ANALYSIS OF THE IMMUNE RESPONSE IN PADEL

María Pía Cádiz Gallardo¹, Castellar Otín Carlos², Carrasco Páez Luis³, and Pradas De La Fuente Francisco²

¹Faculty of Education. University San Sebastián, Chile
²Faculty of Health and Sports Sciences. University of Zaragoza, Spain
³Faculty of Education Sciences. University of Sevilla, Spain

SUMMARY

High intensity exercise and sports activities are closely related to a general state of inflammation that can lead to immunosuppression. This physiological response could decrease sports performance and even compromise the athlete’s health. The objective of this study was to investigate the acute inflammatory response of a padel match. 15 elite players (28.2±7.9 years) participated voluntarily in the study. Different pro-inflammatory (IL-1ß, IL-2, IL-6, IL-7, IL-8, IL-12 and TNFα) and anti-inflammatory cytokines (IL-5, IL-10 and IL-13) were analyzed before and after a match. The results showed a decrease in IL-7 (p=0.007) and IL-8 (p<0.03) and increases in IL-10 (p<0.04). The results obtained suggest that the practice of high-level padel induces an anti-inflammatory response.

Key words: racket sports, inflammation, cytokines, interleukins, immunoassay.

INTRODUCTION

The performance of strenuous exercise and sports activities, of high intensity, without proper rest, etc., is closely linked 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 generated by very stressful sports activities produces, as a more relevant consequence, an elevation of pro-inflammatory cytokines levels, such as interleukin 1 (IL-1), IL-6 and tumor necrosis factor alpha (TNFα) (Cordova, Montserrat, Villa, Reyes & Álvarez-Mon, 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 by a diminished 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, Cuesta & Polo, 1997). Taking these arguments into consideration, it is easy to understand the need for 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 chronic local inflammatory affection 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, 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 the athlete's health in risk (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
沟通的介质被称为细胞因子，可以分为两种类型：促炎和抗炎（Zuber, 2011）。

在分子水平上，细胞因子是蛋白质。它们在体内的功能是协调免疫系统的反应，通过招募或抑制特定细胞，如中性粒细胞的功能。细胞因子可以分为几个组，取决于它们激活的上下文，生产它们的细胞类等。其中，我们强调IL（IL-1，IL-2等），TNF和chemokines（IL-8）（Dinarello，2007）的重要性。

运动的实践，如果以高强度并持续时间，会导致组织损伤，尤其是由于重复的微创伤和氧气消耗的增加导致的自由基的增加（Leeuwenburg, Fiebig, Chndwaney & Ji, 1994），导致炎症状态，导致中性粒细胞的增加，甚至促炎细胞因子如IL-1, IL-6和TNFα（Koning, Gratthwohl, Weinstock, Northoff & Berg, 2000; Macintyre, Sorichter, Mair, Berg & Mc Kenzie, 2001），这些细胞因子与由运动引起的炎症和肌肉损伤密切相关，如从肌肉活检数据中可以观察到（Córdova et al., 2006）。细胞因子是免疫反应的基础。

考虑到描述的免疫学标志对运动员的健康和表现的重要性，评估和控制它们是很有意义的，因为它们可以提供非常详尽的方式来了解和量化所施加的负荷及其对机体的影响。在这种意义上，这项研究的目的是调查保龄球比赛的急性炎症反应。

**METHODOLOGY**

一个由高水平保龄球运动员组成的小组，15名（28.2 ± 7.9岁），自愿参与了这项研究。这些玩家被选中参与这项研究，定期参加全国、国际和/或职业比赛。该小组的特点是运动员的目标和训练非常相似。

在开始研究之前，运动员们口头上被告知研究的目的、程序以及其参与的风险和利益。所有运动员都签署了知情同意书。研究得到了阿伦西亚政府卫生和消费部伦理研究委员会的批准，遵循了赫尔辛基宣言的指南。

为了进行基于促炎（IL-1β, IL-2, IL-6, IL-7, IL-8, IL-12和TNFα）和抗炎细胞因子（IL-5, IL-10和IL-13）的免疫学研究，从10ml试管中分别取了两次血液样本（前和后）。
containing 35 micro-moles of EDTA 2K+ and 1500 IU of the kallikrein inactivator. The tubes were refrigerated until centrifuged at 2150 rpm for 15 min at 4°C. The plasma aliquots 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. Characteristics of the sample (mean ± standard deviation)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>28.2 (±7.9)</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>78.2 (±8.5)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178.3 (±4.4)</td>
</tr>
<tr>
<td>Fat mass (%)</td>
<td>10.6 (±2.5)</td>
</tr>
<tr>
<td>Sports experience (years)</td>
<td>7.3 (±3.3)</td>
</tr>
<tr>
<td>Weekly training (hours)</td>
<td>8.1 (±0.3)</td>
</tr>
</tbody>
</table>

Table 2. Immunological markers analyzed (mean ± standard deviation)

<table>
<thead>
<tr>
<th></th>
<th>PRO-INFLAMMATORY (pg.ml⁻¹)</th>
<th>ANTI-INFLAMMATORY (pg.ml⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>IL-1ß</td>
<td>0.2 (±0.2)</td>
<td>2.6 (±3.2)</td>
</tr>
<tr>
<td>IL-2</td>
<td>0.5 (±0.6)</td>
<td>4.2 (±4.4)</td>
</tr>
<tr>
<td>IL-6</td>
<td>0.2 (±0.0)</td>
<td>0.6 (±0.9)</td>
</tr>
<tr>
<td>IL-7</td>
<td>22.5 (±18.7)</td>
<td>0.2 (±0.3)</td>
</tr>
<tr>
<td>IL-8</td>
<td>0.6 (±0.2)</td>
<td>0.5 (±0.7)</td>
</tr>
<tr>
<td>IL-12</td>
<td>0.6 (±0.6)</td>
<td>9.4 (±1.2)</td>
</tr>
<tr>
<td>TNFα</td>
<td>0.7 (±0.1)</td>
<td>0.9 (±0.5)</td>
</tr>
</tbody>
</table>
DISCUSSION

In order 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 pro-inflammatory character (Filella, Molina & Ballesta, 2002).

The acute TNFα response to a padel competition was not very significant. There was an increase above the basal levels, but only moderate, just as found in previous studies (Pedersen, 2011). The slight increase in this cytokine may be due to the duration and intensity of the competition (Scott et al., 2011), and may be related to the eccentric nature of the game actions that occur in this sport (Pradas et al., 2014). This suggests that the rise of TNFα might be 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). This increase in pro-inflammatory cytokines has been associated with mild muscle damage.

However, the most relevant in this research has been the very significant decrease in IL-7 and IL-8. This data shows the aerobic nature of padel, with efforts of moderate intensity (Pradas et al., 2014), which do not reach high enough levels to trigger a true acute inflammatory process (Krüger & Mooren, 2014). In fact, the situation is quite the opposite, since there is a protective effect derived from the rise of anti-inflammatory cytokines, which induces an organically stable metabolic response to this type of sport, allowing to maintain a greater sport performance to the players (Witek et al., 2016).

The anti-inflammatory cytokines studied have increased significantly (IL-10), similar to what happened in the sport of tennis (Witek et al., 2016). This is probably stimulated by muscle contraction, related as an inhibition response of TNFα (Tilg, Dinarello & Mier, 1997). These results coincide with other studies in which an anti-inflammatory response is showed (Pedersen, 2011).

CONCLUSIONS

The slight increase of the pro-inflammatory 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 this sport.

The increase of the anti-inflammatory interleukins IL-10 and IL-13 makes it possible to affirm that the practice of padel can be considered as a health-enhancing physical activity due to its protective effect.
REFERENCES

АНАЛИЗ ИММУННОГО ОТВЕТА В ПАДЕЛЕ

АННОТАЦИЯ

Высокоинтенсивные физические нагрузки и занятия спортом тесно связаны с общим состоянием воспаления, которое может привести к иммуносупрессии. Такая физиологическая реакция может снизить спортивные результаты и даже поставить под угрозу здоровье спортсмена. Целью данного исследования было изучить острый воспалительный ответ на матч по паделю. В исследовании добровольно приняли участие 15 элитных игроков (28,2±7,9 лет). Различные провоспалительные (IL-1β, IL-2, IL-7, IL-8, IL-12 и TNFα) и противовоспалительные цитокины (IL-5, IL-10 и IL-13) были проанализированы до и после матча. Результаты показали снижение IL-7 (p=0,007) и IL-8 (p<0,03) и повышение IL-10 (p<0,04). Полученные результаты свидетельствуют о том, что занятия паделом на высоком уровне вызывают противовоспалительный ответ.

Ключевые слова: спорт с ракетками, воспаление, цитокины, интерлейкины, иммуноферментный анализ.

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