Peripheral arterial systolic-diastolic velocities in athletes and non-athletes by Doppler ultrasound

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ABSTRACT

Intensive sports practice can result in negative consequences. Although the exercise is considered a benefit to the well-being and health of the human being. The form and intensity with which it is practiced can cause negative changes, namely at vascular level, such as changes in the wall and vascular hemodynamic, traumatic injuries, etc. Evaluate the relationship between arterial flow velocities of the lower limbs and the practice of intensive exercise through arterial Doppler ultrasound. Cross-sectional analytical study using arterial Doppler ultrasound of the lower limbs in 76 male subjects, 38 athletes and 38 non-athletes aged 18 to 30 years. The sample was collected over a period of six months in two football clubs in the central region. The mean age was 26 ± 1.8 years for non-athletes and 24 ± 2.79 years for athletes. There is no statistically significant relationship ($p = 0.553$) between smoking habits and if they are athletes our non-athletes. Regarding the results of the parameters evaluated by Doppler ultrasound the mean of the arterial resistance indices and mean of the systolic and diastolic velocities between the athletes and non-athletes, there were significant variations in some arteries. In this studied sample there is a greater predisposition for athletes to develop small arterial alterations of the lower limbs, however, they are not hemodynamic significant.
Keywords: Arteries; Athletes; Doppler; Ultrasound; Velocity.

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INTRODUCTION

In general, all vascular risk factors affect and cause changes in the vascular wall, but each has a different degree and form of influence. In particular, we emphasize the modifiable risk factors that are associated with lifestyle, where exercise practice is usually a positive contribution due to good vasoconstriction during exercise and good post-exercise vasodilation. But in some particular situations intensive practice has negative effects. For example increased blood pressure during exercise increases the friction between the blood and the arterial wall, which can lead to a weakening of the wall and the formation of aneurysm in the long term. Fistula formation may also occur, aneurysms, occlusions or stenoses, embolism, etc. (Blomqvist and Saltin, 1983) In order to be able to evaluate the morphology and flow dynamics in the main arteries of the lower limbs, there are diagnostic tests, such as peripheral arterial Doppler ultrasound.

MATERIAL AND METHODS

An analytical cross-sectional study was performed on a sample of athletes and non-athletes, using lower limbs arterial Doppler ultrasound and filling a questionnaire related to sports and smoking habits. The sample was collected for six months at two football clubs in the central region.

Participants

After applying the defined inclusion criteria (male individuals athletes and/or non-athletes, aged between 18 and 30 years who accepted participate in the study and performed lower limbs arterial Doppler ultrasound), a sample was obtained with 76 individuals males being 38 athletes and 38 non-athletes aged between 18 and 30 years. The mean age for non-athletes were 26 ± 1.8 years and 24 ± 2.79 years for athletes.

Measures

To perform the Doppler ultrasound besides the physical space it was necessary an ultrasound technician and ultrasound with 7-12MHrz linear probe. In the peripheral arterial exam, three techniques were applied: ultrasound, pulsed Doppler and colour coded Doppler allowing visualizing the arterial lumen, to evaluate the Doppler spectrum morphology, measure the systolic (SV) and diastolic (DV) flow velocity and measure the resistance index (RI). Conventional recommendations were used to perform the tests and analyse their criteria according to Thrush and Hartshorne (1999).

Procedures

Individuals who practiced three times or more sports for week were considered athletes and individuals who did not practice once a week were considered non-athletes. A questionnaire and information of vascular risk factors, physical activity, number of exercise times and peripheral arterial Doppler ultrasound results, namely SV and DV in cm/s and RI of eight arteries in all individuals, were applied: common femoral arteries (CFA), superficial femoral arteries (SFA), deep femoral arteries (DFA) and popliteal arteries (PA).

Analysis

Statistical analysis was performed using the statistical software program Statistical Package for the Social Sciences (SPSS Statistics® version 22). The normality of the sample was verified through the Shapiro-Wilk test. The Chi-square test was performed in conjunction with the Fisher's exact test to correlate the smoking habits with athlete/non-athlete, Student-T and Mann-Whitney tests were performed to verify if there were significant differences between the two groups regarding RI, SV and DV of the arteries of the lower limbs.

RESULTS

Although there were more non-athletes (19 smokers) who smokes than athletes (15 smokers) and there was no significance (Fisher's p=0.553). Of the arteries studied, the relationship between arterial IR and athlete's or non-athlete was only statistically significant in the left DFA (p=0.002) and left PA (p=0.003). Regarding velocities: the arterial SV is higher in athletes in all arteries with the exception of left PFA. The highest SV in athletes and non-athletes was in the right SFA (136cm/s) in the athletes and left CFA (121cm/s) in the non-athletes and the lowest SV were in the PA (36cm/s on the left in athletes and 29.3cm/s on the right in non-athletes). However, between the SV and the athlete or non-athlete, only significant differences were found in the VS of the left CFA (p=0.041); DV is also higher in all arteries in athletes. The highest DV in the athletes and non-athletes was in the left CFA (33.4cm/s) in the athletes and in the left SFA (30.7cm/s) in the non-athletes, as the minimum DV was in the PFA (6.5cm/s left on athletes and 2.4cm/s on right non athletes). However, there was a statistically significant difference between the DV and the athlete in the left CFA (p=0.013), the right PFA (0.004) and the right PA (p=0.024).

DISCUSSION

Investigations in this area refer that pathological alterations suffered by the practice of high-level physical exercise, together with vascular risk factors potentiate its appearance. Smoking habits were studied, which did not reveal a correlation with being an athlete or non-athlete. According to Gaspar de Matos et al. (2003) young people who practice more physical activity report that they have tried but don't smoke regularly and young people who do not practice regular physical activity smoke regularly.

Regarding Doppler ultrasound results, there were no statistically significant differences in almost all studied arteries. Stebbings and Morse (2013) in a study that performed between two groups (trained and control) did not observe changes in the RI of the control group over time. Considering that athletes have larger diameters, it is normal to have an adjusted arterial RI (lower), according to the Poiseuille equation, the increase in arterial diameter causes a decrease in the resistance to the passage of blood flow, they are inversely proportional. There were also no statistically significant differences between the SV and DV in the athlete or not, in the great majority of the arteries. However, there were slight differences in SV and DV (within normal values) between the two groups, being slightly higher in the athletes. Which is accord to Schep and Bender (2001) (2002) who found significantly higher SV in athletes in reference limbs. Brum and Negrão (2004), in a study about acute and chronic physical exercise adaptations in the cardiovascular system, mention Forjaz and Tinucci (2000), who say that in dynamic exercises, as contractions are followed by joint movements, there is no mechanical obstruction of the blood flow, observing an increase of the sympathetic nervous activity, which is triggered by the activation of the central command, muscular mechanoreceptors and, depending on the intensity of the exercise, muscle metaboreceptors. In response to increased sympathetic activity, heart rate, systolic volume, cardiac output, and consequently flow velocities increase. In addition, the production of muscle metabolites promotes vasodilatation in the active musculature, generating a reduction in peripheral vascular resistance. In this way, the authors support the present study, because in the athletes the vascular resistances are smaller and the speeds higher than in the non-athletes (Forjaz and Tinucci, 2000). However, there are studies such as Currie, Thomas and Goodman (2009), where the authors point out that the changes caused by exercise are variable and can vary mainly with the type of exercise, the intensity, the time of practice.

CONCLUSIONS

The practice of exercise may lead to small variations in the lower limb arteries, which are related to the adaptation that the vascular network suffers from the conditions imposed by the practice of the sport, varying with the time practiced and the intensity.

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