ANALYSIS OF THE ACUTE INFLAMMATORY RESPONSE PRODUCED DURING THE GAME OF PADEL

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ORIGINAL SCIENTIFIC ARTICLE

Abstract: There is a multitude of scientific evidence that shows that the practice of physical activity is very beneficial for health. One of its benefits is the maintenance of the immune system. Currently one of the most popular sports in Spain is padel. However, despite the significant increase in people who practice it, there is no scientific evidence to describe the effects produced by padel on the body. The objective of this study was to investigate the acute inflammatory response of a padel match. A total of 29 professional players, 15 men (28.2 ± 7.9 years) and 14 women (29.7 ± 3.7 years), participated voluntarily in the study. Different pro-inflammatory (TNFα and IL-8) and anti-inflammatory cytokines (IL-10 and IL-13) were analyzed before and after a match. The results showed a decrease in IL-8 ($p < 0.03$) and increases in IL-13 ($p < 0.05$) in both sexes and IL-10 in men. The results obtained suggest that the practice of high-level padel induces a moderate pro-inflammatory response. The sport of padel could be considered as a sport beneficial to health.

Key words: racquet sports. cytokynes, interleukins, inflammation, immune system

INTRODUCTION

The physical sports practice carried out regularly but with moderate intensity, carries multiple physiological benefits, behaving as an effective immunomodulation mechanism, since it facilitates the immunological function and increases the resistance to infections (Strauss et al., 1994). However, the performance of strenuous exercise and sports activities, of high intensity, without proper rest, etc., is closely related to the pathogenesis of various muscle injuries and to a generalized state of inflammation (Reighlin, 1993), which in exaggerated acute phase, can even lead to immunosuppression, with results and physiological responses that can not only decrease and significantly affect athletic performance, but can even compromise the health of the athlete.

The immunosuppression produced by very stressful sports activities produces, as a more relevant consequence, an elevation of the levels of proinflammatory cytokines, such as interleukin 1 (IL-1), IL-6 and tumor necrosis

factor alpha (TNFα) (Cordova er al., 2006), although there are many more factors that can modify the function of the immune system (Sigal & Ron, 1994).

Low performance, as a result of a higher than usual requirement, to maintain a certain level of intensity can be due to different causes. It could simply be a transient decrease in the working capacity of the skeletal muscle during the sporting activity itself (Asmussen, 1993), or an acute inability to maintain a certain physical performance, either by not being able to maintain the intensity of the effort (Edwards, 1981), or to see diminished the capacity to generate force (Vollestad & Sejersted, 1988) and maintain an appropriate gestural technique, for example.

This decrease in yield could be derived from an intensification of the organic response of certain immunological markers (Padilla et al., 1997). Taking these arguments into consideration, it is easy to understand the need and importance of controlling all those metabolic and immunological variables that may alter sports performance.

In general, intense exercise induces transitory inflammatory responses, especially in the muscles most requested to withstand some impact and stress, participating in muscle repair processes. However, the repetition of intense and acute inflammatory reactions, caused by excessive daily loads of training or several days of high competition, can provoke a local inflammatory affectation of chronic character that can cause muscle aches, overloads and an important decrease of the physical performance.

As a consequence the intensity of the local inflammatory response is proportional to the muscle damage caused by sports physical activity, it is evident that excessive loads that cause muscle damage elevate the intensity of the inflammation to a degree where it can have systemic repercussions on the body of the athlete. This systemic involvement is an acute phase response to inflammation, which if intense and maintained for a period of time, can alter the immunological capacity of the athlete, generating immunosuppression situations that lead to an increase in susceptibility to infection, decreased performance and even put at risk the health of the athlete (Pedersen, 1997).

The evidence found shows that the performance of strenuous exercise is closely related to the development of muscle injuries and a systemic state of inflammation (Reighlin, 1993). This immunosuppression is almost identical to that generated in disease states and is associated with activation, elevation and communication of mediators called cytokines, which can be of two types, pro and anti-inflammatory (Zuber, 2011).

At a molecular level, cytokines are proteins. Its function in the body is to coordinate the response of the immune system by recruiting or inhibiting the functions of specific cells such as neutrophils. Cytokines can be divided into several groups, depending on their activation context, the class of cells that produce them, etc. Among others, we can highlight the importance of IL (IL-1, IL-2, etc.), TNF and chemokines (IL-8) (Dinarello, 2007).

The practice of a sport, if produced at high intensities and maintained over time, causes tissue damage, especially due to repetitive micro traumas and the increase in the production of free radicals as a result of an increase in the consumption of oxygen (Leeuwenburg et al., 1994), causing an inflammatory state, with increased production of neutrophils and even proinflammatory cytokines such

as IL-1, IL-6 and TNFα (Koning et al., 2000; Macintyre et al., 2001), cytokines closely related to inflammation and muscle damage induced by exercise, as can be seen from the data obtained in muscle biopsies (Córdova et al., 2006). Cytokines are, therefore, the basis of the immune response.

Padel is an intermittent racket sport that is played in pairs on a small artificial grass court (20 x 10 m) surrounded by glass walls and metal meshes, on which the balls bounce (Castillo-Rodríguez et al., 2014). Padel has now become one of the sports preferences of both genders in Spain, growing significantly in the rest of the world (Courel-Ibáñez et al., 2019). However, although the practice of paddle tennis continues to increase, there is a significant information gap on its impact on the health of players. According to the reviewed scientific literature, there are not many studies that address the physiological and health-related effects of high-level padel. A recent study shows that high-level padel competition causes a significant increase in biomarkers of muscle damage (for example, creatine kinase), as well as marked decreases in blood electrolyte concentrations (Pradas et al., 2020).

Taking into account the importance of the immunological markers described for the health and performance of athletes, it is of interest to evaluate and control them, since they allow a very exhaustive way to know and quantify the effort produced by a given load and its impact on the organism. In this sense, the objective of this study was to investigate the acute inflammatory response of a padel match.

METHODS

A group of high level padel players, 15 men (28.2 ± 7.9 years) and 14 women (29.7 ± 3.7 years), participated voluntarily in the study. The players selected to be part of this investigation regularly disputed national, international and / or professional competitions. The show is characterized by being a very homogeneous group of athletes, with common sports objectives and similar training.

Before starting the study, the athletes were verbally informed of the objective, procedure to follow as well as the risks and benefits of their participation. All athletes signed an informed written consent. The research was approved by the Clinical Research Ethics Committee of the Department of Health and Consumption of the Government of Aragon (Spain), following the guidelines of the Declaration of Helsinki.

To perform the immunological study based on the production of pro (IL-8 and TNFα) and anti-inflammatory cytokines (IL-10 and IL-13), two blood samples (pre and post) of 10 ml were taken in test tubes, containing 35 micro-moles of EDTA 2K+ and 1500 IU of the kallikrein inactivator. The tubes were kept on ice until centrifuged at 2150 rpm for 15 minutes at 4° C. The aliquots of the plasma were separated and stored at -80° C. The analysis technique used was by enzyme-linked immunosorbent assay with the ELISA method.

RESULTS

The analysis of the results has been carried out using SPSS 22.0 software (IBM Corp, Armonk, United States), using descriptive, inferential and normality statistical tests to calculate means, standard deviations and confidence intervals. First, the normality of the sample was determined through the Shapiro-Wilk test. When the normality hypothesis was not met, the nonparametric Wilcoxon test was performed

as an inferential test to analyze the pre-post differences of the variables. The criterion of significance was established at p <0.05. Table 1 shows the general characteristics of the sample participating in the research.

Table 1. Characteristics of the sample (mean ± standard deviation)

Variable	Men	Women
Age (years)	28.2 (±7.9)	29.7 (±3.7)
Body mass (k)	78.2 (±8.5)	60.3 (±4.4)
Height (cm)	178.3 (±4.4)	166.7 (±5.1)
Fat mass (%)	10.6 (±2.5)	17.6 (±2.7)
Sports experience (years)	7.3 (±3.3)	7.8 (±3.4)
Weekly training (hours)	8.1 (±0.3)	11.2 (±3.1)

Table 2 shows the immunological markers analyzed. A greater anti-inflammatory response is seen in men than in women, with a significant increase in the two cytokines studied. The proinflammatory response, however, has been similar in both sexes, increasing the two cytokines selected for this investigation, although significantly only IL-8 (p <0.03).

Table 2. Immunological markers (mean ± standard deviation)

Marker	Men		Women	
	Pre	Post	Pre	Post
PROINFLAMATORIES				
IL-8 (pg.ml^{-1})	0.6 (±0.2)	0.5 (±0.7)$^{+}$	1.3 (±1.0)	0.8 (±0.3)$^{+}$
TNFα (pg.ml^{-1})	0.7 (±0.1)	0.9 (±0.5)	0.4 (±0.0)	0.6 (±0.6)
ANTI-INFLAMMATORY				
IL-10 (pg.ml^{-1})	2.3 (±2.4)	202.8 (±27.1)*	4.2 (±2.6)	240.5 (±46.1)
IL-13 (pg.ml^{-1})	0.6 (±0.7)	0.9 (±0.3)*	0.4 (±0.5)	0.9 (±0.5)*

$^{+}$ $p<0.03$; * $p<0.05$

DISCUSSION

To observe if an organic response of inflammation existed, two cytokines, IL-8 and TNFα, have been analyzed, both being considered as the two most relevant ones with a proinflammatory character (Filella et al., 2002).

The acute response in both sexes of TNFα to padel competition has been to increase with respect to basal levels, not significantly, observing only a moderate increase, in a similar way to that found in other investigations (Pedersen, 2011). The slight increase in this cytokine may be due to the duration and intensity of the competition (Scott et al., 2011), probably related to the eccentric character of the game actions that occur in this sport (Pradas et al., 2014), suggesting this rise of TNFα a defense measure against the stress produced by the padel competition.

It has been demonstrated that intense and prolonged exercise causes changes in the immune system (Pedersen & Hoffman-Goetz, 2000), increasing, among others, the levels of IL-8 (Nieman, 1987), finding this increase in proinflammatory cytokines. associated with mild muscle damage.

However, the most relevant in this research has been the very significant decrease in IL-8 in both male and female players. This data shows the aerobic nature of paddle, with efforts of moderate intensity, which do not reach high levels to trigger a true acute inflammatory process (Krüger & Mooren, 2014), but quite the opposite, since there is a protective effect derived from the rise of anti-inflammatory cytokines, which induces that the metabolic response to this type of sport is organically stable, allowing to maintain a greater sport performance to the players (Witek et al., 2016).

The anti-inflammatory cytokines studied have increased significantly in both sexes, however, in the case of male players, both cytokines are significantly increased (IL-10 and IL-13), and only one interleukin in women, specifically the IL-13, although IL-10 has also suffered a significant increase, similar to what happened in the sport of tennis (Witek et al., 2016), probably stimulated by muscle contraction, related as an inhibition response of TNFα (Tilg et al., 1997).

These results are in line with other studies, where an anti-inflammatory response is showed (Pedersen, 2011), more pronounced, in our case, in men compared to women, showing that the game developed in padel is different depending on the gender, being the masculine one of greater intensity in his efforts than the feminine one (Sánchez-Alcaraz, 2014; Pradas et al., 2016).

CONCLUSIONS

The slight increase of the proinflammatory cytokine TNFα together with the important decrease in IL-8 is a positive balance in the padel towards the anti-inflammatory response of the organism during the practice of padel. The increase of the anti-inflammatory interleukins IL-10 and IL-13 makes it possible to affirm that the practice of paddleball can be considered as a physical activity beneficial to health due to its protective effect. In addition, proinflammatory and the anti-inflammatory cytokine response showed an interesting association that needs to be studied in future research.

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