PHYSIOLOGICAL AND BIOMECHANICAL ANALYSES OF WATER POLO GOALKEEPERS

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Abstract

The aim of this study was to examine the physiological and biomechanical demands of water polo goalkeepers. One of the important positions in the water polo is the goalkeeper because the goalkeeper is the last defense of the team. The goalkeeper is the results of the one team if teams have a strong goal keeper then those teams are successful in their competition. Also the control of the game are in goalkeeper hand, the goal keeper must control the speed of the game because from the point of physiology , the goalkeeper have low heart rate and intensity in greater duration of the game than other field players. All the goalkeepers for being successful in their position, they have to exercise on their eggbeater kick. Because the egg better kick is the most important skill for goalkeepers. As the point of biomechanics the Eggbeater kick is strongly related to foot speed and ankle rotations. In addition the better performance of eggbeater kicks more focusing on Anteroposterior (backward and forward) motions and less vertical motions of the feet than poorer performance.

Keyword: water polo, goalkeeper, physiological demand, biomechanics demand

Introduction

Water polo is a popular and high intensity sporadic game(Farajian, Kavouras, Yannakoulia, & Sidossis, 2004). The water polo team are involved the 13 players that 2 of them are goalkeeper and the rest 11 players are field players. There is no so much research that has been done about the water polo goalkeeper also in physiological demand of water polo goalkeeper. In so many years ago that the water polo just was played in Britain, the coach always put the weakest and laziest players on the goal because they believe that on that position they do not do more activity. (Nitzkowski, 1998).Also in the most of the time the coaches chose the breaststroker swimmers for the position of the goalkeeper because they think that they have the strong frog kick for coming up from the water and harness the ball. (Donev & Aleksandrović, 2008; Petric, 1991; J. R. Smith & Norris, 1989).However the kicking that the goalkeeper do in their position are totally different from breaststroke swimmer T the goalkeeper doing the kick that called eggbeater kick.(R. Sanders, 2003). But after the years the coach realizes that the most important position in the water polo that causes the team be successfully or the loser are just the center field player and the goalkeepers.(Donev & Aleksandrović, 2008; Petric, 1991). On previous research the researcher have been reported that the water polo player perform near the hundred spring activity with high intensity during the water polo competition with the duration ranging from 7 to 14 second.(Mujika, McFadden, Hubbard, Royal, & Hahn, 2006). Eggbeater kick is the most important and fastest skill in the water polo for both field players and especially goalkeepers. The players in water polo use this kind of kicking from the low intensity for resting time to very high intensity for getting up their body from the water.(Ross Sanders, 2005). Actually the coach in the water polo especially the goalkeepers coach has to know about the physiology and biomechanics of the water polo goalkeeper and eggbeater kick, so in this article the researcher reviewed some article that research about biomechanics and physiology of the goalkeepers.

The goalkeeper

The goalkeeper is the person that has responsibility to defense of the goalie from the opposing team. In water polo the 6 field players are the first defense and the last defense are the goalkeeper.so the coach must search for a good athlete to choose for a goalkeeping.(Nitzkowski, 1998; Petric, 1991; J. R. Smith & Norris, 1989). The goalie is the important position in the water polo because the speed of the game and also the Counter-Strike of the team or depending to the goalkeeper performance. The result of water polo team games depends, to a great level, on his/her performance. One of the most important different between the goalkeepers and field player are that the field players must swim long distance between the goal but the goalkeeper must stay on their position vertically under the goalie and will be ready for any various jumps.(Hohmann &

Frase, 1992; Pinnington, Dawson, & Blanksby, 1988; Platanou, 2009). The basic of water polo goalkeepers are divided to 3, leg, upper torso, arms and hands.

Legs

A great eggbeater kick is a must. In the past, many goalkeepers were breaststroke-type swimmers who had a good frog kick, which provided a strong body lifting motion but no base. Goalkeepers using the breaststroke kick tended to surge then sink. Shooters needed only a good fake followed by an accurate shot to score. To create the eggbeater, the goalie alternates legs while frog kicking. The eggbeater gives the goalkeeper a solid base and the ability to stay up in a stable position until the ball can be blocked. Goalkeepers must be trained in the eggbeater until they have great leg strength and the ability to ride steady in the upright position. This involves a great deal of leg conditioning in both the horizontal and vertical positions.(Nitzkowski, 1998; Petric, 1991; H. K. Smith, 1998; J. R. Smith & Norris, 1989)

Upper torso

Beyond quickness and flexibility, goalkeepers must have strength. Therefore, they should spend time in the gym working to build upper body strength and thickness. Complete stretching exercises should be included in the regimen. The perfect combination of upper body characteristics for the goalkeeper is adequate thickness to absorb the perimeter power shot, and quickness to help block drive, two-meter and quick-release shots following a cross pass. Successful goalkeepers work to develop both upper body strength and quickness. (Nitzkowski, 1998; Petric, 1991; H. K. Smith, 1998; J. R. Smith & Norris, 1989)

Arms and hands

Long arms and quick hands are advantageous to any goalkeeper. It's difficult (sometimes impossible) to teach quickness. Therefore, it's advantageous to find goal candidates with quick-twitch fibers. Quickness can be improved with individual athletes, but much must be inherent—that's why it's advantageous to find those with native quickness, and then train them to become even quicker. Playing other sports which call for quick hands is good for goalie training. Volleyball, racquetball, handball, team handball and table tennis are all good activities for goalkeepers. Hitting a boxing speed bag (punching bag) is excellent training for hand quickness. All goalkeepers should own a water polo ball and continually handle it. Quick wrist ball bouncing while standing next to a wall is good training. (Nitzkowski, 1998; Petric, 1991; Smith, 1998; Smith & Norris, 1989)

Physiological demands of goalkeeper

There is a limited information for physiological request of goalkeeper, there are only two studies on cinematic analysis and one research for measuring the lactate acid at the end of the water polo game.(Platonou & Thanopoulos, 2000; H. Smith, 1991). The studied demonstrate that as the time is going to the end of the game, the players play with the low intensity and that because of the fatigue of them.(Platanou, 2009). Also in the year 2006 Mujika.at al did a research about the water-polo intermittent shuttle test between 104 water polo players male and female from different religion. He divide them to three group of center player, field layer and goalkeeper (field players (n = 70) other than center forwards (n = 16) and goalkeepers (n = 18)). They did a WIST test that is containing 2×7.5 m go and back at gradually increasing the speed. The WIST test was reliable in 2003 Australian capital territory academy of sport water polo program. The results of the test was that the field players covered the most distance in the test (305±154m) and after that was center forward (255±118m) and then goalkeepers (203±135m). The goalkeeper and other players have a significantly different in distance but there was no any different between three groups in peak Hr (goalkeepers 183±7bpm , center forward 179±8 bpm , field players 184±10bpm) and La_{blood} (goalkeepers 5.4±2.3 mmol/L , center forward 6.4±2.4 mmol/L, field players 6.4±2.4mmol/L). Differences were also witnessing in the pooled WIST act of field players, center forwards, and goalkeepers, in keeping with the specific requirements of their respective playing positions. (Mujika et al., 2006). In other side the Platanou did a research about the basic physiological parameters change in goalkeeper during the game. He did the video

analysis of their activity, checking their blood lactate and records their heart rate of them during the water polo match. He observes that the mean heart rate of the goalkeepers in just playing time (exclude the break time) was 134.3±20.3 for 36 minutes of game duration. He find out that the most part of the game that around the 85% of the game , goalkeepers play with the lower heart rate than 151.4±2.7 bpm and the rest of 14.4% of the game the heart rate of them sudden increase above the anaerobic threshold. Also the La_{blood} was measured in the end of each period that was 3.93±1.64 mmol/L , the individual lactate values was varied from 2 to 8.3 mmol/L. but the important thing that He observed was that the heart rate of the goalkeeper suddenly increase when their team should play with one player less that opposite team. (Platanou, 2009)

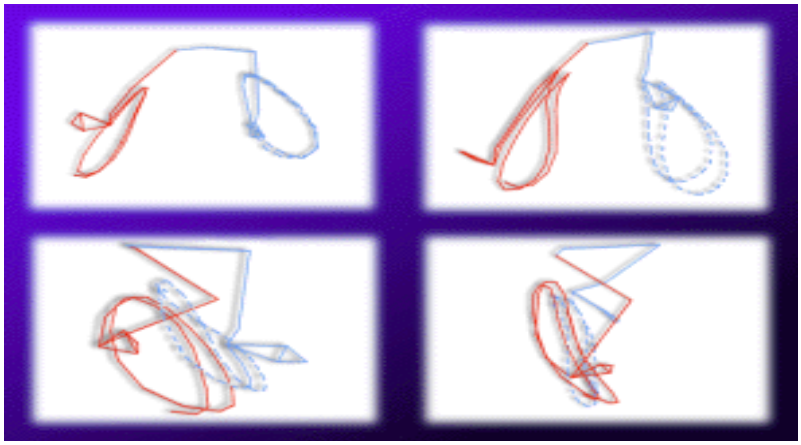
In conclusion the goalkeeper has intermittent position with great variability in the intensity performed. The goalkeeper plays with the low intensity and stress in the great duration of the game and have the high intensity exercise in lower duration of the game. The intensity of goalkeeper exercise does not different from period to period of the game.

Eggbeater kick and biomechanics demand

In water polo the players use two methods to raise their body out from the water for receiving a pass or passing the ball or shouting and goalkeeper for blocking the ball. The first method is called BOOST, in this method the players just driving the upper body upward explosively to achieve the maximum vertical jump , this method mostly use for goalkeepers and the second method is HOLD , in this method the players should keep their body in elevated position for a while. IN both of them the players must use the kicking that called eggbeater kick. The eggbeater kick is the kick that the water polo players used in during the game. The eggbeater kick is totally different from the frog kick in swimming and also trading water.(Zatsiorsky, 2002). The eggbeater kick is the kind of cycling kick of lower body with the movements of right and left side being similar but opposite in phase. The different between the BOOST and the HOLD is that in BOOST the player should kick just one explosive kick but in the HOLD they should kicks as fast as they can for keeping their body in upward position.(R. Sanders, 2003; Ross Sanders, 2005; R. H. Sanders, 1998). Schleihauf did a research about biomechanics demand of eggbeater kick. He gave the participant 30 second eggbeater kick in hold position. The participant was not allowed to do sculling with their hand and they should put their hands out of the water and try to keep their body as upper as they can from the water. He captured the video type from the underwater kicking of the players. He realizes that the most active part of the leg is speed of the feet, the joint actions contributing to the action of the feet and the joint angle influencing the orientation of feet. Eggbeater kick Pitch and sweep back angles were defined in accordance with the definitions of pitch and sweep back angles of the hand in swimming (Bixler & Riewald, 2002; Ross Sanders, 2005; Schleihauf, 1979).

Correa in 2006 reported that the eggbeater kick that used in water polo for keep them afloat in upright position, is strongly related to foot and ankle rotations. (Corrêa, Teixeira, Hirata, Silva, & Guimarães, 2006).

As would be predictable from hydrodynamic ideology, the raising body from the water in is strongly related to foot speed. In addition the direction of the foot action is important for keeping body afloat on water , the best performance of eggbeater kick use more Anteoposterior (backward and forward) action and less vertical (down and up) action of the feet during the eggbeater kick. As you can see in the figurer below it showed that the best performance of eggbeater kick on left and poorer performance on right.



Eggbeater kick is the cycling (round out) kick with the combination of hip extension and flexion, internal and external rotation, Hip abduction and adduction and knee flexion and extension.(R. Sanders, 2003; Ross Sanders, 2005) There are many big and small muscle that are involved in eggbeater cycle, such as Psoas Major and Iliac us, Gluteus Medias, Gluteus Maximus, Quadriceps, Adductor Lingus, Pectin us, Adductor Magnus, Semimembranosus and Semitendinosus, Graceless, Biceps Femora's, Tibialis Anterior; Extensor Digitorum Longus; Peroneus Tertius; Extensor Hallucis Longus, Peroneus, Gastrocnemius; Soleus; Flexor Digitorum Longus; Flexor Hallucus Longus, Tibialis Posterior. These muscles are important for a best eggbeater kick performance.

Conclusion

The goalkeeper is the sensitive post in water polo that have high intensity and low intensity during the game.so the goalkeeper can be the best leader for water polo team because in the most greater 85% of the time duration he has the low heart rate than other players. As biomechanics principle of goalkeeper, they use the eggbeater kick for their actions and the eggbeater kick are strongly related to foot speed and foot angles direction.

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