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Study the correlation between alleles of MCT1 gene and enduring performance in handball players

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ABSTRACT

The current study aimed to determine MCT1 gene A1470T polymorphism is associated it with enduring performance among elite handball players young. The community of study was chosen 100 young players of Iraqi clubs in handball game which their length (171.83 ± 3.060 cm), weight (68.33 ± 2.160 kg) and age (24.4 ± 3.782 years). Genotyping of A1470T polymorphism of the MCT1 gene was done by the PCR-RFLP technique lactate measurement of 100 handball players was examined after testing the endurance of defensive and attack performance. Frequencies of genotypes in 100 players were AA genotype (60%), AT genotype (30%) and TT genotype (10%). The mean of endurance capacity was significantly higher in AA genotype (1.01 ± 0.04 min) versus AT genotype (1.10 ± 0.01 min). (AA + AT) genotypes versus TT genotype (1.14 ± 0.01 min). Mean of blood lactate concentration was significantly higher in AA genotype (16.23 ± 0.35 mMol) versus (AT + TT) genotypes (13.48 ± 0.18 ; 11.66 ± 0.13 mMol) respectively. We concluded that the MCT1 gene A1470T polymorphism enhances enduring performance in elite handball players.

Keywords: Alleles of MCT1 gene; Enduring performance; Handball players.

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INTRODUCTION

The sports performance and physical fitness are a highly complex phenotype which has hygienic trait (Kambouris et al., 2012). The lactic acid system is an important element to provide energy for the tool that performs at full speed and that takes a time ranging between 30s-3min. In handball, all moves are made by the player quickly, in addition to that some physical characteristics including this system such as enduring performance and is the Efficiency of the player to perform the performance requirements for handball during competition without a decrease in the productivity and effectiveness of his performance (Allami, 2012). Some genes are responsible for athletic performance such as muscle performance, endurance capacity and body mass (Cupeiro et al., 2010). The coordinated movement for muscular tissue which needed turn gene expression. So recent research studies all types of changes that occur during physical exercise at the cellular and molecular levels (Calò & Vona, 2008).

Monocarboxylate transport 1 gene (MCT1) is one of the genes that correlate with athletic endurance and physical fitness (Fedotovskaya et al., 2014). The role of this protein that mediates the transport of pyruvate and lactate via the plasma membrane within many tissues. MCT1 protein is found predominantly in oxidative fibres which have a high number of mitochondria (Halestrap & Wilson, 2012). MCT1 is transported lactate to heart and red skeletal muscle for oxidized as a major fuel (Dubouchaud et al., 2000). Removal lactic acid when muscle fatigue influence by a variant of the MCT1 gene for lactate transport and intensity of performance (Bentley et al., 2009).

MCT1 is a gene located in chromosome number 1p13.2 and spans about 44kb, it is encoded to MCT1 protein which composed of 500 amino acid residues (Garcia et al., 1994).

MCT1 protein is a correlation with muscle activity when muscle inactivity reduces MCT1 expression (Wilson et al., 1998). And regulation of MCT1 protein depending on calcium-dependent phosphatase and AMP-activated protein kinase (Halestrap, 2009). In addition to genes, the enduring performance is determining by different factors such as intensity and type of training depending on anthropometric and morphometric characteristics of the athlete (Merezhinskaya et al., 2000).

One of the missense mutations in the MCT1 gene is genotype A1470T causing codon 490 aspartic acid instead glutamic acid. The person with T allele has a range of lactate transport (60-70)% less than normal allele (Maldonado et al., 2002).

Recent research shows a correlation between this SNP and the accumulation of lactate through training Russian athletes for rower and cohort have high frequency with AA genotype (Fedotovskaya, 2014). In our study, we aimed to determine if the MCT1 A 1470T polymorphism that affects physical performance in handball players and accumulation lactate rate in training program.

METHODS

Subject

The researchers identified the research community, they are players of Iraqi clubs participating in the Iraqi elite league. 100 players range in length (171.83 ± 3.060 cm), weight (68.33 ± 2.160 kg) and age (24.4 ± 3.782 years). The type of the study was descriptive to determine the endurance of defensive and attack performance and lactate measurement.

Design

Our study classified handball players into three groups depending on their MCT1 genotype. To exam the effect MCT1 polymorphism on enduring performance and lactate accumulation in handball players by exam lactate content in the blood.

Genotype

The genotype of the players was determined by Intravenous Blood Drawing. The DNA extraction was done by the gDNA mini kit (Geneaid, USA). Then genotyping of samples for the A1470T polymorphism was done by the PCR-RFLP technique. Using forward primer 5'-AGCAAACGAGCAGAAAAAGG-3', reveres primer 5'-CTGGGTCATGAACTGCTCAA-3'. (Bioneer company, Korea).The primers produce 187 bp which digest by Bccl restriction enzyme for (8) hours at 37 °C. Then the product was running in (6%) polyacrylamide gel electrophoresis. And stain with ethidium bromide to visualized in UV.

The amended endurance test of defensive and attack performance of handball:

The purpose of the test: Measure the player's ability to the endurance of defensive and attack performance of handball. Used equipment's: Handballs, Handball field, Plastic cones, Stopwatch.

Method of performance: The leading player stands on the 6m line, and upon giving the starting signal he makes defensive moves between the plastic cones between the 6m line and the 9m line three times and then he takes a ball placed on the 9m line and goes to perform A lightning attack by a ball to the 9m line in the other half of the field to aim at the target, then he performs the same previous performance with a defensive move between the 6m line and the 9m line, then he takes a handball placed on the 9m line to perform a lightning attack by the ball to the 9m line in the other half of the field To aim at the target, and repeat the performance for three consecutive sessions without stopping.

Test conditions: Commitment to defensive moves, and what came in the manner of performance.

Recording: the performance time is calculated from the moment when the start signal is made to the moment the ball is left to the player during the third-round correction.

Endurance of defensive and attack performance test of handball for stud sample was done on Saturday, 16/2/ 2019 at nine o'clock in the morning in the sports hall in Al-Qadisiyah Governorate, after which lactic acid was measured in the blood, and that Using the Lactic meter shown below, as there are three types of strips. The first is used to confirm the reading of the device, as there is a proportion of the lactic acid shown in the instructions with the device. When reading, the result must be by the instructions, otherwise, the results cannot be approved. The second strip is called a strip calibration in which there is a number on the copper slide (F5) when reading it must appear (F5) on the screen as it is used for calibration of the device and after the completion of reading the strip. The third slide is used to measure lactic acid in the blood, as it is Put sterile alcohol on a thumb of Athlete then special acupuncture needle and placed on the Strip test is directly reading after 60 seconds of the device as shown in Figures (1, 2).



Figure 1. Illustrates the lactic meter.



Figure 2. Illustrate steps to measurement lactic acid.

Statistical analysis

The Mean ± SD was used to display and analyse the data involving significant results by one-way ANOVA. Statistical analyses were performed using statistical analysis software (SPSS) version 17.

RESULTS

Table 1. MCT1 genotype distribution in handball players.

Genotyping	No.(100%)
AA	60 (60%)
AT	30 (30%)
TT	10 (10%)
Total	100

Table 1 shows the distributions of MCT1 genotypes in handball players AA 60%; AT 30%; TT 10% was in Hardy-Weinberg equilibrium with no errors for genotyping.

Table 2. The Endurance of defensive and attack performance among the genotyping of MCT1 A1470T polymorphism in handball players.

Genotype	N	Mean (Minute)	SD	p1	p2	p3
AA	60	1.01	0.04	<.001	<.001	<.001
AT	30	1.10	0.01			
TT	10	1.14	0.01			

Table 2 shows regarding, the endurance of defensive and attack performance of handball players, significant differences were found in the AA group (1.01 ± 0.04) versus AT group (1.10 ± 0.01) and AA group with AT group versus TT group (1.14 ± 0.01) ($p < .001$). In detail, handball players with AA and AT genotype had high endurance capacity compare with the TT group. This means, there was a correlation between MCT1 SNP and the endurance of defensive and attack performance of handball players.

Table 3. Blood lactate among the genotyping of MCT1 A1470T polymorphism in handball players.

Genotype	N	Mean (mMol)	SD	p1	p2	p3
AA	60	16.23	0.35	<.001	<.001	<.001
AT	30	13.48	0.18			
TT	10	11.66	0.13			

Note: P1: AA versus AT; P2: AA versus TT; P3: AT versus TT.

Table 3 shows the measurement of blood lactate in three genotypes showed significant differences in high lactate concentration in the AA group (16.23 ± 0.35); AT group (13.48 ± 0.18) versus TT group (11.66 ± 0.13) ($p < .001$).

DISCUSSION

The handball sport is a game in which the anaerobic system prevails. Handball players must have a special endurance because moving them from defence to attack and vice versa. This leads to an accumulation of lactic acid in high concentration in muscles and blood of players, otherwise, the players stop playing and get early fatigue (Abo Al-Ouala, 2003; Vetter, 2007). Changes in MCT1 content are more common in response to contractile activity, whereas changes in lactate transport capacity typically occur in response to changes in metabolic pathways (Thomas et al., 2012).

Training experts believe that endurance is one of the key factors because it means the ability of the individual to maintain his level at a constant rate almost through the competition period" (2). Hence the importance of research to know the relationship between types of alleles in handball players and the ability to endurance the impact of anaerobic exercise.

MCT1 protein found in plasma membrane skeletal muscle. It has a role in exercise tolerance with ancillary protein CD147 (Mykkänen et al., 2011). Acute exercise regulates MCT1 expression and affected by many factors including nutrition, hypoxia and lactate production (Al-Haggar et al., 2017). This protein transports the proton and lactate through the plasma membrane of oxidation in muscle fibres. MCT1 protein is required for the production of lactate with white muscle fibres to enter lactate into red muscles for use lactate as the main storage of respiratory energy (Kobayashi, 2005). Therefore, the description of this missense mutation A1470T in the MCT1 gene has a role in genetic variation. Although this mutation did not change the function of MCT1 protein, there a significant effect on the polymorphism of the gene. A recent study found that polymorphism of this gene with performance endurance showed significant differences between the genetic groups.

Our results showed that the MCT1 A 1470T polymorphism of 100 handball players carrying allele A and AA genotype we high in the performance tolerance ratio with high lactate concentration in the blood compared to TT genotype. This result agrees with Al-Haggar et al suggested that A allele and AA genotype is the best, therefore the exercise and epigenetic factors increase of MCT1 protein function. So, the promoter region is active in several transcriptional factors (Al-Haggar et al., 2017). During exercise, handball players depended

on anaerobic metabolism and then followed an aerobic steady state. This indicates the use of anaerobic metabolism will increase lactate concentration during the first minutes of the exercise and then maintain muscle activity until the end of the exercise using respiratory fuel of blood flow and oxidation of muscles during the aerobic breathing phase of the exercise. As a result, fatigue comes faster, which might lead to a limitation of endurance performance (Mykkänen et al., 2011).

Pilegaard et al showed lactate capacities were different in individuals and they have a very high capacity by the extent of training and inherent athletic ability (Pilegaard et al., 1994). Our result show that AA and AT genotype groups have positive parameter for exercise performance depending on higher maximal lactate concentration in short time for Endurance of defensive and attack performance test. As that muscle work in this state does not lead to rapid appearance fatigue so may be endure this condition for a long time and some researchers consider it an anaerobic threshold (Abo-Alola & Ahmad, 2003).

Results in recent study were in agreement with previous studies in female rowers with AA genotype had high blood lactate than AT and TT genotypes. Several studies showed higher accumulation in T allele carriers. Recent research has found higher blood lactate levels in AA genotype carriers compared to carriers of AT and TT genotypes (Cupeiro et al., 2012).

So, T allele of A1470T polymorphism in MCT1 the gene is functionally important that leads to impaired lactate transport in the muscle fibre to oxidative (Calò & Vona, 2008). And accumulation the lactate in blood after high-intensity exercises this does not allow newly formed lactate. Therefore, player feels fast fatigue and his endurance was limited action.

Some studies mention that high a level of lactate induced to muscle hypertrophy by endogenous anabolic factors (Al-Haggar et al., 2017). Olga suggested the hypertrophy of muscles reach a high –power athletic level (Calò & Vona, 2008).

Finally, our study recognize MCT1 A allele is a genetic marker associated with a good endurance performance to selective handball players. And we suggested studying other genes to assessment handball players.

CONCLUSION

This research summaries that A1470T polymorphism of MCT1 gene is a genetic evidence correlation with enduring performance and lactate concentration in blood for athletes after training exercise.

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