Field Hockey Physiology

ESS 110

Margaret Winter

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All sports require the use of the body’s different energy systems. The three energy systems are the ATP-PC (anaerobic), glycolytic (anaerobic), and aerobic systems. One sport in which player performance relies on these energy systems is field hockey. Despite how different Field Hockey is from other field sports, it is physiologically fairly similar. It is similar in the sense that its bioenergetics requires an interaction of all three energy systems, and each energy system plays a specific role in energy supply during the game. Both ASEP (3) and myself determined what the physical requirements are and to what degree they are used in field hockey (Table 1).

Table 1: The importance of the physical requirements of field hockey

<table>
<thead>
<tr>
<th>Energy Fitness</th>
<th>Muscular Endurance</th>
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<tbody>
<tr>
<td></td>
<td>Aerobic</td>
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<tr>
<td>ASEP</td>
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<td>Me</td>
<td>H</td>
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A plethora of studies and research validate what is shown in Table 1- that the aerobic energy system is highly important to field hockey, and the anaerobic systems are moderately/highly important (summarized in Table 2).

Table 2: Components of each energy system addressed in studies

**ATP-PC (0-6 sec. very intense)**
- intermittent nature allows sufficient rest in between high intensity movements, replenishing the phosphate stores (2)
- Test for with Wingate 10 sec. test. (2)
- Stick skills/movements require ATP-PC system (4)
- Acceleration (which requires ATP-PC system) is more crucial than max speed (4)
- 1.5% of game is spent sprinting (6)
- an avg. of 30±14 sprints per player per game (5)

**Glycolytic (30sec- 2 min heavy)**
- post test blood results contain lactate- glycolytic system contributes to energy (2)
- Test for with Wingate 30 sec. test. (2)
- 4.1% of game is spent striding (6)
- Players stride 75±22 times per game (5)
Aerobic (>3 min. light)

- 80% of game, but not enough alone, also need anaerobic energy supply (2)
- Test for with VO_{2 max} test (2)
- Has big influence on the standard of play (4)
- FH is predominantly an aerobic sport (4)
- 40.5% of game is jogging and 46.5% spent walking (1)

Time-motion analysis indicates that in women’s field hockey about 80% of the game is spent doing low-intensity movements such as walking and jogging. These low-intensity long duration activities require the use of the aerobic energy system (2). A study on 21 elite women field hockey players from The Netherlands used intermittent field tests, which are very similar to the intermittent nature of field hockey (continuous changing between low and high intensity movement). An ISST test of ten shuttle sprints every 20 seconds found that the aerobic energy system supplies energy during bouts of repeated sprints during a game (2). In a field hockey game players typically sprint with or to the ball then actively recover for about 20 seconds before having to sprint again. The 20 seconds of active recovering consist of aerobic movements such as jogging and walking. The aerobic recovery is crucial to replenishing energy and breaking down lactic acid so the player can be ready for his/her next sprint. Since the average player sprints 30±14 times during a 70 minutes game (5), there is a lot of active recovering in between, thus making the aerobic energy system essential to supplying energy in between sprints. The same study used a repeated 30-second shuttle run over a 20-meter course (the ISRT test), which like the ISST test simulated the intermittent nature of a field hockey game. Results from this test indicate that the aerobic energy system is crucial to endurance running. The longer distance and duration of this test incorporated more endurance than
the ISST, yet also yielded results that indicated the aerobic energy system contributes to supplying energy to perform these movements in field hockey (2).

While the aerobic system contributes to the energy supply for repeated sprints and longer duration striding with recovery time in between (2), it is the primary energy system used for low-intensity and long duration (greater than three minutes) movements such as walking and jogging. A time-motion analysis of field hockey determined that players walk about 272±49 times and jog 362±58 times during a game (5, Table 3).

Table 3: The results of a time-motion analysis of a field hockey game

<table>
<thead>
<tr>
<th></th>
<th>Standing</th>
<th>Walking</th>
<th>Jogging</th>
<th>Striding</th>
<th>Sprinting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (n)</td>
<td>77±11</td>
<td>272±49</td>
<td>362±58</td>
<td>75±22</td>
<td>30±14</td>
</tr>
<tr>
<td>Duration (s)</td>
<td>3.6±0.6</td>
<td>6.9±1.0</td>
<td>5.1±1.0</td>
<td>2.1±0.3</td>
<td>1.8±0.4</td>
</tr>
</tbody>
</table>

As a result of the frequency with which field hockey players perform these aerobic movements, their max VO₂ levels increase over the course of the season (4). The improved max VO₂ levels is the evidence that the aerobic energy system is crucial to field hockey. Emphasis is placed on aerobic conditioning because it is so essential to the game that it plays a key role in performance (4). These studies support ASEP’s categorization of field hockey as a highly aerobic sport (Table 1). However, the aerobic energy system is insufficient to cover all of the energy needs of field hockey players, help from the anaerobic energy systems is needed as well.

The anaerobic energy system is broken down into two parts- the ATP-PC and glycolytic pathways. The ATP-PC energy system is used for very intense, very short movements lasting 0 to 6 seconds (3). When intense movements last longer than 6 seconds but less than 2 minutes the glycolytic pathway supplies energy to the body (3). Even though field hockey is primarily an anaerobic sport, 20% of the game is spent in high-intensity movement such as running and sprinting, thereby making the anaerobic...
energy systems crucial to the game as well (2). The ATP-PC energy system is important for several reasons. One of those reasons is that according to time-motion studies, field hockey players change movement patterns approximately every 5.5 seconds (6). This means that a lot of energy is used in short, intense movements like accelerating, decelerating, and changing direction movements that enlist the ATP-PC pathway for energy. Since field hockey incorporates varied sprint distances accompanied by periods of acceleration, deceleration, and directional changes, all with the body in a low crouched position, shuttle tests (which are composed of these elements) are a valid measure of physical fitness in field hockey players (1). Based on this concept, one study used intermittent shuttle tests (the ISST and ISRT) to research the energy demands and systems used by field hockey players. These tests supported the importance of the anaerobic system. This study also incorporated the Wingate 10-second and 30-second tests. The results of the Wingate 10-second test correlate to the number of 20-meter runs in the ISRT test, indicating that the ATP-PC system contributes energy to intermittent movement similar to field hockey (2). In addition to the accelerations and decelerations associated with sprinting, the ATP-PC energy system is needed for stick movement and dribbling skills while sprinting (4). Results from blood tests show the presence of lactate, which indicates that the ATP-PC anaerobic energy system is not the only one helping field hockey players perform.

The glycolytic anaerobic energy pathway is important for any of the high intensity movements such as a long or repeating sprints. The Wingate 30-second evaluated field hockey players’ anaerobic energy systems (2). Since the intense activity lasted longer than 6 seconds, the glycolytic pathway supplied the athletes with energy. The use of the
glycolytic energy system increases with fatigue since players will stand and walk more causing them to be out of position and forcing them to have to sprint longer to get to the ball or play (6). However, since both anaerobic systems only contribute to about 20% of the game, they are essential, but not always highly utilized; the findings from these studies further support ASEP’s analysis of field hockey as a moderate/high anaerobic sport (5, Table 1).

Scientific studies support ASEP’s and my energy analysis of field hockey. They support that there is a high importance of the aerobic energy system and moderate to high importance of the anaerobic energy system (Table 1). This information can be useful when coaching because training programs and team tryouts can utilize the tests in these studies. The intermittent nature of shuttle tests such as the ISST and ISRT makes them similar to game-like conditions. Thus, coaches can use them to evaluate athletic performance, as well as an aid in figuring out what positions to put athletes in. Understanding that field hockey is 80% of the time aerobic and 20% of the time anaerobic in nature enables coaches to properly condition their players so that they can perform optimally in competition.


