

What good is a Ferrari with a one-litre fuel tank?

There have been some great articles and podcasts recently discussing the energy demands of our sport and how to train for it, so I thought I'd add my thoughts to the debate. I've listened with interest to the recent discussions Brian has had with Devan McConnell and Patrick Love, and there have been some great articles by Ben Peterson amongst others who have all made some excellent observations. I've responded to a couple of posts on Twitter recently about the fact that the industry we are in is called 'strength **and** conditioning'. Some high profile coaches seem to focus more on the strength and less on the conditioning, and in my mind it's becoming a problem (hence the title of this piece!)

Following the principle of specificity, we need to know which energy systems we are using before we can decide which ones to train, and this is where the arguments regarding hockey training begin. Historically, coaches stressed the need for a good aerobic system because hockey is a 60 minute (and sometimes longer) game. Long slow duration training on static bikes or runs were all the rage. However, over time there was a swing to high intensity intermittent training. I can see why – a hockey shift fits in with the time frame and intensity of the anaerobic glycolytic system, so on the surface it made sense and quickly gathered popularity.

However, from an energy system standpoint, hockey is a very complex game. There is constant flux – a player could be standing still watching play develop around him, then jump into an all-out sprint, then they might glide for a few seconds, followed by a split second effort of maximum intensity for a shot or a check, then they'll make their way to a bench, sit down for 2 minutes, and do it all again. For 60 minutes. We can all agree that the sport is played at high speed, but just how much of it?

Some recent studies have made interesting attempts to quantify it. Stanula, et al (2016) put players through a standard incremental cycle test to exhaustion, which recorded their heart rate and breathing markers, namely ventilatory equivalent for oxygen ($\dot{V}_E/\dot{V}O_2$) and ventilatory equivalent for carbon dioxide ($\dot{V}_E/\dot{V}CO_2$). Whilst that might sound technical and difficult, it is a standard practice for modern gas analysis kits. When this data is plotted on a graph, there will be a point where an increase in $\dot{V}_E/\dot{V}O_2$ is seen without an increase in $\dot{V}_E/\dot{V}CO_2$, which can be considered the *ventilatory threshold (VT)*. After this, the *Respiratory Circulation Point (RCP)* can be determined at the point when there is a deviation from the linear rise of $\dot{V}_E/\dot{V}O_2$ and $\dot{V}_E/\dot{V}CO_2$, considered to mark the point when an athlete is accumulating a significant amount of lactate in the blood. Stanula, et al (2016) used the heart rates recorded at VT and RCP as markers to determine when an athlete moves from working at low to moderate (aerobic threshold) and moderate to high intensity (anaerobic threshold) on-ice, as heart rate monitoring is the only real practical solution to measuring on-ice physiological state. Stanula, et al (2016) found that RCP occurred at around 92.5% of maximum heart rate in forwards, and 89% in defenders. They also found that approximately 20% of time on-ice in games was spent at this intensity.

We know that a hockey shift will vary in length, but it will rarely exceeds 90 seconds. Using the value of 20% as discussed above, it can therefore be estimated that a shift will consist of around 18 seconds of high intensity work. We also know that shifts are intermittent, involving bursts of activity interspersed with low intensity bouts (standing, gliding, time between whistle stops etc), so it makes sense to suggest that the 18 seconds of high intensity work completed during a shift will be an accumulation of short (3-5 seconds) duration efforts (Stanula et al, 2014). We can therefore reason that the anaerobic glycolytic system, which provides energy for bouts between around 15 secs to 2 minutes, is not the only energy system contributing to these short bursts. It is more likely that the alactic (ATP-PC) system (which meets energy demand for intense bursts of 0-10 seconds) is primarily

responsible for meeting this energy demand (Glaister, 2005), supported by a robust aerobic system to allow for PCr resynthesis, which is an oxygen-dependent process.

So how can we achieve this? It's fair to say there is no fixed answer, and I have seen some excellent programming around. Adam Douglas (Hockey Canada) and I have recently collaborated for an upcoming publication on ice hockey strength and conditioning, and a summary of our approach to off-season energy system work is outlined in the table below. We recommend addressing 4 key areas: aerobic capacity and power, and lactate capacity and power.

Area	W:R ratio	Accumulated load per session	Example
Aerobic capacity	1:0 or 1:1	20 – 30 mins	Tempo runs @ 65-75% maximum running speed, bike work @ 65-75% HR maximum
Aerobic power	1:2	12-15 mins	5 x 2-min runs (@ near VO2max) with 4 min active recovery (walk jog) periods
Lactate capacity	1:1 to 1:5	2-6 mins	Repeated shuttle run or skate (5 reps of 45 second sprint with 2-3 mins rest)
Lactate power	1:5 to 1:10	2-4mins	Maximum effort sprints or med-ball slams. 20 reps of 10 sec with 60 sec recovery

In-season, when athletes are receiving a lot of anaerobic stimulus through on-ice training sessions, it is important to train the ends of the scale which may get forgotten about to maintain a well-rounded profile. In-season conditioning programming should focus on some aerobic capacity work, as well as some lactate power and alactic work to ensure a balance of overall conditioning.

Thanks for reading!

References

Glaister, M., 2005. Multiple Sprint Work. *Sports Medicine*, 35(9), pp. 757-777.

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