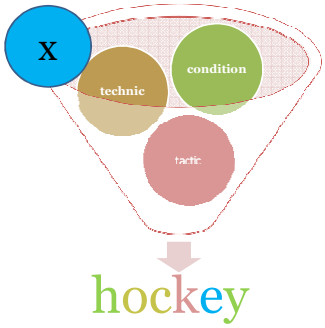
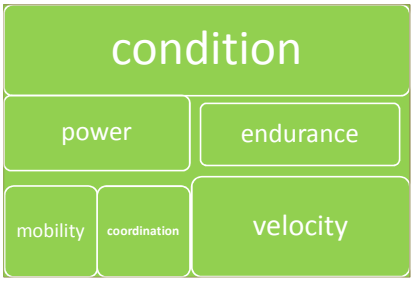
Profile of Hockey



Physiological Main Factors

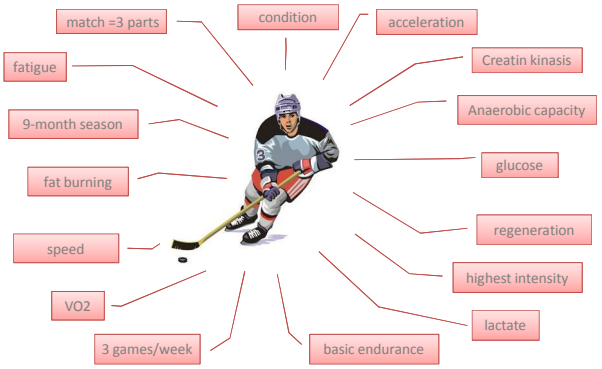


What is Endurance?

The durability of the organism against fatigue and / or the fast recovery after the exercise.

(Harré, 1967)

Physiological Aspects



The Rule of Endurance

Long-lasting, constant intensity **vs.** Short, varying intensity

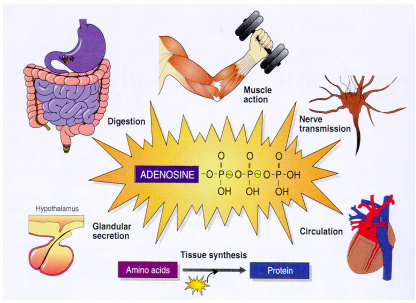
Endurance in Hockey

recuperativeness (physiological)
acut– directly after the sprint
delayed in the break,
after the match
- after training/match – day (s)
- month view
- whole saison / play off

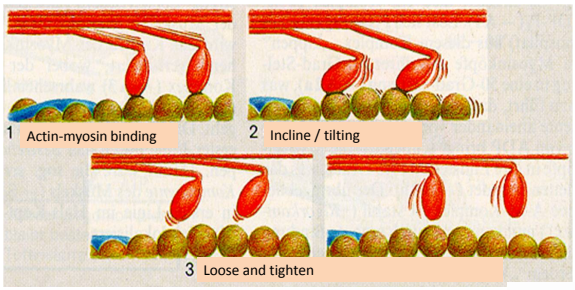
- **recuperativeness (neuronal)**
  - concentration – motivational aspects

Physiological View

ATP = Universal Energy Source



Mechanism of Filament Sliding



ATP-Resynthesis

ATP -> ADP + P $\Delta\uparrow$ free energy

ADP + P -> ATP $\Delta\downarrow$ energy demand

Forms of ATP-Resynthesis

anaerobic alacticide

Creatinphosphat + ADP ⟷ Creatin+ATP

-> very fast, short, max, few seconds: limited capacity

lactacide

Glucose (Glycogen) ⟷ lactat + ATP

-> quiet fast, < 20 sec, influence to pH: limited capacity

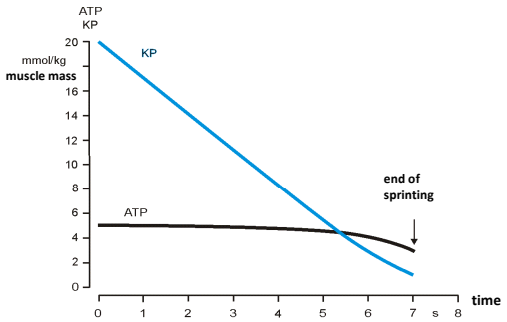
aerobic

Glucose (Glykogen) + O2 ⟷ CO2 + H2O + ATP

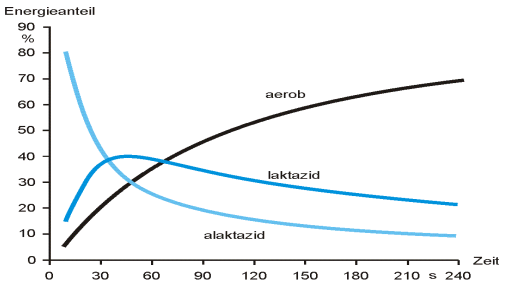
Free Fatty Acid + O2 ⟷ CO2 + H2O + ATP

-> slow, big pool: unlimeted capacity

Capacity of Phosphate

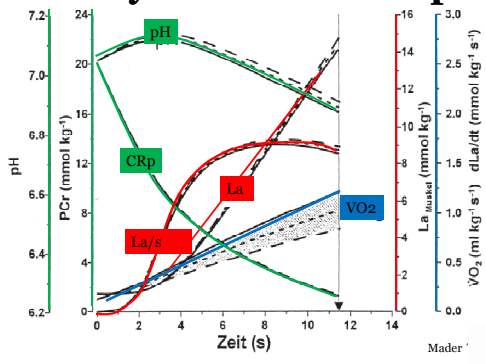


Ratio of ATP-Resynthesis



de Marées: Sportphysiologie, 2002

ATP-Resynthesis: Short Sprint



Mader

What happens during a Hockey Match?

main question: how to rebuild ATP (resynthesis) to show peak performance

- focus on time/ for **O2** – transport

during aerobic pathway

$C_6H_{12}O_6 + 6O_2$ $6CO_2 + 6\ H_2O$

$2\ C_{51}H_{98}O_6 + 145\ O_2$ $102\ CO_2 + 98\ H_2O$

Physiological Stress

- Time on ice 20 – 60 sec
  - Speedups (number) 5 – 7
  - Speedups (time) 2 – 3,5 sec
- Bench time 3 – 5 min
- Exchanges per match 15 – 25
- Total time on ice 15 – 25 min

statisics during competition (IIHF 2004b)

Physiological Stress: A ratio

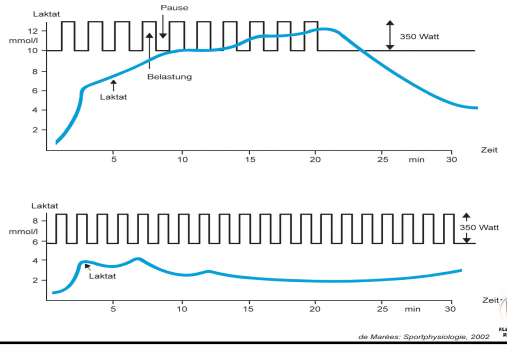
	Anaerobic alactocid	Anaerobic lactocid	Aerob
speed ups	85%	10%	5%
5s sprints	60%	35%	5%
30s activity sprint checks	15%	70%	15%
1 min intermittend (speed ups, curves,starts/stops)	10%	60%	30%

Percent of energy metabolism in hockey – near to (IIHF 2004b)

What happens during a Hockey Match?

- **Answer:**
  - »**Aerobic pathways**
  - »**Anaerobic pathways**

Short Intervalls vs. Longer Intervalls



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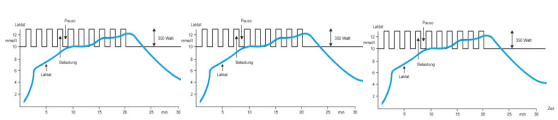
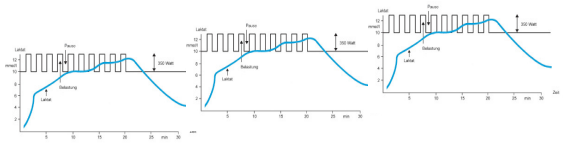
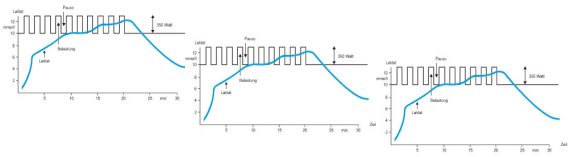
Type 1: Stress in a match



Type 2: Stress in a match



Type 3: Stress in a match



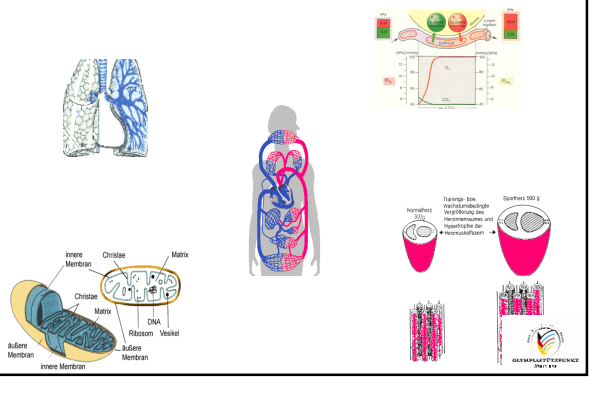
Players remain able-bodied

- if lactate tolerance was trained (DEG-lok Moskau)
- if energy system is filled up (acute-glucose level, training???)
- if muscle learned to use lactate as a fuel
- if VO2 is high (lactate clearence is faster)

Conclusions

- build up high lactate levels
- use lactate as a fuel
- oxidaze lactat with high VO2

Influence of VO2 max

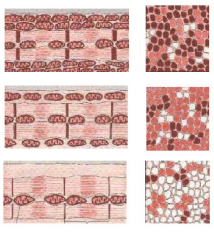


Muscle Cells

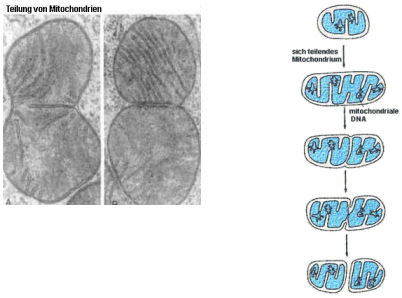
red muscle cell
slow long term
Typ 1

Intermediate cell
Typ IIa/c

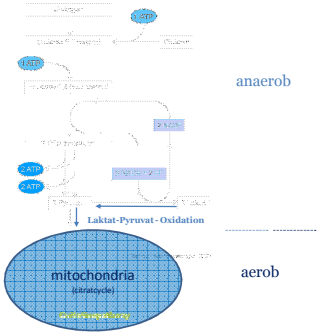
white muscle cell
fast short term
Typ IIb



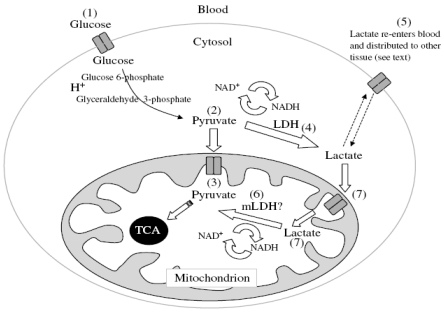
Powerhouse of the Cell



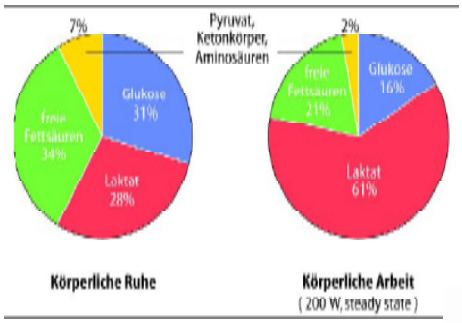
Lactat: Not only a By-Product



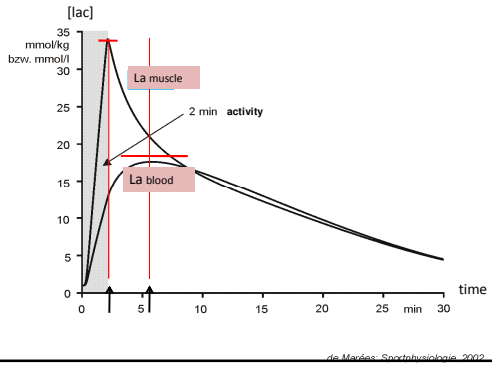
Lactat Transport



Lactate: Energy for the heart cell



Lactat Transport



de Marées, Sportphysiologie, 2002

Lactat: Fuel for the muscle

- vasodilatiation of vessels
- sympathicusregulation
- neuronal activation
- impuls for oxidazing phosphats
- Kollagensynthese (Wundheilung!)

→ **biological effect on cell**

- **transport of lactate**
  - •monocarboxylase MCT1 and MCT4
  - •transport through membran 70%, rest diffusion
  - • system can be trained to improve

→ **„fuel for muscel work“**

Conclusions

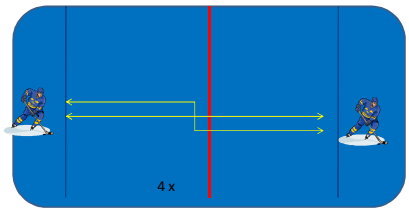
- **Endurance Test**
  - **VO2 max**
  - **Steptest on ICE / bike / treadmill**
- **Test for anaerobic capacity**
  - VLa_{max} (maximum lactate building per second)
  - Speed tests

Explanation VLa_{max}

- **100m run**:
  - 10 sec. building up to 10mmol as maximum (meas. in ~8min)
  - building rate: 1 mmol per second = **1** mmol/s
- **400m run**:
  - 40 sec. building lactate up to 20mmol as maximum
  - building rate: 20mmol/40sec = 0,5 mmol/s
- **10000m run**:
  - 30 – 60 minutes
  - Concentration of lactate ~ 3 mmol /l
  - building rate = lactate oxidation: steady state

Conclusion:
100m runner must improve his building rate to become faster
400m runner must improve his building rate **and** his VO2max
10000 m runner must improve his VO2max – endurance as main todo
Marathon runner must improve his VO2max – endurance as main todo

Anaerobic on Ice Test



~ 30 s – 17 mmol

10 min on bench for measurment

lactate building rate

Final Conclusions

- **hockey player should be an intermediat type** (muscle)
  - » depending on played system / position
- **use your individual views and testing**
  - » find out deficites (physiological + ...)
  - » build trainings groups
  - » train what is needed during competition
  - » remember training is the balance between activitie and recovery
  - » if you train with high intensities give enough recovery (acitve and passive)
  - » organise the environment

Thank you for audiance

Diagnostics in Hockey

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