Preparticipation screening in pediatric athletes. Should we be concerned about the PR interval?

Cribado preparticipativo de deportistas pediátricos. ¿Debería preocupar el intervalo PR?

To the Editor,

The PR interval is an important electrocardiogram (ECG) feature that reflects conduction through the atrioventricular (AV) node. Prolonged PR interval (or first-degree AV block) is a common—usually benign—ECG manifestation among athletes.[1,2] Less information is available on short PR interval, with no data in pediatric athletes. Nevertheless, this is an important question because, when associated with ventricular pre-excitation or with symptoms, this otherwise benign condition could be a cause of of concern, and should not be overlooked in pre-participation screening (PPS) programs.[3] We therefore aimed to determine the prevalence of PR alterations in pediatric athletes undergoing PPS.

The protocol conformed to the Declaration of Helsinki. We followed a single-center observational design. We studied athletes aged 5 to 16 years who attended a mandatory PPS launched by the Soccer Federation of Valencia (Spain) from August 2018 to June 2019. Twelve-lead ECG tracings were obtained following standard protocols using a portable PC-based ECG-12R electrocardiograph (Labtech Ltd, Debrecen, Hungary) and a specific software (Cardiospy v5.04.01, Labtech Ltd). First-degree AV block was defined as PR interval > 170 ms (for children aged < 12 years) or > 180 ms (for those aged ≥ 12 years), and short PR as PR interval < 90 ms (< 12 years) or < 95 ms (≥ 12 years).[4] We excluded rhythms other than sinus or respiratory sinus arrhythmia.

We studied 6307 children (mean ± standard deviation age, 11 ± 3 years; 100% Caucasian; 94% male; sports practice, 5.2 ± 2.6 h/wk.; regular sinus, 86.4% of total; sinus arrhythmia, 13.6%). The prevalence of first-degree AV block was 2.0% (95% confidence interval [95%CI], 1.6-2.3). No participant had a PR interval above the threshold criterion for pathological first-degree AV block in adult athletes (ie, > 400 ms) and none had a PR interval > 300 ms. In addition, no child with first-degree AV block had an associated pathological ECG change, and none had high-grade AV block. The prevalence of short PR was 0.6% (95%CI, 0.5-0.9). Nine participants were diagnosed with Wolff-Parkinson-White (WPW) syndrome, of whom 1 (2.5% of the subgroup) showed a short PR. Nevertheless, when we used adult criteria (ie, PR interval < 120 ms), 7 of the 9 children with WPW had a short PR (with PR interval = 120 ms in the other 2 children).

The main demographic and ECG characteristics of participants with abnormal PR duration did not essentially differ compared with those of their peers with normal ECG, except for QRS width (table 1). First-degree AV block was not associated with age, sex, hours of sports practice or other ECG characteristics (all $P > .1$), whereas children with a short PR were more likely to have a wider QRS (odds ratio, 1.07; 95%CI, 1.04-1.10; $P < .001$) (figure 1). These results remained unaltered after exclusion from the analyses of the 9 patients with WPW (data not shown).

This is the largest cohort of pediatric athletes undergoing PPS to date. Our findings suggest a low prevalence of first-degree AV block among Caucasian pediatric athletes, which is similar to and below previous values reported for Caucasian (1.1%) and African athletes (11.4%), respectively, aged 8 to 18 years.[2] An important finding of our study was the absence of pathological first-degree AV block when we used the cutoff for adults, 400 ms. In addition, there is scarce data on short PR in athletes, with only Parry-Williams et al.[5] reporting the prevalence of this condition (ie, 4.9%). Owing to the older age of the athletes studied by these authors (14-35 years) compared with our cohort, they used the adults' threshold to define short PR (ie, PR interval < 120 ms[1]) whereas here we used the criteria for the pediatric population (< 90 ms or < 95 ms for age < 12 years and ≥ 12 years, respectively). This could explain, at least partly, the higher prevalence of short PR in the study by Parry-Williams et al.[5]—if we applied adult criteria to our cohort, the prevalence of short PR would indeed increase to 16.3%.

Short PR is considered a benign condition and no further evaluation is recommended unless it is associated with ventricular pre-excitation or symptoms. In this regard, the prevalence of WPW syndrome found was very low and in agreement with previous data (0.14%).[6] Interestingly, when using pediatric criteria, as we did here, only 1 of the 9 children diagnosed with WPW syndrome had a short PR. This finding has not been reported previously, maybe because adult criteria for short PR (< 120 ms) have usually been applied to pediatric cohorts, thereby potentially overestimating the true prevalence of this condition. Indeed, in our study, PR interval was ≤ 120 ms in all the children with WPW. Therefore, in the presence of wide QRS complex and slurring of the QRS upslope, a diagnosis of WPW should not be discarded in children in the presence of a normal-for-age PR interval.

Table 1
Descriptive characteristics of study participants.

	Normal PR (n = 6144)	Short PR (n = 40)	1st degree AV block (n = 123)	*P*-value for group effect[a]
Age, y	11.2 ± 2.9	11.6 ± 2.8	11.1 ± 2.9	.646
Male sex, %	93.8	90.0	90.2	.169
Sports practice, h/wk^{-1}	5.2 ± 2.6	5.6 ± 2.5	5.3 ± 2.9	.625
Heart rate, bpm	80 ± 14	78 ± 16	80 ± 15	.633
QTc, ms	418 ± 17	416 ± 19	415 ± 18	.173
QTc in the upper limit, %[b]	4.9	7.5	5.7	.684
QRS, ms	93.5 ± 8.6	99.6 ± 15.3[d]	92.4 ± 8.3	< .001
Wide QRS, %[c]	0.7	10.0	0.0	< .001[e]

AV, atrioventricular.
Data are presented mean ± standard deviation. See text for definition of short PR and first-degree AV block.
[a] Statistical analyses were performed with a 1 -factor (ie, "group") ANOVA.
[b] Bazett's corrected QT (QTc) in the upper limit if QTc width ≥ 440 and < 470 ms (male) or ≥ 450 and < 480 ms (female).
[c] Wide or narrow QRS if QRS width ≥ or < 120 ms, respectively.
[d] $P < .001$ vs both normal PR and first-degree AV block in post hoc pairwise comparisons (Bonferroni test).
[e] Statistical analysis performed with chi-square test.

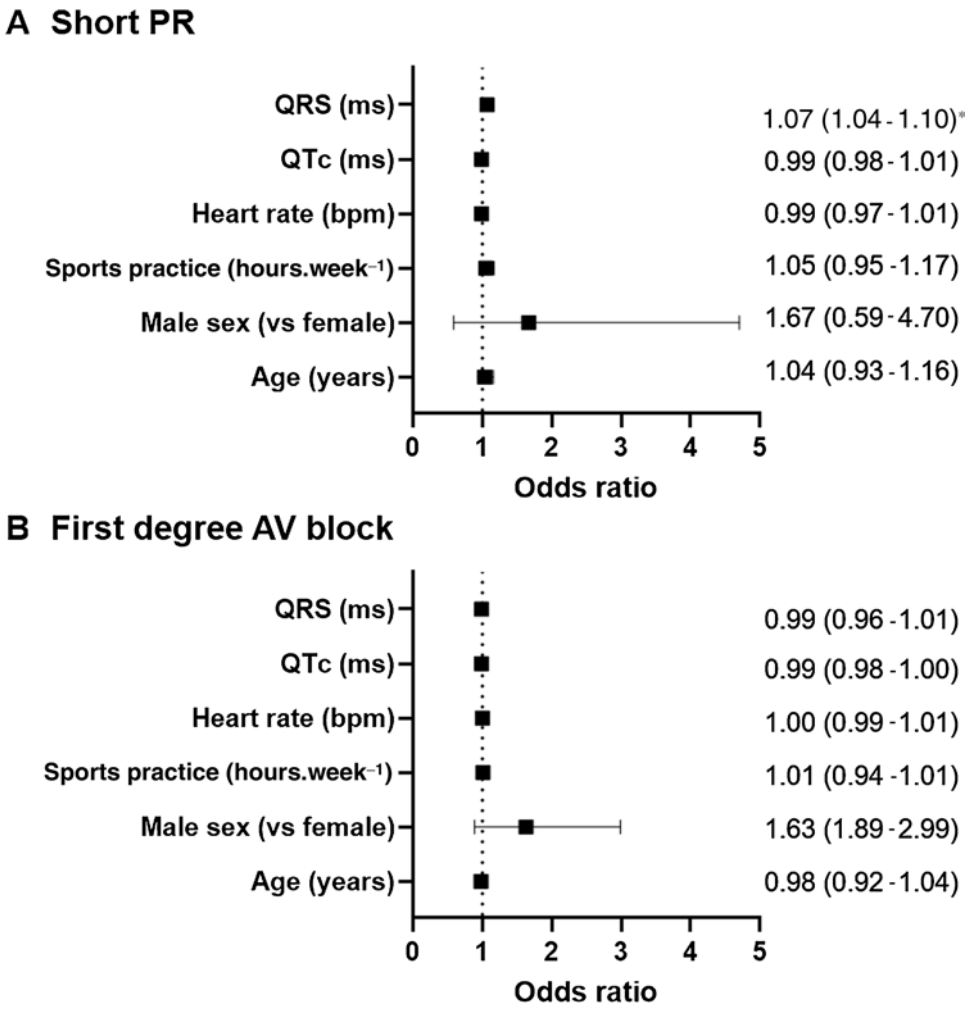

Figure 1. Associations found for short PR and first-degree AV block. AV, atrioventricular. * Significant differences were found.

In summary, PR interval abnormalities are overall neither prevalent nor pathological among pediatric athletes. It must be noted, however, that some children with a normal PR interval attending to age-standardized thresholds might present with a serious condition that needs careful consideration, WPW syndrome.

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AUTHORS' CONTRIBUTIONS

All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

CONFLICTS OF INTEREST

None.

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Middle cerebral artery stroke due to paradoxical embolism in a patient with COVID-19 pneumonia

Ictus de la arteria cerebral media por embolia paradójica en paciente con neumonía por COVID-19

To the Editor,

A 40-year-old woman was admitted to the intensive care unit due to pneumonia caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and subsequently experienced a stroke in the left middle cerebral artery. Cranial computed tomography (CT) showed focal occlusion of the M1 segment and, therefore, mechanical thrombectomy was performed. Lower limb ultrasound ruled out thrombosis. However, contrast-enhanced transthoracic echocardiography (TTE) with agitated saline solution, performed from the peripherally inserted central catheter (PICC) in the left cephalic vein, revealed a massive shunt to the left atrium (LA), with no obvious foramen ovale or interatrial defect. TTE showed direct passage of bubbles from the PICC to the LA, without passing through the right atrium (RA), indicating extracardiac shunt. There was no evidence of cardiac chamber or coronary sinus dilatation, interatrial defect, or *ostium secundum* in any of the venae cavae. Once the left-sided PICC line was removed, a contralateral PICC was inserted and the TTE was repeated. This time, the agitated saline serum remained only in the right chambers (figure 1, figure 2).

Stroke due to paradoxical embolism was suspected because of abnormal drainage of the venous system of the left arm to the LA. Hence, thoracic CT angiography was performed, revealing the presence of a vein originating in the left subclavian vein, draining a segmental pulmonary vein of the left upper lobe and the LA. Additionally, the innominate vein was severely stenotic, the coronary sinus was normal, and there were no defects between the latter and the LA. Consequently, the differential diagnosis included persistent left superior vena cava (PLSVC) and levoatriocardinal vein.

Diagnostic workup was completed with 72 hours of cardiac telemetry, which found no potentially emboligenic arrhythmia. Therefore, the etiology was considered to be paradoxical embolism, facilitated by the left-sided PICC line.

Paradoxical embolism can occur when a thrombus passes from venous to arterial circulation through a vascular or intracardiac defect.[1] Approximately 2% of acute arterial ischemia episodes are due to paradoxical embolisms (a rare cause of stroke). The intracardiac defect most often associated with this condition is patent foramen ovale.[2] Paradoxical embolism can also arise due to other conditions, such as systemic venous drainage abnormalities that produce right-to-left extracardiac shunting: pulmonary arteriovenous fistulae (Rendu-Osler disease), PLSVC drainage into the LA or a levoatriocardinal vein connecting pulmonary venous circulation (usually the left superior pulmonary vein), and systemic venous circulation (generally the left innominate vein).

The most common abnormality of systemic venous drainage is PLSVC, observed in 0.3% to 0.5% of the total population and 12% of

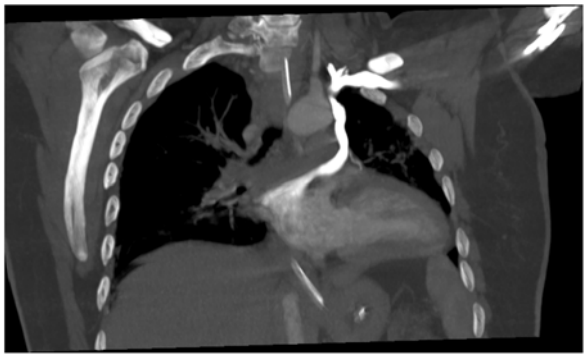

Figure 1. Contrast-enhanced computed tomography: venous system joined to the right superior pulmonary vein and the left atrium wall.

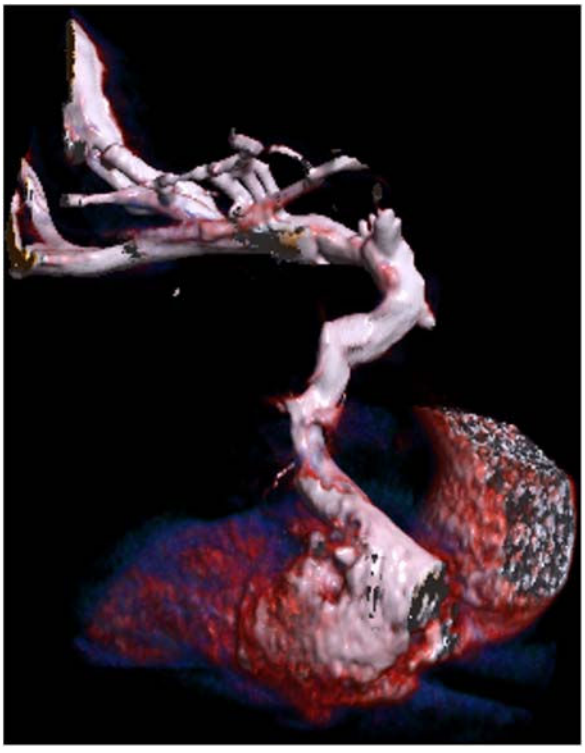

Figure 2. Three-dimensional reconstruction (anterior view).