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Atrial fibrillation with rapid ventricular rate during thyroid storm

Migotanie przedsionków z szybką czynnością komór w czasie przełomu tarczycowego

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Abstract

We present the case of an unconscious 81 year-old woman admitted to the Emergency Department with fever and significant tachycardia up to 210 bpm. The patient was referred by the general physician to the neurology department with suspected stroke. Atrial fibrillation (AF) with rapid ventricular rate was found. The causes of significant tachycardia, in this case, were complex and associated with dehydration, fever, infection and thyroid storm. It could be assumed that the deterioration of the patient's general condition and a decreased fluid intake had caused hypertonic dehydration which could have led to further acceleration of the heart rhythm and loss of consciousness.

Thyroid function tests are indicated in all cases of paroxysmal AF. In the presented case, the suspicion of thyroid storm was based on the results of analysis and it was confirmed later by the results of free traction of thyroid hormones' levels. The very fast ventricular rate was related to metabolic disorders and the influence of thyroid hormones on the electrophysiological properties of the atrioventricular junction. In order to stabilise the condition of the patient, passive oxygen therapy, an antipyretic drug, the correction of water and electrolyte disturbances, and digoxin were administered. This treatment improved the patient's general condition and state of consciousness, resulting in slowing heart rate and respiratory rate.

Key words: atrial fibrillation, dehydration, thyroid storm

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Case report

An 81 year-old female patient was transported to the emergency department (ED) from a nursing home after losing consciousness. She was referred to the neurology department with a stroke diagnosis made by a doctor at the nursing home. The medical transport team provided information that the patient suffered from hypertension and dementia. Loss of consciousness was not sudden but gradual. On the day of admission, she had completely stopped eating and drinking and became unresponsive. The patient's documentation contained an electrocardiogram that had been recorded a few months earlier which showed sinus rhythm. The patient was treated chronically with amlodipine, nicergoline, and acetylsalicylic acid.

The patient was immediately admitted to the red area. On the Glasgow Coma Scale (GCS) she scored 3 points. The patient's airway was patent, but respiration was rapid

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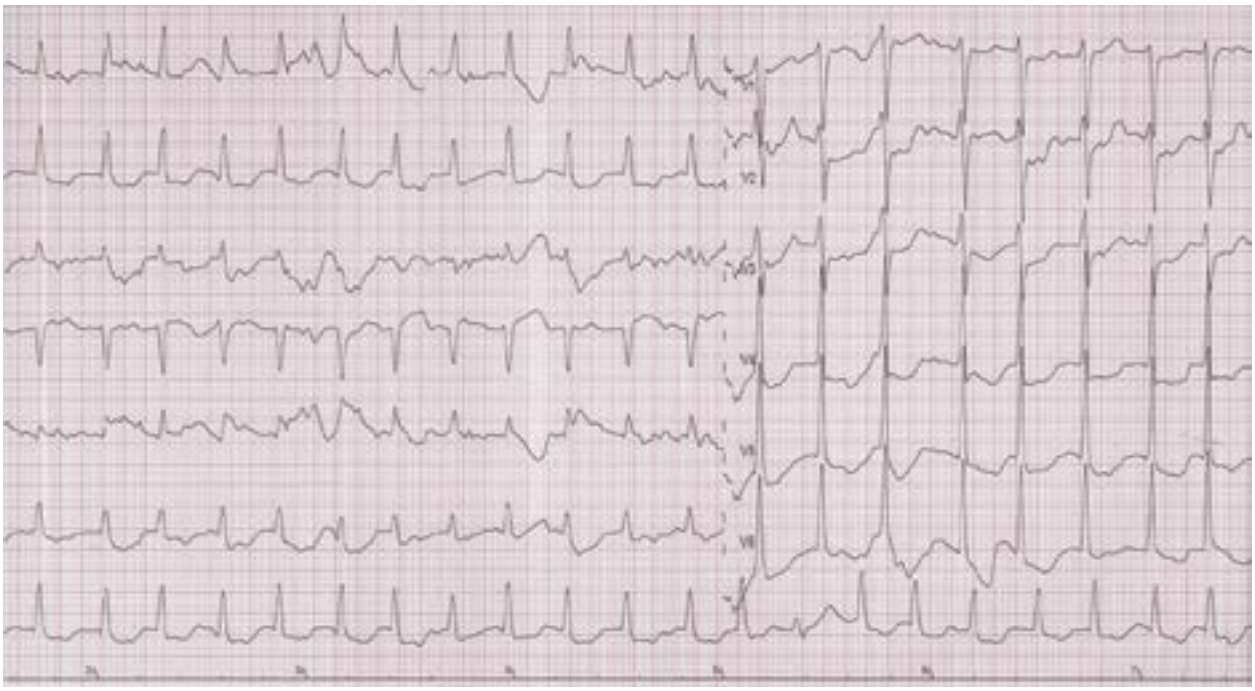

Figure 1. An electrocardiogram at admission. Atrial fibrillation with mean ventricular rate of 210/min (paper speed 50 mm/s)

(30 breaths per min) and laboured. Pulse oxymetry revealed oxygen saturation at 85% and a pulse rate of 220/min. The patient was immediately given oxygen via a nasal cannula with a flow of 3 L/min. Blood pressure was 150/90 mm Hg and temperature was 38°C. Venous blood gas analyses showed pO_2 45.6 and pCO_2 45.6 FOHb 73.6%. Other critical biochemical parameters were: normal glucose level, high level of sodium, and low level of potassium. The electrocardiogram (ECG) revealed atrial fibrillation (AF) with ventricular rate up to 210 bpm (Figure 1). Diagnostics for infection (including the urinary and respiratory tracts), acute cerebral ischaemia and hyperthyroidism were initiated. At the same time, the patient was hydrated with a hypotonic solution of 5% dextrose in water with potassium chloride and insulin. Furthermore, 0.25 mg of digoxin and 1 g of paracetamol were administered. Her consciousness level, body temperature, breathing frequency, and heart rate gradually improved. After three hours, the patient started to spontaneously open her eyes and look towards an approaching person. Blood pressure was within the same range as at admission, however pulse oximetry had increased to 95%, and heart rate was 104 bpm.

The results of laboratory tests are presented in Table 1. C-reactive protein (CPR), D-dimer and troponin T levels were slightly elevated. The troponin level was increased but stable and three hours later was on the same level as at admission. Intracerebral haemorrhage and skull bone injury were not found in the computed tomography scan of the head. There were no signs of infection in the chest X-ray or urinalysis.

Table 1. Laboratory results

Parameter	Value	Norm
Sodium [mmol/L]	164	135–145
Potassium [mmol/L]	3.4	3.5–5.1
Haemoglobin [g/dL]	14.6	11.0–16.0
RBC [T/L]	4.92	3.50–5.0
Troponin T [pg/mL]	88	< 13.0
D-dimer [ng/mL]	1,993	< 500.0
CRP [mg/L]	21.66	< 6.0
TSH [μU/mL]	0.012	0.27–4.2
fT4 [pmol/L]	50.3	12–22
fT3 [pmol/L]	6.08	6.7–13.13
Serum lactate [mmol/L]	5.37	< 1.2

RBC — red blood cells; CRP — C-reactive protein; TSH — thyroid-stimulating hormone (thyrotropin); fT4 — free thyroxine; fT3 — free triiodothyronine

Levels of free thyroid hormone fractions were checked. Because the free thyroxine (fT4) level was significantly increased, the diagnosis of thyroid storm was made. The patient was transferred to the department of internal diseases.

Discussion

Admissions to the ED of an unconscious patient account for 0.4–1% of all admissions. Unconscious patients are

at a high risk of death. A prompt and accurate diagnosis is crucial for their survival. The main reasons for non-traumatic loss of consciousness are seizures, glucose level disturbances, and intoxication. About 30% of such patients have no obvious cause and 1% of patients have unsuspected traumatic brain injury.

In the presented case, discovering the cause of the extremely rapid ventricular rate of the first diagnosed atrial fibrillation was crucial. The ventricular rate during AF depends on the activity of the autonomic system and the properties of the atrioventricular node. Rapid ventricular rate (RVR) during AF has been defined as an average ventricular rate > 110/min in many studies [1]. The mean ventricular rate in patients with the first AF in the study by Naffaa et al. [2] was 128 ± 30. AF with RVR may occur during many disorders and disease processes that may co-exist, including sepsis, hypoxia, acute heart failure, dehydration, fever, pre-excitation syndrome, and thyroid storm. Especially in the last two of these cases, very high ventricular rates exceeding 200 bpm have been described [3].

The first step in selecting a treatment strategy for AF is to assess the influence of AF on the patient's haemodynamic status, duration of AF, anticoagulant therapy, current complications and coexisting conditions. In the presented case, the parameters that could indicate haemodynamic instability were unconsciousness, rapid breathing, and increased lactate level. However, normal blood pressure, the absence of signs of fluid retention in physical examination and chest X-ray, and no pulse deficit assessed by pulse oximetry all argued against the assumption that the cause of unconsciousness was haemodynamic instability. The duration of AF was certainly shorter than a few months, but could not be exactly determined. Therefore cardiac electrocardioversion was not performed at the patient's admission to ED.

The clinical picture suggested that the cause of the patient's state could be sepsis, although the slightly elevated CRP concentration and normal chest X-ray and urinalysis argued against this. Even before obtaining the results of additional tests and determining the full diagnosis, it was necessary to correct metabolic disorders, including hypertonic dehydration, with an infusion of nonelectrolyte fluids. High sodium concentrations indicate hypertonic dehydration, which may be a consequence of hyperventilation or reduced water intake. Both of these causes could co-exist within the patient. The patient did not have a thyroid-related medical history. However, abnormal results of hormonal tests together with the whole clinical picture comprising increased body temperature, impaired consciousness, and AF with RVR, helped towards a diagnosis of thyroid shock. In Burch-Wartofsky score, the patient scored 75 points consisting of thyrotoxicosis [elevated free triiodothyronine (fT3) and/or fT4 level] with coma (30 points), tachycardia of 220/min (25 points), AF (10 points) and fever 38°C (10 points). A total of points ≥ 45 is required for a diagnosis of thyroid storm [3, 4]. Therefore, attention should be paid to the existence of contraindications to the administration of amiodarone, which could be considered due to the absence of a depressive effect on the myocardial contractility [5].

It cannot be ruled out that if a medical emergency team was called to the patient, the decision to administer amiodarone intravenously could have been made. Recommendations regarding the management of patients with thyroid crisis and AF with rapid ventricular rate include administration of a beta-blocker: esmolol infusion or metoprolol in an intravenous bolus, but cases of effective control of the ventricular rate using digoxin [5–7] have also been reported in the literature.

AF with RVR may also occur if there is an additional conduction pathway (as in Wolff-Parkinson-White syndrome), but in those circumstances a large variation in the morphology of QRS complexes would be expected, which was not observed in the presented case [3]. One explanation for the presence of AF with RVR could be an excess of thyroid hormones that have a positive chronotropic effect [8, 9]. They affect atrial cells by shortening their repolarisation period, which can lead to AF arrhythmia.

Another property of triiodothyronine is its effect on the atrioventricular node, where it shortens the conduction period and the relative refraction time, which explains the rapid rhythm of the ventricles in the described case.

The case we have presented allows us to emphasise the occurrence of two findings: lack of pulse deficit, which indicated hyperkinetic circulation, and a significant slowdown of the heart rate after administration of fluids and digoxin, which has a weak effect in the case of an activated sympathetic nervous system. The RVR in this case seems to have been mainly driven by dehydration and fever. However, thyroid hormones acting on the electrophysiological properties of the cardiac conduction system could enhance this response [8, 9]. Moreover, the fever could be at least partially caused by thyrotoxicosis. Weakness caused by fever and thyrotoxicosis could enhance dehydration due to reduced water intake.

Conclusions

1. Thyroid storm can occur at any age, including among elderly people. It can lead to coma as a result of metabolic disturbances, fever, and dehydration. 2. AF with a rapid ventricular rate, as well as coma of unknown cause, are indications for the assessment of thyroid function simultaneously with other diagnostic tests and ongoing treatment.

Conflict(s) of interest

The authors declare no conflict of interest.

Streszczenie

W pracy przedstawiono przypadek nieprzytomnej 81-letniej kobiety przywiezionej na szpitalny oddział ratunkowy z gorączką i znaczną tachykardią do 210/min skierowanej przez lekarza rodzinnego na neurologię z podejrzeniem udaru mózgu. W zapisie elektrokardiograficznym stwierdzono migotanie przedsionków (AF) z szybką czynnością komór. Przyczyny wystąpienia znacznej tachykardii w tym przypadku były złożone i związane z odwodnieniem, gorączką, infekcją oraz przełomem tarczycowym. Pogorszenie stanu pacjentki i zmniejszone przyjmowanie płynów prowadziło do odwodnienia hipertonicznego, co mogło prowadzić do dalszego przyspieszenia rytmu serca i utraty przytomności.

Badanie czynności tarczycy jest wskazane u wszystkich pacjentów z napadowym AF. W prezentowanym przypadku pozwoliło ono podejrzewać przełom tarczycowy, potwierdzony następnie w badaniu stężeń wolnych frakcji hormonów tarczycy. Bardzo szybka częstość komór w tym wypadku wiązała się z zaburzeniami metabolicznymi oraz wpływem hormonów tarczycy na właściwości elektrofizjologiczne łącza przedsionkowo-komorowego. W celu wstępnej stabilizacji stanu pacjentki zastosowano nawadnianie, tlenoterapię bierną, podano lek przeciwgorączkowy, uzupełniano niedobór elektrolitów i podano digoksynę, co pozwoliło na poprawę stanu ogólnego pacjentki i jej stanu świadomości, zwolnienie czynności serca i częstotliwości oddychania.

Słowa kluczowe: migotanie przedsionków, odwodnienie, przełom tarczycowy

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