



# Taking Strength and Conditioning to the Next Level

Scientific Tests – Powerful Tools in Elite  
Sports Training

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# Purposes of scientific test

- ∞ Determining characteristics and current conditions of athletes
- ∞ Monitoring training intensity
- ∞ Enhancing optimum training intensity and training efficiency



# Different types of tests

- ∩ Physiological
- ∩ Biochemical
- ∩ Biomechanical
- ∩ Psychological



## Relationship between different types of tests and training programs

∞ Training efficiency is all about programming and control of training intensity. Scientific tests are powerful tools in helping program design and intensity control.



# Physiological tests

- ∞ Determine physiological characteristics → better prescription
- ∞ Monitor training intensity → minimize over or under training
- ∞ Assess training progress → adjusting training load



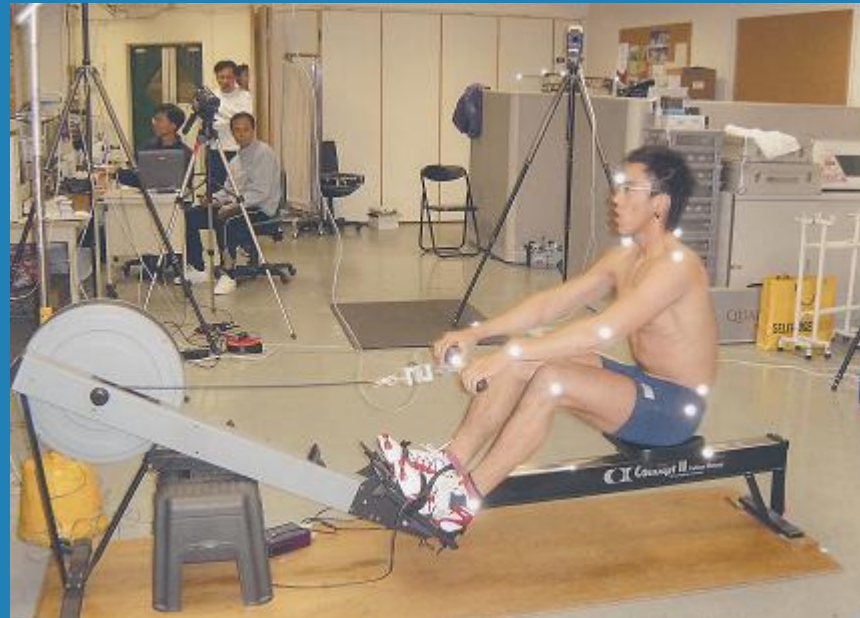
# Biochemical tests

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- ∩ Assess stress of training
- ∩ Assess progress of recovery → fine tuning training program
- ∩ Suggest supplements needed to improve recovery

# Biomechanical tests

∞ Assess movement and technique →  
technique modification





# The use of lactate measurement on Hong Kong elite rowers

Measuring exercise blood lactate is the most important and useful monitoring element carried out on the elite rowers in Hong Kong. It can be laboratory or field based.



# Equipment for lactate measurement

∞ YSI Sport 1500



∞ ARKRAY LactatePro



# Blood Lactate Measurement

## 1. Advantages:

∞ More accurate in indicating training intensity

## 2. Disadvantages

∞ Involves certain risks and requires technical persons



# Laboratory testing

## VO<sub>2</sub>max test

- ∞ VO<sub>2</sub>max is one of the most important predictors for 2K ergo performance
- ∞ VO<sub>2</sub>max value, power at VO<sub>2</sub>max, VO<sub>2</sub> at AT, power at AT, AT as %VO<sub>2</sub>max can be determined
- ∞ Observing the test together with the data can provide coaches and physiologists a good understanding of a rower's physiological characteristics and current condition, as well as technique changes with increasing intensity



# VO<sub>2</sub>max test illustration





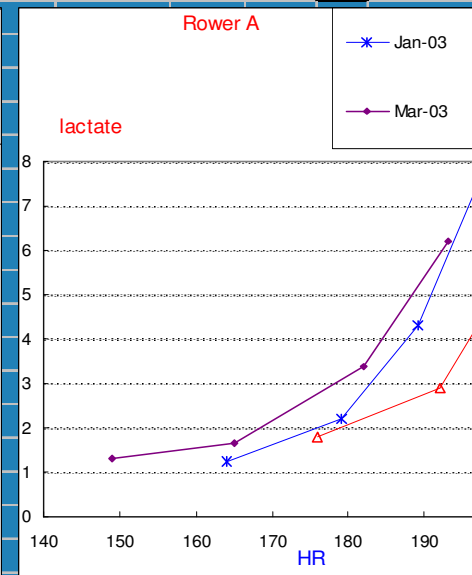
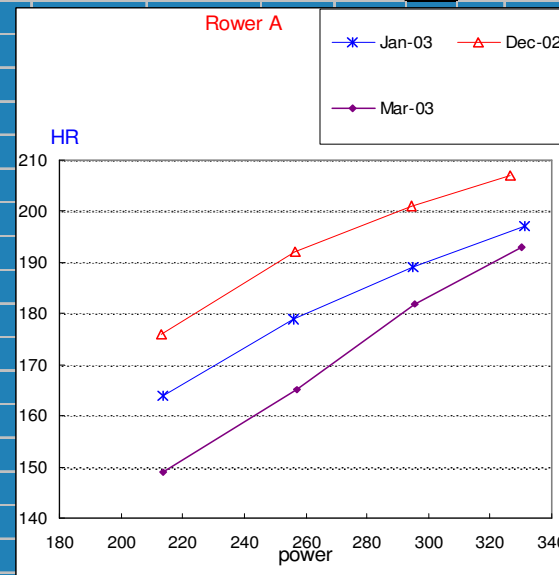
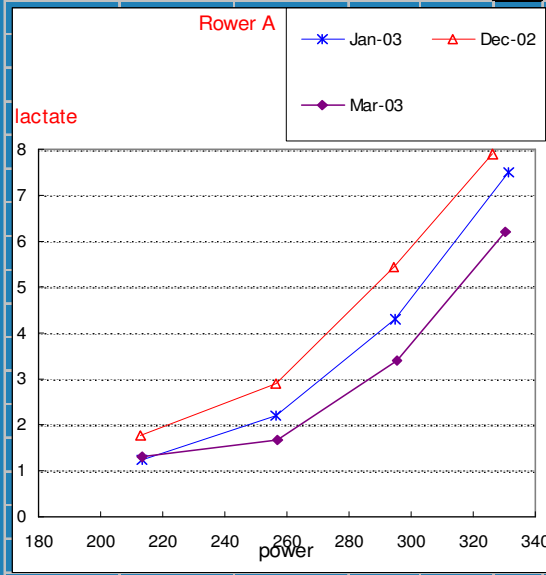
# Laboratory testing

## Step test (monthly)

- ∞ Identify correct aerobic (~2 mM and 3 mM) and anaerobic threshold (~4 mM) training zones
- ∞ Establish Power-Lactate and Pace-Lactate relationship
- ∞ Also serves as a function to assess rower's physiological condition on a regular basis

# Changes of blood lactate profile of an elite rower during a 2-month period

Rower	Dec-02					Jan-03					Mar-03				
	Power	Pace	rate	HR	La	Power	Pace	rate	HR	La	Power	Pace	rate	HR	La
1st	213	1:58.0	21	176	1.8	213	1:57.9	22	164	1.2	213	1:57.9	22	149	1.3
2nd	257	1:50.9	21	192	2.9	256	1:50.9	23	179	2.2	257	1:50.8	24	165	1.7
3rd	294	1:45.9	23	201	5.5	295	1:45.9	24	189	4.3	296	1:45.8	25	182	3.4
4th	326	1:42.4	25	207	7.9	331	1:41.8	26	197	7.5	330	1:42.0	27	193	6.2
3'	UT2HR=180 Pace=1:56.6				7.9	UT2HR=176 Pace=1:52.6				6.8	UT2HR=168 Pace=1:49.7				5.7
5'	AT pace= 1:48.6				--	AT pace= 1:46.6				--	AT pace= 1:45.1				--





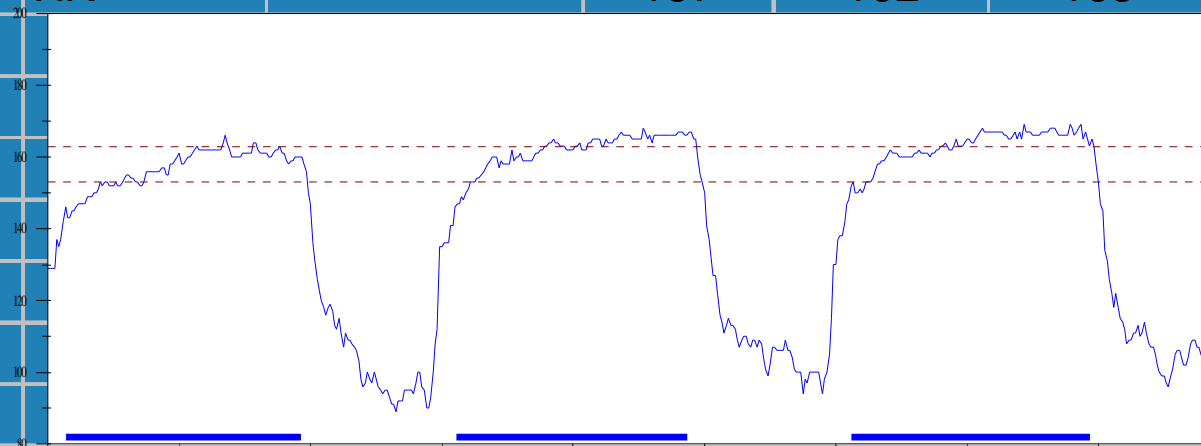
# Training monitoring

## Lactate and HR monitoring during anaerobic threshold (AT) training

- ∩ AT training maximizes aerobic capacity
- ∩ Also indicates rower's training progress
- ∩ Power/pace at AT level is one of the most important predictors for 2K ergo performance.
- ∩ Widely used by coaches.

# AT training lactate and HR (ergometer)

Date: <b>9-May-2003 Fri</b> (4:30PM) SI Gym					
Ergo 10min x3, rest 5min, AT pace					
		target pace	1st	2nd	3rd
<b>Rower</b>	pace	<b>1:51</b>	1:51.0	1:51.0	1:50.9
	rating		24	25	24
	<b>lactate</b>		<b>3.9</b>	<b>3.9</b>	<b>4.1</b>
	<b>HR</b>		157	162	163



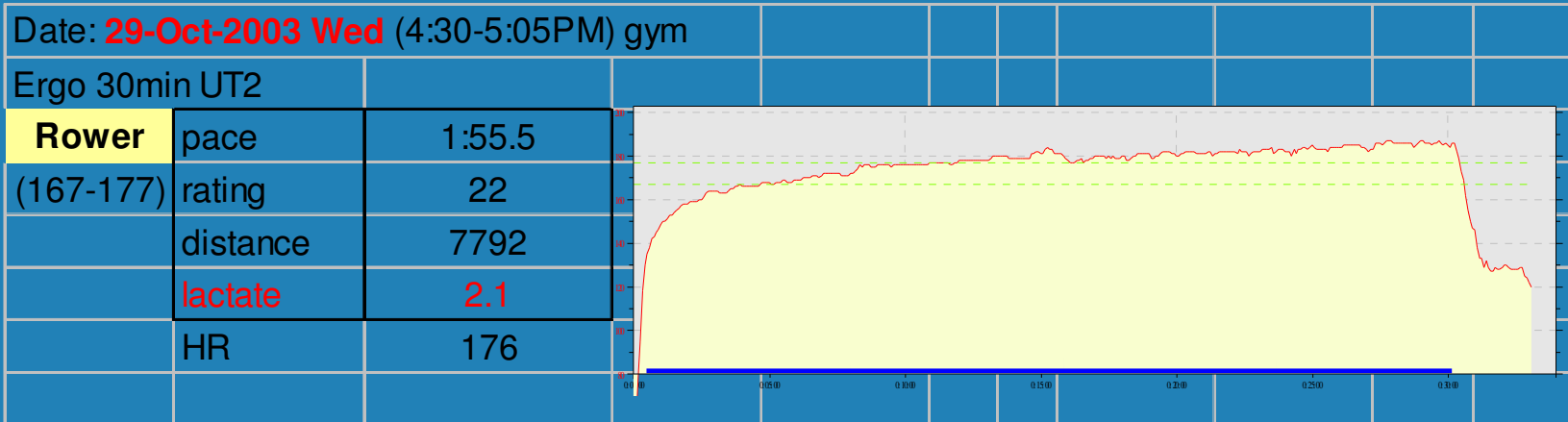




## Intensity control

- ∞ 3 to 4 sets of rowing ergometer exercise (~10 min with pauses (~ 5 min))
- ∞ Rower rows in his/her own AT training zone as defined by the step test
- ∞ Target power/pace should be adjusted with reference to blood lactate level
- ∞ Data on pace, lactate, and HR are collected for understanding rowers' blood lactate profile and changes in condition

# Aerobic training lactate and HR





# Field testing

- ∞ More specific to the sport but environmental factors are difficult to control
- ∞ Blood lactate can be measured for normal steady state aerobic base training for intensity control.
- ∞ AT training with blood lactate measurement can be carried out similar to that in the lab.

# AT training lactate and HR (on-water)

Date: **5-Aug-2003 Tue** (8:45-10:15AM) **3x3K AT** 24C 48% sunny, v

Rower	1st	2nd	3rd			
appr. time	11:50	11:25	11:40			
HR max	191	191	190			
HR ave	183	181	182			
Lac	3	--	3.2			





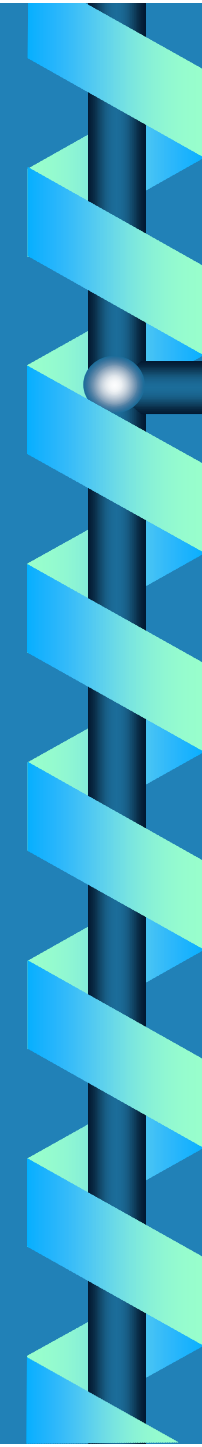
# Heart rate monitoring

## 1. Advantages:

- ∩ Easy to measure (with a transmitter belt and a receiver watch)
- ∩ Easily illustrate the recovery rate of the rowers

## 2. Disadvantages

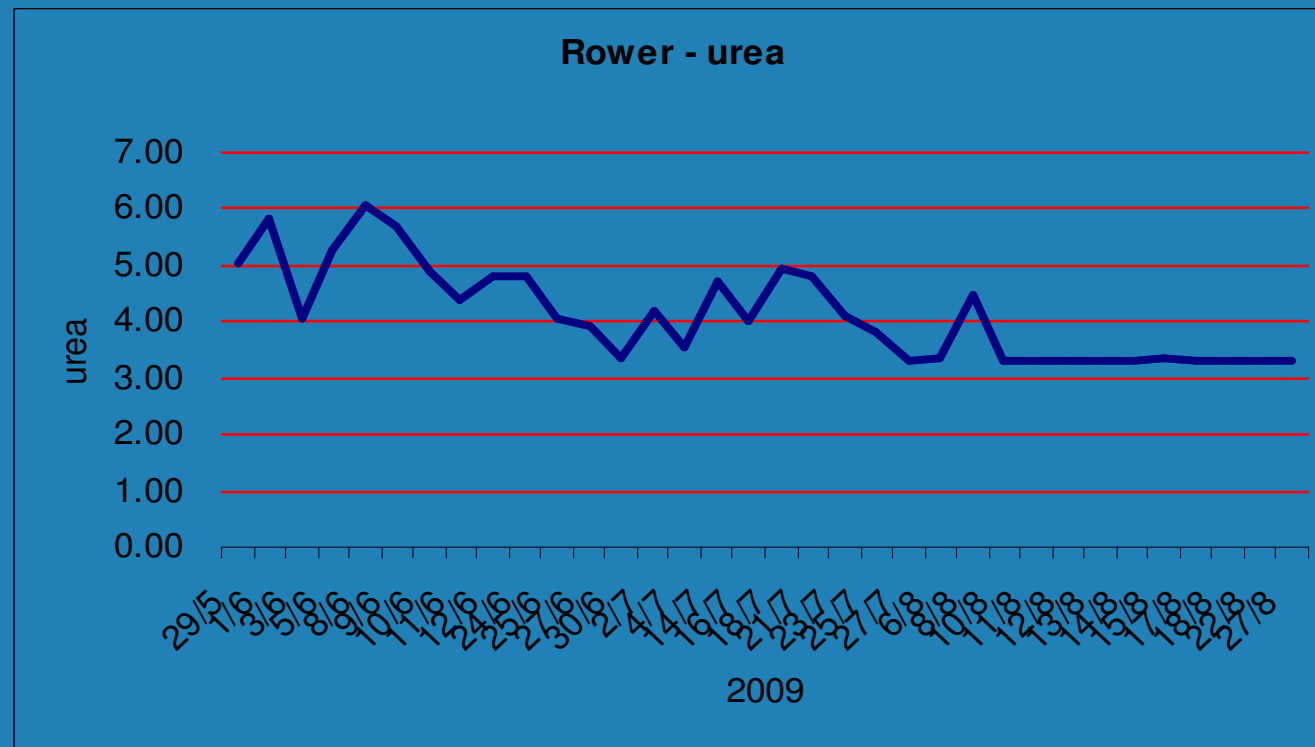
- ∩ Quite easily affected by many factors including rower's health condition, weather, etc.



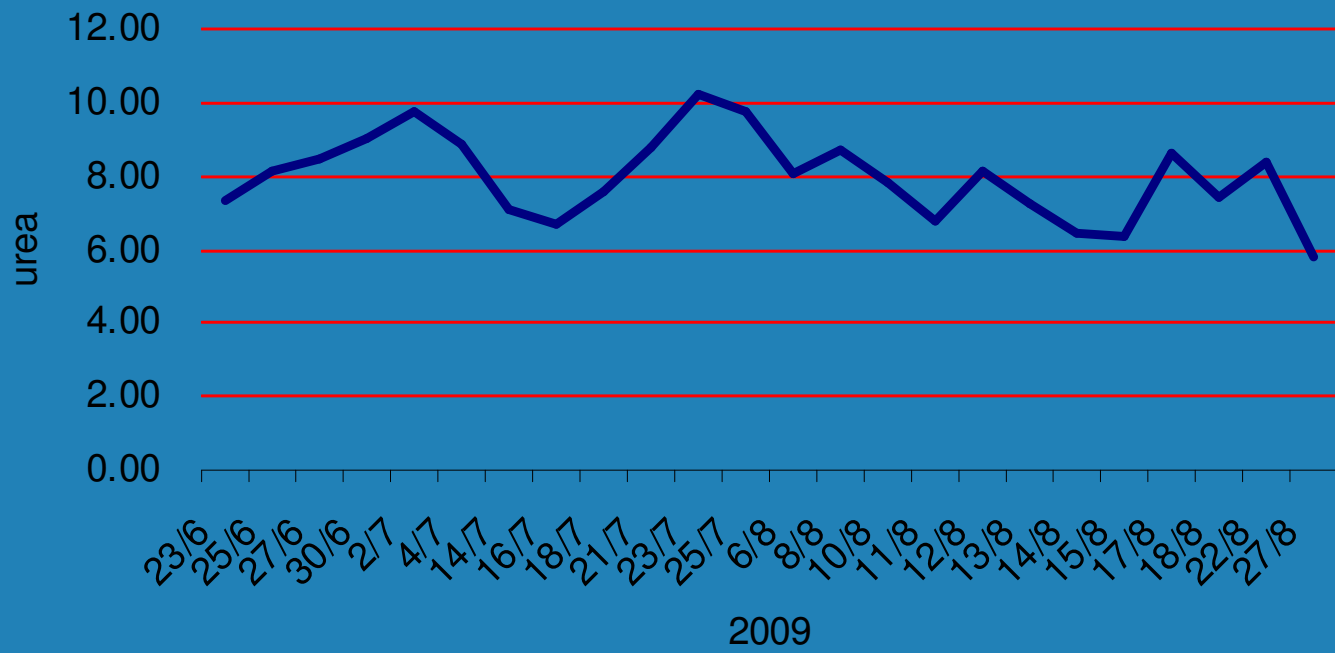
# The use of blood urea measurement

- ∞ Blood urea monitors training stress and adaptation of a rower.
- ∞ Intra-individual comparison
- ∞ Baseline data should be collected.
- ∞ Training, food intake and rest information should be used for more accurate presentation of blood urea changes

# Changes of blood urea profile of elite rowers approaching competition



Another rower - urea







# Body composition

- ∩ Most HK rowers are in the lightweight category.
- ∩ Proper body composition is important for training and racing.
- ∩ %BF data are important indicators to coaches in program prescription.
- ∩ Sports Nutrition specialists in HKSI lead the role in monitoring the body composition of rowers and giving them diet recommendations.



# Scientific tests and training

- ∞ The ultimate goal of scientific tests is to promote training efficiency by providing important information for better program prescription.
- ∞ Long term daily monitoring and observation combining test data are important for understanding the characteristics and current conditions of an athlete.



Thank you.