

Correlation between external respiratory indicators and amino acid composition of blood in athletes

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Abstract

Objective of the study was to identify the role of amino acids in the formation of the specific signs of the structural trace of adaptation.

Methods and structure of the study. The tidal volume rates were obtained by means of spirometry, including inspiratory and expiratory reserve volumes (RV_{insp}, RV_{exp}) and actual vital capacity; by means of morphometry - predicted vital capacity, maximum tidal volume under loads, respiratory minute volume, maximum and specific tidal volume (per Watt of energy), as well as PWC₁₇₀, specific PWC₁₇₀ and critical specific power (specific power, at which the respiratory function efficiency is reduced).

Results and conclusions. Branched-chained amino acids (their relative content) in the wrestlers have a comprehensive effect on the external respiration function. The critical specific power in the hockey players positively correlates with the absolute glycine level and negatively - with the absolute taurine (TAU) level. In addition, there is a positive correlation with the relative glutamine and arginine levels.

Therefore, the identified difference in the amino acid composition of the athletes' blood is accompanied by different correlation relationships between the external respiratory indicators. It should be noted that it is ancient amino acids that have the largest number of such correlations - in representatives of all sports. The wrestlers were found to have more correlations with the absolute content of amino acids, and the hockey players have more correlations with the relative content of amino acids.

The data obtained can be used as a marker for the athletes' training level.

Keywords: *adaptogenic amino acids, sports training, external respiration indicators.*

Background. The nature of activities of representatives of various sports is related in some ways to their metabolism, with different absolute and relative amino acid contents, on the one hand, and a variety of trends in the amino acid content due to the skills grow, on the other hand [3].

The total amino acids form the substrate basis of the structural trace of adaptation. The structural trace of adaptation is formed in representatives of various sports to ensure activities typical of a particular sport. This trace is also present in the body structure and is detected during the functional diagnostics of the state of the internal organs and in the psychological tests, which is well known to every sports coach [1, 2].

Objective of the study was to identify the role of amino acids in the formation of the specific signs of the structural trace of adaptation.

Methods and structure of the study. The tidal volume rates (TV) were obtained by means of spirometry, including inspiratory and expiratory reserve volumes (RV_{insp}, RV_{exp}) and actual vital capacity (VC); by means of morphometry - predicted vital capacity, maximum tidal volume under loads, respiratory minute volume (RMV), maximum and specific tidal volume (per Watt of energy), as well as PWC₁₇₀, specific PWC₁₇₀ and critical specific power (CSP) (specific power, at which the respiratory function (RF) efficiency is reduced).

**Table 1. Correlations between absolute amino acid content and respiratory function in wrestlers**

Indicators	«Ancient» amino acids	Sulfur amino acids	Glutamine derivatives	Branched-chain amino acids	Cyclic amino acids	Total
RV _{insp}	SER		GLN			2
RV _{exp}	-SER, -GLY		-GLN		-TRY	4
Actual VC			-ORN		-TRY	2
Predicted VC						
TV _{max}		-CYS	GLN			2
RMV _{max}			GLN			1
Specific TV						
PWC ₁₇₀						
Specific PWC ₁₇₀	ASP					1
CSP						
	4	1	5		2	12

Results and discussion. In the wrestlers, RV_{insp} and RV_{exp} are characterized by two types of correlation, several of which are reciprocal. For example, the absolute serine (SER) and glutamine (GLU) levels positively correlate with RV_{insp} and negatively – with RV_{exp}. In addition, the relative amount of isoleucine (ILE) negatively correlate with RV_{insp} and positively – with RV_{exp}. There are also negative correlations between RV_{exp} and absolute glycine (GLY) and tryptophan (TRY) levels, as well as positive correlations with leucine (LEU) (Table 1).

The actual vital capacity negatively correlates with the absolute content of ornithine (ORN) and tryptophan levels and the relative tryptophan level. The predicted vital capacity in the wrestlers does not correlate with the amino acid metabolism.

The maximum tidal volume and maximum respiratory minute volume in the wrestlers correlate with the absolute glutamine level. The absolute glutamine level in the wrestlers' blood is therefore associated with the effectiveness of the external respiration function. The wrestlers' ability to breathe is supported by the

Table 2. Correlations between relative amino acid content and respiratory function in wrestlers

Indicators	«Ancient» amino acids	Sulfur amino acids	Glutamine derivatives	Branched-chain amino acids	Cyclic amino acids	Total
RV _{insp}				-ILE		1
RV _{exp}			-GLN	ILE, LEU		3
Actual VC					-TRY	1
Predicted VC						
TV _{max}				LEU		1
RMV _{max}				-LEU		1
Specific TV				-LEU		1
PWC ₁₇₀						
Specific PWC ₁₇₀	ASP, -ALA					2
CSP				-LEU		1
	2		1	6	1	10

**Table 3. Correlations between absolute amino acid content and respiratory function in hockey players**

Indicators	«Ancient» amino acids	Sulfur amino acids	Glutamine derivatives	Branched-chain amino acids	Cyclic amino acids	Total
RV _{insp}		-MET		-ILE		2
RV _{exp}		MET		ILE		2
Actual VC	ASP					1
Predicted VC			-ORN, -ARG		-HIS	3
TV _{max}						
RMV _{max}	-GLU, GLY					2
Specific TV	-GLU					1
PWC ₁₇₀						
Specific PWC ₁₇₀					TYR	1
CSP	GLY	-TAU				2
	5	3	2	2	2	14

Table 4. Correlations between relative amino acid content and respiratory function in hockey players

Indicators	«Ancient» amino acids	Sulfur amino acids	Glutamine derivatives	Branched-chain amino acids	Cyclic amino acids	Total
RV _{insp}						
RV _{exp}						
Actual VC	-GLY					1
Predicted VC					TYR	1
TV _{max}						
RMV _{max}	-SER	-MET	GLN			3
Specific TV		-MET	ORN			2
PWC ₁₇₀						
Specific PWC ₁₇₀						
CSP			GLN, ARG			2
	2	2	4		1	9

intensity of the detoxification reactions in the brain. The cysteine (CYS) level negatively correlates with the maximum tidal volume, that is, it has more correlation relationships with the structure of the respiratory organs than with their function. The relative leucine level also correlates with the maximum tidal volume and respiratory minute volume, yet in different ways: there is a positive correlation with the maximum tidal volume, but a negative one with respiratory minute volume, as well as with the specific tidal volume.

The wrestlers' power rates in the PWC₁₇₀ does not correlate with the amino acid composition of the

blood. At the same time, the specific power positively correlates with the aspartic acid (ASP) level and negatively – with the alanine (ALA) level.

Finally, the critical specific power (at which respiratory failure occurs) negatively correlates with the relative leucine level.

RV_{insp} and RV_{exp} in the hockey players, like in the wrestlers, reciprocally correlate with the absolute amino acid content (Tables 3, 4). Unlike the wrestlers, in the hockey players, the absolute methionine (MET) and isoleucine levels negatively correlate with RV_{insp} and positively – with RV_{exp}.



The actual vital capacity in the hockey players positively correlate with the absolute aspartic acid level. The predicted vital capacity negatively correlates with absolute levels of ornithine, arginine (ARG) and histidine (HIS) and positively correlates with the relative tyrosine (TYR) level.

The maximum tidal volume in the hockey players is not associated with the amino acid metabolism. The maximum respiratory minute volume in the hockey players positively correlates with the absolute glycine level and negatively - with the absolute glutamic acid level. The same indicator negatively correlates with the relative serine and methionine levels and positively - with the relative glutamine level.

The specific tidal volume (per unit of work power) in the hockey players is associated with the amino acid metabolism. There is a negative correlation with the absolute glutamic acid level, a negative correlation with the relative methionine level, and a positive correlation with the relative ornithine level.

The PWC_{170} rates in the hockey players have no correlation relationships. The specific PWC_{170} (per kilogram of weight) correlates with the absolute tyrosine.

Conclusions. Branched-chained amino acids (their relative content) in the wrestlers have a comprehensive effect on the external respiration function. The critical specific power in the hockey players positively correlates with the absolute glycine level and negatively - with the absolute taurine (TAU) level. In addi-

tion, there is a positive correlation with the relative glutamine and arginine levels.

Therefore, the identified difference in the amino acid composition of the athletes' blood is accompanied by different correlation relationships between the external respiratory indicators. It should be noted that it is ancient amino acids that have the largest number of such correlations - in representatives of all sports. The wrestlers were found to have more correlations with the absolute content of amino acids, and the hockey players have more correlations with the relative content of amino acids.

The data obtained can be used as a marker for the athletes' training level.

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