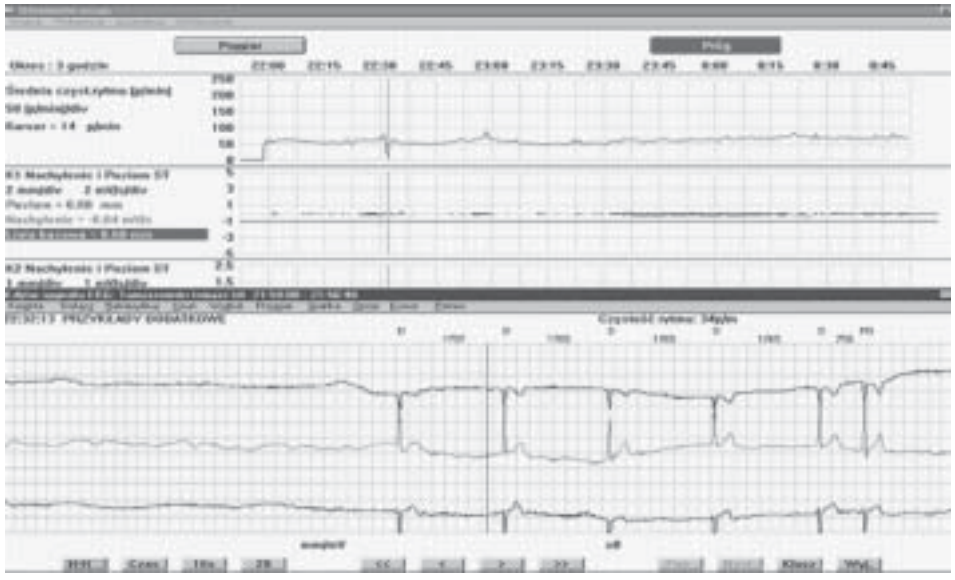

Figure 2. A representative ECG strip from a VP(+)/JR(+) group patient. Junctional rhythm after a ventricular pause during neurocardiogenic reaction provoked by tilt testing (TT was performed before noon; time on recorder has not been set properly)

tion-injection phobia, the use of NTG during TT, and the duration of the longest R-R interval during neurocardiogenic reaction. Receiver operating characteristics (ROC) analysis was used to calculate the best cut-off point of the junctional rate to predict loss of consciousness. A p value < 0.05 was considered significant.

RESULTS

The JR occurred in 32% of positive TT, and in no subject from the control group. The demographics and medical history data of the patients divided into groups on the basis of the rhythm during neurocardiogenic reaction are presented in Table 1.

Table 1. Demographics and clinical data

Group	Age [years]	Female gender [%]	Syncope number median (IQR)	Traumatic injuries [%]	BII [%]	Syncope related to BII [%]	Syncope BII only [%]	Hypertension [%]	Diabetes [%]	MI in the past [%]	Beta-blockers [%]	ICE/ATII [%]	Diuretics [%]	Ca blockers [%]	Beta-blocker before TT [%]
VP(–)/JR(+)	37.3 ± 16.3#	60	2.5 (1–6)*	22*	28	14.9#	9.5#	23	0	1	4	11	3	3	7
VP(+)/JR(+)	41.4 ± 17.4	58	4 (2–12)	45	34	21.8#,$	5.0	21	2	1	5	9	6	4	1
VP(+)/JR(–)	41.7 ± 16.8	67	4 (2–10)	39	23	8.7	2.9	22	0	1	6	17	1	2	6
VP(–)/JR(–)	45.8 ± 18.9	69	2 (0–5)*	27*	13*	6.9	2.4	29	2	2	7	15	5	6	6

BII — blood-instrumentation-injection phobia; IQR — interquartile range; *p < 0.05 *vs* VP(+)/JR(+) group and VP(+)/JR(–) group; #p < 0.05 *vs* VP(–)/JR(–) group; $p < 0.05 *vs* VP(+)/JR(–) group; syncope related to BII — syncope related to emotional distress; syncope BII only — syncope related only to emotional distress; MI — myocardial infarction; IEC/ATII — treatment with converting enzyme inhibitors or blockers of angiotensin II receptor; TT — tilt testing

The VP(–)/JR(+) group patients were younger and had lower incidence of syncopal events and traumatic injuries related to syncope than patients from the VP(+)/JR(+) and VP(+)/JR(–) groups.

The TT data is presented in Table 2. Total loss of consciousness as an outcome of TT was more frequent in groups VP(+)/JR(+) and VP(+)/JR(–) than in groups VP(–)/JR(+) and VP(–)/JR(–). The junctional rate in the VP(–)/JR(+) group was significantly faster and JR lasted significantly longer than in the VP(+)/JR(+) group.

The duration of VP was longer in the VP(+)/JR(+) group than in the VP(+)/JR(–) group ($p < 0.05$). In the VP(+)/JR(+) group, JR occurred in 26 (25%) patients both before and after VP, whereas in 75 (75%) patients only after VP.

Logistic regression analysis revealed that the occurrence of JR was associated with younger age (OR unit change 0.99; CI 0.98–1.00; OR range 0.45; CI 0.21–0.97), male gender (OR 1.67; CI 1.12–2.51), history of blood-instrumentation-injection phobia (OR 1.94; CI 1.21–3.11) and higher number of syncopal spells in the medical history (OR unit change 1.20; CI 1,04–1.39, OR range 2.54; CI 1.24–5.21; $p < 0.001$).

Multivariate regression analysis showed that the rate of JR was negatively related to the duration of the longest R-R interval (regression coefficient –0.271; standard error 0.084 and older age (regression coefficient: –0.197 standard error 0.084) ($p < 0.002$). The ROC analysis revealed that a junctional rate ≤ 49 bpm was associated with a total loss of consciousness during TT with 81.8% sensitivity and 55.6% specificity ($p < 0.05$) (Fig. 3).

A comparison between patients with syncope and presyncope revealed that the prevalence of JR was higher in the syncopal group; however, the duration of JR was longer and its rate was higher in the presyncopal than in the syncopal group (Table 3). The number of syncopal spells in the medical history was higher in patients with syncope than presyncope at TT termination.

DISCUSSION

The main finding of our study is that patients experiencing JR, which was not interrupted by VP, were less prone to develop total loss of consciousness during TT than patients with VP. The second finding is that the faster junctional rate was related to the preservation of consciousness. However, the patients with JR during TT were more prone to experience a total loss of consciousness than those with a positive TT result and sinus rhythm during the whole examination. The characteristics of the JR differed between the groups with or without VP, which may indicate the differences in autonomic balance during neurocardiogenic reaction between these groups.

In the literature, there have been no studies regarding correlations between JR during neurocardiogenic reaction and syncope or presyncope occurrence, and only case reports are available. Our findings regarding the percentage of presyncope

Table 2. Tilt testing (TT) clinical outcome and electrocardiographic findings during neurocardiogenic reaction induced by TT

	VP(–)/JR(+) group	VP(+)/JR(+) group	VP(+)/JR(–) group	VP (–)/JR(–) group	Control group	False positive control group
Number	74	101	69	288	46	7
mR-R [ms] before TT; median (IQR)	911 (825–1027)	950 (841–1041)	912 (827–971)	919 (829–1024)	896 (844–1000)	881 (841–1047)
Syncope at TT	81%[a, b, c, d]	96%[c, d, e]	94%[c, d, e]	62%[d]	0%	57%
NTG provocation	76%	76%	80%	81%	100%	86%
Junctional rhythm	65 (88%)[a, b, c, d, e]	67 (66%)[b, c, d, e]	0%	0%	0%	0%
Junctional beats only	9 (12%)[a, b, c, d]	34 (34%)[b, c, d]	0%	0%	0%	0%
Junctional rate [bpm]; median (IQR)	46.5 (40–55)[a]	37 (33–42)	NA	NA	NA	NA
Duration of junctional rhythm [s]; median (IQR)	40 (12–108)[a]	16 (8–24)	NA	NA	NA	NA
Longest R-R interval [s]; median (IQR)	1.4 (1.2–1.8)[a, b]	8.7 (4.7–20.7)[b, c, d, e]	6.9 (3.9–14.0)[c, d, e]	1.1 (1–1.4)	1 (0.9–1.1)	1.1 (1.0–1.4)
VASIS I	81%[a, b, d]	0%[c]	0%[c]	83%[d]	0%	86%
VASIS II	19%[a, b, c, d]	100%[c, d, e]	100%[c, d, e]	7%	0%	14%
VASIS III	0%	0%	0%	10%	0%	0%

[a]$p < 0.01$ *vs* VP(+)/JR(+) group; [b]$p < 0.01$ *vs* VP(+)/JR(–) group; [c]$p < 0.01$ *vs* VP(–)/JR(–) group; [d]$p < 0.01$ *vs* control negative group; [e]$p < 0.01$ *vs* false positive group; NA — not applicable; IQR — interquartile range

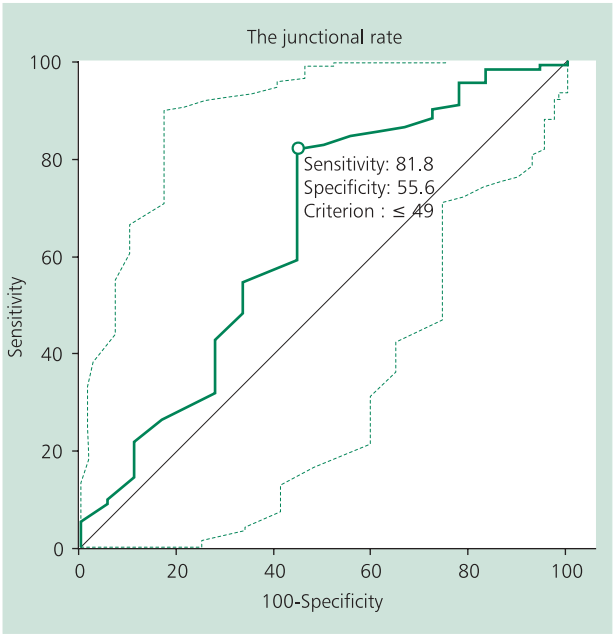

Figure 3. The ROC curves showing the sensitivity and specificity of junctional rate in predicting total loss of consciousness during tilt testing. Area under curve (AUC): 0.64; CI 0.56–0.72, $p < 0.05$

occurrence as a TT outcome in patients with JR at a relatively high rate during neurocardiogenic reaction provoked by TT align with case reports presented in the literature [11–13]. The patients with presyncope had faster junctional rate than those with syncope, which agrees with our results [11–15].

The second important result of our study is the lack of any JR event in the control group with negative TT after NTG challenge. In other studies, the occurrence of JR during negative TT with ISO provocation was reported by Oh et al. [4], but in the literature we could not find reports on JR during negative TT after NTG provocation. In the Oh et al. [4] study, the occurrence of JR after ISO provocation in positive TT was 32.2% which was significantly more frequent than 5.9% in negative TT. The JR during false positive TT was reported by Carlioz et al. [1] in 38.9% of healthy volunteers, each time after ISO provocation, and its rate was as high as 80–100 bpm. It was reported that in 88.9% of cases with a positive TT in the control group, syncope occurred after 5 μg/kg/min ISO infusion and only in 11.1% after 2 μg/kg/min infusion. On the contrary, in the patient group, 64.3% positive responses occurred after 2 μg/kg/min infusion. This clearly indicates the direct influence of the drug used for neurocardiogenic reaction provocation. In that study, the data regarding JR during negative TT was not presented. The JR occurrence after ISO provocation is related to drug properties, increasing the automaticity of subsidiary pacemaker cells in the setting of simultaneous activation of parasympathetic nervous system and the inhibition of sympathetic nervous system, decreasing the sinus rate. Parasympathetic activation during neurocardiogenic reaction inhibits the sympathetic one and the mechanism of simultaneously enhanced parasympathetic and sympathetic

Table 3. Clinical and electrocardiographic characteristics of patients who had presyncope and syncope at tilt testing (TT) termination

	Presyncope at TT termination	Syncope at TT termination	P
Number of patients	131	401	–
Age [years ± SD]	43.1 ± 19.9	43.3 ± 17.1	NS
Syncope number; median (IQR)	2 (0–5)	3 (1–7)	< 0.05
Female gender	81 (62%)	267 (67%)	NS
Junctional rhythm	16 (12%)	116 (29%)	< 0.01
Junctional beats only	5 (4%)	38 (9%)	NS
Junctional rate [bpm]; median (IQR)	50 (36–58)	41 (35–47)	< 0.05
Duration of junctional rhythm [s]; median (IQR)	100 (37–197)	20 (9–94)	< 0.05

activity is not expected to occur, but could not be excluded in pathophysiological conditions.

To the best of our knowledge, there is no report on JR during negative TT with NTG provocation. This observation indicates that JR during TT with NTG provocation is associated with a positive TT result. Our false positive group was small and therefore it is difficult to assess whether the lack of patients with JR in that group means that the JR does not occur in false positive TT. Because some patients with presumed false positive TT actually may have neurocardiogenic reaction which had not been revealed so far, it may be that some patients with false positive TT actually have JR during TT.

The percentage of positive TT results with JR was 32%; this was lower than in other studies which have reported its occurrence in 40–92% of positive TT [1, 5, 16, 17]. The difference may be due to a drug used for provocation or, less probably, a different angle of tilting. In all the abovementioned studies, ISO was used, whereas we used NTG.

According to the previous ESC guidelines, TT should be terminated at syncope [18]; the current ESC guidelines allow presyncope as the end-point TT [19]. Our results justify the use of presyncope and JR during a passive TT or TT with NTG provocation as a positive TT result.

It is believed that heart rhythm during TT reproduces poorly the one during spontaneous syncope [20, 21]. During TT, the ISO provocation may increase the type of mixed neurocardiogenic reaction, whereas after provocation with NTG the cardioinhibitory type of neurocardiogenic reaction is more prevalent [22]. The reproduction of heart rhythm of spontaneous syncope during TT-induced syncope may be at least partially related to the provocative agent.

In normal resting conditions, parasympathetic activation predominates and, when present, sympathetic activation is suppressed. The ECG characteristics of JR during neurocardiogenic reaction in the VP(–)/JR(+) group share the features of the escape JR (usually below 60 bpm) and accelerated JR (occurring without substantial slowing of the heart rate). The ECG characteristics of JR during neurocardiogenic reaction may indicate the important pathophysiological differences between selected groups. When JR occurs after moderate sinus rate slowing in the VP(–)/JR(+) group and the rhythm is stable, it may be presumed that its occurrence is related to the simultaneously ongoing processes: the imbalance of parasympathetic activation of sinoatrial and atrioventricular node, co-activation of parasympathetic and sympathetic nervous system with prevalence of sympathetic activation of atrioventricular node, and parasympathetic suppression of sinoatrial node as well as suppression of the subsidiary pacemaker by the parasympathetic system.

In the VP(+)/JR(+) group, the JR after VP shares the characteristics of the escape rhythm; however, it is slower than expected, taking into account the textbook knowledge regarding escape JR, which could be due to the parasympathetic suppression of the subsidiary cells. Our study indicates the heterogeneity of the autonomic nervous system activation during TT and the preservation of the sympathetic activity during neurocardiogenic reaction in subset of patients.

A comparison between syncopal and presyncopal patients revealed that the occurrence of JR was higher in the syncopal group; however, the duration and rate of JR were higher in the presyncopal than the syncopal group. The lower number of syncopal spells in the medical history in patients with presyncope than syncope at TT termination is the second finding indicating that the differences in TT outcome are related to the neurocardiogenic reaction characteristics.

CONCLUSIONS

1. The JR frequently occurs during positive TT, and in no subject with a negative TT.
2. Among patients with JR, two groups may be identified on the basis of VP occurrence, and these groups differ in respect to clinical characteristics and TT outcome.
3. Relatively rapid JR without VP is related to consciousness preservation during neurocardiogenic reaction and fewer syncopal spells, as well as lower rate of syncope associated with injury in the past.
4. In patients with JR and VP, the JR is slower, lasts for a shorter period, and more frequently single or pairs of junctio-

nal beats occur, which indicates high parasympathetic activity, whereas the relatively rapid and stable JR may be the symptom of simultaneously increased sympathetic and parasympathetic activity.

Conflict of interest: *none declared*

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Znaczenie rytmu węzłowego podczas testu pochyleniowego u pacjentów z omdleniami wazowagalnymi

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Streszczenie

Wstęp: W czasie reakcji neurokardiogennej wyzwolonej podczas testu pochyleniowego (TT) mogą wystąpić różnego typu zaburzenia rytmu serca, w tym: bradykardia zatokowa, zahamowanie zatokowe, blok przedsionkowo-komorowy oraz rytm węzłowy lub pobudzenia węzłowe (JR). Charakterystyka JR podczas reakcji neurokardiogennej i powiązania między występowaniem JR podczas reakcji neurokardiogennej a klinicznym obrazem oraz następstwami reakcji neurokardiogennej nie były do tej pory systematycznie ocenione.

Cel: Celem pracy była ocena zależności między wystąpieniem JR a wynikiem TT oraz danymi klinicznymi dotyczącymi pacjentów z omdleniami wazowagalnymi.

Metody: Grupę badaną stanowiło 532 osób w wieku 43,3 ± 18,2 roku z dodatnim wynikiem TT podzielonych na grupy wyodrębnione na podstawie obecności lub braku pauzy R-R lub JR: grupa VP(–)/JR(+) — pacjenci z obecnym JR bez pauzy R-R, grupa VP(+)/JR(+) — pacjenci, u których stwierdzono zarówno pauzę R-R, jak i JR, grupa VP(+)/JR(–) — pacjenci z pauzą R-R bez JR, grupa VP(–)/JR(–) — pacjenci, u których nie stwierdzono ani pauzy R-R, ani JR. Grupę kontrolną stanowiło 53 osób z ujemnym wywiadem w kierunku utrat świadomości i stanów przedomdleniowych, w tym 46 osób z ujemnym wynikiem TT (grupa kontrolna negatywna) oraz 7 osób z fałszywie dodatnim wynikiem TT (grupa fałszywie pozytywna). TT wykonywano wg protokołu włoskiego z prowokacją NTG, jeśli bierna faza badania była ujemna (60°, 20 min, 0,4 mg NTG s.l., 15 min). Badanie przerywano przed planowanym czasem, jeśli wystąpiła pełna utrata świadomości, obecne były przedłużające się nasilone objawy stanu przedomdleniowego ze spadkiem ciśnienia skurczowego < 90 mm Hg o czasie trwania nieakceptowanym przez pacjenta i przez lekarza wykonującego badanie. W trakcie TT monitorowano EKG za pomocą monitora przyłóżkowego, zapisywano rytm serca przy użyciu holterowskiego rejestratora EKG oraz mierzono ciśnienie tętnicze metodą oscylometryczną.

Wyniki: U 32% pacjentów z grupy badanej stwierdzono JR. U osób z grupy kontrolnej negatywnej i kontrolnej z fałszywie dodatnim wynikiem TT nie zanotowano JR podczas badania ani po jego zakończeniu. Wśród pacjentów z fałszywie dodatnim TT u 1 osoby stwierdzono pauzę RR, a u pozostałych — rytm zatokowy podczas reakcji neurokardiogennej. Pacjenci z grupy VP(–)/JR(+) byli istotnie młodsi niż pacjenci z grupy VP(–)/JR(–) (odpowiednio 37,3 ± 16,3 *v.* 45,8 ± 18,9 roku; p < 0,05). Liczba omdleń w wywiadzie była istotnie niższa w grupie VP(–)/JR(+) i grupie VP(–)/JR(–) niż w grupach VP(+)/JR(+) i VP(+)/JR(–) [mediana liczby omdleń i rozstęp międzykwartylowy wynosiły odpowiednio 2,5 (1–6) i 2 (0–5) *v.* 4 (2–12) i 4 (2–10); p < 0,05]. Urazy w następstwie omdleń istotnie rzadziej występowały w grupie VP(–)/JR(+) niż w grupie VP(+)/JR(+) i grupie VP(+)/JR(–). Pełna utrata świadomości podczas TT wystąpiło w grupie VP(–)/JR(+) istotnie rzadziej niż w grupie VP(+)/JR(+) i grupie VP(+)/JR(–) (odpowiednio 81% *v.* 96% i 94%; p < 0,05) oraz istotnie częściej w grupie VP(–)/JR(+) niż w grupie VP(–)/JR(–) (odpowiednio 81% i 62%; p < 0,05). Obecność JR wiązała się z młodszym wiekiem, płcią męską, występowaniem w wywiadzie reakcji neurokardiogennych na widok krwi, iniekcje, instrumentacji oraz większą liczbą omdleń w wywiadzie. Częstotliwość JR była istotnie wyższa w grupie VP(–)/JR(+) niż w grupie VP(+)/JR(+) [mediana i rozstęp międzykwartylowy wynosiły odpowiednio 46,5/min (40–55/min) *v.* 37/min (33–42/min); p < 0,01]. Czas trwania JR był istotnie dłuższy w grupie VP(–)/JR(+) niż w grupie VP(+)/JR(+) [mediana i rozstęp międzykwartylowy wynosiły odpowiednio 40 s (12–108 s) *v.* 16 s (8–124 s); p < 0,01]. Analiza krzywych ROC pozwoliła na stwierdzenie, że częstotliwość rytmu węzłowego do 49/min z 81,8% czułością i 55,6% specyficznością wiąże się z wystąpieniem utraty świadomości podczas TT (p < 0,05).

Wnioski: 1. Rytm węzłowy jest częstym zjawiskiem podczas dodatniego TT i nie stwierdza się go w ujemnym TT. 2. Wśród pacjentów z JR można na podstawie występowania pauzy RR wyodrębnić 2 grupy o odmiennej charakterystyce pod względem klinicznym i wyniku TT. 3 Względnie szybki, stabilny JR podczas TT wiąże się z zachowaniem świadomości podczas reakcji neurokardiogennej, mniejszą liczbą omdleń i częstotliwością urazów w wywiadzie. 4. U pacjentów z JR i pauzą R-R rytm węzłowy jest wolniejszy, trwa krócej oraz częściej występują jedynie pojedyncze lub pary pobudzeń węzłowych niż u pacjentów bez współistniejącej pauzy, co wskazuje na większe napięcie nerwu błędnego w tej grupie, natomiast względnie szybki JR może być przejawem jednoczesnej aktywacji układu współczulnego i przywspółczulnego.

Słowa kluczowe: omdlenia wazowagalne, rytm węzłowy podczas testu pochyleniowego

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