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CASE REPORT

MANAGEMENT OF VENTRICULAR ARRHYTHMIA INCIDENTALLY DETECTED DURING PERIODIC EXAMINATIONS IN POLISH AIR FORCE PILOTS

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Abstract: Cardiac rhythm disorders are the most frequent reason for referring military pilots for hospital examinations to determine the cause, treatment, and control of arrhythmias, which directly affects their further service in the air. The article presents the procedure in the case of detecting ventricular extrasystoles during periodic examinations of pilots of the Polish Air Force, using the example of aviators who have recently been admitted to our department.

Keywords: cardiac arrhythmia, ventricular arrhythmia, premature ventricular contraction, military pilot, high-maneuverability aircraft

Figures: 2 • **Tables:** 4 • **References:** 21 • **Full-text PDF:** http://www.pjambp.com • **Copyright** © 2024 Polish Aviation Medicine Society, ul. Krasińskiego 54/56, 01-755 Warsaw, license WIML • **Indexation:** Index Copernicus, Polish Ministry of Science and Higher Education

INTRODUCTION

Cardiac rhythm disorders are the most common cardiological reason for temporarily suspending military pilots from their service in the air and referring them for further diagnostics to the hospital. According to data from other countries related to civil aviation, these are also the most common reason for disqualifying pilots from further flying [12]. Among cardiac rhythm disorders, ventricular arrhythmia, along with atrial fibrillation, is the most common abnormality recorded during periodic examinations in ECG recordings, which is a reason for further cardiological diagnostics [7].

CASE PRESENTATION

Two pilots were referred to the Internal Medicine Clinic of the Military Institute of Aviation Medicine within a 3-day interval from the Regional Military Aviation Medical Commission due to ventricular cardiac rhythm disorders (VCRD).

A 37-year-old military pilot of high-maneuverability aircraft, previously feeling healthy, was referred due to asymptomatic ventricular extrasystoles recorded in a resting 12-lead ECG during routine periodic examinations. He had not taken any medication recently. In the last 3 years, he twice had a mild SARS-CoV-2 infection (in 2020 and 2023), and previously underwent tonsillectomy and laparoscopic cholecystectomy.

Upon admission, irregular heart activity (single additional contractions), elevated blood pressure (145/84 mmHg), and overweight (BMI 28 kg/m2) were noted.

In laboratory tests (tab. 1), the patient had reduced HDL levels, mild hypertriglyceridemia, and abnormal fasting glycemia.

Tab. 1. Results of fasting blood laboratory tests of a 37-year-old pilot.

Designation (unit)	Result	Standard a
Glucose (mg/dl)	92	70 – 99
Sodium (mmol/l)	138.8	136 – 146
Potassium (mmol/l)	4.46	3.5 – 5.1
Magnesium (mg/dl)	2.2	1.3 – 2.6
Creatinine (mg/dl)	0.9	0.7 – 1.3
MDRD eGFR (ml/min/1.73 m2)	95	>= 60
Uric acid (mg/dl)	6.9	3.5 – 7.2
Total cholesterol (mg/dl)	163	< 190
LDL cholesterol (mg/dl)	92	< 115
HDL cholesterol (mg/dl)	39	>= 40
Triglycerides (mg/dl)	159	<= 150
TSH (uIU/ml)	1.43	0.27 – 4.20

[a] reference value in the laboratory where the determination was performed

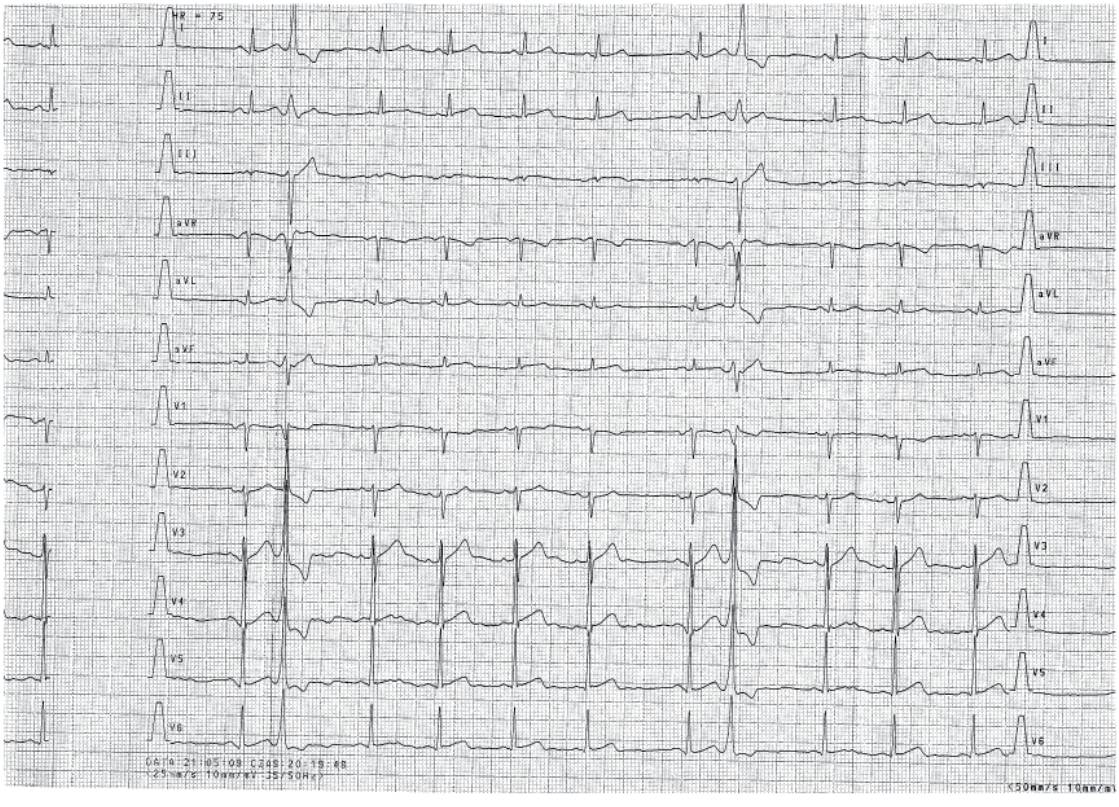

Fig. 1. Electrocardiogram recorded on admission to the hospital (tape travel 25 mm/s); description in text.

In the resting ECG (fig. 1), a regular sinus rhythm was recorded, disrupted by a single ventricular extrasystole with LBBB morphology.

In the 24-hour ECG Holter monitoring (tab. 2), a sinus rhythm with a tendency towards bradycardia was observed, quite numerous single monomorphic premature ventricular contractions, and a single episode of supraventricular tachycardia lasting 7 seconds, with the patient being unaware of the arrhythmia during the recorded cardiac rhythm disturbances.

Table 2. Result of 24-hour Holter ECG monitoring.

HR	Supraventricular arrhythmias	Ventricular arrhythmias
Mean 60/min	total 90 SVE	total 5789 VE
the Ministry 38/min	1 SV-Tachy	42 episodes of trigeminia
Max. 122/min		

HR – heart rate; SVE – supraventricular extrasystole; VE – ventricular extrasystole; SV-Tachy – supraventricular tachycardia

In the RR measurements in the department, normal values of blood pressure were observed. An exercise test was performed, which was negative with good physical fitness; during the test, a single ventricular extrasystole was observed at rest, which subsided during exercise and reappeared during rest at a slower ventricular activity.

Echocardiographic examination revealed a normal size of the heart chambers, no valvular defects, concentric remodeling of the left ventricle without signs of hypertrophy, and normal systolic and diastolic function of the left ventricular muscle.

To exclude coronary artery disease, a coronary CT angiography was performed, which showed atherosclerotic wall changes.

Given the asymptomatic, mild nature of the supraventricular and ventricular arrhythmia, which did not impair circulatory system efficiency, antyarrhythmic treatment was not initiated.

To exclude a post-inflammatory etiology of ventricular arrhythmia or other structural heart muscle disease, a cardiac MRI was performed, which showed no myocardial morphology disorders.

Based on the diagnostics conducted, ventricular arrhythmia was considered a mild cardiac rhythm disorder, not affecting exercise and psychomotor efficiency, and thus the pilot was cleared for further service in high-maneuverability aircraft.

Another military pilot (a 50-year-old helicopter pilot) was referred to our department due to numerous single ventricular extrasystoles observed during an electrocardiographic exercise test performed as part of periodic medical examinations. He denied heart palpitations, fainting, and loss of consciousness, but periodically felt nonspecific chest pains of non-cardiac origin. In recent years, the patient had recorded several instances of elevated blood pressure without being diagnosed with hypertension, and, among other risk factors, he had been a long-term smoker (quit 3 years ago; previously 20 pack-years).

Upon admission, deviations from the normal state included second-degree obesity (BMI 38 kg/m2), abnormal blood pressure (RR 140/100 mmHg), umbilical hernia, and skin discoloration up to the ankles secondary to periodically occurring edema.

In laboratory tests (tab. 3), the patient showed abnormal fasting glycemia and impaired glucose tolerance, elevated levels of non-HDL cholesterol, and triglycerides

Tab. 3. Results of fasting blood laboratory tests of a 50-year-old pilot.

Designation (unit)	Result	Standard a
Fasting glucose (mg/dl)	103	70 – 99
Glucose 2h after 75g glucose	161	< 140
Sodium (mmol/l)	140.8	136 – 146
Potassium (mmol/l)	4.03	3.5 – 5.1
Magnesium (mg/dl)	1.8	1.3 – 2.6
Creatinine (mg/dl)	1.0	0.7 – 1.3
MDRD eGFR (ml/min/1.73 m2)	79	>= 60
Uric acid (mg/dl)	7.1	3.5 – 7.2
Total cholesterol (mg/dl)	176	< 190
LDL cholesterol (mg/dl)	90	< 115
HDL cholesterol (mg/dl)	44	>= 40
Triglycerides (mg/dl)	210	<= 150
TSH (ulU/ml)	1.12	0.27 – 4.20

[a] reference value in the laboratory where the determination was performed

Elevated blood pressure values were observed in RR measurements in the ward. 24-hour blood pressure monitoring showed elevated mean blood pressure values during the day and night. Grade 1 hypertension was diagnosed and perindopril was started, achieving normotension.

Echocardiography showed an enlarged left atrial cavity, concentric remodeling of the left ventricular muscle, mild atrioventricular valve regurgitation, a dilated ascending aorta, and otherwise showed normal systolic function of the left ventricular muscle.

In the 24-hour ECG Holter monitoring (tab. 4) single ventricular premature contractions and occasional supraventricular beats were found.

Tab. 4. Result of 24-hour Holter ECG monitoring.

HR	Supraventricular arrhythmias	Ventricular arrhythmias
Mean 58/min	total 45 SVE	total 1 VE
the Min. 39/min	1 pair SVE	
Max. 100/min		

HR – heart rate; SVE – supraventricular extrasystole; VE – ventricular extrasystole.

The result of the exercise test performed using the Bruce protocol was negative with average physical fitness; no cardiac rhythm disturbances were observed during this test.

To exclude coronary artery disease, coronary CT angiography was also performed, which revealed no atherosclerotic changes.

Given the second-degree obesity with concomitant hypertension, an increase in physical activity and diet modification were recommended for weight reduction.

DISCUSSION

Ventricular rhythm disorders are often the first manifestations of previously undiagnosed heart disease. In Poland, cardiovascular diseases still remain the most common cause of death. According to the latest epidemiological updates by the European Society of Cardiology, our country belongs to the group with a high population risk of cardiovascular diseases [19]. During annual periodic examinations of military pilots, in addition to a medical examination and basic laboratory tests, a resting electrocardiographic recording, and for older pilots over 35 years of age, an electrocardiographic exercise test, are performed to detect potential heart diseases.

Ventricular rhythm disorders can be a symptom of structural heart disease or may occur without a clear cause. In the general population, they are found in standard ECG recordings in 2-7% of people. In military pilots, they are registered much less frequently, only in 0.8% of cases [1,11]. This is mainly because military pilots are a selected group of people who undergo electrocardiographic, echocardiographic, and electrocardiographic exercise testing when qualifying for air service to exclude cardiovascular system pathologies, and then they are subjected to regular periodic examinations at least once a year, including for heart diseases (an exception to this rule was the COVID-19 pandemic when some periodic examinations were suspended).

Even the diagnosis of ventricular arrhythmia in a resting ECG, even in the form of a single ventricular extrasystole, is considered an independent prognostic factor increasing the risk of death from cardiovascular causes and from any other cause [4]. In the population of middle-aged and older people without structural heart disease, the number of PVCs>30/hour increases the risk of death and heart attack more than 2.5 times over 5 years [17].

The most common cause of VCRD is coronary heart disease, especially in people over 35 years of age [13]. Given the high costs of military pilot training, valuable experience gained with age, and legal conditions shifting the retirement age for soldiers, the period of professional service in the coming years will be extended in Poland, and thus an increasing proportion of pilots will be older soldiers, over 35 years of age.

Besides coronary heart disease, there are other causes of ventricular rhythm disorders: congenital factors such as channelopathies or cardiomyopathies, which play a major role in young people, and acquired/external factors such as myocarditis or various types of intoxicants [18].

In the diagnosis of ventricular arrhythmia, in addition to assessing its severity, efforts are made to determine the risk of its recurrence and to detect all organic heart diseases and extra-cardiac factors influencing its occurrence.

The diagnostics and further management in case of diagnosis of ventricular rhythm disorders according to the guidelines of the European Society of Cardiology are presented in figure 2 [13].

The clinical descriptions presented illustrate the diagnostic approach and further decision-making in cases of ventricular rhythm disorders accidentally detected in periodic examinations of pilots of the Polish Air Force. The rhythm disturbances occurred in two phenotypically different individuals, burdened with different cardiovascular risks: the younger pilot, despite atherogenic dyslipidemia, abnormal fasting glycemia, and overweight, had a low risk of cardiovascular episodes according to the SCORE2 scale, while the older pilot with numerous risk factors for premature atherosclerosis development belonged to the high-risk category.

However, in the course of the diagnostics, it was the younger pilot who turned out to have a more advanced form of ventricular arrhythmia – numerous ventricular extrasystoles. Besides 24-hour ECG Holter monitoring, imaging studies play a fundamental role in the diagnosis of ventricular arrhythmia. A negative result of the imaging study suggests primary electrical heart disease in patients with VCRD. Echocardiography is easily accessible and is the first diagnostic tool for risk stratification in assessing valvular diseases, coronary heart disease, and cardiomyopathies [6]. In the examined pilot, apart from concentric remodeling of the left

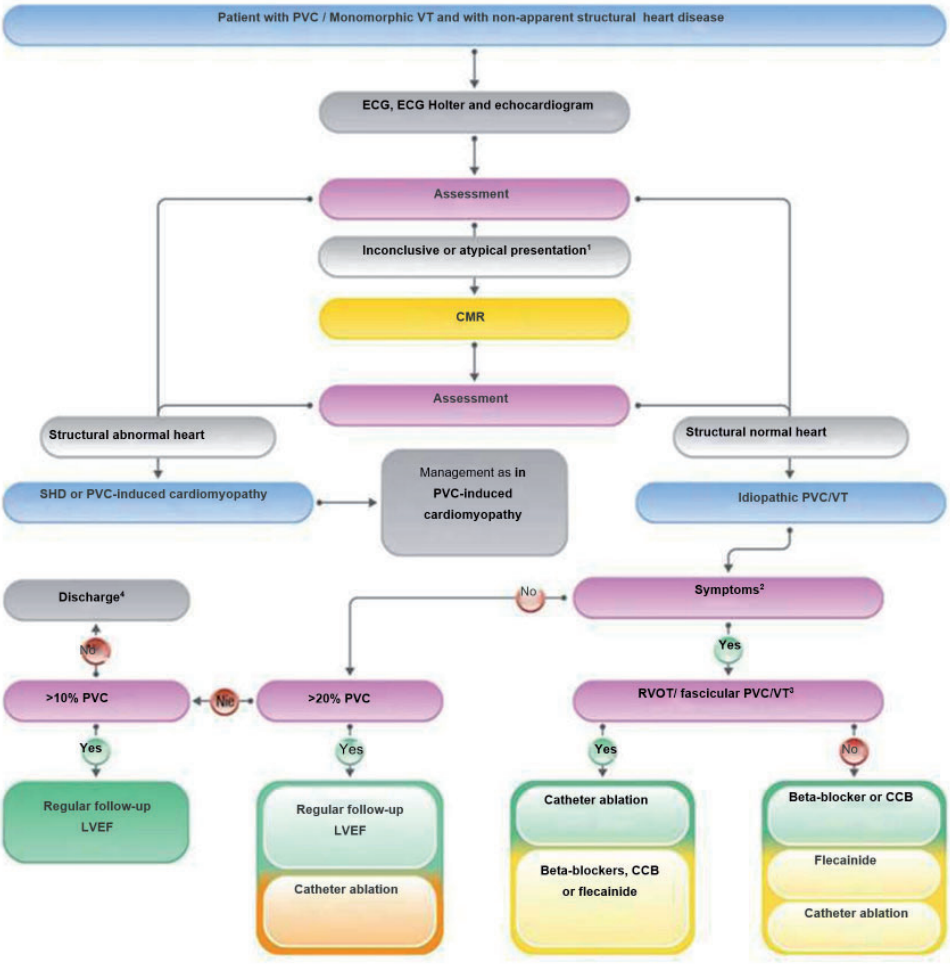

Fig. 2. Algorithm for the management of patients with idiopathic premature ventricular contractions/ventricular tachycardia and non-apparent structural heart disease.

CCB - Calcium Channel Blocker; CMR - Cardiac Magnetic Resonance; ECG - electrocardiogram; LVEF - Left Ventricular Ejection Fraction; N - No; PVC - Premature Ventricular Contraction; RVOT - Right Ventricular Outflow Tract; SHD - Structural Heart Disease; VT - Ventricular Tachycardia; Y - Yes.

1. Atypical presentation: e.g. older age, right bundle branch block morphology, sustained monomorphic VT consistent with re-entry.
2. Symptoms should be relevant and related to PVC/VT.
3. Origin suspected by ECG or confirmed during electrophysiological evaluation.
4. Consider re-evaluation in case of new symptoms or changes in patient clinical condition.

ventricle, no significant abnormalities were found in the echocardiographic examination. To assess the relationship between ventricular arrhythmia and exertion, an electrocardiographic exercise test was performed on him. This test, generally widely available, also provides clues to answer whether a given arrhythmia is idiopathic or related to heart disease. Features such as the occurrence of only single, monomorphic, premature ventricular contractions, which subside with increasing exertion, suggest their benign nature and idiopathic cause [3]. In the examined pilot, only rhythm disturbances with the above characteristics were observed, which further allowed us to consider it highly probable that during flight, under exposure to numerous stress factors, including hypoxia significantly intensifying arrhythmias, there would be no undesirable events related to cardiac rhythm disturbances that would disrupt the pilot's work [12]. One of the most recommended tests performed to exclude coronary artery disease is CT angiography, which allows for a non-invasive anatomical assessment of the vessels [10]. Thanks to the use of contrast agents, it allows visualizing the lumen of the coronary arteries with quality comparable to coronary angiography [9].

In young people, among the most common causes of ventricular rhythm disturbances, primary electrical heart diseases and cardiomyopathies, as well as myocarditis and coronary artery anomalies, predominate [15,20]. Cardiac MRI is the best test for assessing the heart muscle in terms of excluding cardiomyopathies and myocarditis. It provides the most accurate measurement of atrial

function, global and segmental systolic function of both heart chambers, and enables the detection of cardiomyocyte edema, fibrosis, infiltration, and perfusion disorders [5,14,16]. In the pilot presented, a history of twice contracting the SARS-CoV-2 virus with no heart rhythm disturbances in previous periodic examinations suggested past myocarditis and secondary changes in the myocardium causing ventricular arrhythmia. A normal result of the MRI excluded structural heart muscle disease as the cause of ventricular rhythm disturbances, thus being the final step before allowing the examined pilot to continue flying high-maneuverability aircraft, for which the highest health requirements are set among all pilot classes.

In the case of the older pilot, despite metabolic syndrome, structural heart abnormalities found in the echocardiographic examination, and high cardiovascular risk, the ventricular arrhythmia recorded during periodic examinations was an episodic event and did not recur in subsequent examinations. The literature often emphasizes the fact of spontaneous variability in the occurrence of heart rhythm disturbances, hence control examinations can confirm or exclude their permanent nature [2,8].

The possibility of antiarrhythmic treatment of military pilots, in terms of pharmacotherapy, is limited only to the use of beta-blockers, and in the case of more advanced forms of arrhythmia treatable by ablation, this method of therapy is also permissible. Hence, the greater importance in the group of military pilots is the prevention focused on controlling modifiable risk factors for cardiovascular diseases, such as maintaining proper body weight, blood pressure, regular physical activity, and eliminating harmful habits such as smoking [1,7,21].

AUTHORS' DECLARATION:

Study Design: Michal A. Kurek. **Data Collection:** Michal A. Kurek. **Manuscript Preparation:** Michal A. Kurek. The Author declares that there is no conflict of interest.

REFERENCES

1. Aerospace Medicine Waiver Guide. Air Force Waiver Guide. Case No.: 88ABW- 2013-5432, 20 Dec 2013.
2. Candinas RA, Podrid PJ. Noninvasive diagnosis of ventricular arrhythmias by means of ambulatory-ECG monitoring. Herz. 1990; 15(1):1-10.
3. Corrado D, Drezner JA, D'Ascenzi F, Zorzi A. How to evaluate premature ventricular beats in the athlete: critical review and proposal of a diagnostic algorithm. Br J Sports Med. 2020; 54(19):1142-1148. doi: 10.1136/bjsports-2018-100529.
4. Engel G, Cho S, Ghayoumi A, Yamazaki T, Chun S, Fearon WF, Froelicher VF. Prognostic significance of PVCs and resting heart rate. Ann Noninvasive Electrocardiol. 2007; 12(2):121-9. doi: 10.1111/j.1542-474X.2007.00150.x.
5. Garg R, Friedrich MG. Cardiomyopathies. ESC CardioMed. 3rd ed. Oxford University Press. 2022: 510–515.
6. Gorenek B, Fisher JD, Kudaiberdieva G, Baranchuk A, Burri H, Campbell KB, Chung MK, Enriquez A, Heidbuchel H, Kutyifa V, Krishnan K, Leclercq C, Ozcan EE, Patton KK, Shen W, Tisdale JE, Turagam MK, Lakkireddy D. Premature ventricular complexes: diagnostic and therapeutic considerations in clinical practice : A state-of-the-art review by the American College of Cardiology Electrophysiology Council. J Interv Card Electrophysiol. 2020; 57(1):5-26. doi: 10.1007/s10840-019-00655-3.
7. Guettler N, Bron D, Manen O, Gray G, Syburra T, Rienks R, d'Arcy J, Davenport ED, Nicol ED. Management of cardiac conduction abnormalities and arrhythmia in aircrew. Heart. 2019; 105(Suppl 1):s38-s49. doi: 10.1136/heartjnl-2018-313057.
8. Horowitz LN. Ventricular arrhythmias: control of therapy by Holter monitoring. Eur Heart J. 1989; 10 Suppl E:53-60. doi: 10.1093/eurheartj/10.suppl_e.53.
9. Knuuti J, Ballo H, Juarez-Orozco LE, Saraste A, Kolh P, Rutjes AWS, Jüni P, Windecker S, Bax JJ, Wijns W. The performance of non-invasive tests to rule-in and rule-out significant coronary artery stenosis in patients with stable angina: a meta-analysis focused on post-test disease probability. Eur Heart J. 2018; 39(35):3322-3330. doi: 10.1093/eurheartj/ehy267.
10. Knuuti J, Wijns W, Saraste A, Capodanno D, Barbato E, Funck-Brentano C, Prescott E, Storey RF, Deaton C, Cuisset T, Agewall S, Dickstein K, Edvardsen T, Escaned J, Gersh BJ, Svitil P, Gilard M, Hasdai D, Hatala R, Mahfoud F, Masip J, Muneretto C, Valgimigli M, Achenbach S, Bax JJ; ESC Scientific Document Group. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J. 2020; 41(3):407-477. doi: 10.1093/eurheartj/ehz425. Erratum in: Eur Heart J. 2020; 41(44):4242.

11. Kurek M. Retrospektywna ocena zaburzeń układu bodźca-przewodzącego serca u pilotów Polskich Sił Zbrojnych. Wojskowy Instytut Medycyny Lotniczej. Praca doktorska. 27.04.2022.

12. Mantziari L, Styliadis C, Kourtidou-Papadeli C, Styliadis I. Arrhythmias, sudden cardiac death and incapacitation of pilots. Hippokratia. 2008; 12(Suppl 1):53-8.

13. Marzlin KM. Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death Guideline Update. AACN Adv Crit Care. 2020; 31(2):221-227. doi: 10.4037/aacnacc2020586.

14. Mavrogeni S, Petrou E, Kolovou G, Theodorakis G, Iliodromitis E. Prediction of ventricular arrhythmias using cardiovascular magnetic resonance. Eur Heart J Cardiovasc Imaging. 2013; 14(6):518-25. doi: 10.1093/ehjci/jes302.

15. Risgaard B, Winkel BG, Jabbari R, Behr ER, Ingemann-Hansen O, Thomsen JL, Ottesen GL, Gislason GH, Bundgaard H, Haunsø S, Holst AG, Tfelt-Hansen J. Burden of sudden cardiac death in persons aged 1 to 49 years: nationwide study in Denmark. Circ Arrhythm Electrophysiol. 2014; 7(2):205-11. doi: 10.1161/CIRCEP.113.001421.

16. Roca-Luque I, Mont-Girbau L. Cardiac Magnetic Resonance for Ventricular Tachycardia Ablation and Risk Stratification. Front Cardiovasc Med. 2022; 8:797864. doi: 10.3389/fcvm.2021.797864.

17. Sajadieh A, Nielsen OW, Rasmussen V, Hein HO, Frederiksen BS, Davanlou M, Hansen JF. Ventricular arrhythmias and risk of death and acute myocardial infarction in apparently healthy subjects of age >or=55 years. Am J Cardiol. 2006; 97(9):1351-7. doi: 10.1016/j.amjcard.2005.11.067.

18. Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, Chamberlain AM, Chang AR, Cheng S, Delling FN, Djousse L, Elkind MSV, Ferguson JF, Fornage M, Khan SS, Kissela BM, Knutson KL, Kwan TW, Lackland DT, Lewis TT, Lichtman JH, Longenecker CT, Loop MS, Lutsey PL, Martin SS, Matsushita K, Moran AE, Mussolino ME, Perak AM, Rosamond WD, Roth GA, Sampson UKA, Satou GM, Schroeder EB, Shah SH, Shay CM, Spartano NL, Stokes A, Tirschwell DL, VanWagner LB, Tsao CW; American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics-2020 Update: A Report From the American Heart Association. Circulation. 2020; 141(9):e139-e596. doi: 10.1161/CIR.0000000000000757.

19. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, Benetos A, Biffi A, Boavida JM, Capodanno D, Cosyns B, Crawford C, Davos CH, Desormais I, Di Angelantonio E, Franco OH, Halvorsen S, Hobbs FDR, Hollander M, Jankowska EA, Michal M, Sacco S, Sattar N, Tokgozoglu L, Tonstad S, Tsioufis KP, van Dis I, van Gelder IC, Wanner C, Williams B; ESC National Cardiac Societies; ESC Scientific Document Group. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J. 2021; 42(34):3227-3337. doi: 10.1093/eurheartj/ehab484. Erratum in: Eur Heart J. 2022; 43(42):4468.

20. Winkel BG, Holst AG, Theilade J, Kristensen IB, Thomsen JL, Ottesen GL, Bundgaard H, Svendsen JH, Haunsø S, Tfelt-Hansen J. Nationwide study of sudden cardiac death in persons aged 1-35 years. Eur Heart J. 2011; 32(8):983-90. doi: 10.1093/eurheartj/ehq428.

21. Zeppenfeld K, Tfelt-Hansen J, de Riva M, Winkel BG, Behr ER, Blom NA, Charron P, Corrado D, Dagres N, de Chillou C, Eckardt L, Friede T, Haugaa KH, Hocini M, Lambiase PD, Marijon E, Merino JL, Peichl P, Priori SG, Reichlin T, Schulz-Menger J, Sticherling C, Tzeis S, Verstrael A, Volterrani M; ESC Scientific Document Group. 2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death. Eur Heart J. 2022; 43(40):3997-4126. doi: 10.1093/eurheartj/ehac262.

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