APARELHO LOCOMOTOR
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INCIDENCE OF NONTRAUMATIC MUSCULOSKELETAL INJURIES IN HANDBALL ATHLETES

ARTIGO ORIGINAL

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ABSTRACT

Competitive athletes often present musculoskeletal injuries, some of these nontraumatic. Usually these injuries are attributed to mechanical factors. The present study aimed to investigate a group of handball players and check a possible action of immune-inflammatory and hormonal factors in the genesis of these lesions. Laboratory parameters were studied measuring in the plasma the concentration of plasma hormones and neurotransmitters, and production "in vitro" of cytokines and prostaglandin E2. The results indicate that in 29% of the athletes included in the study the occurrence of nontraumatic musculoskeletal injuries was observed. In this group there was an increased production of pro-inflammatory cytokines assayed in the supernatant of culture of peripheral blood cells with increased concentrations of IL-1, IL-2, TNF-α and IFN-α, as well of prostaglandin E2.

Keywords: cytokines, sports, nontraumatic injuries.

INTRODUCTION

Overload of the musculoskeletal system is intrinsic to sports practice and within physiological thersholds, there is a compensation. However, excessive or miscompensated overload hampers a suitable rebalance process, leading to disorganization of the system causing injuries[1]. These injuries are classified as nontraumatic or injuries by excessive use (overuse syndromes) which, when causing microtrauma by the application of shear stress will be compensated until this additional stress results in injury[2]. The decreased contractibility of fatigued muscles limits their capacity to absorb shock and stress[1]. Training volume is also mentioned as cause of this kind of injury [2], being suggested that in runners there is a direct relation between mileage and onset of this kind of trauma.

Hill *et al.*[3], in a study in which they followed female softball players for a two-year period, showed that more than 70% of the athletes presented musculoskeletal injuries and that 70% of these were related to injury mechanisms by overtraining, demonstrating the importance of this mechanism. Other factors were mentioned by Ekstrand *et al.*[4], who, when following the national Sweden soccer senior team for seven years, found out that injury incidence was five times higher after competitive matches when compared with training. It has also been demonstrated that the number of injuries significantly increased when the team lost the games, suggesting that non-mechanical factors could be involved in the genesis of nontraumatic injuries.

Small[5] observed that 80% of the complaints reported in sports medicine clinics referred to pain and that in the absence of trauma, fibromyalgia[6] was one of the main causes associated to pain triggering. Cramer[7] also suggests that athletes can present a situation similar to the chronic fatigue syndrome and that these can be associated with the onset of musculoskeletal injury. This author highlights the need to distance viral pathology, stress, depression or exposure to environmental toxin[8]. When observing athletes, Vaisberg *et al.*[9] observed that complaints of muscular pain occur in high proportion in track and field and Olympic gymnastics practitioners, as well as the need for winning as an important factor related to the development of anguish which was clearly associated with pain complaint[10].

Ader and Cohen[11] and Besedovsky *et al.*[12], in the 1970's, experimentally demonstrated the close functional relation between the neuroendocrine and immunological systems, which enabled an integrated view of the homeostatic mechanisms of the human body, providing physiopathological grounding which explain as alterations of psychological nature such as stress, anxiety and depression present association with greater incidence of sports injuries without trauma.

Recently, many studies in experimental models and humans demonstrated that psychological stress stimulates the production of pro-inflammatory cytokines[17-19]. Black[20], in extensive review on the topic, shows that, in response to the psychological stress, an inflammatory process occurs by the release by sensory nerves of neuropeptides. The lipids release which occurs in response to stress is an additional factor for activation of macrophages and release of cytokines[21]. Therefore, the activation of the inflammatory process by the central nervous system helps to understand how a psychological process may cause through mediation of pro-inflammatory cytokines and oxygen and nitrogen intermediate reactives muscle, tendon and bursa injuries, in the absence of physical trauma[22].

The present study had the aim to verify the incidence of musculoskeletal injury without trauma in handball athletes relating its incidence to the production of cytokines and neurotransmitters.

METHODOLOGY

Sample

The experimental protocol was approved by the Ethics Committee of the Institute of Biomedical Sciences of the University

of São Paulo. All subjects were informed about the aims and risks of the study, and their informed consent was obtained in a free and clear way, according to resolution 196/96 from the National Health Board.

59 handball athletes, mean age of 31.9 ± 4.2 years, engaged in regular competitions and not presenting symptoms of acute infection or trauma were studied in the present study. The blood samples (20ml) were collected from an antecubital vein with the individuals at sitting position, before the training session (09:00h a.m.), after a minimum period of eight hours at fasting and 20 hours from the last training session, for analysis of cytokines production by mononuclear cells of the peripheral blood, and determination of the hormone and neurotransmitter concentration.

Clinical Assessment

Evaluation of injury without trauma occurred with analysis of the athletes' medical records, being considered as injury without trauma patients those who visited the infirmary at least twice a month for six consecutive months, with complaint of injury in the soft tissues (muscles, tendons and bursas), without apparent trauma. Based on that evaluation, the athletes were divided in two groups: injury without trauma – repetitive stress injury (RSI) and athletes without repetitive injury (WI). As supporting instrument for evaluation of muscular pain, the athletes were submitted to clinical assessment following criteria by the American College of Rheumatology[6], validated for the Brazilian population[23], using the discomfort criterion through application of force of 4kg/cm^2 on the spot proposed as fibromyalgia triggering-spots, a condition associated with chronic pain. Such instrument was used due to report by Small, relating chronic pain of the athlete with fibromyalgia[5]. The clinical evaluation was performed by an experienced rheumatologist.

Hormone and neurotransmitter plasma concentration

Each 10ml blood sample was transferred to a glass tube containing 5ml of heparin (500IU/ml). The tubes were kept in ice until centrifugation at 960xg per 8min. The plasma concentration of cortisol, prolactin and growth hormone (GH) was measured by radioimmunoassay (commercial kit AIA-PACK, Medics Tosoh, Inc.). Adrenalin, dopamine, noradrenalin and L-dopa plasma levels were determined by high-performance liquid chromatography (HPLC), with electrochemical detection[24]. The chromatographic system (Shimadzu) was composed of a LC-10AD pump vp isocratic HPLC, a C18, RP 18 Brownlee 4.6 x 250mm of spherical 5ml, a steel column (Millipore Co), and an electrochemical detector L-ECD-6A operated in DC mode, controlled by the Shimadzu CLASS-VP software through a system interface module. The samples were eluded with a mixture: 20mM dibasic sodium; 20mM phosphate, in citric acid of pH 2.64 and 10% of methanol, Na_2EDTA 0.12mM and 566mg/L of heptane sulphonic acid.

Determination of cytokines production

The total blood cells were plated (1.0 x 106 cells/ml) in plastic Petri dishes RPMI 1624 (medium enriched with glutamine 02mM, streptomycin 2.5mg/ml and penicillin 2.5UI/ml). After 48h, the concentrations of the IL-1, IL-2, IL-4, IL-6 cytokines, the interferon alpha (IFN-α) and the tumor necrosis factor alpha (TNF-α) were measured in the supernatant using ELISA kits (Quantikine®, R&D Systems, Inc). The prostaglandin E_2 (PGE_2) was measured using an Amersham Pharmacia Biotech kit (Biotrak™). Total blood culture without stimulus was the choice to preserve the athletes' conditions at the collection time.

STATISTICAL ANALYSIS

Data were considered parametric after a K-S test (α = 5%), and compared using Student's t test and Welch correlation, whenever necessary. Minimal significance level of $p < 0.05$ was chosen for all statistical comparisons. Data are presented as mean ± SEM.

RESULTS

The evaluation of the medical records of the athletes indicated that 29% out of the 59 athletes presented repetitive strain injury without trauma and chronic muscular pain (group RSI). Additionally, it was observed that the group of athletes with highest incidence of musculoskeletal injuries without trauma presented higher number of painful spots to the clinical assessment (figure 1), with median of painful spots of 09, while athletes who did not present muscular repetitive strain injury presented median of five positive points.

Concerning the plasma cortisol, prolactin, GH, adrenalin, noradrenalin, dopamine, L-dopa and creatinine concentrations, there was no significant difference between groups (table 1).

Increase in production of IL-1, IL-2, TNF-α, IFN-α and PGE_2 was observed on the supernatant of cultures obtained from athletes of the group fibromyalgia, compared with the control group. The IL-4 and IL-6 concentration in the supernatant of the cultures were not different between groups (table 2).

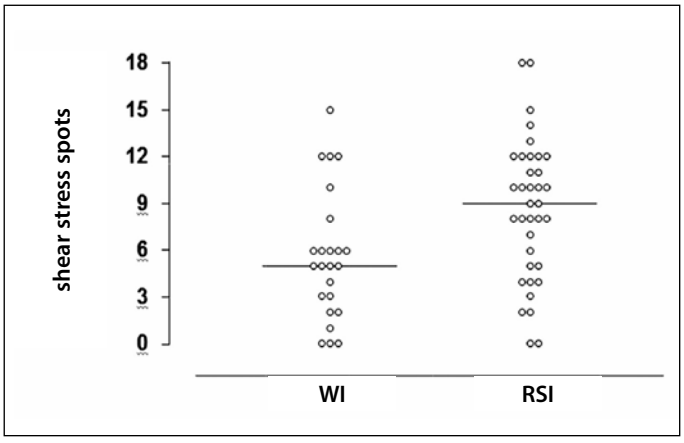

Figure 1. Median of the painful spots (0-18) comparing athletes with repetitive strain injuries (RSI) and athletes without repetitive strain injury (WI), detected by the doctor, through clinical evaluation and presence of musculoskeletal injuries, as evidenced by the medical records of the athletes (P = 0.0148).

Table 1. Concentration of plasma hormones and neurotransmitters comparing values obtained in fibromyalgia patients or non-patients.

	SRI (n = 17)	Control (n = 42)	P value
noradrenalin (pg/ml)	88.64 ± 34.77	76.24 ± 51.18	0.405
adrenalin (pg/ml)	16.40 ± 13.64	26.84 ± 58.31	0.512
l-dopa (pg/ml)	250.83 ± 65.69	274.64 ± 107.89	0.442
dopamine (pg/ml)	263.03 ± 244.29	198.39 ± 120.99	0.198
gh (ng/ml)	2.04 ± 3.31	1.13 ± 2.10	0.242
prolactin (ng/ml)	8.75 ± 3.56	9.93 ± 5.40	0.469
cortisol (µg/dl)	15.31 ± 5.12	16.20 ± 4.27	0.528
creatinine (mg/dl)	182.17 ± 78.97	151.55 ± 55.46	0.117

The values are expressed in mean ± SEM.
Student's t test and Welch correlation, p ≤ 0.05.

Table 2. Cytokines production (IL-1, IL-2, IL-4 and IL-6, TNF-α and INF-α) and prostaglandin E2 (PGE2) by mononuclear cells of the peripheral blood stored by 48 hours, comparing values obtained in fibromyalgia syndrome patients and non-patients.

	SRI (n = 17)	Control (n = 42)	P value
IL-1 (ng/mL)	121.24 ± 44.37	44.36 ± 77.24	0.001
IL-2 (ng/mL)	122.42 ± 60.18	15.35 ± 6.37	0.0001
IL-4 (ng/mL)	80.19 ± 16.82	74.60 ± 14.49	0.28
IL-6 (ng/mL)	9.00 ± 11.18	11.55 ± 10.10	0.443
TNF-α (ng/mL)	297.61 ± 83.17	167.44 ± 120.04	0.0001
INF-α (U)	324.24 ± 136.04	86.19 ± 62.06	0.0001
Prostaglandin E2 (ng/mL)	570.38 ± 161.83	270.18 ± 97.00	0.0001

Results expressed in mean ± SEM.
Student's t test and Welch correlation, $p \leq 0.05$.

DISCUSSION

It could be observed that an expressive number of athletes presented muscular repetitive strain injury (RSI) without trauma. It was associated with well-defined laboratory alteration, with increase of pro-inflammatory cytokines an activation of the immune-inflammatory response. Such finding offers us the opportunity to build a rich information scenario which can have great value, both in the diagnosis and prevention of nontraumatic injury of athletes.

The athletes included in this study were in their normal sports practice and did not present any apparent pathology. However, those who presented RSI presented laboratory alterations compatible with an inflammatory episode, evidenced by increase of pro-inflammatory cytokines and activation of immune system, proved by the increase of IL-2. Recently, Black[20], when discussing the mechanisms associated with neurogenic inflammation, proposed that, in response to the psychological stress or to certain physical stressing agents, an inflammatory process may occur by the release of neuropeptides, with consequent activation of inflammatory cells. It is consistent in the literature the correlation between production of cytokines in response to psychological stressing agents[18,19,25].

The stress hormones (cortisol, prolactine and GH), as well as the neurotransmitters, did not present differences between groups, suggesting that even if the athletes are submitted to similar physical stress, it would not be the factor associated with the pathogenesis of the scenario. However, the production of pro-inflammatory cytokines and prostaglandine E_2 suggests activation of the immune-inflammatory system, which, regardless of mechanical factor, suggests the activity of another mechanism.

The two groups of athletes presented positive triggering points to the exam; however, the group in which muscular repetitive strain injuries occurred presented median of positive points almost two times higher than the one presented by the group which did not present injuries. The positive and statistically significant correlation demonstrated between the number of positive triggering points and the increase of onset of nontraumatic injuries, suggests that these two findings may have an association.

The report by Small[5], relating chronic pain and fibromyalgia as the main complaint in sports medicine infirmaries, although cannot allow the diagnosis of fibromyalgia in these athletes, makes us suppose that there may be a common pathogenic mechanism or that the final manifestation which produces the complaint is similar, so that the use of triggering points could be a simple manner to early detect the risk for muscular injury without trauma in athletes.

CONCLUSION

An exacerbated immune-inflammatory response seems to be the physiopathogenic basis of muscular injury without trauma. Probably, many factors collaborate to this finding and it seems more to be an individual response to stress, be it physical or mental. This finding is important so that the team coaches and doctors are able to help the athletes who present repetitive injuries trying to refer the specialized service. Since the cytokine dosing currently is only available in research laboratories, the evaluation of triggering points by a trained doctor may be a diagnosis instrument which, joined to the athlete's history, is able to diagnose muscular injury without trauma and help taking the necessary measures.

Further studies with other modalities and with a higher number of athletes are necessary to corroborate our findings.

All authors have declared there is not any potential conflict of interests concerning this article.

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