Iberian Congress on Basketball Research, 2007, 4, 83-86.

ENZYMATIC AND METABOLIC RESPONSES TO COMPETITION IN ELITE JUNIOR MALE BASKETBALL PLAYERS[1]

JULIO CALLEJA

Faculty of Physical Activity and Sport Sciences, University of País Vasco

JOSE A. LEKUE, XABIER LEIBAR

Technical Performance Center, Department of Culture, Sport Authority for the Basque Government

JESÚS SECO

Falculty of Physical Therapy, Ponferrada Campus, University of León

ALEJANDRO VAQUERA

Faculty of Physical Activity and Sport Sciences, University of León

NICOLÁS TERRADOS

Department of Functional Biology, University of Oviedo

Summary.—The purposes of this study were to establish the resting levels and the acute enzymatic and metabolic responses during competitive games with male top-level junior basketball players. Creatine kinase concentration increased significantly during the game and there was a significant difference between the postgame values and the values 48 hours later. Lactate dehydrogenase increased significantly during the game. Alcaline phosphatase decreased significantly between pregame values and also compared to values 48 hours later. Urea in blood was significantly higher after the game. In summary, the anaerobic enzymes studied showed changes during the games in serum. The parameter urea was sensitive during the game.

Kuipers (1994) proposed the control of enzymatic parameters in the blood (creatine kinase, lactatdehydrogenase, and phosphofructokinase) to monitor the training load and establish their relationship with the exercise recovery process. However, there are few studies in basketball (Rotenberg, Seip, Wolfe, & Bruns, 1988; Hoffman, Epstein, Yarom, Zigel, & Einbinder, 1999; Stalnacke, Tegner, & Sojka, 2003), and further there is little information about muscle metabolism in adolescents (Haralambie, 1982). Therefore, the aim of this study was to determine the enzymatic (creatine kinase, lactatdehydrogenase, and alkaline phosphatase) and metabolic (urea) responses in two competitive games in a group of highly trained male under-19 basketball players before, during, and after the games in relation to player position.

[1]Address correspondence to Julio Calleja-González, Carretera de Lasarte s/n. Vitoria 1007 (Álava), Spain or e-mail (juliocalleja@inicia.es).

DOI 10.2466/ICBR.4.83-86

Methods

Nine male junior international basketball players from the Siglo XXI project of the Spanish Basketball Federation participated in this study. All were members of the Spanish Junior National Team in one of three positions (guard, $n=3$; forward, $n=3$; center, $n=3$). Anthropometric characteristics of the subjects as follows: age, 16 yr. ($SD=0.0$), weight, 91 kg ($SD=6.7$), height, 197.5 cm ($SD=5$), body fat, 8.13% ($SD=2.3$). The subjects were examined before the games (Pre), after the games (Post 1), and 48 hr. after the games (Post 2). Blood samples were drawn from the ear after the subjects had rested for 10 min. in a seated position. Means and standard deviations were calculated for all variables. Repeated measures analysis of variance was employed to compare Pregame, Postgame, and 48 hr. postgame values of the different parameters measured. A paired t test was used for comparison between groups. Pearson's correlation were calculated. Significance was set at $p<.05$. Statistical analyses were performed with SPSS 14.0.

Results

Plasma creatine kinase concentration increased significantly during the game ($p<.01$), and there was a significant difference between the Postgame values and 48 hr. postgame values ($t=$•.•, $p<.05$, see results in Table 1). There were no significant differences between Pregame values and Postgame values. A significant change in lactatdehydrogenase values was seen between Pregame and Postgame values ($t=$•.•, $p<.05$) but there were no significant differences between Pregame and 48 hr. postgame values. Alkaline phosphatase decreased significantly between Pregame values and 48 hr. postgame values ($t=$•.•, $p<.05$) though significant differences were not observed between Pregame values and Postgame values ($t=$•.•, $p<.05$). Urea in blood was significantly higher postgame ($t=$•.•, $p<.05$) but there were no significant differences between Postgame values and 48 hr. postgame values ($t=$•.•, $p<.05$). Weight significantly decreased during the match ($t=$•.•, $p<.05$) as well as 48 hr. postgame ($t=$•.•, $p<.05$).

TABLE 1

Enzymatic, Substrate, and Mineral Responses to Two Basketball Games (n = 9)

Variable	Pregame		Postgame		48 hr. Postgame		A vs B	A vs C	B vs C
	M	*SD*	*M*	*SD*	*M*	*SD*			
CPK, Iu	813.1	313.1	1107.3	343.2	511.6	185.4	+	*	
ALP, Iu	235.1	95.2	235.7	99.31	212.7	73.3		+	
LDH, Iu	781.8	303.9	1248.3	779.7	663.6	215.0	*		
Weight, kg	84.1	6.9	83.4	6.8	83.5	6.8	+	+	+
Urea,mMol/L	34.0	4.83	35.0	5.3	27.0	3.6	+		

*$p<.05$. +$p<.01$.

Discussion

There have been few studies that determine the value of the training load during basketball competition using enzymatic parameters (Hoffman, *et. al.,* 1999; Stalnacke, *et al.,* 2003), though only one of these studies used top-level basketball players (Hoffman, *et al.,* 1999) while another (Rotenberg, *et al.,* 1988) used basketball athletes in their formative years. The present study's findings can help clarify enzymatic adaptation during competition. Alkaline phosphatase is an enzyme that is present in almost all human body tissues and plays a major role in the liver and bone. It presents a large variety of isoforms related to cellular activity in bones. One of the major reserves of alkaline phosphatase is in the bones of youth during the maturation period. In the present study a significant decrease ($p < .01$) between Pregame and 48 hr. postgame values was observed (see Table 1), though there was not a significant difference between Pregame and Postgame. In young men, alkaline phosphatase concentration is altered when bone metabolism is elevated. There are no other studies of such changes during competition in young players with which to compare. Creatine kinase in blood is related to muscle damage reflected in biochemical changes. In this study, plasma creatine kinase concentration increased significantly during the game, although the study by Hoffman, *et al.* (1999) did not find changes in creatine kinase concentration even after 4 weeks of intensive training, nor during the training period. Lactatdehydrogenase is most often measured to evaluate the presence of tissue damage. The enzyme is in many body tissues and catalyzes the interconversion of pyruvate and lactate. Many studies have described significant increases after short training (Linossier, Denis, Dormois, Geyssant, & Lacour, 1993), though other researchers have not found this relationship (Thorstensson, Sjodin, & Karlsson, 1975). The present study's data showed significant changes in the Pregame values compared to Postgame values but not between Postgame and 48 hr. postgame values. In this study with a selective group of junior players, it was confirmed that basketball games influence lactatdehydrogenase concentration as previous studies have reported. Rotenberg, *et al.* (1988) showed significant differences in the lactatdehydrogenase concentration before starting a game and values after finishing the game in college players. When the enzyme lactatdehydrogenase is present in high levels in the blood, there are alterations in mitochondrial or cellular membrane permeability, which occur due to an increase in catecholamines in addition to an oxygen deficit. Protein catabolic rate derived from measured total urea output was compared to recorded daily protein intake. A rapid increase in this parameter may suggest a catabolic situation (Lehman, Dickhuth, Gendrish, Lazar, Thum, Kaminski, Aramendi, Peterke, Wieland, & Keul, 1991). The urea values significantly increased 48 hr. after the game when compared to Pregame values, though in the study by Hoffman, *et al.* (1999) there were no significant changes in the urea concentration after four weeks of intensive training.

REFERENCES

HARALAMBIE, G. (1982) Enzyme activities in skeletal muscle of 13–15-year-old adolescents. *Bulletin Europeen De Physiopathologie Respiratoire,* 18, 65-74.

HOFFMAN, J., EPSTEIN, S., YAROM, Y., ZIGEL, L., & EINBINDER. M. (1999) Hormonal and biochemical changes in elite basketball players during a 4-week training camp. *Journal of Strength and Conditioning Research,* 13, 280-285.

KUIPERS, H. (1994) Recovery, the difference between overtraining and success. In *Top Performance. Research Reports from the Research Institute for Olympics Sports,* Jiväskylä, 49-56.

LEHMAN, M., DICKHUTH, H. H., GENDRISH, G., LAZAR, W., THUM, M., KAMINSKI, R., ARAMENDI, J. F., PETERKE, E., WIELAND, W., & KEUL, J. (1991) Training–overtraining. A prospective, experimental study with experienced middle- and long- distance runners. *International Journal of Sports Medicine,* 12, 444-452.

LINOSSIER, M. T., DENIS, C., DORMOIS, D., GEYSSANT, A., & LACOUR, J. R. (1993) Ergometric and metabolic adaptation to a 5-s sprint training programme. *European Journal of Applied Physiology,* 67, 408-414.

ROTENBERG, Z., SEIP, R., WOLFE, L. A., & BRUNS, D. E. (1988) "Flipped" patterns of lactate dehydrogenase isoenzymes in serum of elite college basketball players. *Clinical Chemistry,* 34, 2351-2354.

STALNACKE, B. M., TEGNER, Y., & SOJKA, P. (2003) Playing ice hockey and basketball increases serum levels of S-100B in elite players: a pilot study. *Clinical Journal of Sport Medicine,* 13, 292-303.

THORSTENSSON, A., SJODIN, B., & KARLSSON, J. (1975) Enzyme activities and muscle strength after "sprint training" in man. *Acta Physiologica Scandinavica,* 94, 3113-3118.