Poor aerobic fitness

Hockey – defensive channelling

C1 – Aerobic Fitness Defensive skill 1 – defending/channelling on the left side:

 For this particular skill a requirement for cardiovascular aerobic fitness and stamina is needed. I must be able to track back with the attacker, reflecting his every move. The attackers’ aim is to beat/out run me with fast paced actions; I must be able to match his pace of movement or even beat it. This requires a certain level of anaerobic fitness for quick changes in direction, but mainly aerobic due to the length of the match. This defensive situation may be at any point of the match, however as the match progresses I would find myself in many defensive situations of this type. This would mean I will gradually start to endure the effects of fatigue. This means my ability to match my opponents speed of movements will decrease due to a lack of aerobic fitness. The onset of fatigue will be due to a build-up of lactic acid. This creates an increasing inability to maintain speed and fast defensive actions. For example the jab tackle will be increasingly strenuous to perform and therefore become in-effective. Throughout the match I have little time to slow down or stop and rest. This means I am almost constantly running and using my aerobic energy system; meaning I should be remaining under my lactate threshold. In hockey however bursts of power and speed are needed and therefore I switch to anaerobic lactic acid energy system and ATP-PC systems. This enables me to perform those bursts of speed, e.g. when channelling. Due to the nature of the game this would have to be used on many occasions therefore crossing my lactate threshold and inducing the onset of blood-lactate accumulation. Each channel/defensive execution will become more intense, consequently muscle contractions in the used muscle groups require more ATP. In order to resynthesize ATP more glucose is needed to be broken down through glycolysis, resulting in a large number of hydrogen molecules being produced in the Krebs cycle. To facilitate this, oxygen is required in the electron transport chain to combine with the hydrogen to produce the ATP. However there is so much hydrogen and not enough oxygen. This is due to my lower VO2 max which means I cannot get enough o2 to the working muscles. Therefore the excess hydrogen joins with the bi-product of glycolysis – pyruvate. This combination forms lactic acid, lowering the PH levels in my blood and muscles. This subsequently leads to fatigue. Therefore, it becomes increasingly hard to remain at high intensity for longer periods of time. This means that where, for example Rich Mantell could continue performing the defensive action of channelling perfectly even when the onset of fatigue occurs, I would become lethargic and slow in my channelling not being able to match my opponents speed and pressurise a mistake effectively.

C2 - Aerobic Fitness Defensive skill 1 – defending/channelling on the left side: Altitude Training.

The main issue with my channelling is my inability to maintain the speed of movements. This is due to a lack in aerobic fitness. My chosen corrective measure is altitude training; this will allow me to improve my aerobic fitness without changing the type of muscle fibres from type 2a to type 2b. Altitude training enhances aerobic fitness because the body has to adapt to the low levels of oxygen. The body does this in several different ways. One is the increase in the number of red blood cells, a result of this is increased haemoglobin volume and concentration. There is also an increase in capillarisation of the alveoli in the lungs, creating larger surface area of capillaries. This results in faster gas exchange through diffusion and therefore quicker transportation of oxygen, which means I wont cross the lactate threshold as early. As well as this, the body can deal with lactic acid more effectively. These benfits can last up to ten to fourteen days once I return to sea level.

The three phases I need to go through in order to achieve successful results from my altitude training are as follows:

- Acclimatisation: I will start to acclimatise as soon as I reach altitude. My body will begin adapting to the new conditions. I will need to start some form of light exercise in order to kick start the body adaptations. I need to start with light exercise because my body wont sustain high intensity exercise for a long period of time due to the lower partial pressure of oxygen, also I will require plenty of recovery time. This prolonged period of recovery time is due to the lack of oxygen intake at altitude and therefore slower recovery rate. This whole phase may take 3 to 10 days.

- Primary Training: This is the phase where the training I do increases progressively in both intensity and frequency. This will enable my body to continue acclimatisation but also adapt to the increases. I will carry on increasing training until I reach the level of training I was at sea level. Due to the nature of hockey I will need to vary my training, I must do sprints but mainly longer distance running to improve my aerobic fitness. This phase would last up to 3 weeks.

- Recovery: This phase will last for 2 to 5 days depending on the intensity of the previous exercise. This phase is to prepare for the return back to sea level, allowing me to recover from fatigue; training will decrease in intensity over this period.

During my return to sea level there are another three phases where the effects of altitude training are apparent:

- Positive phase: In the first couple of days after returning to sea level there is a significant increase in the capacity of the blood to carry oxygen.

- Progressive return to sea level: This phase involves the introduction to progressive levels of exercise, focusing back to my specific sport. Levels of performance may be varied as co-ordination and skill based performance were not used at altitude. After acclimatisation to sea level has occurred, increased levels of co-ordination and fitness levels are noticeable.

- Final/finish: My aerobic fitness will be at its peak 15 to 20 days after returning to sea level. This would be the best time for me to compete/play a match. The positive factors, increased oxygen transport, improved economy and maintenance of breathing adaptations explain the better performance.

There are also negatives to altitude involved when travelling to do altitude training. One of which is the noticeably decrease in the amount of skill based training when at altitude. This will mean when I return to sea level and compete, my fitness will be improved but my skill based performance will be low. Another drawback to altitude training would be the cost. It would be very expensive to travel to and from high altitude areas and also receive the expertise required to train at altitude. There is also a risk of me getting altitude sickness and also the fatiguing factors of long distance travel that will prevent me from training.

An alternative method of achieving the benefits of altitude training but taking away unwanted side effects and considerable cost, I could enrol the use of a hypoxic tent. This tent would still cost money but considerably less than travelling and training at altitude. The hypoxic tent replicates the conditions of high altitude by reducing the amount of oxygen inside the tent. This would allow me to train as normal at sea level without hindering my skill based performance; I would then recover/rest in the tent to receive the benefits of altitude training. This is also becoming recognised as most beneficial to live and sleep at altitude but to train at sea level; the hypoxic tent allows me to do both in a much more feasible way.

This altitude training will allow me to channel more effectively because I wont pass my lactate threshold so quickly and can maintain aerobic energy systems for longer, enabling me to quickly switch over to anaerobic movements when I need.

Horseriding – Jumping an upright

**-Jumping an upright**

**C1: Cause – Poor Aerobic Fitness**

When jumping a show jumping course I get very tired by the end of the course and I find it hard to maintain jumping up-rights efficiently, due to my lack of aerobic fitness. This causes me to get left behind in the jumping position as I do not have the energy to be quick enough to fold, it can also cause me to lean to the side and dip my back. Low intensity exercise activities, such as jumping an upright in a show jumping course, with duration of longer than 1-3 minutes use the aerobic system generally. This system requires oxygen. In the aerobic system ATP is regenerated from glucose in three stages. The first is Glycolysis; this is where glycogen is broken down into glucose, which is then broken down into pyruvic acid, with a net of 2 ATP produced. The second is the Krebs cycle; the pyruvic acid diffuses into the matrix of the mitochondria and a complex cycle of reaction occurs. The reactions result in the production of two molecules of ATP plus carbon dioxide and hydrogen. The carbon dioxide is breathed out and the hydrogen is taken to the electron transport chain. The third is the electron transport chain; the hydrogen given off in the Krebs cycle is carried to the electron transport chain by hydrogen carriers. This occurs in the cristae of the mitochondria and the hydrogen splits into hydrogen ions and electrons. They are charged with potential energy. The hydrogen ions are oxidised to form water while the hydrogen electrons provide the energy to re-synthesise ATP. Throughout this process 34 molecules of ATP are formed. Fats can also be used as an energy source in the aerobic system. They are broken down first into glycerol and then free fatty acids. These fatty acids go through a process called beta oxidation. This is where they are broken down in the mitochondria to produce acetyl-CoA, which is the entry molecule for the Krebs cycle. From this point on, fat metabolism follows the same path as carbohydrate (glycogen) metabolism. More ATP can be made from one mole of fatty acid than one mole of glycogen, which is why in long-duration exercise e.g. a cross country course; fatty acids will be the main energy source.

I have low aerobic fitness due to my poor VO2 max. I have a poor VO2 max due to my lack of cardiac hypertrophy and also due to my lack of capilliarisation of my muscles, which means I have a lower resting stroke volume and a lower cardiac output. Therefore I have less oxygen going to my working muscles and so I have less time before the build up of lactic acid in my muscles, so I reach my lactate threshold quickly. This poor VO2 max means that I have an inability to take in and use oxygen efficiently. A lack of oxygen means that I go to anaerobic systems sooner and build up of lactic acid because there is not enough oxygen to join with hydrogen. As my aerobic fitness is low it means that my production of ATP for energy is low. This causes me to be tired by the end of the course. This causes me to not look up and ride a straight line into uprights (causing me to get the wrong stride) and as I am tired by the end I do not sit up quickly enough or fold quickly enough.

Other possible causes will be that I have a high resting heart rate and a low resting stroke volume. I have an insufficient transport and use of oxygen and this means that my fat is not used during the exercise. Finally my maximal oxygen consumption (V02 max) is low.

**C2: Corrective measure – Continuous training**

A type of training that I could use to help improve my aerobic fitness therefore improving my efficiency of jumping uprights by not becoming tired at the end of a show jumping course, allowing myself to fold and sit up quickly after an upright, would be continuous training. Continuous training involves exercise without rest intervals. As this will place stress on my aerobic energy system. It will concentrate on developing my endurance, which will help me to gain stamina in order for me to be able to maintain my stamina throughout the course, allowing me to jump uprights efficiently. The types of activities that I will undertake for this training will be swimming, cycling or running.

For me to make improvements in my aerobic fitness, it is important that I follow the principles of training which are, specificity (I must make sure that the training I do is relevant to jumping uprights), progression (I must make sure I apply the gradual application of overload), overload (this involves increasing one of either, frequency, intensity, time or type), reversibility (making sure I do not de-train) and tedium (I have to make sure that I avoid tedium; I will need to make sure that my training programme has variety in order to help maintain my motivation and interest).

I must train at least three times per week and I must train at 60-75% of my maximum heart rate. When I train it should last for at least 20 minutes however, 30 minutes to 2 hours would be best. This will make sure that my aerobic system is working properly. I should apply the principle of overload after a few weeks, as my body will adapt to the exercise and my resting heart rate will decrease. So to ensure that I am working at 60 – 75% of my maximum heart rate, I will need to work harder by increasing frequency, intensity or time. The training that I carry out should be specific to the requirements of jumping an upright. I need to be careful not to over train as this could cause me an injury where I would detrain as my level of aerobic fitness will drop if I stop training. By keeping the training interesting by varying the training skills, loads and activities it will keep me motivated.

Fartlek training would be a slightly different method of continuous training, to keep my training varied in order to not become un-motivated. The pace of the run is varied as this will stress my aerobic and anaerobic energy systems. This will improve my Vo2 max and recovery. A session should take me around 40 minutes and I should work at high and low intensities.

The effects of this training will decrease my resting heart rate and will increase my resting stroke volume. My heart will undergo cardiac hypertrophy where is will increase in volume and get stronger, this means that an increased volume of blood can be pumped per beat and per minute. I will have increased muscle stores of glycogen and triglycerides which will give me more energy when jumping uprights to fold and sit up quickly. I will have increased capilliarisation of my muscles so that more oxygen can be taken and diffused into my muscles to allow them to work for longe and prevent the build up of lactic acid. I will have an increased number and size of mitochondria in my body which will help with aerobic respiration as this is where it takes place. Also, I will have a more efficient and effective transport and use of oxygen and this means that my fat will be used more during exercise (carbs will be saved for higher intensity). Finally my maximal oxygen consumption (V02 max) increases as a result. VO2 max is the maximum amount of oxygen taken in, transported and used by the body per minute. Therefore due to the above factors my stamina and fitness will increase and so this will improve my aerobic fitness allowing me not to become tired at the end of a show jumping course so that I can jump an upright without being tired, preventing me from getting left behind and not sitting up quickly.

Rugby – Passing

C1- Passing

Lack of Aerobic Fitness

Throughout the duration of a rugby match I can make quite a few passes. As a result of this and the other aspects of the game, my technique can begin to fade as my body fatigues in the later stages of a match.

My body fatigues as a result of low levels of oxygen consumption, which is required for the range of muscles used in passing. The lack of oxygen will have a negative effect on my passing technique, as I am unable to get in the correct preparation position quick enough or complete the action efficiently and with precision. This can lead to an off target pass or not passing quickly enough therefore spoiling an opportunity.

My muscles will require more ATP in the short sharp action of passing, meaning that more ATP must be resynthesized in reaction to this. Therefore more glucose is broken down through the process of glycolysis, forming pyruvate. This joins with coenzyme A to create Acetyl coenzyme A. This leads in to the Krebs cycle, where hydrogen is produced. This then leads in to the Electron transport chain where oxygen re-joins with hydrogen. There is excess hydrogen when there is not enough oxygen present, which is as a result of poor V02 max. This excess hydrogen combines with pyruvate as it is a bi-product of glycolysis. The combination of hydrogen and pyruvate forms lactic acid. This leads to fatiguing, as result of acidosis (build-up of lactic acid). As this occurs it becomes increasingly difficult to perform a pass as effectively as I would have at the start of a match. It leads to a drop in my technique, and not getting my hands up as a target for the player passing to me. This can lead to the pass I receive being off target. Once more due to my fatiguing I do not get my passing elbow high enough to perform a flat pass which either sends the ball too high or too low to the receiver, giving them an awkward pass to receive. This slows down the pace of play or a move if being performed, and in the worse scenario could lead to the opposition regaining possession.

C2- Altitude Training

To prevent my passing technique from failing as I tire throughout a match, I have chosen altitude training as it enhances aerobic fitness as the body is forced to adapt to receiving lower levels of oxygen.

The main problem with my pass is I am unable to maintain the high speed required in the passing motion during the later stages of a game. This is down to a lack in aerobic fitness. To combat this however, I do not wish to do too much distance running as I don’t want it to affect the muscle fibres in my legs, as I do not want any of my type II B muscle fibres transforming into type II A fibres. The corrective measure I have chosen, in view of these factors, is altitude training.

Altitude training enhances aerobic performance because the body is forced to adapt to lower levels of oxygen. It responds to this lack of oxygen in multiple ways. There is an increase in the number of red blood cells, and with this increased haemoglobin volume and concentration. There is increased capiliarisation on the alveoli in the lungs, creating a larger surface area of capillaries, enabling a much faster rate of gaseous exchange through diffusion. As well as increasing the rate of oxygen transportation, the body is able to buffer lactate more effectively. All of these changes will result in me seeing an improvement to my V02 max. Which improves my overall performance as there is more oxygen available, therefore means that the hydrogen ions can join with 02, as opposed to any spare H ions having to join with pyruvate. These benefits continue for ten to fourteen days after I return to sea level. Therefore, I would time this training so that I could return to compete in an important match and be able to feel the positive effects.

Altitude Training happens in three phases:

1. Acclimatisation- This happens as soon as reach altitude, and usually occurs for 3-10 days. Here I would get used to reduced partial pressure of oxygen (p02) and need to take longer recovery time in comparison to when at sea level.
2. Primary Training- Lasts between 1-3 weeks. I would progressively increase the amount of training, until capable of training at intensity I was at sea level.
3. Recovery- Lasts 2-5 days. It is the preparation of returning to sea level, it is an opportunity to recover from the fatigue as a result of the high altitude and gradually reduce frequency and intensity of training.

After I return from altitude to sea level, there are three further phases that take place.

1. Positive Phase- This is when I will have an increased capacity of oxygen being carried in the blood, usually lasts up to four days.
2. Progressive Training- The volume and intensity of my training will gradually increase, however level of performance may drop as a result of altered fitness levels and coordination losses from the altitude training. After several days of this there will hopefully be improvements in fitness and coordination.
3. Fitness Peak- The optimal time for competing is 15-20 days after returning to sea level. This is due to there being a mixture of positive factors; increased oxygen transport, more economical breathing. Leading to a better performance in this final stage.

It is essential to try and stick to this schedule when training at altitude at within the recovery process, in order to see the best results and prevent any risks to my health.

Judo - Morote Seoi Nage

C1 Morote Seoi Nage - Lack of Aerobic fitness:

When performing in a judo match I can become fatigued towards the end of the match, as well as between the stages of execution and recovery, as I can struggle to rapidly change energy systems from aerobic to anaerobic when squatting down to then pick up the opponent and throw them over my shoulder. My lack of aerobic fitness is visible towards the end of a five minute match as I lack the energy to attack and therefore tend to hold off my opponent playing defensively rather than challenging them, as I hit my wall due to the lack of energy. The aerobic energy system is used here as the activity lasts longer than one to three minutes, and oxygen is required to sustain energy levels. Also in major competition you can have up to five fights a day therefore aerobic fitness is very important, also in competition fights are not always continuous, they are more of a stop start exercise therefore matches require a good level of aerobic endurance. Having a lack of aerobic endurance therefore means that I cannot work at a consistent intensity for long periods of time making it easier for the opponent to throw me over when fatigue starts to set in.

The aerobic energy system requires oxygen to complete the breakdown of glucose and this happens in three stages. Glycolysis is the initial stage of the breakdown of one molecule of glucose in the sarcoplasm, the process of breaking down the molecule of glucose produces the chemical pyruvate, with a net production of two adenosine triphosphate (ATP). The end product of Glycolysis is then added Coenzyme A resulting in it becoming acetyl coenzyme A which allows the chemical to enter the net stage of aerobic breakdown which occurs in the mitochondria and is known as the Kreb’s cycle. This stage contains a series of enzyme driven reactions that oxidise acetyl coenzyme A resulting in the formation of carbon dioxide which is then breather out in respiration. Also hydrogen atoms that form part of acetyl coenzyme A combine with hydrogen carries which eventually reach the next stage called the Electron Transport Chain. At this stage a series of carries oxidise the hydrogen to produce water, and large amounts of ATP are produced with a total yield of 38 ATP with 34 ATP formed in this last stage. Fat can also be used as an energy source for the aerobic energy system. Fatty acids formed from the breakdown of triglycerides are themselves broken down in sarcoplasm by beta oxidation – this is where fats are broken down into acetyl coenzyme A. This then enters the Kreb’s cycle and eventually the electron transport chain resulting in both carbon dioxide and water, however even more ATP can be produced but far more oxygen is required which is why this source is used in long duration activities. The advantages of aerobic energy production is that it does not produce any fatiguing products and far more adenosine triphosphate are produced from aerobic metabolism than anaerobic therefore more energy can be utilised.

The aerobic system can also be measured by calculating my VO2 max, this is the maximum amount of oxygen taken in, transported and used by the body per minute. A higher VO2 max is better and means that there is more oxygen being transported to the muscles to supply energy, however having a lack of aerobic fitness suggests that I have a lower VO2 max. This could be cause by factors such as lacking cardiac hypertrophy which means the efficiency of the heart is lowered, also causing me to have a lower resting stroke volume and cardiac output. Therefore less oxygen is transported around the body and to the muscles so the accumulation of lactic acid becomes quicker.

Also VO2 max is dependent upon the surface area of alveoli, red blood cell and haemoglobin levels, the capillary density in the lungs and muscle cells, transfer of oxygen to the mitochondria via myoglobin and take up and use of oxygen by mitochondria. Therefore if I am naturally lacking in any of these areas the aerobic energy system becomes weaker causing an in efficiency in transporting oxygen to the working muscles. Training to improve aerobic fitness will also improve my VO2 max and the most of the factors it depends upon, although some are genetically determined, aerobic training can help in improve the efficacy of the aerobic energy system.

C2 Corrective measure – Continuous training:

The training method that would help to improve my aerobic fitness is continuous training. This method of training includes exercises such as running, swimming, rowing or cycling at a ‘steady state’ in order to develop aerobic endurance as I often get fatigued in the later stages of competition. As well as in the execution stage of my lack of aerobic fitness makes it hard to complete the throw successfully by picking up my opponent and throwing them over my shoulder as I do not have sufficient oxygen are therefore energy in my muscles to successfully pick my opponent up. Undertaking running activities involves variation of distance rather than speed, and swimming activities involves varying the stroke, distance and speed in order to work the aerobic energy system. Continuous training is also focused upon developing the aerobic system so that both stamina and endurance are increased, this method of training is therefore beneficial as I need to improve my stamina in order to hold off fatigue during competition and improve the throw Morote Seoi Nage.

Continuous training should be performed at a constant intensity and therefore it involves completing individual exercises without taking any rest intervals. This type of training should also excess 15 minutes because the emphasis of training is on distance rather than speed as training should sufficiently work the aerobic energy system, develop aerobic endurance and stamina. Even though a Judo competitions can last from 3 to 5 minutes aerobic endurance is just as important as anaerobic as having an improved aerobic system means that I do not become fatigued quickly so that I can produce some more advanced throws and remain energetic when completing throws that require a lot of strength to pick the opponent up.

Moreover this type of training requires me to work at least two to three times a week for a minimum of 15 minutes so that my training load reaches up to 60% – 80% of my maximum heart rate so that improvements on the aerobic system can be made. Although exercising for 30 minutes to 2 hours would further improve my aerobic energy system so that I can deal with prolonged exercise and learn how to maintain my energy levels. The principles of training should also be applied to the continuous training so that I can make improvements gradually as training to quickly could cause overtraining to occur. Applying principles such as frequency, intensity, time and type will allow me to overload the body after a few weeks of training as the stress of prolonged exercises will cause the body to adapt.

Training to improve the aerobic energy system means that this specific system is being stressed in every individual exercise under taken causing the body to adapt and ultimately make this system more efficient. Long term adaptations include, cardiac hypertrophy where the heart becomes larger so that it can pump more blood around the body in one single beat therefore delivering more oxygen to the muscles. This also causes a decreased resting heart rate and maximal heart rate as the heart begins to pump more blood around the body, an increased resting stroke volume, blood volume and haemoglobin. Other training effects include an increase in muscle stores of glycogen and triglyceride, which means that more can be converted to energy during aerobic energy production which will help me to remain energetic whilst grip fighting in the preparation stage of Morote Seoi Nage. Also I will gain an increased myoglobin content in the muscles, increased capilliarisation of the muscle so that more oxygen can be diffused into the muscles allowing them to work for longer periods of time as well as preventing the build-up of lactic acid. I will also have an increased number and size of mitochondria which aids aerobic respiration, as well as having an increased concentration of oxidative enzymes.

Moreover, as a result of these adaptation to the body maximal oxygen consumption (VO2 Max) increases. VO2 max is the maximum amount of oxygen that can be taken in, transported and used by the body per minute, therefore the increase in VO2 max allows aerobic fitness to improve in the areas of endurance and stamina as I more oxygen will be transported to the muscles. Also having a higher VO2 max as a result of training would allow to a train and compete at a higher exercise intensity before reaching my lactate threshold, and the onset of blood lactate accumulation (OBLA). This means that I would be able to work for longer before lactic acid starts to build up in the muscles. Furthermore, increased aerobic fitness will also mean that I will be able to recover quicker as I can deal with lactic acid and also be able to resynthesise ATP and PC stores more quickly, as this would be beneficial for sudden bursts of exercise followed by a 30s break to replenish these PC stores in order to continue fighting. Not only does the system become more effective in general, but I can produce more energy and therefore hold of the fatigue so that I can maintain high levels of energy throughout the competition; which results in my throws becoming a lot stronger as I would put in more effort in the standing position rather than dropping to my knees which can be easily countered.

Climbing – Lay Back

**Lay Back - Leo Houlding, famous elite rock climber, known for his dynamic and smooth style.**

**C1: Lack of aerobic fitness**

My cause for weakness in lay backing is largely down to poor ARC (aerobic energy restoration and capillarity). Performing a lay back is very physically demanding skill. A lot of the time I find my forearms intoxicated with lactic acid, causing me to fall. Lay backs tend to be used to reach other holds, place some protection gear or to change body positions – this often involves staying in a lay back for quite some time. All three primary adenosine triphosphate resynthesizing systems are in use here but some are more effective and sustainable than others as the activity lasts for at least a few minutes. The aerobic pathway is vastly more efficient than the other two as it produces thirty-four molecules of adenosine triphosphate for every molecule of glycogen and doesn’t just feature the glycolysis stage, compared to the lactic acid component for example which only uses the glycolysis stage in the sarcoplasm and produces a net total of two ATP. The aerobic pathway has barely any by-products, only creating water energy and heat. It is also efficient at breaking down fats, thus helping lower my weight (making climbing less strenuous); through beta-oxidation fatty acids and fat stores are broken down into acetyl coenzyme A which enter and are used in the Kreb’s cycle. In comparison, during glycolysis, the only stage the anaerobic lactacid pathway takes, pyruvic acid is produced as well as more hydrogen which will later require buffering through EPOC.

Towards the end of a lay back I frequently find myself using the lactate anaerobic energy system to re-synthesise ATP as all of my ATP-PC stores have been used up (this only takes ~8 seconds) and my aerobic system is not efficient enough to maintain the energy production required. The longer I am lay-backing the more hydrogen gets released from glycolysis and the Kreb’s cycle to the electron transport chain. It takes approximately half a minute of lay backing alone until there is no longer enough oxygen in my electron transport chain to deal with the hydrogen so the excess hydrogen ions combine with the pyruvate from glycolysis to form lactic acid. By the time I reach the lactate threshold (~2mmol lactic acid per litre of blood) I can noticeably feel the lactic acid build up. The onset of blood lactacid accumulation forces me to either take a fall or stop lay backing and start using a different technique which is often less efficient or not suitable for my climb, as the build-up of lactic acid slows ATP resynthesis are neurotransmitter efficiency. This is why I would majorly benefit if I were able to maintain the aerobic pathway as my primary energy production system for longer. This could be achieved with the typical effects of aerobic energy system training, for example increased muscle stores of glycogen, cardiac hypertrophy and larger numbers and size of mitochondria.

**C2: Continuous Training**

My corrective measure for my weakness in lay backing is to undergo cardiopulmonary continuous training. I intend to maintain an efficient lay back as it is the most efficient technique in many situations and allows reaches that are otherwise not possible. In order to do this my aerobic energy restoration efficiency needs to be improved; the effects of my training can be measured using my VO2 max (how much oxygen my body can take in and use in a minute). Whilst I am aware a person’s VO2 max is roughly 75% genetically determined, thus leaving a somewhat small margin for improvement, the improvement potential is enough to keep me using my aerobic metabolic processes as my dominant energy production system, which is beneficial as it is massively more efficient at producing ATP in comparison to the anaerobic systems and does not have a performance-hindering by-product such as lactic acid which causes muscle fatigue and slows neurotransmitter responsiveness.

VO2 max is the maximum amount of oxygen that can be taken in and used by an individual in one minute, measured in millilitres of oxygen per kilogram of body mass. Trained elite athletes tend to have a VO2 max of 60-75 ml/kg/m. My approximate VO2 max is 50 ml/kg/m.

With a cardiovascular training program I could see many improvements that lead to a greater VO2 max. Cardiac hypertrophy would allow for more efficient blood flow and a stronger heart, resulting in increased stroke volume and a decreased average heart rate for maintaining cardiac output. With decreased heart rate I will by psychologically more relaxed and focused on my climb and this slight increase in physiological relaxation will prevent me from over-gripping holds and sweating as much, leading to my blood not being as viscous and slow-moving as before. Viscous blood also causes cardiovascular drift as stroke volume decreases due to the thickness of the blood so heart rate has to increase in order to maintain the necessary cardiac output.

Through increased stress on the heart I expect cardiac hypertrophy to occur which, in turn, will create a greater stroke volume thus allowing blood flow to be more efficient. Through increased use, blood capillary density in the lungs and muscles will increase and the networks will widen. I expect haemoglobin levels to rise as a result of increased red blood cell levels, allowing for more efficient oxygen exchange.

A suitable training program would consist of continuous training. Continuous training is often massed practice as the whole session tends to be filled with continuous exercise. It often focuses on endurance and stamina.

Whilst it is beneficial to train by rock climbing to better stimulate motor engrams and schema, it is less efficient for cardiovascular training in particular. When on the rock, local endurance climbing (long term use of muscles of low intensity; ~25% maximum strength usage) is ideal. This is best done on low-gradient slabs when not many moves required much strength. When off the rock, using a rowing machine in the local gymnasium is an ideal form of continuous training, and is specific to upper-body muscles so my capillary networks can be widened and muscle hypertrophy may occur.

In summary, through improving aerobic energy restoration and capillarity I will have a more efficient aerobic-production system which will allow my blood to stay below the lactate threshold for longer, and save my muscle glycogen stores (which typically last ~60-90 minutes) for high intensity climbing moves. As well as this, greater haemoglobin levels will be achieved, more efficient oxygen exchange will occur and cardiac hypertrophy will help to improve stroke volume and directly lower my heart rate.

Rugby – Sidestep

**C1- Inefficient energy systems (inefficient aerobic system)**

During any part of the game I may be required to sidestep an opponent. Since the skill could be completed at any time I need a good level of aerobic fitness. At the start of the game my ATP-PC and lactic acid systems can be used but as the game enters its final stages, 70-80 minutes, I will be more reliant on my aerobic systems. If my aerobic fitness is not good enough my body can fatigue quickly and I will not have enough oxygen required by the range of muscles used during the sidestep particularly at the later stages of the game.

My muscles require ATP (adenosine tri-phosphate) in order to work. ATP is broken down to release ADP+ Pi+ energy which in the end allows my leg muscles to contract. The first stage of the aerobic energy system is glycolysis; one molecule of glucose is split up into two molecules of pyruvate or pyruvic acid and two ATP are produced. The pyruvate produced from this then joins with coenzyme A (CoA) to produce acetyl coenzyme A and goes to the Krebs cycle; this then leads to H atoms being released for the last stage which is the electron transport chain. Hydrogen atoms are oxidised to produce water and 32 molecules of CO2; in total there is a net gain of 36 ATP for 1 molecule of glucose. Because currently my aerobic energy system is weak I end up reaching my VO2 max (maximum amount of oxygen the body can take in and use) quite early on in the game. Factors which affect VO2 max include capillary density in heart, lungs and muscles, surface area of alveoli and efficiency of heart and circulatory system; by training my aerobic system these factors will improve meaning I can prolong the onset of my anaerobic systems. It is also essential that the ATP-PC system is continuously resynthesized to allow me to use anaerobic systems for the short sprint during the side step; a stronger aerobic system is vital for this to happen.

After exercise there are two ways in which my body can replenish stores of energy, this is called excess post exercise oxygen consumption (EPOC). During the game the main system used is the fast (alactacid) component; this uses O2 to re-synthesise ATP and phosphocreatine levels, it also re-saturates myoglobin (which transports O2 from blood to muscle fibres). These components when replenished provide more energy that the body can use. I am able to regain these components by taking in oxygen whilst there are breaks in play (such as lineout of penalty kick). If I am able to delay how early the lactate threshold (the maximum amount of lactic acid the body can cope with in the system above resting levels, 2mmol per litre of blood) currently kicks in I can re-synthesise ATP and phosphocreatine levels quickly before my body has to use the anaerobic energy systems. Improving my VO2 max will allow this to happen by increasing my lactic threshold.

Improving my aerobic energy system will greatly improve my overall game because I can perform at a high level for the full game time, also the standard and skill qualities will not drop off as the game continues. If my aerobic system falters it could lead to poor decision making and possibly allowing the opposition team to regain possession due to fatigue.

**C2- Altitude training to improve Aerobic fitness**

My corrective measure for improving my weak aerobic energy systems is altitude training. Altitude training enhances aerobic fitness because of the increases in the number of red blood cells being produced at altitude. Enhancing my aerobic energy systems will improve my VO2 max; increasing the lactate threshold currently preventing me from resynthesizing my ATP and PC levels. A higher VO2 max also means the body buffers lactic acid more effectively meaning it delays the onset of OBLA. An advantage of altitude training over other techniques is that I do not have to train continuously to get an improved VO2 max; I can do fartlek training at altitude which is more replicable to rugby. My fast twitch muscle fibres in my legs will remain type IIb rather than change to type IIa, there is no evidence to show that fast twitch fibres can turn slow twitch. This means they still have the power needed for rugby and the side step.

At high altitude, usually over 8000 feet above sea level, the partial pressure (quantity of a gas) of oxygen is reduced even though the air still contains approximately 21% of oxygen. The body adapts to this lack of oxygen by increasing the concentration of red blood cells and haemoglobin. Haemoglobin consists of 4 sub-units joined together; when an oxygen molecule binds to one sub-unit the other sub-units become more likely to bind to oxygen. The body naturally produces a hormone called erythropoetin (EPO) which stimulates the production of red blood cells which carry oxygen to the muscles. A larger concentration of red blood cells means that more oxygen can be carried by the blood to the muscles, thus providing higher performance in aerobic energy production. Also at higher altitudes everyone hyperventilates, it is necessary to do this in order to survive. The function of the lungs is to expose blood to fresh air and breathing faster increases the flow of fresh air past the blood; this means that whenever an oxygen molecule is taken away by the blood it is quickly replaced by another. Altitude training would therefore help during a game in EPOC as more oxygen is being used to resynthesize ATP and PC as well as re-saturating myoglobin allowing me to prolong OBLA.

Altitude training in a natural environment involves 3 phases; these are acclimatisation, primary training and recovery. Acclimatisation starts immediately on arrival at altitude, during this I will get used to the reduced PO2 and therefore mustn’t overdo exhaustive training, it is also vital for long recovery periods after training. The duration of this phase lasts between 3-10 days depending on the total camp duration and training frequency. Primary training lasts between 1-3 weeks, but can last longer if the type of training requires. The aim is to progressively increase the training volume until I reach the volume and intensity of training I would at sea level. The third phase, which is recovery, can last up to 5 days. This stage is designed to prepare for the return to sea level and allow recovery from high fatigue that high altitude training causes. Volume and intensity tapers down the closer to the return of sea level. Upon return there is a further 3 phases; the positive phase where there is an increase in the oxygen-carrying capacity of the blood. Secondly is the progressive return to sea level during which the probability of good performance is reduced. Finally peak fitness lasts 15-20 days after return. This is when the optimal time for competition occurs due to a combination of improved oxygen transport and maintenance of breathing adaptations.

The advantages of altitude training are clear to see and have been tested and proven to enhance performance; however there are many disadvantages of such a technique. Accessibility is rare to such high altitudes for everyday training, this means that for the majority of the world, training camps will need to be set up, however the cost of transport, coaching and other costs makes this hard to do often unless there is significant backing; for me I do not have this. I would therefore use altitude machines which consist of a mask based simulator to replicate the conditions of altitude. As high altitude countries such as Kenya and Ethiopia are far away psychological problems can occur due to being far away from friends and family; training may then not be completed fully reducing the impact of the training method. Possibly however the main disadvantage of altitude training is that the effects on performance are not long term and usually decrease after 15 days as red blood cell count decreases due the lowered demands of oxygen, this is not helpful over the course of a season, especially as I am not playing every week, because of this I would have to make altitude training part of my regime in the gym which could affect other skills such as ball handling which can’t be done whilst on a machine.

One technique to combat this is the “live high train low” (LHTL) .The LHTL method of training involves living at higher altitudes for a period of several weeks, but going down to lower altitudes to train. This type of training gets my body used to the hypoxic conditions present at higher altitudes, forces it to adapt, then allows me to perform at a much higher level when you return to lower elevations to train. Once again the practicality of being able to do this is limited so the use of hypoxic tents is exploited, I would sleep in the unit during night times but still train at lower altitudes, and I will be able to spend more time in the tents when sleeping than if I were training in high altitudes. In hypoxic tents the oxygen percentage could be around 12% whereas normal oxygen percentage is around 21%.

Due to financial and sponsorship reasons the live high train low method will not be possible for me to do on a regular basis which is needed for the method to use. For part of my training regime I will use the altitude machines as part of my weekly aerobic training and more often during long breaks in matches as I will have time to acclimatise and get used to the demands of altitude training.

The use of altitude training will vastly improve my aerobic energy system which will in return help my body resynthesize ATP and PC and re-saturating myoglobin, allowing me to maintain a high level of aerobic performance throughout the game and I will not fatigue during anaerobic sprints due to these energy systems being replenished.

Horseriding – jumping a single fence

**Jumping a Single Fence.**

**C1**

**Cause- poor aerobic fitness**

When I am jumping a course of show jumps my poor aerobic fitness hinders my performance for several reasons. Due to being fatigued in the later stages of the event I lose my strength which causes me to be unable to organize my horses canter. This may be due to not being strong enough to hold my horse which may result in my horse running through the bridle and loading its front end. It will also cause the canter to become flat. Also due to my fatigue my leg aid will not be as strong. This can cause a lack of energy in the canter. This may cause there not to be enough power to jump the fence. When jumping a course of show jumps it usually lasts for about two to four minutes. It is a low intensity activity so is likely to use aerobic energy systems. This uses oxygen. The aerobic system involves the breakdown of adenosine triphosphate (ATP). It does this through three stages, Glycolysis, Kreb’s cycle and the Electron Transport Chain.

In Glycolysis glycogen is broken down into glucose, this is then broken down into pyruvic acid. The net product of glycolysis is 2 ATP produced.

This then leads onto the Kreb’s cycle. The pyruvic acid from glycolysis then diffuses into the matrix of the mitochondria. This is followed on by several complicated reactions. The reactions then produce two molecules of ATP, carbon dioxide molecules and hydrogen. The carbon dioxide produced is then breathed out in expiration while the hydrogen is carried on to the next stage which is the electron transport chain.

In electron transport chain the hydrogen that has been carried from the Krebs cycle by hydrogen carriers is then split into hydrogen ions and electrons. The hydrogen ions are then oxidized to create water (H2O). Meanwhile the hydrogen electrons will resynthesize the ATP. At the end of the process 34molecules of ATP are formed.

Fats can also be used as an energy source. Fatty acids produce more ATP per mole than glycogen so they are more useful when exercising for a long time. For example when I am riding a cross country round which will last between five to eleven minutes I will use fatty acids as my main source of energy. The process that breaks down fatty acids is Beta Oxidation. In this process they are broken down in the mitochondria to produce acetyl-CoA. This is then carried on into the Kreb’s Cycle. The breakdown of fatty acids then follows the same process as the breakdown of glycogen.

Another reason for my poor aerobic fitness may be due to my low VO2 max. A poor VO2 max means that I cannot take in and use oxygen efficiently. This causes there to be less oxygen going to my working muscles. This results in me fatiguing sooner due to the build-up of lactic acid meaning I reach my lactate threshold sooner. This is due to the hydrogen ions not being able to join with oxygen so instead they join with pyruvate which forms lactic acid. This causes me to become tired so when jumping an individual fence towards the end of a show jumping course I will not be as effective at adjusting my horse’s canter which will result in having a poor stride to the fence and therefore maybe having it down.

**C2**

**Corrective Measure- Continuous Training**

To help improve my aerobic fitness and improve my ability to jump a single fence effectively and prevent myself from fatiguing during a show jumping course I may use different types of training. I may also increase the intensity of my training routine to try and increase my aerobic fitness. Increase the length of my training sessions or increase the frequency that I do the exercise. I may use continuous training to improve my aerobic fitness. Continuous training is a training method that involves exercising without having breaks from exercise. I chose to participate in continuous training because it will improve the effectiveness of my aerobic energy system. It will also help to improve my stamina which will mean I am able to use my aid more effectively throughout my show jumping round which will then mean my ability to jump a single fence effectively will improve.

When I am planning my training program I will ensure that I follow the principles of training. These are specificity, progression, overload, reversibility, and tedium. To ensure these are met I need to make sure my training program is focused on improving my aerobic fitness so I am able to ride more effectively for longer while jumping a single fence. I also need to include progression into my training program by including overload. I need to use overload for example increasing the frequency of my training sessions, increasing the intensity of my training sessions, for example the length of running or the speed I am running at. I would also need to increase the time I am doing it for. I will start to use overload about two weeks into my fitness program. This is necessary I need to work at between 65-75% of my max heart rate to be able to improve my aerobic fitness.

 I also need to ensure that reversibility doesn’t occur, for example if I injure myself and have to rest I will lose fitness. I also need to make sure my training is enjoyable and includes variety so that I don’t get tedium. It will also help me keep motivation.

Ideally to improve my aerobic fitness I will need to train at least three days a week. To make my training sessions effective I need to ensure that I am working at at least 65-75% of my maximum heart rate. To make sure I am working at this level I will use a Heart rate Monitor to check. To ensure my aerobic system is being used and tested so that it will improve I need to make my sessions last a minimum of 30 minutes, and they can last for as long as two hours.

The changes to my body and aerobic fitness after my fitness program has been carried out effectively will be things such as a reduced resting heart rate. My heart will become stronger and increase in volume due to cardiac hypertrophy. This will enable more blood to be pumped around my body per minute.

Athletics – long jump run up

**C1 Long Jump run up**

In Long Jump competitions I have to jump usually five times in quite quick succession. The last two jumps in particular are in quick succession as only the top three or four jumpers get the extra two jumps. This means that my run up can be severely affected as the jumps progress due to a lack in aerobic fitness.

As the competition progresses, I will start to experience the effects of fatigue on my body. This will be because of a low level of oxygen consumption which is utilised in the muscles during exercise coupled with a low level of cardio-vascular endurance. This will have a detrimental effect on my performance and my ability to maintain a high speed run up each jump. The onset of fatigue means that I may become slower and feel more lethargic in my actions, unable to reach the speed required to get a good distance jump.

As the competition progresses I will have made multiple jumps, the last two of which will have been in much quicker succession. This will induce the onset of blood-lactate accumulation through the lactate threshold. During this attacking run up, the exercise will become more intense and so the muscular contractions will require more ATP, therefore, more ATP must be resynthesized to facilitate this. This leads to more glucose being broken down through glycolysis. By doing this more hydrogen is produced through the Krebs cycle, which is then released into the Electron Transport Chain. More oxygen is required to combine with the hydrogen. However, there is so much hydrogen that is released into the Electron Transport Chain that there is not enough oxygen present to bond with the hydrogen to create water. Instead, the hydrogen combines with pyruvate, which is present as a bi-product of glycolysis. These two combine to form lactic acid, which lowers the PH level in the blood and the muscles. This leads to fatigue, which means the glucose reserves become depleted. As fatigue kicks in it becomes harder to maintain the high intensity required for the sprint and so, the overall quality of the jump is affected. This means that where, for example, Dwight Phillips would be able to carry out and identical run up to his first and perform a perfect jump even when the aspects of fatigue are present, I will become slower in my technique and therefore lead to some side effects such as not having the required number of strides due to reduced stride length, resulting in not being on the board.

Another factor, in addition the idea of fatigue having a negative effect, is how heart rate intensities can affect my performance and my ability to carry out the required run up in competition.

As exercise goes on, blood viscosity increases because I start to perspire to maintain my core temperature which means there is less liquid in the blood. The increased viscosity makes it much harder for the blood to be pumped round the body, and returned through venous return to get the oxygen needed to the muscle site and remove the lactic acid which has been created. This means that the heart needs to pump harder and faster to maintain oxygen deliver levels required, and so as chemoreceptors detect that the acidity level in the blood has increased, a message is sent to the medulla oblongata and then down the sympathetic nervous system to the heart’s Sino Atrial Node which initiates the heartbeat, to increase in frequency, resulting in more oxygen being delivered to the muscles and facilitating carbon dioxide removal. This means that a lack of oxygen results in further fatigue and therefore makes sprinting down the run way even more difficult.

 All of this has a detrimental effect on my performance. For example, when not fatigued, I am able to perform all the phases of the long jump without undue difficulty; such as the overall speed achieved during the run up. As fatigue increases however, I will reproduce this action with increasingly less effective results.

**C2 Long Jump run-up**

The main problem with my long jump run up was my inability to maintain the high speed required throughout my jumps. This is down to a lack in aerobic fitness. To combat this however, I do not wish to do too much distance running as I don’t want it to affect the muscle fibres in my legs, as I do not want any of my type II A muscle fibres transforming into type II B fibres. The corrective measure I have chosen, in view of these factors, is altitude training.

Altitude training enhances aerobic performance because the body is forced to adapt to lower levels of oxygen. It responds to this lack in oxygen in multiple ways. There is an increase in the number of red blood cells, and with this increased haemoglobin volume and concentration. There is increased capillarisation on the alveoli in the lungs, creating a larger surface area of capillaries, enabling a much faster rate of gaseous exchange through diffusion. As well as increasing the rate of oxygen transportation, the body is able to buffer lactate more effectively. These benefits continue for ten to fourteen days after the athlete returns to sea level.

**Altitude Training schedule**

There are three phases of training at altitude:

* **Acclimatisation**: Acclimatisation begins immediately on arrival at altitude. I will start with light training as my body will not be able to sustain any high effort exercise for any length of time, and I will allow lots of recovery time after exercise as my body will require more recovery time compared to at sea level as it takes in less oxygen. This phase will last for three to ten days.
* **Primary training**: Primary training is a progressive increase in intensity and frequency to allow the body to acclimatise and adapt to each increase. This increase in training will continue until it reaches the level of training which I was training at at sea level. This phase should last for one to three weeks, in which I will do repetitive sprints of the distance of 50m to increase my ability to run my run up at full pace each time in competition.
* **Recovery**: This phase can last for two to five days and is designed to prepare for the return to sea level and allow me to recover completely from the fatigue produced by high altitude training. The training volume and intensity is gradually reduced during this phase.

When returning to sea level, there are three stages of the effects upon my performance:

* **Positive phase**: During the first one to four days there is a visible increase in the capacity of the blood to carry oxygen.
* **Progressive return to sea level**: There is then a progressive return to sea level training volume and intensity, during which the probability of my having a good performance is reduced; this may be due to my altered fitness levels and loss of coordination whilst I was training at altitude. However, after several days of sea level training, there will be improvements in fitness and coordination.
* **Finally**, I will experience a fitness peak fifteen to twenty days after returning to sea level. The optimal time for me to compete is during this phase. A combination of positive factors, increased oxygen transport, improved economy and maintenance of breathing adaptations, explains the better performance during this third phase.

There are however many negatives involved in travelling to altitude to train; the reduced capacity to train whilst at altitude can detrimentally affect skill levels, which would have to be trained back up when I reached sea level. There is considerable cost and time involved if I were to travel to and from altitude to train, and there would be fatigue caused by the long distance travel too. There is also a risk of my getting altitude sickness and therefore being unable to train to any degree to make it worth it.

And so, to still gain the advantages of altitude training, but not experience the unwanted side effects, it would be most beneficial if, instead of going to altitude, I used a hypoxic tent which simulates altitude by reducing oxygen levels. This then would allow me to still be able to train at sea level, therefore not losing any skill or fitness levels. It is also becoming recognised that it is most beneficial to live and sleep at altitude but to train at sea level. This hypoxic tent allows me to effectively do this and so would be the most effective method of ‘altitude training’ for me to use.

Football Goalkeeper – Kicking

**C1 – Cause of losing concentration when kicking – Fatigue/Poor anaerobic fitness**

When kicking the ball it is important to keep your eyes on the ball so you get optimal contact on the ball. I can sometimes not focus on the ball when kicking it, the times when I forget to focus on the ball is mainly when I have had an intense period of the game where I may have had several saves to make or have had to focus intensely.

My training at the moment involves as much fitness training as possible. But due to the restricted amount of time it is hard to fit any hard physical training into the sessions. So when I do have an intense period in the game it can affect my kicking because I forget to focus on the ball when I am about to kick it, resulting in an ineffective contact on the ball. The training I do at the moment when I get a chance to do fitness works on my aerobic energy systems. This is okay for goalkeeping when there isn’t a lot of intense saves to make in quick succession. Goalkeeping mainly involves short bursts of intense work so it involves the anaerobic system. Due to me not working the anaerobic system in training it fatigues very quickly which in turn decreases my levels of concentration in turn affecting my kicking from my hands.

The anaerobic system is used for exercise which is in short bursts and is moderate to high intensity. To resynthesise ATP using the anaerobic system there is two ways in which this can be done, through the phosphocreatine or ATP-PC system or the Lactate system. Phosphocreatine is an energy rich compound which can be broken down to resynthesise ATP. When PC is broken down it releases enough energy to resynthesise one molecule of ATP. There are only sufficient amounts of phosphocreatine to sustain high intensity work for 5-8 seconds. When goal keeping this high intensity of work happens more often than the prolonged aerobic exercise. If the anaerobic system is required for longer than 8 seconds then another source is needed this comes in the form of the lactate energy system. The lactate system involves the partial break down of glucose, not a full break down as there is no oxygen present. Hydrogen is released during glycolysis which is the breakdown of glucose to pyruvate. This is done during the Krebs cycle which is where complex chemical equations occur to release hydrogen. The hydrogen ions then combine with oxygen from respiration which has occurred in the electron chain. The higher the level of work the more ATP which is required therefore as the level of work increases the amount of glucose which is broken down increases and subsequently more hydrogen released into the electron chain. This relates to goalkeeping as the movements required are very quick movements. This leads to a build-up of lactic acid which due to the poor efficiency of my anaerobic system isn’t converted into glycogen through the Krebs cycle. This leads to a drop in overall performance due to fatigue and can result in my movements becoming slow and my concentration levels becoming very low.

**C2 – Corrective measure for fatigue – Circuit training to improve anaerobic energy system**

The main energy system used when goalkeeping and the one which causes the most fatigue is the anaerobic system. This is because when exercising anaerobically there is no oxygen present, which is required to turn pyruvate back into hydrogen through the Krebs cycle, but without the oxygen the pyruvate is turned into lactic acid this causes the levels of lactic acid to increase meaning I reach OBLA or onset of blood lactate accumulation this is considered to occur when blood lactate levels exceed 4mmol per litre of blood. The body is then unable to deal with the high levels of lactic acid causing fatigue. Training this system will decrease the amount of lactic acid accumulation within the muscles, which is described as lactic acid tolerance. I am going to devise a circuit training programme which is focused on improving my anaerobic system. The best form of circuit training for anaerobic training is intermittent training. It works by alternating periods of work and rest, this is exactly like goalkeeping. In goalkeeping you will have moments of high work rate e.g. making a save then claiming the rebound and then you will have a rest period whilst the ball is away from the goal area and there is no immediate danger to the goal. This allows full intensity workout then a short rest, the short rest allows you to work at a higher intensity than normal circuit training. It is an easy method to add variation to as you can alter the type, intensity and duration of the exercises. The same exercises can be used as normal circuit training but have to be performed at a high intensity.

The circuit which I am going to do to improve my levels of anaerobic fitness will involve:

* ***Sprinting shuttle runs*** – I will set two cones up about 15 meters apart, I will then sprint back and forth between them at maximum intensity for 20 seconds, I will then recover for 30 seconds. This will increase my overall lactic acid tolerance whilst also boosting my sprint speed which will help when running out to sweep behind my defence.
* ***Squat jumps*** - From a standing position with my arms out in front of me I will squat down making a 90o angle at the knee joint with my quadriceps parallel to the ground. I will then jump up off the ground using my arms to get as high as possible, once I land I will go back down into the squat position and then repeat the jumping movement. I will do these for 20 seconds at maximum intensity then recover for 30 seconds. These will improve the lactate tolerance within my muscles in my legs mainly the quadriceps, hamstrings and gastrocnemii whilst also improving the power in them. This is key as a lot of squatting is involved in football especially when in the ‘set’ position.
* ***Hurdles*** – I will set out 10 hurdles evenly apart. I will then jump over them with both feet together for 20 seconds at maximum intensity, then recover for 30 seconds. When jumping over hurdles it requires short powerful contractions this is just like movements in goalkeeping.
* ***Press ups*** – I will perform press ups at maximum intensity for 20 seconds and then recover for 30 seconds. Press ups require short powerful movements. In goalkeeping have strong arms and wrists are essential. In goalkeeping contractions which occur within the arms muscles especially the wrist flexors, forearm flexors, biceps and triceps tend to be isometric and they tend to be very short but very powerful so by doing press ups at a high intense rate will make the lactic acid tolerance larger within these muscles.
* ***Sit ups*** – I will perform sit ups at maximum intensity for 20 seconds and then recover for 30 seconds. This will not only work my anaerobic system but will help my performance as having stronger abdominals will help me to get up quicker after making a save to reach the rebound.
* ***Squat thrusts*** – I will get into the press up position I will then bring my knees up to my chest and then return them back into the press up position. I will do this for 20 seconds at maximum intensity and then 30 seconds recovery. Squat thrusts will also work the anaerobic system but it will also help with strength in my legs especially the quadriceps and gastrocnemii. This will improve my stamina when squatting in the ‘set’ position.

2 - Squat Jumps

1 - Sprinting Shuttle Runs

6 - Squat Thrusts

3 - Hurdles

5 - Sit Ups

4 - Press Ups

I will vary the length of time these exercises are performed as the week’s progress, so for example after 4 weeks I will increase the time to 30 seconds or 40 seconds. I will do this circuit once a week as it I still need to practice the skills in my other training session of the week.

After about 4 weeks of doing this circuit I should begin to see an improvement in my anaerobic fitness. This will result in fatigue taking later to set in subsequently enabling me to concentrate more meaning I will focus on a point on the ball when kicking.