

Department of Cardiology, Medical University of Lublin

ZBIGNIEW PIJANOWSKI, HENRYKA MITURZYŃSKA-STRYJECKA,  
TERESA WIDOMSKA-CZEKAJSKA

*Influence of ventricular arrhythmia on sudden cardiac death  
in patients with systolic chronic heart failure\**

Recently the number of patients with chronic heart failure (CHF) has been increased significantly (2, 8, 11). The prognosis in CHF is unfavourable, especially in cases in which causative treatment is impossible or difficult (4, 5, 8). CHF predisposes to cardiac arrhythmias and conductance disturbances (1, 7, 11, 14). It is known that in approximately 80% of patients with left ventricle failure, numerous ventricular arrhythmias occur and in 50–60% of those patients episodes of ventricular tachycardia (VT) are observed (6, 7, 8, 13). CHF patients are at high risk for SCD (7, 14). Approximately 50% of CHF patients die abruptly, shortly after life-threatening symptoms occur (1, 10). Ventricular fibrillation (VF) and sustained VT are the most common mechanisms of sudden cardiac death (SCD). These arrhythmias are noted in 65–80% of those cases (7, 9, 14).

There are many prognostic factors for SCD in HF patients but only a few are supported by reliable scientific evidence (7). Ventricular arrhythmias, especially VT, are important markers for SCD risk (3, 9, 10, 13). However, clinical studies results are diverse, therefore, the role of ventricular extrasystole in HF still remains controversial.

The aim of the study was to assess the influence of the cardiac arrhythmias severity on general and SCD mortality in patients with chronic systolic heart failure.

#### METHODS

The study comprised 107 patients (71% males and 29% females) aged 40–88 years (mean age 65.9 years). Ischemic heart disease and hypertension were the most common cause of HF (58.9% and 19.6%, respectively). Patients were classified into I, II, III and IV NYHA class in 11.2%; 43.9%; 23.4%; and 21.5%, respectively. Patients were treated for HF according to currently recommended standards.

Resting electrocardiogram, basic laboratory blood tests, chest X-ray, echocardiogram and 24-hour Holter monitoring were performed in all patients during the compensation phase of heart failure, ambulatory or during hospitalization. On the base of Holter results cardiac rhythm, mean heart rate, sinus rhythm variability parameters and the number of ventricular and supraventricular premature beats including the number couplets and tachycardia episodes. After one year the frequency and the type of death (sudden or non-sudden) were determined.

## RESULTS

The number of ventricular premature beats, their couplets and nonsustained ventricular tachycardia (nsVT) episodes per day varied 0–17206 (the mean  $1766.4 \pm 3622.3$ ), 0–823 (the mean  $50.0 \pm 220.4$ ), and 0–185 (the mean  $4.5 \pm 18.4$ ), respectively. Over one year follow-up, 22 (20.6%) patients died; 45% of deaths were SCD.

There was a statistically significant relationship between annual mortality rate and the age of patients ( $p < 0.03$ ). Female and male mortality rates did not differ significantly ( $p < 0.59$ ). NYHA class, nocturnal dyspnea, lower extremities edema, liver enlargement and resting heart rate were significantly related with annual mortality rate ( $p < 0.0009$ ,  $p < 0.004$ ,  $p < 0.0009$ ,  $p < 0.003$ , respectively).

Annual mortality rate depended significantly on the total number of ventricular beats including ventricular extrasystoles ( $p < 0.05$ ), couplets ( $p < 0.003$ ) and episodes of nsVT ( $p < 0.00004$ ). In addition, there were significant correlations between SCD incidence and the number of ventricular couplets ( $p < 0.04$ ) and nsVT ( $p < 0.001$ ). In a multivariate analysis, the number of episodes of nsVT appeared the only parameter indicating an increased risk of total mortality and SCD mortality.

Table 1. Correlation between ventricular arrhythmia and mortality

	Total mortality		SCD	
	R	p	R	p
Ventricular ectopic beats	0.20 *	0.05	0.14 *	0.17
Ventricular couplets	0.31 *	0.003	0.21 *	0.04
Episodes of nsVT	0.41 *	0.00004	0.33 *	0.001

\* Spearman correlation test

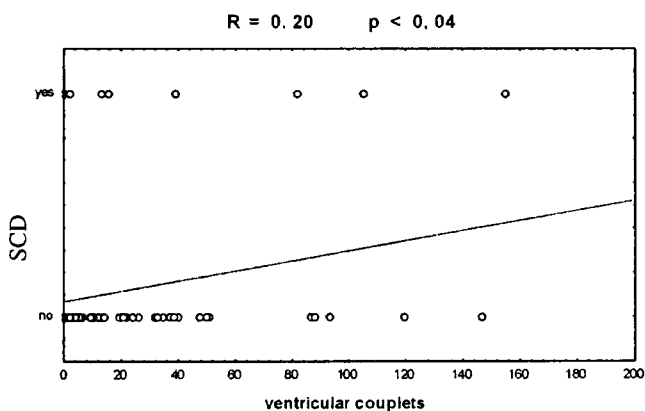


Fig. 1. Correlation between the number of ventricular couplets and SCD mortality

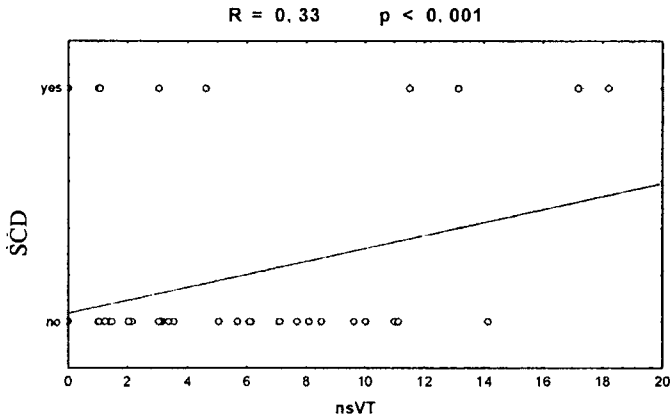


Fig. 2. Correlation between the number of episodes of nsVT and SCD mortality

## DISCUSSION

Despite the continuous advent of new therapy regimens for chronic heart failure and diseases resulting in HF, mortality rate still remains high (2, 5, 8). Ventricular arrhythmia appeared to be the predictor of general mortality in HF patients (7, 9). However, the statement that the presence of complex ventricular ectopy including nonsustained ventricular tachycardia, is a specific predictor for increased SCD risk remains controversial. Some studies suggested that nsVT was independent and specific SCD predictor in HF patients (3, 10), whereas others did not confirm this observation (6, 13).

In our study, a statistically significant correlation between quantitative and qualitative ventricular arrhythmia parameters and mortality rate in HF patients was found. Episodes of nsVT demonstrated the most significant relationship with mortality rate. Some authors obtained similar results concerning the significance of nsVT (3, 10), but only a few ones demonstrated the relationship between mortality and the total number of nsVT (12). In addition, commonly observed significant relationships in univariate analysis became statistically insignificant after taking into account other parameters. Nonsustained ventricular tachycardia most often appeared an independent prognostic factor of SCD (9), similarly as in our study.

There is no ideal, sensitive and specific parameter, enabling predicting of greater risk of death, specially SCD, in patients with CHF. Prognostic value may increase by using several risk factors of mortality. One of this parameters is ventricular arrhythmia evaluated based on 24-hour ambulatory ECG monitoring. Although since the use of  $\beta$ -blockers became universal, the role of arrhythmia in predicting SCD decreased, ventricular arrhythmia still remains an important SCD risk factor in HF. However, some authors did not find ventricular arrhythmia valuable in predicting SCD risk, it might be due to the incorrect classification of the type of death. The data obtained from implanted cardioverter-defibrillator memory would probably make this question more clear.

## CONCLUSIONS

1. Ventricular arrhythmia incidence is significantly greater in patients with chronic compensated heart failure than in healthy individuals.

2. Both the presence and the number of ventricular premature beats, ventricular couplets and nonsustained ventricular tachycardia appear significant prognostic factors of general mortality and SCD mortality in heart failure patients.

3. Nonsustained ventricular tachycardia found in ambulatory ECG monitoring is the strongest and independent risk factor of death.

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#### SUMMARY

There are many prognostic factors for SCD in HF patients but only a few are supported by reliable scientific evidence. The statement that the presence of complex ventricular ectopy including nonsustained ventricular tachycardia (nsVT), is a specific predictor for increased SCD risk remains

controversial. The aim of the study was to assess the influence of the cardiac arrhythmias severity on general and SCD mortality in patients with chronic systolic heart failure. The study comprised 107 patients (71% males and 29% females) aged 40–88 years. 24-hour ambulatory ECG monitoring was performed in all patients during the compensation phase of heart failure. On the base of Holter results the number of ventricular premature beats including the number of couplets and tachycardia episodes. After one year the types of death (sudden or non sudden) and their percentages were defined. Annual mortality rate depended significantly on total number of ventricular beats including ventricular extrasystoles ( $p < 0.05$ ), couplets ( $p < 0.003$ ) and episodes of nsVT ( $p < 0.00004$ ). In addition, there were significant correlations between SCD incidence and the number of ventricular couplets ( $p < 0.04$ ) and nsVT ( $p < 0.001$ ). In multivariate analysis, the number of episodes of nsVT appeared the only parameter indicating an increased risk for total mortality and SCD mortality. Conclusions: Ventricular arrhythmia incidence is significantly greater in patients with chronic compensated heart failure than in healthy individuals. Both the presence and the number of ventricular premature beats, ventricular couplets and nonsustained ventricular tachycardia appear significant prognostic factors of general mortality and SCD mortality in heart failure patients. NsVT found in ambulatory ECG monitoring is the strongest and independent risk factor of death.

#### Wpływ komorowych zaburzeń rytmu na ryzyko nagłego zgonu sercowego u chorych z przewlekłą niewydolnością serca

Istnieje wiele czynników prognostycznych SCD u chorych z HF, ale tylko nieliczne poparte są wiarygodnymi dowodami badań naukowych. Stwierdzenie, że obecność złożonej ektopii komorowej, w tym nieutralonego częstoskurczu komorowego, jest specyficznym czynnikiem prognostycznym zwiększonego ryzyka nagłej śmierci, pozostaje kontrowersyjne. Celem pracy była ocena zależności śmiertelności ogólnej i śmiertelności spowodowanej nagłym zgonem sercowym od obecności i nasilenia zaburzeń rytmu serca u chorych z przewlekłą wyrównaną niewydolnością serca. Grupę badaną stanowiło 107 chorych w wieku od 40 do 88 lat (średnio 65,9 lat), w tym 71 % mężczyzn oraz 29 % kobiet. W okresie wyrównania niewydolności serca u wszystkich chorych wykonano 24-godzinne monitorowanie EKG metodą Holtera. Opierając się na wyniku zapisu holterowskiego obliczono liczbę pobudzeń dodatkowych komorowych z uwzględnieniem liczby par pobudzeń oraz epizodów częstoskurczu. Po upływie roku określono odsetek i rodzaj zgonów w badanej grupie. Śmiertelność roczna była istotnie zależna od bezwzględnej liczby komorowych zaburzeń rytmu. Zależność tę stwierdzono w przypadku liczby pojedynczych pobudzeń dodatkowych komorowych ( $p < 0,05$ ), par pobudzeń komorowych ( $p < 0,003$ ) oraz częstoskurczów komorowych ( $p < 0,00004$ ). Ponadto wykazano istotny związek liczby par pobudzeń komorowych ( $p < 0,04$ ) i częstoskurczów komorowych ( $p < 0,001$ ) z występowaniem zgonu nagłego. Liczba częstoskurczów komorowych okazała się w analizie wieloczynnikowej jedynym parametrem wskazującym na zwiększone ryzyko śmiertelności całkowitej oraz śmiertelności spowodowanej nagłym zgonem sercowym. Wnioski: U chorych z przewlekłą, wyrównaną niewydolnością serca znacząco częściej niż u osób zdrowych występują komorowe zaburzenia rytmu serca. Zarówno obecność, jak i bezwzględna liczba komorowych zaburzeń rytmu serca stanowią znaczące wskaźniki prognostyczne śmiertelności ogólnej oraz wystąpienia nagłego zgonu sercowego u chorych z przewlekłą niewydolnością serca. Częstoskurcze komorowe, stwierdzone w monitorowaniu EKG metodą Holtera, są najsilniejszym i niezależnym czynnikiem wskazującym na zwiększone ryzyko zgonu.