English/Spanish/Portuguese

Young, feverish man, with shortness of breath and carrier of HIV positive serology

Hombre joven y febril, con dificultad para respirar y portador de SIDA positiva

Homem jovem e febril, com falta de ar e portador de sorologia HIV positiva.

What is the diagnosis of chest X-ray and ECG?

Qual o diagnóstico de ambos Rx de tórax e ECG?

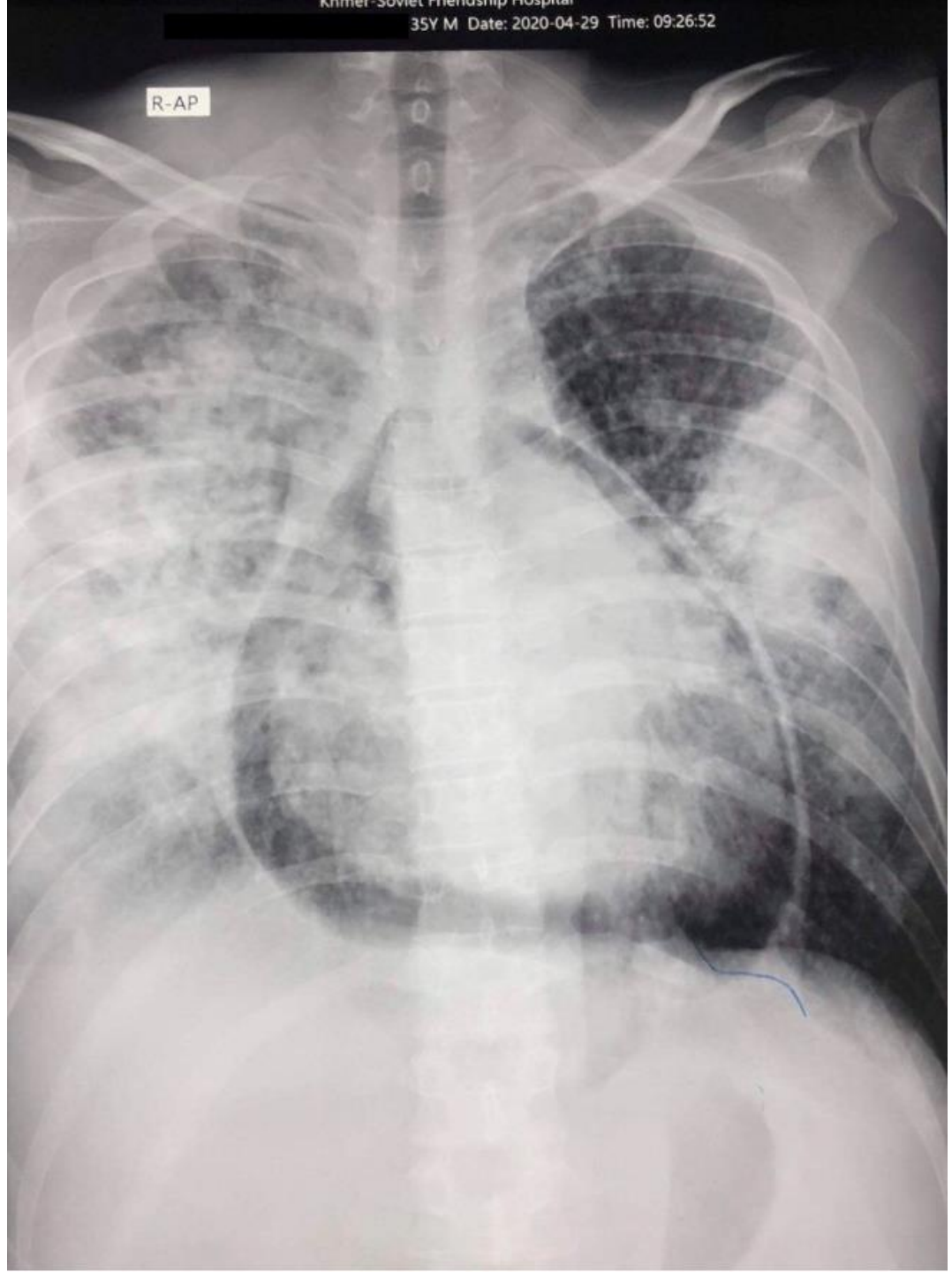
¿Cuál es el diagnóstico de la radiografía de tórax y del ECG?

Dear Prof Melvin

How are you doing so far? I hope you doing fine. I saw a patient 35 YO male, high fever and dyspnea, was requested from ED to have TTE, we cannot see his heart during echo. Chest x ray showed very terrible and the next day I went to ICU to see his ecg (attached photo) and showed as below (attached photo). Blood test show he had HIV+. I haven't seen this case in my life. What do you think sir?Estimado profesor Melvin

¿Cómo te va hasta ahora? Espero que le vaya bien. Vi a un paciente de 35 años de edad, varón, fiebre alta y disnea, se le solicitó a ED que tuviera TTE, no podemos ver su corazón durante el eco. La radiografía de tórax se mostró muy terrible y al día siguiente fui a la UCI para ver su ECG (adjunta) y se mostró a continuación (foto adjunta). El análisis de sangre muestra que tenía VIH +. No he visto este caso en mi vida.

¿Qué le parece señor?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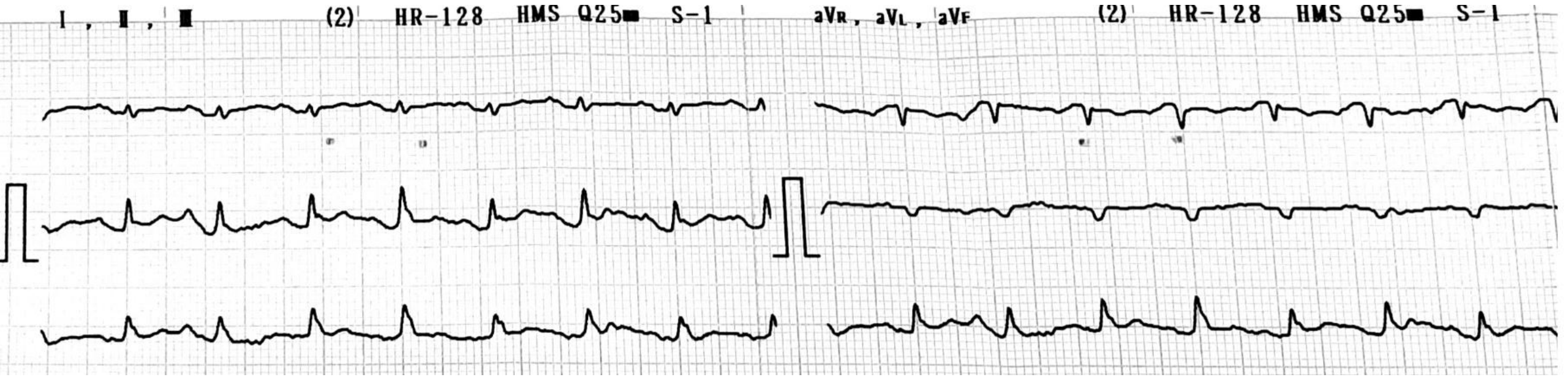
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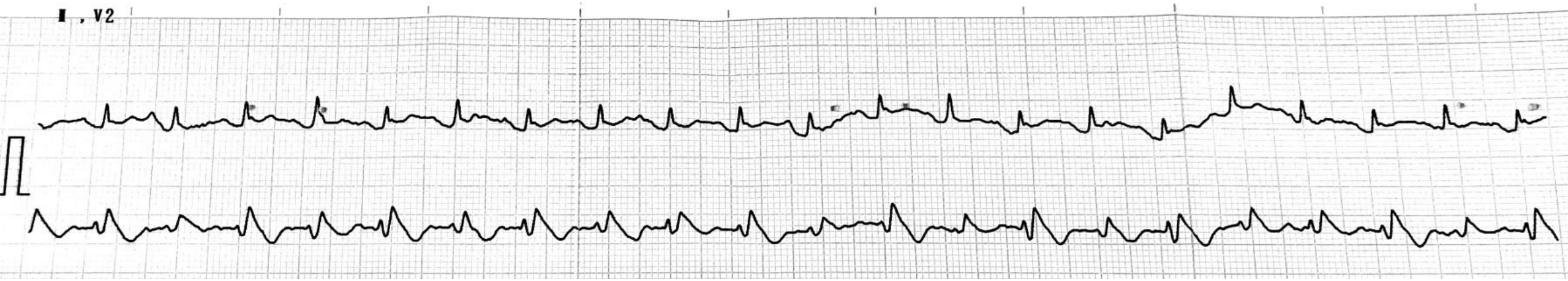
aVR , aVL , aVF
(2) HR-128 HMS Q25■ S-1



Dear Professor Melvin and colleague: what a special case! Deserves to try an urgent publication

I would like to hug you when this pandemic goes away

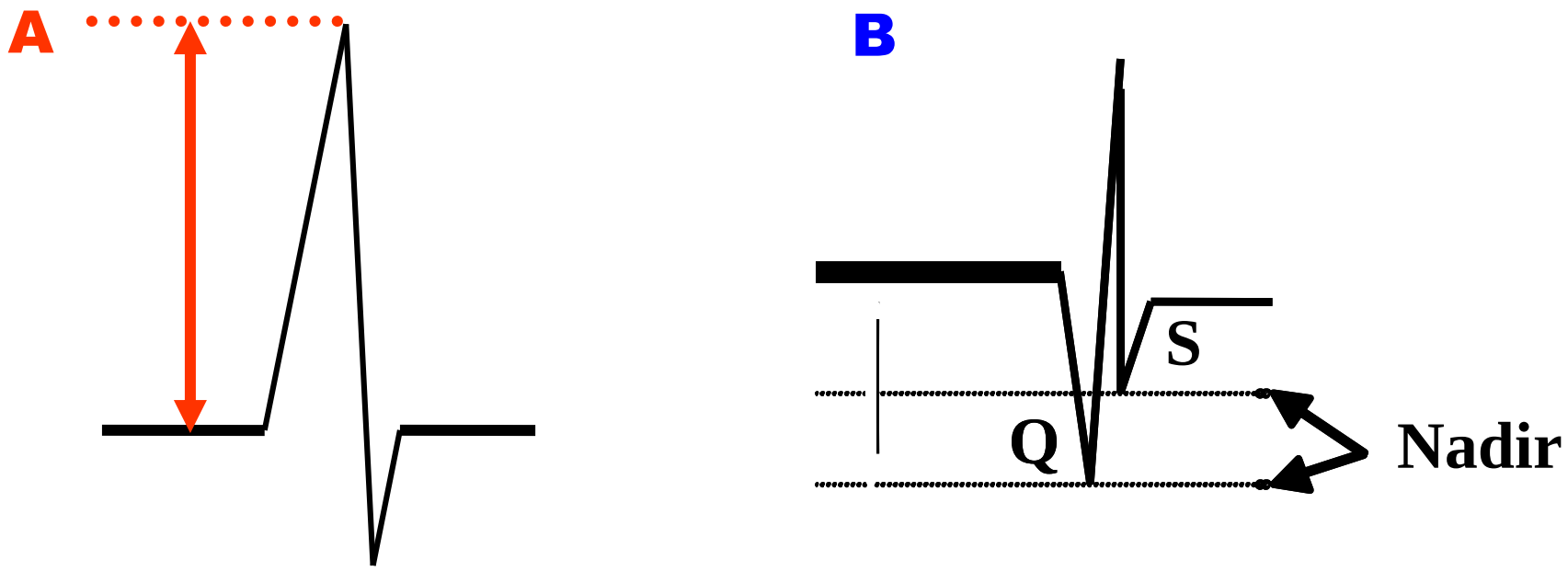
I miss you very much despite knowing you only virtually

A tight hug for both.

In a few days I will send a more detailed analysis

My opinion: **Calcified cardiac tamponade, severe bilateral pneumonia, near low voltage of the QRS complexes and Brugada type 1 electrocardiographic pattern caused by fever because the sodium channel is thermosensitive.**

Outline that shows the proper measurement of voltage and width of the QRS complex.



Proper measurement way:

The voltage of the R wave should be measured from the superior border of the baseline to the apex of the R wave (A).

The voltage of Q and of S should be measured from the inferior border of the baseline to the nadir of the wave (B).

Low voltage criteria in the frontal and horizontal plane.

IN THE FRONTAL PLANE

When no wave exceeds 5 mm (1 large square or 5 small squares, vertically) in the leads of the FP, it is considered low voltage.

IN THE HORIZONTAL PLANE

If no wave exceeds 8 mm (some authors state 10 mm as the border in this plane).

CAUSES OF LOW VOLTAGE OF QRS

1) Obesity;
2) Anasarca;
3) **Pleural, pericardial, or pleuro-pericardial effusion**
4) Left pneumothorax;
5) Hypothermia;
6) Myocardiosclerosis;
7) Extensive infarctions;
8) Cardiomyopathies;
9) Hemochromatosis;
10) Myxedema;
11) Amyloidosis;
12) Cachexia;
13) Heart failure;
14) Normal variant;
15) Mitral stenosis;
16) Emphysema.

Fever and Brugada syndrome

Since temperature affects permeability, temperature change forces the Na+ channel and other channels to modify their functional state[1]. INa^+ kinetics depends strongly on temperature[2]. Thus, an increase of 10ºC increment the voltage or width by a factor of 1.3 to 1.6 and increases the time of opening and the number of times that the channel is opened by a factor of three. Activation and inactivation kinetics for early INa^+ are twofold faster at higher temperature, and shift activation and steady-state inactivation[3]. Then, the fever is considered triggers to PVT/VF in the Brugada Syndrome (BS) jointly with other causes that causing modifications in the degree of elevation of the J point and of the ST segment. The other factors capable to get worse the ventricular repolarização are: antimalarial agents; tricyclic antidepressants; class IA (ajmaline and procainamide) and 1C (flecainide, pilsicainide) anti-arrhythmic agents; hyperglycemia; nocturnal bradycardia by vagal predominance; alcohol consumption; mental stress and cocaine use. In BrS, fever is associated with a greater chance of tachyarrhythmic events; this suggests that the increase in temperature affects the Na+ channel conductance. Mutations in a cardiac sodium channel gene have been linked to this syndrome and some experimental data suggest that the dysfunction of the mutated channel can be temperature sensitive[4].

Dumaine et al[5]**.** hypothesized that at more physiological temperatures; the missense mutation may change the gating of the sodium channel such that the net outward current is dramatically augmented during the early phases of the right ventricular AP. The authors tested this hypothesis by expressing Thr1620Met in a mammalian cell line, using the patch-clamp technique to study the currents at 32 degrees C. They concluded that Thr1620Met current decay kinetics are faster when compared with the wild type at 32 degrees C. Recovery from inactivation was slower for Thr1620Met at 32 degrees C, and steady-state activation was significantly shifted. These findings explain the features of the ECG of BS patients, illustrate for the first time a cardiac INa^+ channel mutation of which the arrhythmogenicity is revealed only at temperatures approaching the physiological range, and suggest that some patients may be more at risk during febrile states.[6]

Nagatomo et al[7] characterized early INa^+ (the peak and initial decay) and late INa^+ of the wild-type hH1 channel and a mutant channel (DeltaKPQ) associated with LQT3. Channels were stably transfected in HEK-293 cells and studied at 23 and 33 degrees C using whole cell patch clamp.

Activation and inactivation kinetics for early INa^+ **were two fold faster at higher temperature for both channels** and shifted activation and steady-state inactivation in the positive direction, especially for DeltaKPQ. For early INa^+ (<24 ms), DeltaKPQ decayed faster than the wild type for voltages negative to -20 mV but slower for more positive voltages, suggesting a reduced voltage dependence of fast inactivation.

Late INa^+ at 240 ms was significantly greater for DeltaKPQ than for the wild type at both temperatures. The majority of late INa for DeltaKPQ was not persistent; rather, it decayed slowly, and this late component exhibited slower recovery from inactivation compared with peak INa^+.

Kinetic changes for early and peak INa^+ for DeltaKPQ compared with the wild type at both temperatures were:

Reduced voltage dependence of steady-state inactivation with no difference in midpoint;

Positive shift for activation kinetics, and;More rapid recovery from inactivation.

There are references of ST-segment elevation, spontaneous T wave alternans, premature ventricular contractions, severe polymorphic ventricular tachycardia with syncope and incessant monomorphic ventricular tachycardia with fatal electrical storm related in febrile states[8-9-10-11]. Additionally, ECG changes typical of BrS can be unmasked during a febrile illness[12]. Then, some BS patients may display the ECG phenotype only during a febrile state and at normal body temperature, the patient's ECG return to normal[13-14].

Wakita et al[14] had evidenced that SCN5A-H681P mutation (a single amino acid substitution (H681P) in the SCN5A gene) induces a significant loss of transmembrane current and is clinically associated with a pathologic phenotype that is elicited by hyperthermia.

Brugada syndrome, competitive athletic activities and body temperature

Candidates should not participate in competitive athletic activities, considering the possibility that intense training and competitions increase SCD risk. On the other hand, the group of the Brugada brothers states that in this condition, there is no increased risk during strenuous sports activities. The point of view is not to restrict exercise to BrS carriers. Effort increases sympathetic tone, which improves repolarization as demonstrated by Guevara Valdívia et al, in patients who were BrS carriers during the stress test[15-16]. In sports that demand extreme efforts that could potentially lead to fatigue, in hot environments, heat dispersion produced as a product of metabolism during exercise is not dispersed efficiently by skin convection, radiation and evaporation. Thus, it can lead to hyperthermia, a factor that is well known to worsen repolarization in BrS. In case of dehydration or in a lower efficacy of the sweat glands, an increase of internal body temperature can be observed, what theoretically could worsen repolarization in BrS. The information is scant on BrS and sports. Progressive hyperthermia that can be caused by an intense physical activity in a room not properly ventilated, theoretically could increase body temperature and thus worsen ventricular repolarization, making onset of tachyarrhythmia events in phase 2 easier. During rest, body temperature is near 37 degrees (99F), and during exercise, when the organism is incapable of dispersing heat as fast as it is produced (by conduction, convection, radiation and mostly by evaporation, which is the most important one) a normal person can reach a temperature near the 40 degrees (104F), and muscles can reach 42 degrees (107.6F), activating thermo receptors that via hypothalamus cause vasodilatation and sweat. In concomitance of a hot and humid environment with low speed of air and poor thermal radiation, mostly if there is also dehydration, hyperthermia can extend and cause a tendency to arrhythmias. This effect could be counterbalanced by a higher presence of circulating catecholamines. It is different in hyperthermia of infectious states, where catecholamines increase is not observed. We think that with the evidence available until the present time, the recommendation should be being cautious with letting patients practice competitive sports in BrS, since we don't have enough bibliography,

postures are conflicting, and intimate pathophysiologic mechanisms during exercise are not yet conveniently clear. On the other hand, from the ethic-legal point of view, we don't have a reply to protect appropriately the health of these patients and ourselves as physicians.

References

1. Antzelevitch C, Brugada R. Fever and Brugada syndrome. Pacing Clin Electrophysiol 2002; 25:1537-1539.
2. Nagatomo T, Fan Z, Ye B, Tonkovich GS, January CT, Kyle JW, Makielski JC. Temperature dependence of early and late currents in human cardiac wild-type and long Q-T DeltaKPQ Na+ channels. Am J Physiol 1998;275:H2016-H2024.
3. Gonzalez Rebollo JM, Hernandez Madrid A, et al. Recurrent ventricular fibrillation during a febrile illness in a patient with the Brugada syndrome. Rev Esp Cardiol 2000; 53:755-757
4. Saura D, Garcia-Alberola A, Carrillo P, Pascual D, Martinez-Sanchez J, Valdes M. Brugada-like electrocardiographic pattern induced by fever. Pacing Clin Electrophysiol. 2002; 25:856-859.
5. Dumaine R, Towbin JA, Brugada P, et al. Ionic mechanisms responsible for the electrocardiographic phenotype of the Brugada syndrome are temperature dependent. Circ Res 1999; 85:803-809.
6. Madle A, Kratochvil Z, Polivkova A. The Brugada syndrome Vnitr Lek. 2002; 48:255-258.
7. Ortega-Carnicer J, Benezet J, Ceres F. Fever-induced ST-segment elevation and T-wave alternans in a patient with Brugada syndrome. Resuscitation. 2003;57:315-317.
8. Nagatomo T, Fan Z, Ye B, Tonkovich GS, January CT, Kyle JW, Makielski JC. Temperature dependence of early and late currents in human cardiac wild-type and long Q-T DeltaKPQ Na+ channels. Am J Physiol 1998;275:H2016-H2024.
9. Morita H, Nagase S, Kusano K, Ohe T. Spontaneous T wave alternans and premature ventricular contractions during febrile illness in a patient with Brugada syndrome. Cardiovasc Electrophysiol. 2002; 13:816-818.

10. Porres JM, Brugada J, Urbistondo V, Garcia F, Reviejo K, Marco P. Fever unmasking the Brugada syndrome. Pacing Clin Electrophysiol. 2002; 25:1646-1648.Dinckal MH, Davutoglu V, Akdemir I, Soydinc S, Kirilmaz A, Aksoy M. Incessant monomorphic ventricular tachycardia during febrile illness in a patient with Brugada syndrome: fatal electrical storm. Europace. 2003; 5:257-261.
11. Kum LC, Fung JW, Sanderson JE. Brugada syndrome unmasked by febrile illness. Pacing Clin Electrophysiol. 2002; 25: 1660-1661.
12. Patruno N, Pontillo D, Achilli A, Ruggeri G, Critelli G.Electrocardiographic pattern of Brugada syndrome disclosed by a febrile illness: clinical and therapeutic implications. Europace. 2003; 5:251-255.
13. Wakita R, Watanabe I, Okumura Y, Yamada T, Takagi Y, Kofune T, Okubo K, Masaki R, Sugimura H, Oshikawa N, Saito S, Ozawa Y, Kanmatsuse K. Brugada-like Electrocardiographic Pattern Unmasked by Fever. Jpn Heart J. 2004; 45:163-167.
14. Guevara-Valdivia ME, Iturralde Torres P, de Micheli A, Colin Lizalde L, Medeiros Domingo A, Gonzalez-Hermosillo JA. Electrocardiographic changes during stress test in a patient with "Brugada syndrome" Arch Cardiol Mex. 2001; 71:66-72.
15. Guevara Valdivia ME. Iturralde Torres P, de Micheli A, Colín Lizalde L, González Hermosillo JA. Electrocardiographic alterations during exercise stress testing in the "Brugada Syndrome". SYMPOSIUM ABOUT THE BRUGADA SYNDROME: TEN YEARS OF HISTORY: 1992/2002.