Hematological and biochemical alterations originating from the combat training in of Olympic Kung fu athletes


ABSTRACT: The present work investigates and discusses the behavior of hematological (of white and red series) and biochemical variables of 20 individuals’ of the gender masculine, healthy, submitted to the combat training of Olympic Kung fu. The results indicate that the red hematological variables had little modifications before referred the training, although a small hemolysis has been demonstrated by the laboratorial exams, causing a significant statistical difference in the medium corpuscular hemoglobin concentration MCHC (p=0.003). However, the white hematological components behaved very different from the previous ones, demonstrating a significant leukocytosis (p=0.02). It was evidenced that the neutrophils was the subpopulation that had more increase in their serum levels (p=0.001), being described in rod cells (p=0.001) and segmented (p=0.001). The lymphocytes differently answered with a fall in their serum levels (p=0.002), likely to the eosinophils (p=0.001). In against, the biochemical components came as the most responsive to the referred training, especially creatine kinase (CK) that registered an increase of 78.23% (p=0.005). Other components, as the creatinine (p=0.001), the total proteins (p=0.022), the globulins (p=0.016) and the uric acid (p=0.001) registered significant modifications, where all these listed components above demonstrated a significant increase in their concentrations, immediately after the training. Being like this, it is ended that the combat training of Olympic Kung fu has high intensity, generating several hematological and biochemical answers, although the hematological answers of red series are modest.

Keywords: hematology, biochemistry, kung fu

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INTRODUCTION

The martial arts have exerted significant influence in humans for millennia. With the coming of these masters martial for the West in the decades of 20, 30, 40 and 50 have won these fans, in the many different Western nations. In view of the boom in martial arts and the entry of some of these in the Olympic universe, the science of the training begins to study the physiological and biochemical effects of these practices in humans. In 2002 the Chinese kung fu became an Olympic mode, and then called Kung fu Olympic or simply WUSHU. The kung fu Olympic has a huge range of techniques to combat, and that the fight of the Olympic Kung fu is called Sanshou. The main trends of sanshou, are: 1.Chuan: techniques of wrist (punches), 2. Bhu: techniques of legs (chutes), 3. Shuai: techniques of pitches (falls). The science of modern sports training makes use of various means for evaluation, prescription and control of the training. The test non-invasive measurement of concern valências and physical abilities, such as strength and flexibility among others. However, the invasive research provides important data about the answers organic subsidizing desicion making. Therefore, to achieve more reliable results about the effects of the training it is advisable to use invasive techniques, or examinations of blood among others, seeking measure and interpret data hematological and biochemical.

The measurement of hematological and biochemical data provide many answers about how the training is being interpreted by the various systems, or identify apoptosis or even increase in the counting of cells given, be they of white series (leukocytes) or red (erythrocytes) and biochemical. Given the information now listed, this study aimed to investigate the hematological and biochemical changes from one session of training for combat in the Olympic Kung fu.

MATERIALS AND METHODS

 Participated 20 individuals in this study of the males, of kung fu Olympic athletes with at least one year of experience in competitions, with registration at the International Association Chan Lee kung fu-RJ, linked to the Federation of Kung fu of the State of Rio de Janeiro. With age of 22.4 ± 4.4 years, weight 67.1 ± 8.6 kg, height 170.7 ± 5.3 cm and percentage of fat from 10.4 ± 3.3, healthy, which did not present any kind of injury or illness opportunistic by at least one month before the experimental protocol, who were not using dietary supplements, drugs or anabolic steroids, and hematologic and biochemical characteristics controlled. Participants were informed about the procedures of experience and the possible discomfort associated with the study when it signed the informed consent for participation in research as declaration of Helsinki. For collecting, packaging, transport, measurement and analysis of data biochemical and hematological a laboratory specialist was hired. The data collected were hematological: haematological parameters of white series (leukocytes, lymphocytes, eosin-
phils, neutrophils which are targeted, and bastonetes total and monocytes) and haematological parameters series of red (red cells, hemoglobin, hematocrit, VG, MCV, MCH, MCHC). The biochemical data were collected: Lactate dehydrogenase (LDH), glucose, creatinine, urea, ammonia, albumin, creatino kinase (CK), total protein, globulin and uric acid.

Individuals suffered the first collection to 6hs after fasting for 12 hours, setting the initial state of the athletes (pre-test).

After the first collects the athletes had a dejum, prepared by nutritionist, composed of: An apple, a banana, a sandwich (sliced bread with cheese and ham), a yogurt and a small refreshment of guarana. This dejum was prepared in accordance with the needs of the sport. An hour after the dejum began the training under this protocol applied to the Olympic kung fu which was based on the training of combat, according to the guiding axis studies by Guimarães et al18, Cordeiro, Guimarães and Baptista5, and the guidelines of the International Wushu Federation (IWF)19, 20. The exercises were conducted to concentric failure or loss of efficiency; sessions suffered intervals for carrying out - Twist of arms to the failure concentric; abdominal (variety) to be a loss of efficiency; sessions of specific attacks (XUANGFEIJAO, TENGKONG BALIAN as IWF; blows from fists against apparatus for this purpose (gloves of focus); kicks against apparatus for this purpose (rackets for kicks) and combat itself, totaling 40 minutes of uninterrupted specific training on the method of fighting;

2. Realization of the second collection;
3. Vote for calm: Trote smooth for 5 minutes and 5 minutes of static stretching, 10 minutes of giving back to the calm.

In order to avoid distortions in the data hematological and biochemical caused by dehydration, in the course of the entire protocol was the supply of water, and is offered in the following way: Every 15 minutes of training were offered 250 ml of water.

After the collection and analysis of blood, hematological and biochemical data were analyzed by Student’s t test, which compared the averages up of the moments before and after training.

Results of white cells in the moments before and after the training of fighting, kung fu Olympic. * The median was used, coefficient of variation exceeding 25%.

<table>
<thead>
<tr>
<th>TABLE 1: DATA HEMATOLOGICAL SERIES WHITE</th>
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<tbody>
<tr>
<td><strong>DATAS</strong></td>
</tr>
<tr>
<td>Monocyte(%)</td>
</tr>
<tr>
<td>Segment (%)</td>
</tr>
<tr>
<td>Neutrophils (%)</td>
</tr>
<tr>
<td>Eosinophils (%)</td>
</tr>
<tr>
<td>Bat (%)</td>
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<tr>
<td>Leukocytes (1000/mm3)</td>
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<tr>
<td>Lymphocytes (%)</td>
</tr>
</tbody>
</table>

Finally, it is interesting to note the responses of the total white cell via leukocyte count. In response to the training of the kung fu fighting was Olympic observed a significant leukocytosis (Graph 2).

According Tate et al.15, are the neutrophils, the subtype of leukocytes that more increases in plasma in response to training, as one of the most responsible for leukocytosis come of the exercise.

**RESULTS**

The haematological parameters series of white (table 1) showed distinct changes and even intra-group. Following the guidelines of the average Shimakura21 was replaced by the median where the coefficient of variation presented percentage above 25%.

The netrófílos whether these be segmentandos or bastonetes responded with significant increases, demonstrating that this training really changes the counting of these cells (Figure 1). According Vaisberg and Rosa16 and Leandro et al22 this considerable increase occurs often the output of these cells in peripheral tissues to the bloodstream. Shephard23 says that this situation is through action of hormones such as cortisol. It is likely that in the present study this situation has happened.

The eosinóilos suffered reductions in their total count, about 60%. These cells are present in very small numbers in the blood, being attracted to the inside of tissues (including muscle) by chemotaxis due to injury or inflammation16, 23. Therefore, it is very likely that the extravasation of substances of sarcoplasma has promoted the penetration of these cells in tissue musculo-skeletal thus decreasing their serum concentration, which, incidentally, was already short before, making it even smaller. It is possible that the magnitude of the penetration of eosinophils in the interior of the muscles are depending on the intensity of exercise14.

The years of training to combat promoted still a drop in total lymphocyte counts. This fall reached 30.65% showing that the training influenced marcantemente counting on these cells. Studies with rats conducted by Leandro et al22 showed that the apoptosis of lymphocytes can be amenizada exercises by moderate aerobic in nature, however, in this study the exercises were predominantly anaerobic character and high intensity. This promoted a drop in the count of lymphocytes that probably has been generated by increased secretion of cortisol and catecholamines12, 24, 25. Some scholars say that after vigorous exercise these cells may have a decrease in the order of 30% to 50% below baseline levels and remained so up to 6 hours23, 24, corroborates this assertion with the findings of this study.
The monocytes but have not been statistically significant, which also experienced increases in the total count may have influenced the increase in leukocytes. Based on these comments and supported the studies of Nascimento et al\textsuperscript{11}, and Shephard\textsuperscript{23}, it can be observed that, leukocytosis come to the training of kung fu fighting in the Olympic suggests that the intensity is directly related to the departure of neutrophils in peripheral tissues and its entry into the bloodstream, thus contributing to a significant leukocytosis.

However, the responses of hematologic red cells had very different behaviour of the white cells (table 2).

Given that the average number of hematological components have changed little red and only one was significantly amended (the MCHC or mean corpuscular haemoglobin concentration of\textsuperscript{28,29,30}). However, the results show that the training caused an imbalance on the relationship erythrocyte / hemoglobin, causing a statistically significant difference in this parameter (Figure 3).

Increased corpuscular hemoglobin concentration, mean (MCHC), can be directly related to injury of erythrocytes and concomitant release of hemoglobin within the cell injured\textsuperscript{26}.

Zoppi et al\textsuperscript{31} say about 2 to 5% of all the oxygen (O\textsubscript{2}) that consumes during the day if surfaced O\textsubscript{2} reactive species (EROs). The
same authors also argue that the exercise increases the maximum of O2 consumption by 20 times, and that this increase, directly influences the formation of EROs, also bringing these values, and more, the generation of EROs is directly linked to the volume and intensity of the exercise. Also according Zoppi et al31 the EROs can harm and even destroy some cells. The affirmative sometimes cited can be part of the answers that this study seeks, as far that the hematological test on the relationship erythrocytes hemoglobin suffered significant changes (MCHC). These changes may be tied to the death of erythrocytes (even in small proportion) on account of the large amount of EROs generated by the high intensity of the training, working with the increase in hemoglobin free31, 32.

According Shaskey and Green14 injured when the red cells release their contents (hemoglobin), and observing the table 2 may be noted that the drop in the percentage of red cells are very close to the percentage of increase in hemoglobin, this situation highlights the possible reason why the MCHC was significantly changed.

Regarding biochemical markers the LDH, glucose, ammonia and albumin showed no significant changes to the training, when evaluated on the test T Student (table 3).

Based on studies of Silveira and Denadai33 he decrease in serum glucose was something expected of the type of training offered. However, this decrease was not significant. It is likely that this situation has been generated by dejejum (coffee in the morning) proposed, since this dejejum was prepared specifically for the training used in this study.

The creatinine is the result of the accumulation of intramuscular creatine, that is, the higher the donation of inorganic phosphate (Pi) in breach of ATP, will be larger quantities of creatine free-intramuscular34, 35. This creatine when dried becomes creatinine35. In the present study this biochemical marker underwent significant changes. The molecules of ADP from the release of energy from the ATP during the training, were hydrolysed is converting into AMP34, 35. The AMP suffers a desaminação by the enzyme adenylate desaminase, generating ammonia and inosine monophosphate (IMP), which has great ability to spread quickly in the muscle, causing an accumulation of this, causing a duplicate of metabolism, forming a inosine, hypoxanthine, xanthine and finally uric acid36,37,38.

The situation explained above probably also contributed to the significant increase of serum uric acid, recorded in this study, and this increase of 39.39% of the pre-training time for the post-training, as can be observed in Chart 4.

The total protein suffered a significant increase in the order of 3.89% demonstrating that the training of high intensity promotes changes in the behaviour of serum proteins as studies by Lucia-no and Melo39 (Chart 5). This may be due to large intensity of the training that promoted a release of proteins for catabolism, in reaction to cortisol that probably increased, or the second Santos et al.32, the high overhead of training may have inhibited the synthesis of glutamine by the fall part of the activity of the enzyme-glutamine synthetase, then promoting the accumulation of glutamate. Adding to the above, there is still according to the same author that training with great overload can cause the protein catabolism, possibly, increases the plasma concentration of branched-chain amino acids (BCAA), in particular leucine40.

The globulins demonstrate a statistically significant increase, and that this situation probably due to the need for increased transport of nutrients for energy generation and ressíntese41, then the processes of cellular transport tend to increase their speed as required35.

### Table 2: Data hematological of red cells

<table>
<thead>
<tr>
<th>DATOS</th>
<th>START (Average)</th>
<th>FINAL (Average)</th>
<th>MEANING (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythrocyte (million/mm3)</td>
<td>5.02±0.39</td>
<td>4.96±0.26</td>
<td>0.5780</td>
</tr>
<tr>
<td>Hemoglobin (g/dl)</td>
<td>14.48±1.59</td>
<td>14.73±1.17</td>
<td>0.5670</td>
</tr>
<tr>
<td>Haematocrit (%)</td>
<td>45.00±4.43</td>
<td>44.05±2.99</td>
<td>0.4320</td>
</tr>
<tr>
<td>VG(µ)</td>
<td>0.89±0.02</td>
<td>0.88±0.02</td>
<td>0.2560</td>
</tr>
<tr>
<td>VCM(%)</td>
<td>89.53±2.42</td>
<td>89.34±1.29</td>
<td>0.7580</td>
</tr>
<tr>
<td>HCM(%)</td>
<td>28.81±1.146</td>
<td>29.67±1.25</td>
<td>0.0502</td>
</tr>
<tr>
<td>CHCM(%)</td>
<td>32.18±1.48</td>
<td>33.39±0.87</td>
<td>0.0030</td>
</tr>
</tbody>
</table>

Results of white cells in the moments before and after the training of fighting, kung fu Olympic.

### Table 3: Data biochemical

<table>
<thead>
<tr>
<th>DATOS</th>
<th>START</th>
<th>FINAL (Average)</th>
<th>MEANING (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDH (mg/dl)</td>
<td>162.950±38.780</td>
<td>156.400±26.140</td>
<td>0.534</td>
</tr>
<tr>
<td>GLOCOSE (mg/dl)</td>
<td>79.530±10.030</td>
<td>73.780±9.160</td>
<td>0.065</td>
</tr>
<tr>
<td>CREATININE (mg/dl)</td>
<td>1.200±0.170</td>
<td>1.430±0.140</td>
<td>0.000</td>
</tr>
<tr>
<td>UREA (µmol/l)</td>
<td>*36.000±8.900</td>
<td>34.060±6.650</td>
<td>0.707</td>
</tr>
<tr>
<td>AMMONIA (µmol/l)</td>
<td>*20.000±11.940</td>
<td>*49.000±17.220</td>
<td>0.596</td>
</tr>
<tr>
<td>ALBUMIN (g/l)</td>
<td>4.790±0.340</td>
<td>4.740±0.190</td>
<td>0.059</td>
</tr>
<tr>
<td>PCK (u/l)</td>
<td>*157.000±104.120</td>
<td>*218.000±198.090</td>
<td>0.005</td>
</tr>
<tr>
<td>TOTAL PROTEIN (g/l)</td>
<td>7.710±0.510</td>
<td>8.010±0.220</td>
<td>0.022</td>
</tr>
<tr>
<td>GLOBULINS (g/l)</td>
<td>2.920±0.550</td>
<td>3.260±0.270</td>
<td>0.016</td>
</tr>
<tr>
<td>ACID URIC (mg/dl)</td>
<td>3.910±0.950</td>
<td>*7.500±1.560</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Results biochemical at times before and after the training of fighting, kung fu Olympic. * The median was used, coefficient of variation exceeding 25%.
Among the biochemical markers investigated in this work what else has changed was the CK, (Chart 6). The label showed a significant increase of 78.23%.

According Barbosa et al.9 the CK is one of the biochemical markers more suitable for measuring the level of aggression musculo-skeletal. The same authors maintain that elevated plasma concentrations of the marker indicates that there was extensive damage to muscle tissue. However, CK is directly linked to the volume and intensity of the year10, 42. Another factor that may have induced such an increase would be the same fight since the fight in the Olympic Kung fu is the contact is necessary that the coup really hit the opponent6, 18, 19, this situation may have contributed to this increased marker biochemical. Starting from the premise that the legs are targets of powerful kicks, which are targeted in particular the thighs (and a lesser proportion legs). These chutes can be desferidos both medial and lateral they are made with the anterior surface of the tibia, setting an impact harmful to the muscles, medial (adductors) and lateral (vastus lateralis)18.

As the exercise presents as stress, which is mechanical, physiological and psychological43 often the damage caused by one and one alternate were in different situations. Quantities of CK, protein, globulin and uric acid found in this study show the presence of mechanical stress and physiological generated by muscle injuries from several successive contractions and the impacts from the sanshou, the fight of kung fu Olympic39, 44.

**CONCLUSION AND RECOMMENDATIONS**

As the goal proposed by this study, it was observed that the training of Kung fu fighting the Olympic cause changes in hematological and biochemical parameters in athletes evaluated. Thus it is noted in that the cells of hematological tests series white are good markers of the intensity of the exercise, however, the number of red not had adequate for this purpose. Furthermore the biochemical markers [creatinine, CK, total protein, globulin and uric acid] came as good predictors of the intensity of the exercise to fight for the practitioners of kung fu Olympic, providing important information about the physiological effects of this training.

It is recommended that further studies will be conducted with other practitioners of Olympic Kung fu, even from other states. Let N be established larger, which can be studied both the practitioners of combat (Sanshou), as the practitioners of ways (Tao lu). And finally that the female might be studied as well, so that they can create larger, which can be studied both the practitioners of kung fu Olympic, providing important information about the physiological effects of this training.

**BIBLIOGRAPHIC REFERENCE**