Contraintes cardiovasculaires en kayak et en aviron



Rame, rame. Rameurs, ramez?

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Plan de l'intervention

- Quelques différences entre *ramer* et *pagayer*
- Aviron & kayak: 2 activités hautement aérobie?
- Des contraintes énergétiques aux risques cardiovasculaires
- En guise de conclusion:
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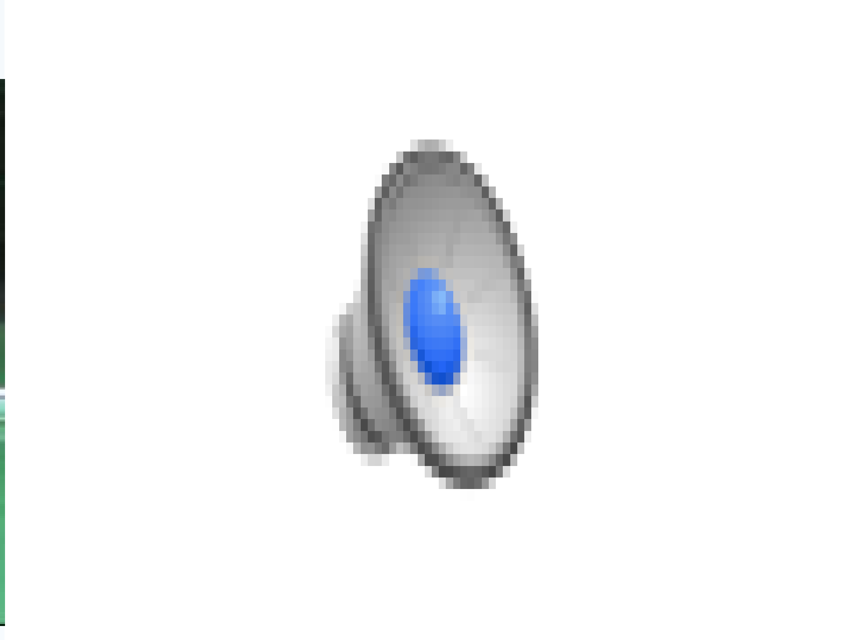
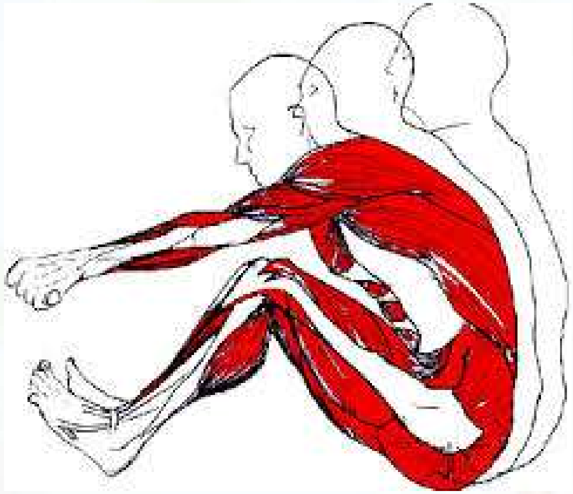
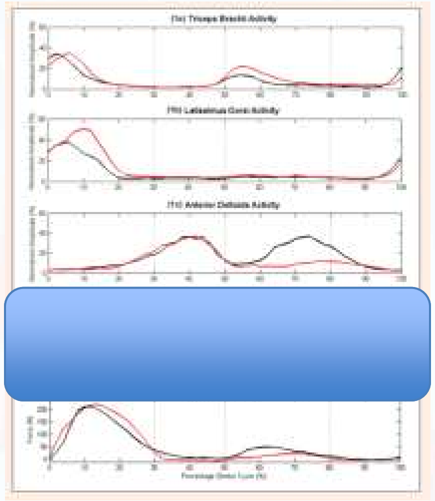
Quelques différences entre ramer et pagayer







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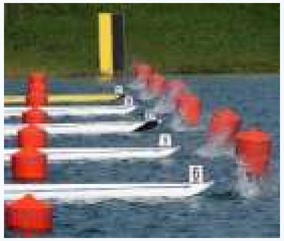

- Performance en course en ligne: VO_2 et aviron

J Sports Sci. 1999 Nov;17(11):845-52.

The relationship between selected physiological variables of rowers and rowing performance as determined by a 2000 m ergometer test.

Cosgrove MJ[1], Wilson J, Watt D, Grant SF.

Author information

Abstract

The aim of this study was to establish the relationship between selected physiological variables of rowers and rowing performance as determined by on a Concept II Model B rowing ergometer. Their mean (+/- s) age, body mass and height were 19.9+/-0.6 years, 73.1+/-6.6 kg and 180.5+/-4.6 cm respectively. The participants were tested on the rowing ergometer to determine their maximal oxygen uptake (VO2max), rowing economy, predicted velocity at VO2max, velocity and VO2 at the lactate threshold, and their velocity and VO2 at a blood lactate concentration of 4 mmol x l(-1). Percent body fat was estimated using the skinfold method. The velocity for the 2000 m performance test and the predicted velocities at the lactate threshold, at a blood lactate concentration of 4 mmol x l(-1) and at VO2max were 4.7+/-0.2, 3.9+/-0.2, 4.2+/-0.2 and 4.6+/-0.2 m x s(-1) respectively. A repeated-measures analysis of variance showed that the three predicted velocities were all significantly different from each other (P<0.05). The

- Performance en course en ligne: VO_2 et kayak

Buglione et al. Energetics of Best Performances in Elite Kayakers and Canoeists. Med. Sc. Sports Exerc. 43(5):877-884, May 2011.

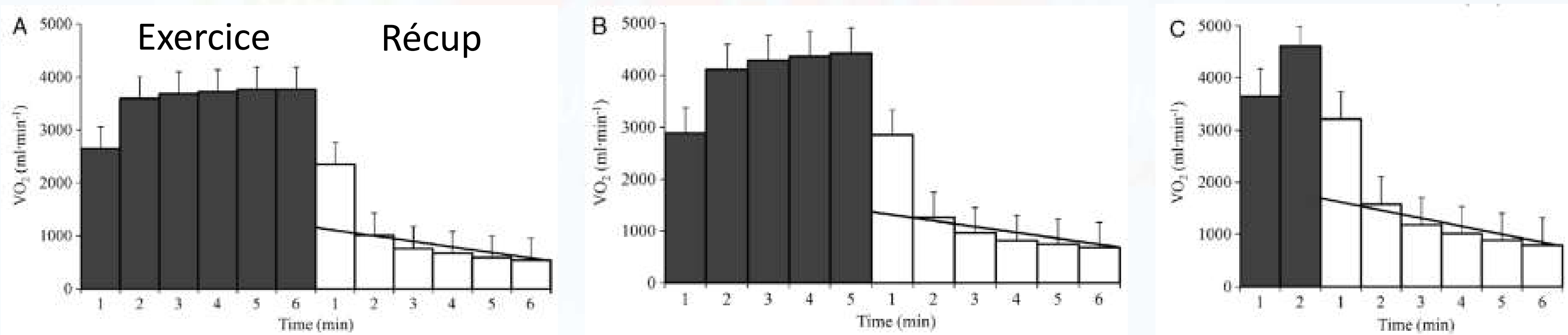

TABLE 2. The overall energy cost per unit of distance for covering 1000 m (C_k) is reported at the three investigated speeds.

Subjects	Speed ($m \cdot s^{-1}$)	C_k ($J \cdot kg^{-1} \cdot m^{-1}$)	C_k ($J \cdot m^{-1}$)	Net Blood Lactate (mM)	Alactic Sources (%)	Lactic Sources (%)
K1M (n = 46)	3.61 ± 0.10	4.02 ± 0.44	314 ± 42	1.1 ± 0.61	7.89	1.26
	3.86 ± 0.10	5.09 ± 0.38	397 ± 33	4.1 ± 1.22	10.10	4.41
	4.36 ± 0.14	6.06 ± 0.43	473 ± 39	7.6 ± 1.38	17.02	26.01
K1F (n = 23)	3.34 ± 0.06	4.28 ± 0.41	281 ± 31	1.1 ± 0.70	8.34	1.36
	3.55 ± 0.06	4.80 ± 0.35	316 ± 27	3.4 ± 1.23	9.85	4.13
	3.89 ± 0.12	5.71 ± 0.42	376 ± 37	6.2 ± 1.25	16.35	29.43
C1 (n = 5)	3.31 ± 0.07	5.16 ± 0.23	396 ± 25	1.5 ± 1.96	7.89	1.52
	3.63 ± 0.09	5.75 ± 0.27	442 ± 38	4.7 ± 3.56	9.63	4.72
	4.00 ± 0.16	6.71 ± 0.44	516 ± 49	7.3 ± 0.48	16.58	25.45

C_k per kilogram of BM is also indicated together with the corresponding percent O_2 equivalent of the energy derived from alactic, lactic, and aerobic sources (values are presented as mean ± SD).
K1M, male kayakers; K1F, female kayakers; C1, male canoeists; n, number of subjects; C_k, energy cost per unit of distance.

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- Mais de quelles contraintes *parlons-nous?*

En mécanique, le terme de **contrainte** est utilisé pour qualifier toute "**grandeur mesurant une interaction superficielle** "., et dans ce cas, celle-ci peut être **positive ou négative voire nulle**. Ainsi en étendant ce sens aux interactions dans un système territorial, on peut traiter simultanément le fait et son action sur la société.

(Marchand JP, Contraintes climatiques et espace géographique, ed. Paragdime,1985)

« *Une période de sécheresse estivale dans le midi aquitain peut être catastrophique pour le maïs et une bénédiction pour les Sauternes...* »

(Marchand JP, Hypergeo, 2014)

Des contraintes énergétiques aux risques cardiovasculaires

Bouckaert J et al. **Cardiorespiratory response to bicycle and rowing ergometer exercise in oarsmen.** *Eur J Appl Physiol Occup Physiol. 1983;51(1):51-9.*

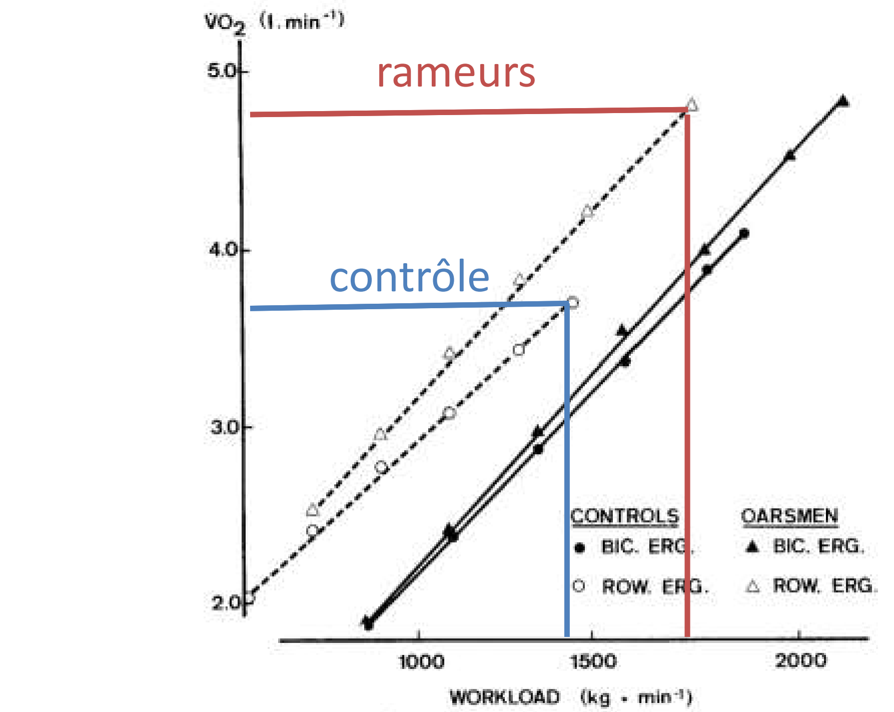


Fig. 3. Mean values for oxygen uptake ($\dot{V}O_2$) in relation to workload in oarsmen (n = 9) and in control subjects (n = 9) during exercise on the bicycle and on the rowing ergometer

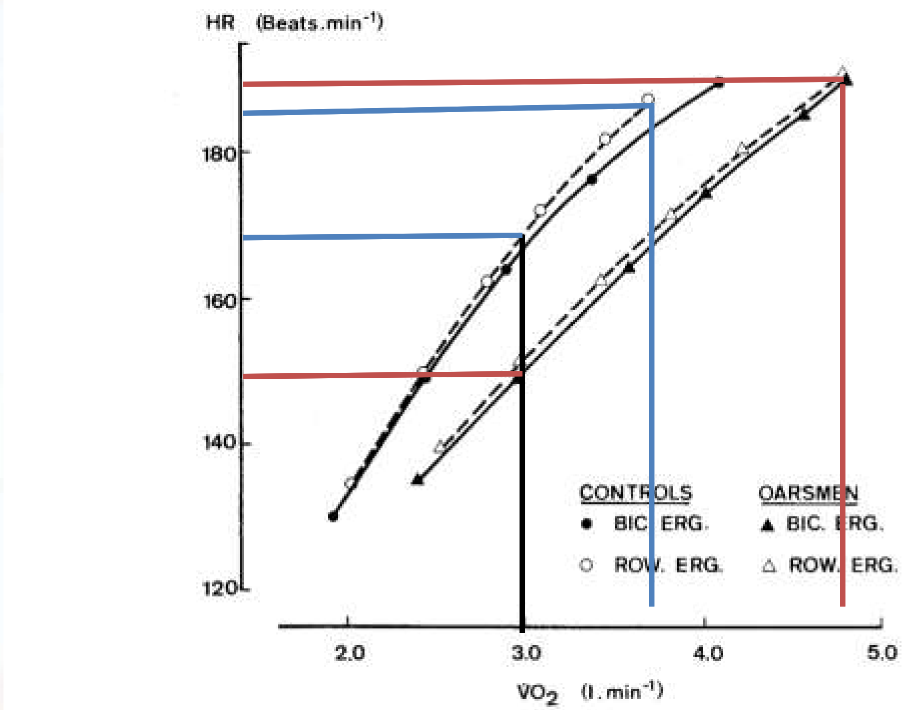


Fig. 1. Mean values for heart rate (HR) in relation to oxygen uptake in oarsmen (n = 9) and in control subjects (n = 9) during exercise on the bicycle and on the rowing ergometer

Pelliccia et al.
The upper limit of physiologic cardiac hypertrophy in highly trained elite athletes.
N Engl J Med. 1991 Jan 31;324(5):295-301.

Des contraintes énergétiques aux risques cardiovasculaires

- Comment expliquer que pour une même VO_2 absolue, la FC du rameur < sédentaire?

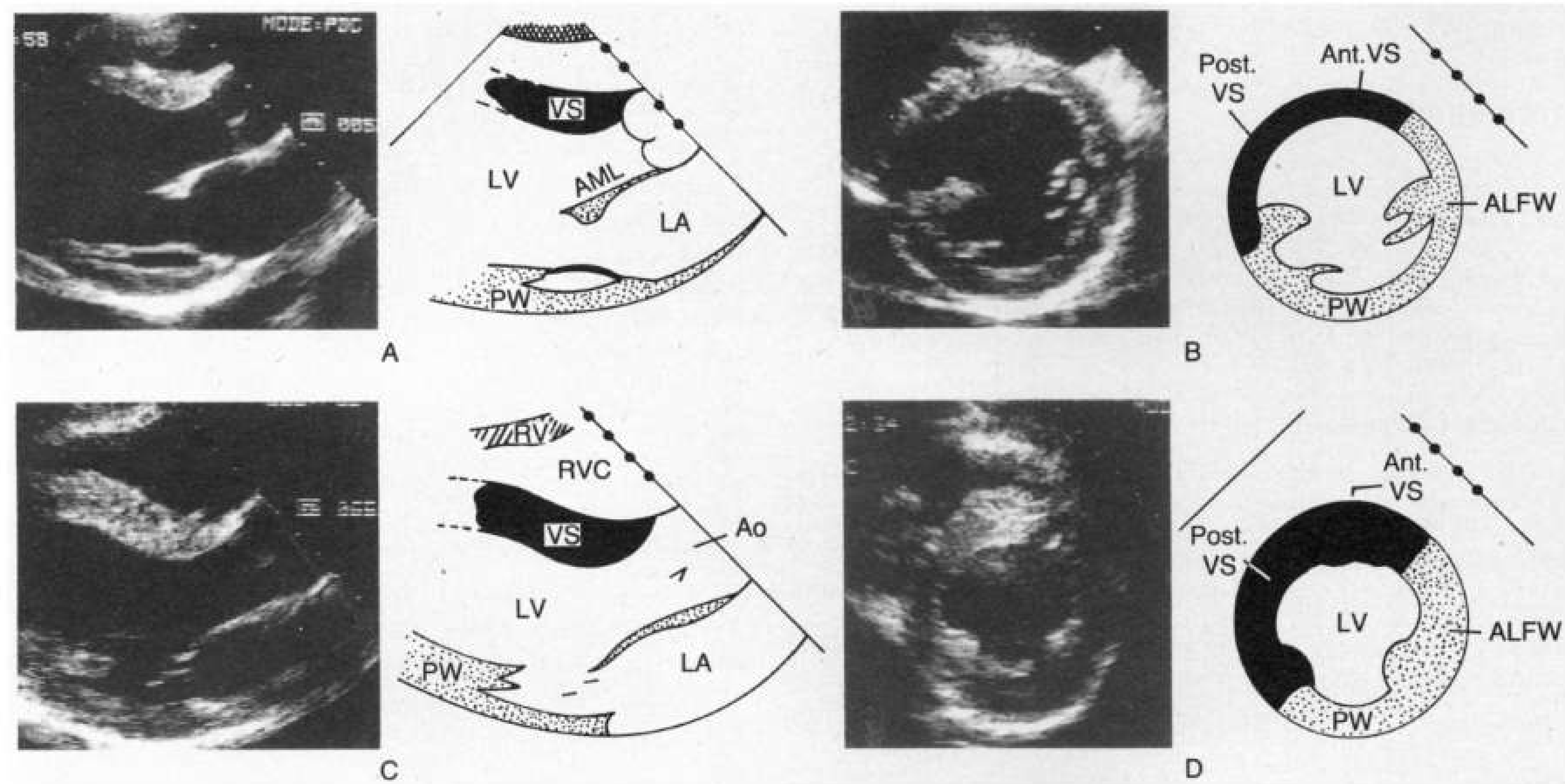
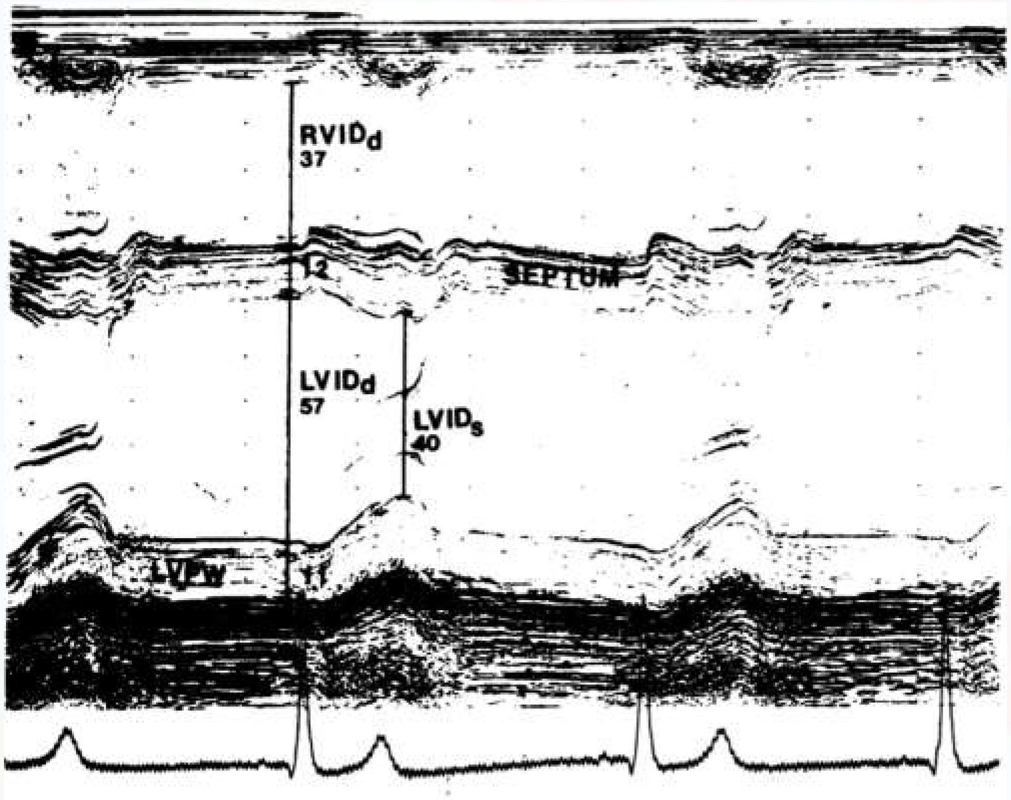


Figure 2. Stop-Frame Two-Dimensional Echocardiograms Obtained during Diastole and Corresponding Schematic Drawings from a 21-Year-Old Cyclist with a Normally Thick Left Ventricular Wall and a 25-Year-Old Canoeist with Thickening of the Left Ventricular Wall.

- Comment expliquer que pour une même VO_2 absolue, la FC du rameur < sédentaire?



Wieling et al. Echocardiographic dimensions and maximal oxygen uptake in oarsmen during training. Br Heart J. 1981 Aug;46(2):190-5.

(1) Left ventricular internal diameter at end-diastole ($LVID_d$).
(2) Left ventricular internal diameter at end-systole ($LVID_s$).
(3) Interventricular septal thickness at end-diastole (IVS).
(4) Left ventricular posterior wall thickness at end-diastole (LVPW).
(5) Right ventricular internal diameter at end-diastole ($RVID_d$).
(6) Diameter of the aortic root at end-diastole (aorta).
(7) Diameter of the left atrium at end ventricular systole.
(8) Percentage shortening of the left ventricular internal diameter, calculated as: $(LVID_d - LVID_s)/LVID_d \times 100$.

Fig. 1 *Echocardiogram of a silver medal winner at the 1979 World Rowing Championship. $LVID_d$, left ventricular end-diastolic diameter (mm); $LVID_s$, left ventricular end-systolic diameter (mm); LVPW, left ventricular posterior wall thickness (mm); $RVID_d$, right ventricular end-diastolic diameter (mm).*

Aksakal ***et al.*** *The effect of incremental endurance exercise training on left ventricular mechanics: a prospective observational deformation imaging study. Anadolu Kardiyol Derg. 2013 Aug;13(5):432-8.*

- Comment expliquer que pour une même VO_2 absolue, la FC du rameur < sédentaire?

Table 1. Clinical and echocardiographic characteristics before and after incremental endurance exercise training

Variables	Before IEET	After IEET	*p
Age, years	21.6±2.0	N/A	-
Body surface area, m^2	1.91±0.14	1.88±0.13	<0.001
Body mass index, kg/m^2	24.7±2.3	24.1±2.1	<0.001
Systolic blood pressure, mmHg	112±15	115±14	0.24
Diastolic blood pressure, mmHg	69±11	70±10	0.49
Mitral annular Sm –average, cm/s	0.09 (0.08-0.11)	0.12 (0.11-0.14)	0.14

Data are shown as mean±standard deviation or median (interquartile range) and numbers/percentages
*Wilcoxon or paired t-test
IEET - incremental endurance exercise training, LV - left ventricle, N/A - not applicable, Sm - tissue Doppler imaging mitral annular systolic velocity

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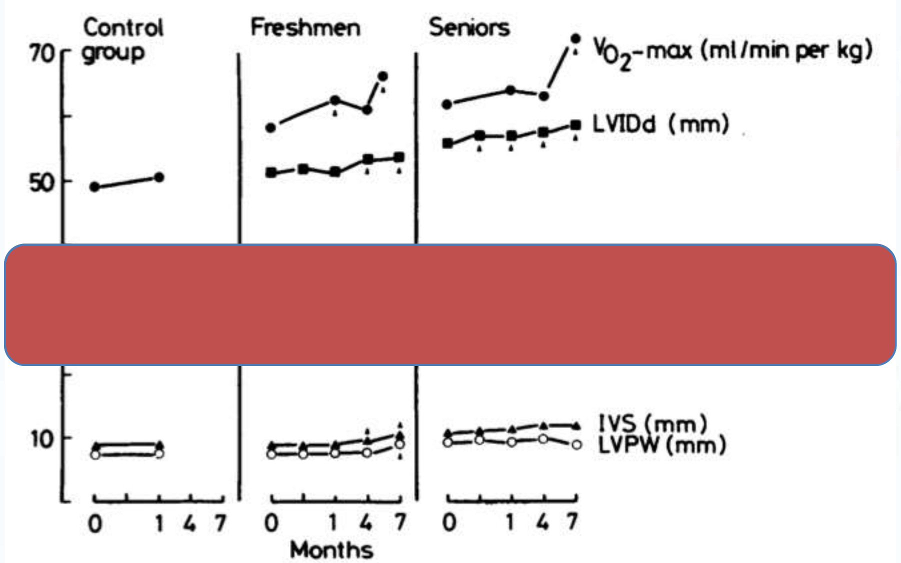

Fig. 2 *Changes in V_{O2} max, $LVID_d$, SV_1+RV_5 or V_6, and septal and left ventricular posterior wall thickness during seven months of training. Arrows indicate significant differences from control values.*

ELECTROCARDIOGRAPHIC MEASUREMENTS

test the

2: SV_1+RV_5 or V_6>44 mm,[15]
3: point score system according to Romhilt and Estes.[16]

Wieling et al. Echocardiographic dimensions and maximal oxygen uptake in oarsmen during training. Br Heart J. 1981 Aug;46(2):190-5.

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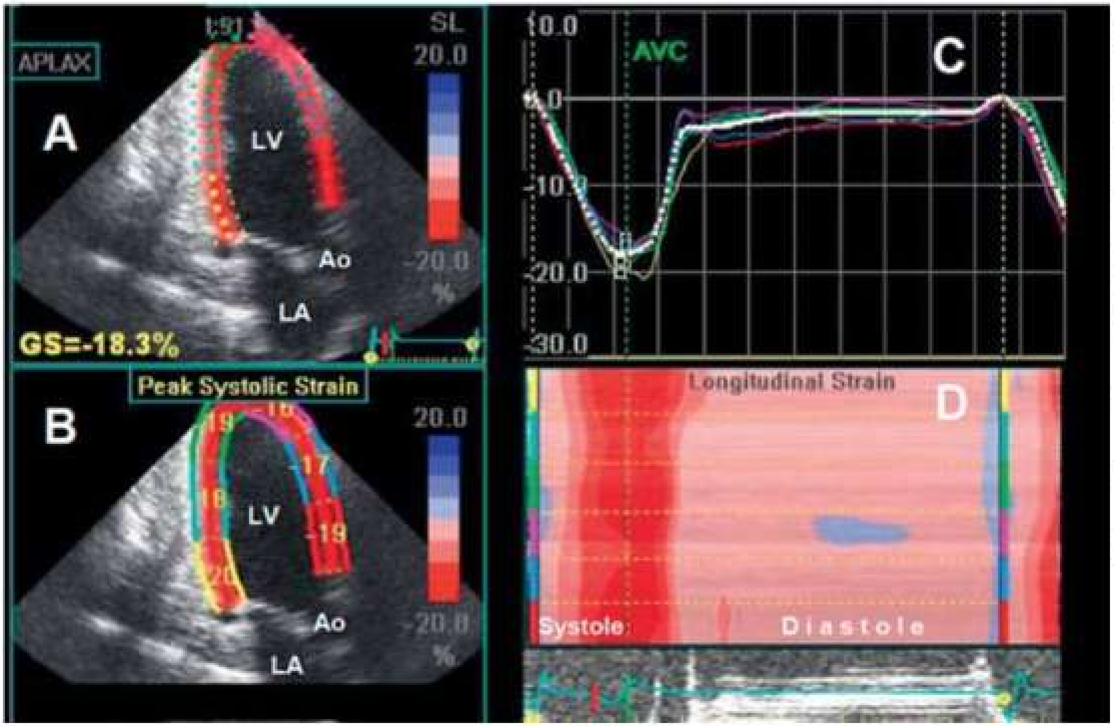

Above: Echocardiography (four-chamber view) of an athlete's heart in a male world-class endurance athlete with a heart volume of 19.0 mL/kg body weight. There is a harmonic relationship between the left and right ventricle (LV and RV) and between the left and right atrium (LA and RA).
Below: Echocardiography of an athlete's heart in a healthy, female, nationally top-ranked endurance athlete with a heart rate of 29 beats per minute at rest.
A: Three-chamber view with wall-motion analysis by 2D speckle tracking.
B: Display of the maximal relative deformation (strain) and shortening of the myocardial segments in systole.
C: The course of relative deformation of the myocardial segments over the cardiac cycle.
D: Display of all analyzed myocardial segments in a three-chamber view (y-axis with color labeling of the segments from B) with synchronous short contraction (red) of all myocardial segments, followed by a long period of relaxation and filling in diastole (pink).
LV, left ventricle; LA, left atrium; Ao, aorta.

Scharhag *et al.* **Competitive sports and the heart: benefit or risk?** *Dtsch Arztebl Int. 2013 Jan;110(1-2):14-23.*

- Comment expliquer que pour une même VO_2 absolue, la FC du rameur < sédentaire?

Table 2. Left ventricular strain and twist measurements before and after incremental endurance exercise training

Variables	Before IEET	After IEET	*p
Basal rotation, degree	4.3±1.34	4.4±2.0	0.74
Apical 4-chamber-LS, %	19.4±1.96	20.1±1.86	0.01
Apical long-axis-LS, %	20.2±1.30	20.5±1.17	0.16
Apical 2-chamber-LS, %	19.9±1.75	20.7±1.75	0.003
LV-global strain,%	19.8±1.33	20.4±1.26	0.001
Apical circumferential strain, %	23.0±3.1	23.6±3.2	0.03
Apical radial strain, %	40.0±7.1	41.5±7.6	0.11
Basal circumferential strain, %	21.1±2.2	21.6±2.5	0.03
Basal radial strain, %	40.8±6.2	39.7±7.6	0.31

Results are shown as mean±standard deviation and numbers/percentages
*Wilcoxon or paired t-test
IEET - incremental endurance exercise training, LS - longitudinal strain, LV - left ventricle

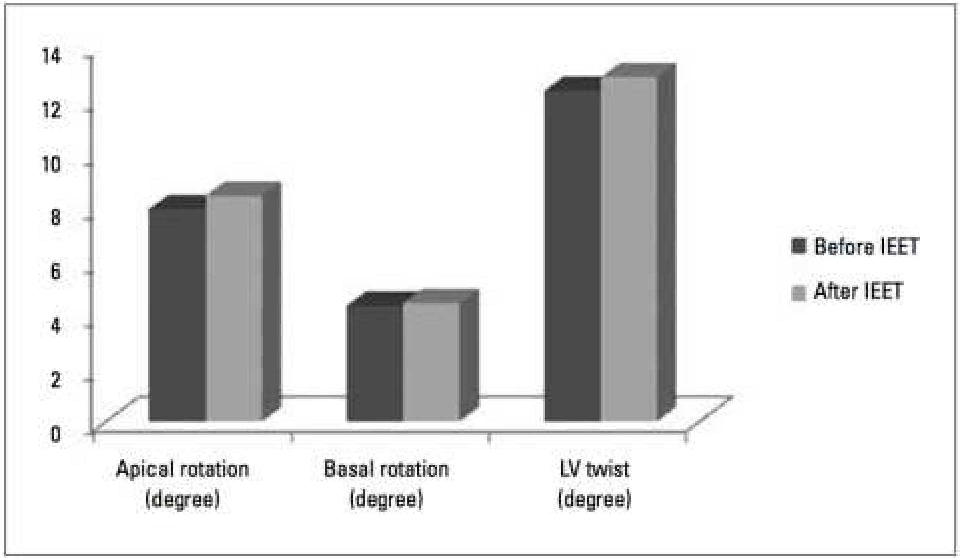

Figure 2. Left ventricular twist measurements before and after incremental endurance exercise training

Aksakal ***et al.*** *The effect of incremental endurance exercise training on left ventricular mechanics: a prospective observational deformation imaging study. Anadolu Kardiyol Derg. 2013 Aug;13(5):432-8.*

Des contraintes énergétiques aux risques cardiovasculaires

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Table 2. Left ventricular strain and twist measurements before and after incremental endurance exercise training

Variables	Before IEET	After IEET	*p
Apical rotation, degree	7.9±0.95	8.4±0.74	0.001
Basal rotation, degree	4.3±1.34	4.4±2.0	0.74
LV twist, degree	12.3±1.65	12.8±1.47	0.039
Apical 4-chamber-LS, %	19.4±1.96	20.1±1.86	0.01
Apical long-axis-LS, %	20.2±1.30	20.5±1.17	0.16
Apical 2-chamber-LS, %	19.9±1.75	20.7±1.75	0.003
LV-global strain,%	19.8±1.33	20.4±1.26	0.001
Apical circumferential strain, %	23.0±3.1	23.6±3.2	0.03
Apical radial strain, %	40.0±7.1	41.5±7.6	0.11
Basal circumferential strain, %	21.1±2.2	21.6±2.5	0.03
Basal radial strain, %	40.8±6.2	39.7±7.6	0.31

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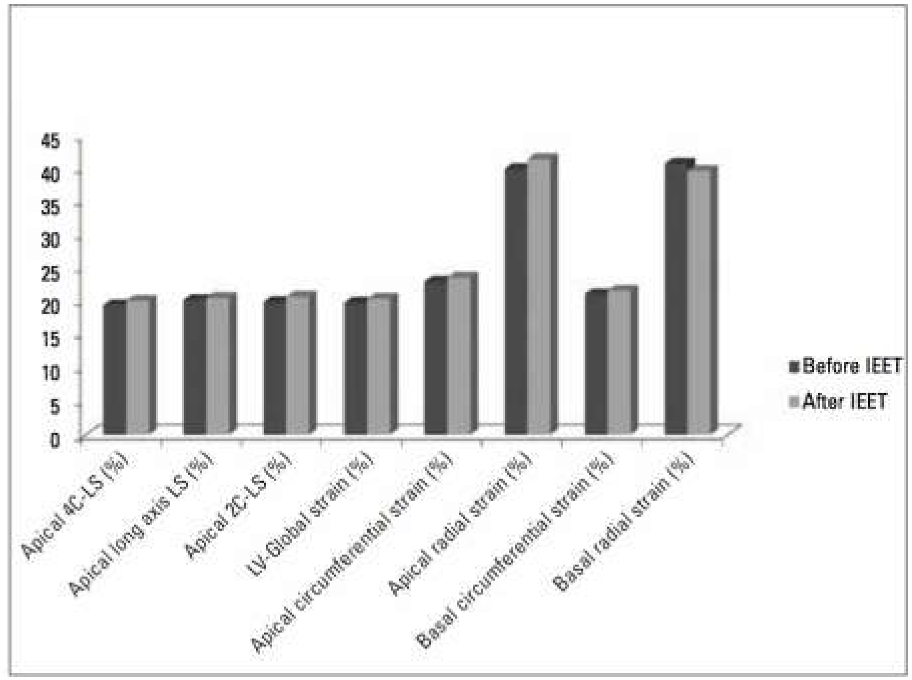

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- Quels sont les conséquences d'avoir un gros cœur?

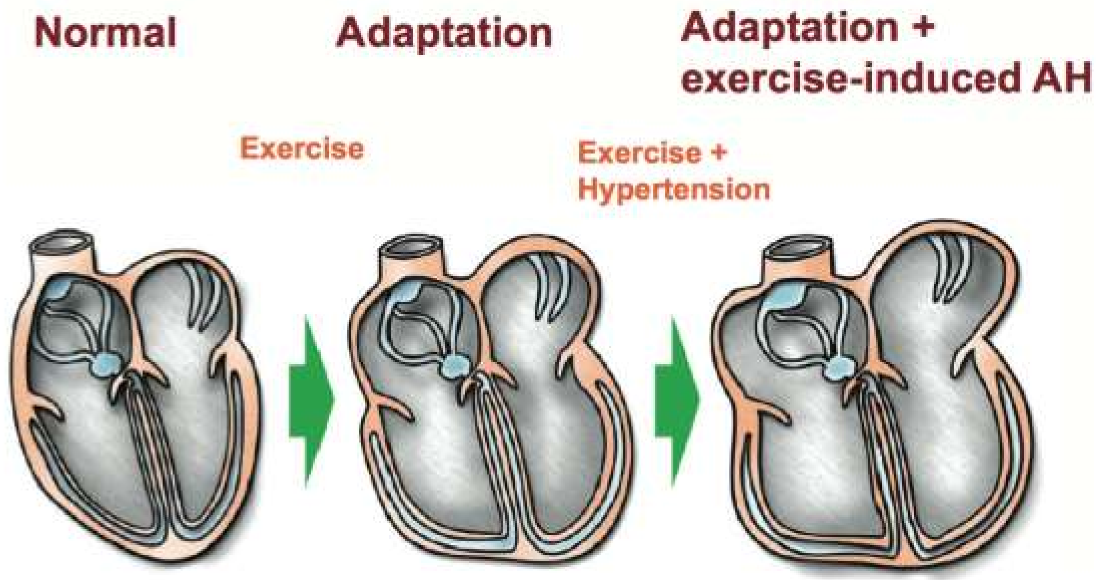


Figure 2. Scheme of possible adaptation of cardiac cavities in endurance sport and possible pathological enlargement/hypertrophy in case of exercise-induced arterial hypertension. Right and left atrium have more connective tissue construct as muscular ventricular chambers and more affinity for pathological enlargement in case of pressure overload.

Leischik et al. Exercise-induced arterial hypertension - an independent factor for hypertrophy and a ticking clock for cardiac fatigue or atrial fibrillation in athletes? F1000Res. 2014 May 12;3:105.

- Quels sont les conséquences d'avoir un gros cœur?

Table 3. Heart rate, oxygen uptake and performance in both groups of triathletes with different LVM. The table is divided in three main blocks: the first block reflects data at the aerobic threshold, the second one at the anaerobic threshold and the last one at the maximum exercise stage.

	LVM <220g			LVM >220g			p-value
	n	Mv	sd	n	Mv	sd	Mann-Whitney-U-Test
VAT (ventilatory aerobic threshold)							
HR	27	150.0	14.8	24	152.7	12.6	0.503
Watt	27	265.6	46.6	24	301.3	53.4	0.023
RCP (respiratory compensation point = anaerobic threshold)							
HR	27	162.7	12.5	24	163.7	12.0	0.599
Watt	27	295.6	43.5	24	332.2	51.3	0.014
Peak capacity							
HR	27	179.4	10.6	24	176.2	11.5	0.385
Watt	27	336.7	41.9	24	363.8	56.6	0.042

Mv = Mean value;
sd = standard deviation,
aVO2 = absolute oxygen uptake in L/min,
rVO2 = relative oxygen uptake in ml/min/kg,
% point of the overall exercise-test
HR = heart rate,
Watt = power output

Leischik et al. F1000Res. 2014 May 12;3:105.

- Quels sont les conséquences d'avoir un gros cœur?

	LVM <220g			LVM >220g			p-value
	n	mean	sd	n	mean	sd	Mann-Whitney-U-Test
Aorta (cm)	27	2.9	0.4	24	3.0	0.3	0.236
Left atrium (cm)	27	2.46	0.27	24	2.64	0.27	0.020
LAESV* (ml)	27	27.7	8.00	24	30.7	7.5	0.098
IVS diastolic (cm)	27	1.16	0.10	24	1.31	0.12	0.000
IVS systolic (cm)	27	1.57	0.13	24	1.78	0.16	0.000
PWD diastolic (cm)	27	1.13	0.08	24	1.32	0.13	0.000
PWD systolic (cm)	27	1.59	0.1	24	1.83	0.14	0.000
Relative wall thickness	27	0.48	0.06	24	0.53	0.07	0.055
LVEDD (cm)	27	4.7	0.4	24	5.0	0.3	0.003
LVESD (cm)	27	4.7	0.4	24	5.0	0.3	0.003
LVM (g)	27	185.3	19.3	24	254.1	27.0	0.000
LVM (g/m²)	27	95.3	10.1	24	128.8	17.6	0.000
RV parasternal	27	3.1	0.1	24	3.30	0.1	0.000

Leischik et al. Exercise-induced arterial hypertension - an independent factor for hypertrophy and a ticking clock for cardiac fatigue or atrial fibrillation in athletes? F1000Res. 2014 May 12;3:105.

- Quels sont les conséquences d'avoir un gros cœur?

692 **Pelliccia *et al.***
Left Atrial Remodeling in Competitive Athletes

JACC Vol. 46, No. 4, 2005
August 16, 2005:690–6

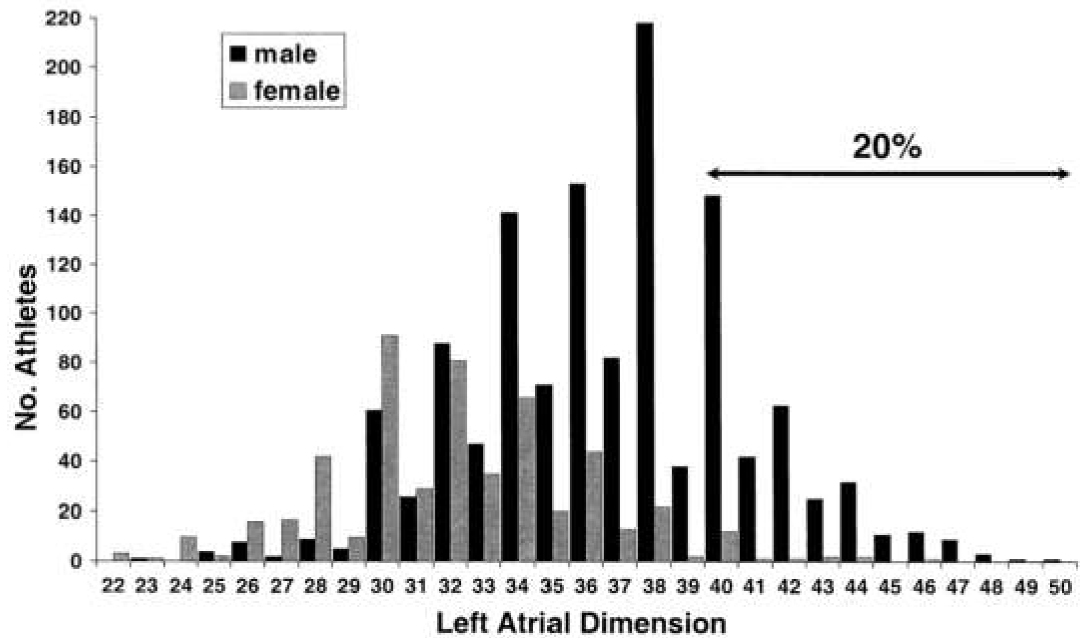


Figure 1. Distribution of transverse left atrium dimensions in 1,777 highly trained athletes. Data are shown separately for female **(grey bars)** and male **(black bars)** athletes. Twenty percent of athletes had an enlarged left atrium (range, 40 to 50 mm), including 2% with an atrial dimension ≥45 mm.

- Quels sont les conséquences d'avoir un gros cœur?

Table 2. Clinical, Demographic, and Echocardiographic Findings in 1,777 Elite Athletes With Respect to Left Atrial Dimension

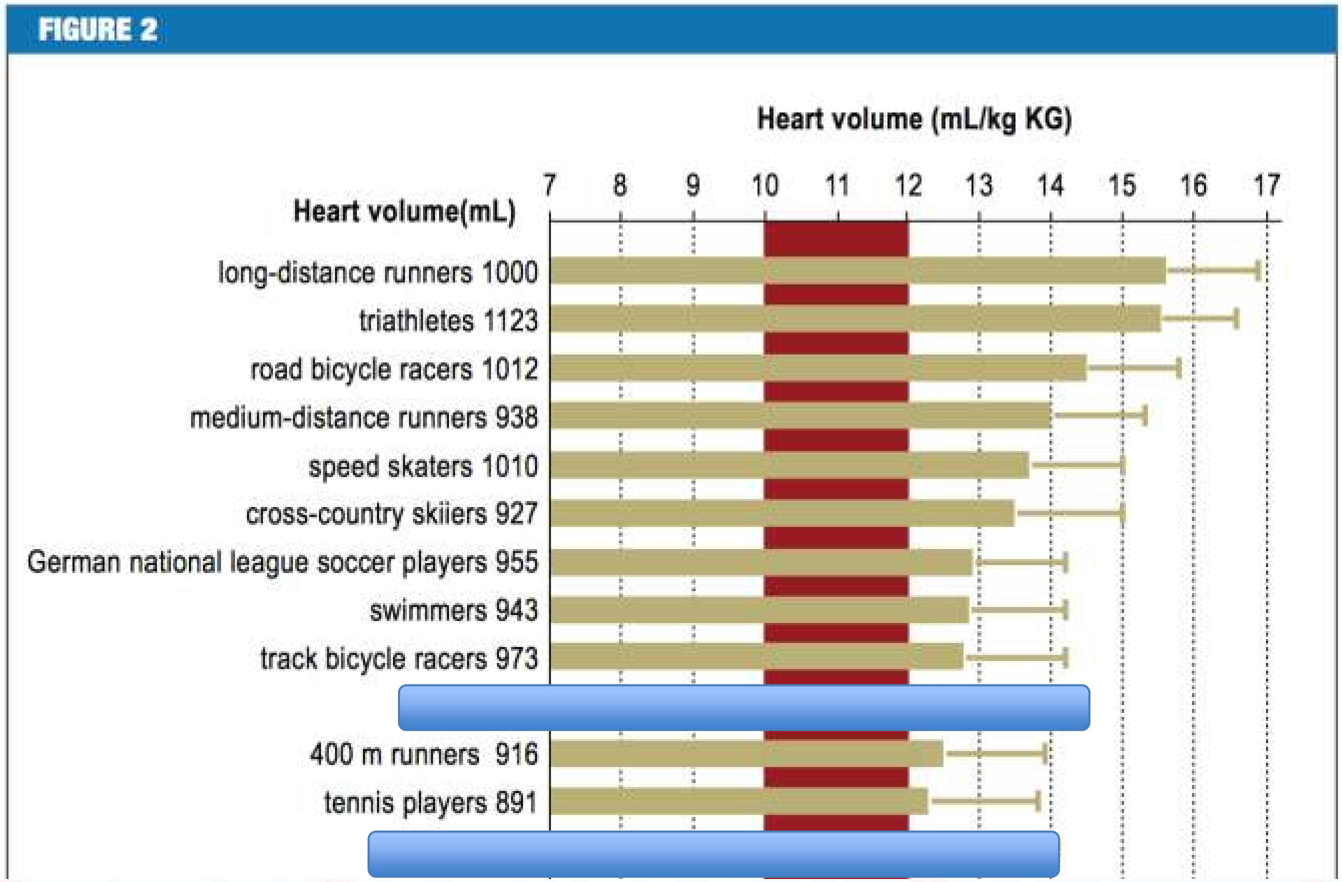
Parameter	LA Dimension ≥40 mm	LA Dimension <40 mm	p Value
No. athletes	347	1,430	—
Transverse LA dimension	41.7 ± 2.1	33.9 ± 3.4	—
No. (% male)	339 (95%)	959 (67%)	<0.001
Body surface area (m^2)	2.06 ± 0.20 (1.51–2.67)	1.81 ± 0.23 (0.98–2.59)	<0.001
Heart rate (beats/min)	53 ± 10 (31–94)	58 ± 11 (31–112)	<0.001
LV end-diastolic dimension (mm)	58.9 ± 3.9 (48–70)	52.3 ± 4.9 (38–67)	<0.001
Max. LV wall thickness (mm)	10.4 ± 1.1 (7–16)	9.1 ± 1.3 (5–15)	<0.001
LV mass index (g/m^2)	121 ± 21 (70–195)	95 ± 21 (44–170)	<0.001
h/r ratio	0.36 ± 0.04 (0.26–0.60)	0.35 ± 0.04 (0.23–0.60)	<0.004
Aorta (mm)	33.5 ± 2.7 (25–44)	30.3 ± 3.3 (20–43)	<0.001
E_{max} (mm/s)	68 ± 13 (35–109)	71 ± 14 (12–123)	NS
A_{max} (mm/s)	31 ± 9 (15–60)	32 ± 9 (12–108)	NS
E/A ratio	2.3 ± 0.8 (0.85–4.8)	2.4 ± 0.8 (0.4–6.2)	NS

Values are expressed as mean ± standard deviation and range in parentheses.

A_{max} = peak flow-velocity at late diastole, derived by pulsed Doppler; E_{max} = peak flow-velocity at early diastole, derived by pulsed Doppler; h/r = relative wall thickness (ratio of averaged ventricular septal and posterior free wall thicknesses to internal LV cavity radius); LA = left atrium; LV = left ventricular; Max. = maximum; NS = not significant.

- Quels sont les conséquences d'avoir un gros cœur?

Heart volumes in different types of competitive athletes
Means and standard deviations of relative heart volumes in male athletes in different sports. The mean absolute heart volumes are given at the left edge of the figure. Red: normal range. Athlete's heart is defined, in men, as a heart volume ≥ 13 mL/kg body weight. Gray zone: 12–13 mL/kg body weight



Scharhag *et al.* **Competitive sports and the heart: benefit or risk?** *Dtsch Arztebl Int.* 2013 Jan;110(1-2):14-23.

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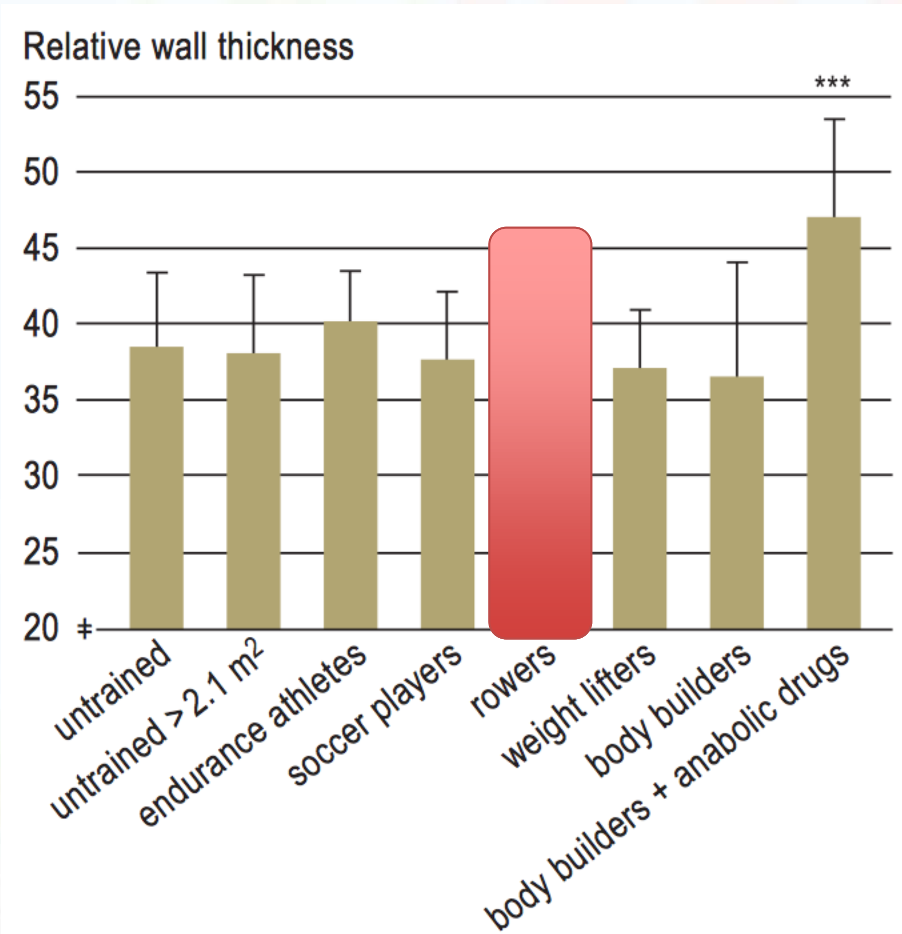

Relative wall thickness (mean and standard deviation) in healthy, athletically untrained persons of varying body size, endurance athletes, soccer players, strength-endurance athletes (rowers), and strength athletes with and without anabolic drug abuse (total, 230 subjects). Only body-builders taking anabolic drugs had concentric cardiac hypertrophy with a significantly elevated relative wall thickness ($p < 0.001$). m^2, body surface area in square meters. Reprinted from (10) with the kind permission of Springer publishers.

Scharhag *et al.* **Competitive sports and the heart: benefit or risk?** *Dtsch Arztebl Int. 2013 Jan;110(1-2):14-23.*

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Pelliccia *et al.*
Left Atrial Remodeling in Competitive Athletes

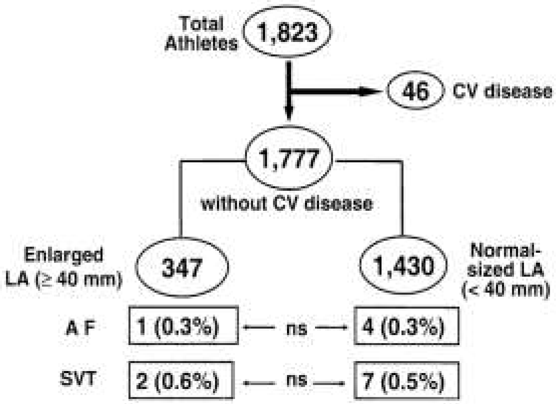


Figure 3. Prevalence of supraventricular tachyarrhythmias (i.e., paroxysmal atrial fibrillation or supraventricular tachycardia) before or at initial evaluation in our institute with respect to left atrial (LA) dimension, as assessed by echocardiography in 1,777 athletes. AF = paroxysmal atrial fibrillation; CV = cardiovascular; SVT = supraventricular tachycardia.

Table 1. Demographic and Clinical Features of the 14 Athletes With Supraventricular Tachyarrhythmias Identified Among 1,777 Highly Trained Athletes

Athlete	Gender	Age (yrs)	Sport	Palpitations at	Diagnostic Testing*	Arrhythmia	LA (mm)
[redacted]							
2	M	32	Soccer	Rest	ECG	AF	38
[illegible]	M	[illegible]	Volleyball	Exercise	Holter	AVRT	[illegible]
[redacted]							
5	M	36	Handball	Rest	EPS	AF	38
6	M	22	Cross-country skiing	Exercise	EPS	AVNRT	40
7	M	18	Pentathlon	Rest	Holter	AF	32
8	F	25	Field hockey	Exercise	Holter	AVNRT	32
9	M	15	Gymnastics	Exercise	Holter	AVNRT	36
10	F	28	Basketball	Exercise	EPS	AVNRT	36
11	M	18	Skating	Exercise	EPS	AVRT	33
12	M	23	Skating	Exercise	ECG (during exercise)	AVNRT	36
13	M	17	Basketball	Exercise	EPS	AF	44
14	F	28	Basketball	Rest plus Exercise	Holter	AVNRT	46

*Test during which the arrhythmia associated with symptoms was recorded.
AF = paroxysmal atrial fibrillation; AVNRT = atrio-ventricular nodal re-entrant tachycardia; AVRT = atrio-ventricular re-entrant tachycardia; ECG = 12-lead electrocardiogram; EPS = electrophysiologic study; Holter = 24-h Holter electrocardiographic monitoring; LA = left atrium transverse diameter.

- Quels sont les conséquences d'avoir un gros cœur?

« The electrocardiographic T wave changes in highly trained athletes during training. An old problem revisited. »

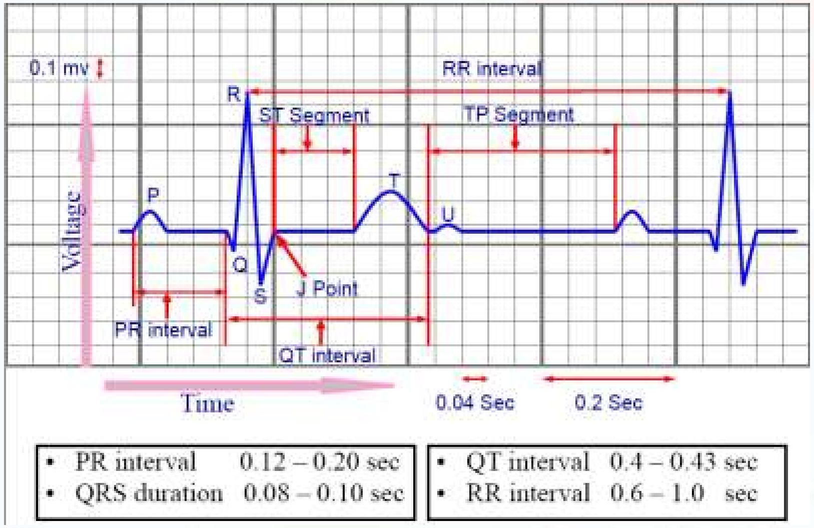
(Spataro et al. J Sports Med Phys Fitness. 1998 Jun;38(2):164-8)

✓ Altération de l'amplitude de l'onde T

✓ Altération du complexe QRS et de l'intervalle R-R

(Iellamo et al. Med Sci Sports Exerc. 2004 Aug;36(8):1342-6)

- Quels sont les conséquences d'avoir un gros cœur?



- **Uncommon, training-unrelated ECG changes**
  - T wave inversion in at least two adjacent leads
  - epsilon wave*[1]
  - ST segment depression
  - pathological Q waves
  - left atrial enlargement
  - left anterior hemiblock, left axis deviation
  - left posterior hemiblock, right axis deviation
  - right ventricular hypertrophy
  - ventricular preexcitation syndrome (Wolff-Parkinson-White syndrome)
  - complete left or right bundle branch block
  - long or short QT intervall (long or short QT syndrome)
  - Brugada-like early repolarization*[2]

ECG changes

- **Common, training-related ECG changes**
  - sinus bradycardia
  - 1st-degree AV block, 2nd-degree AV block of Wenckebach type
  - incomplete right bundle branch block
  - early repolarization
  - isolated QRS voltage criteria for left heart hypertrophy

Common ECG changes that require no further evaluation in healthy, asymptomatic athletes, versus uncommon ECG changes unrelated to athletic training that require evaluation in athletes; modified from Corrado et al. (5).

*[1] Post-excitation with a small wave in the ST segment in leads V1 to V3 as evidence of an arrhythmogenic right ventricular cardiomyopathy (ARVC)

*[2] Brugada-syndrome: an ion-channel disease characterized by ST elevation in leads V1 through V3, with an elevated risk of sudden cardiac death

Scharhag *et al.* ***Competitive sports and the heart: benefit or risk?***
Dtsch Arztebl Int. 2013 Jan;110(1-2):14-23.

- Quels sont les conséquences d'avoir un gros cœur?

Table 1. Typical echocardiographic findings in physiological (athlete's heart) and pathological (hypertrophic cardiomyopathy) cardiac hypertrophy.

Echocardiographic index	Athlete's heart	Hypertrophic cardiomyopathy
Left ventricular chamber size (diameter)	Normal / slightly enlarged	Normal / decreased
Mitral valve systolic anterior motion	Absent	Present
Acoustic density of the myocardial wall	Normal	Increased
Interventricular septum thickness	< 16 mm	> 16 mm
Interventricular septum thickness ratio to posterior wall thickness	< 1.3	> 1.3
Interventricular septum motion and shape	Regular	Irregular
Left ventricular diastolic function	Normal / improved	Decreased
Ejection fraction	Normal	Depressed
Left atrial volume	Increased moderately in proportion to other cardiac chambers	Enlarged markedly

J Sports Sci Med. 2007 Jun 1;6(2):166-71. eCollection 2007.
The role of echocardiography in the differential diagnosis between training induced myocardial hypertrophy versus cardiomyopathy.
Venckunas T1, Mazutaitiene B.

Original Article Ann Acad Med Singapore 2008;37:261-5

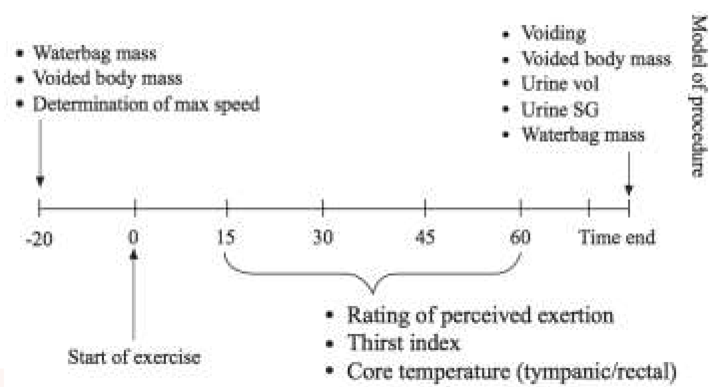
Dehydration Rates and Rehydration Efficacy of Water and Sports Drink During One Hour of Moderate Intensity Exercise in Well-trained Flatwater Kayakers

Jeremy MF Sun,[1] *MBBS*, Jason KK Chia,[1] *MBBS, MSpMed (Aust)*, Abdul Rashid Aziz,[2] *BPE (Sport Studies)*, Benedict Tan,[1] *MBBS, DFD (CAW), MSpMed (Aust)*

	Water	Gatorade
Volume of fluid consumed (mL)	519 ± 269	578 ± 240
Urine output (mL)	104 ± 142	120 ± 71
Urine specific gravity	1.02 ± 0.012	1.018 ± 0.008
Mean loss in body mass (kg)	0.70 ± 0.39*	0.46 ± 0.27*
Mean estimated water loss (L)	1.22 ± 0.59	1.04 ± 0.32
Mean time of maximal exertion (s)	31.7 ± 8.5‡	37.7 ± 10.3‡

Table 1. Subject Characteristics (n = 10)

	Male	Female	Total
Age (y)	22.8 ± 1.1	21.0 ± 2.7	21.9 ± 2.2
Body stature (cm)	173.4 ± 3.2	159.6 ± 4.7	166.5 ± 8.2
Body mass (kg)	70.8 ± 5.0	52.2 ± 7.3	61.5 ± 11.5
Experience in sport (y)	5.8 ± 1.1	4.4 ± 2.2	5.1 ± 1.8



* Body mass loss in water intervention significantly higher than body mass loss in Gatorade intervention (P <0.05)

† Mean percentage dehydration in water intervention significantly higher than mean percentage dehydration in Gatorade intervention (P <0.05).

‡ Mean time of maximal exertion is significantly longer in individuals consuming Gatorade compared to individuals consuming water [P <0.05 (one-tailed)].

➔ **Risque de troubles cardiaques**

- Et le compartiment sanguin dans tout ça?
  - Exercice, déshydratation et volume plasmatique

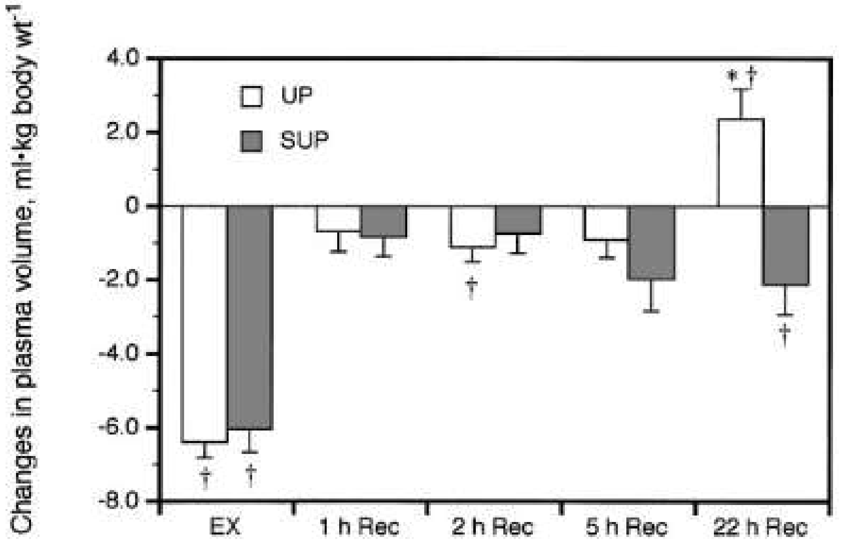


Fig. 2. Changes in plasma volume from control during exercise (Ex) and at 1, 2, 5, and 22 h of recovery (Rec) in Up and Sup. Values are means ± SE for 7 subjects. *Significant difference between Up and Sup, $P < 0.05$. †Significantly different from control, $P < 0.05$.

Nagashima et al. Mechanism for the posture-specific plasma volume increase after a single intense exercise protocol. J Appl Physiol (1985). 1999 Mar;86(3):867-73.

- Et le compartiment sanguin dans tout ça?
  - Exercice, déshydratation et volume plasmatique

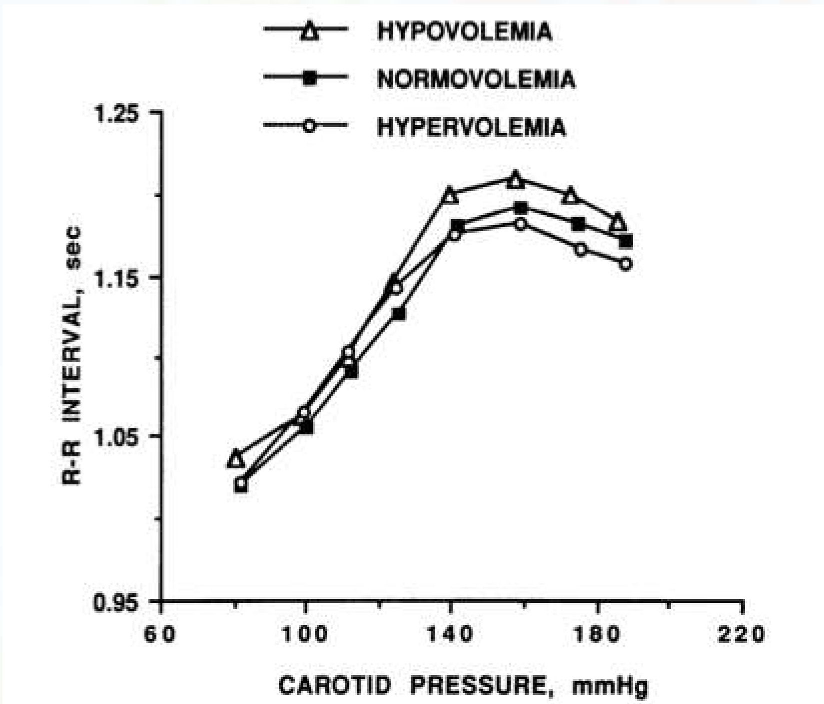


FIG. 1. Stimulus-response relation of carotid-cardiac baroreflex during hypovolemia, normovolemia, and hypervolemia. Symbols are means ± SE ($n = 8$ men).

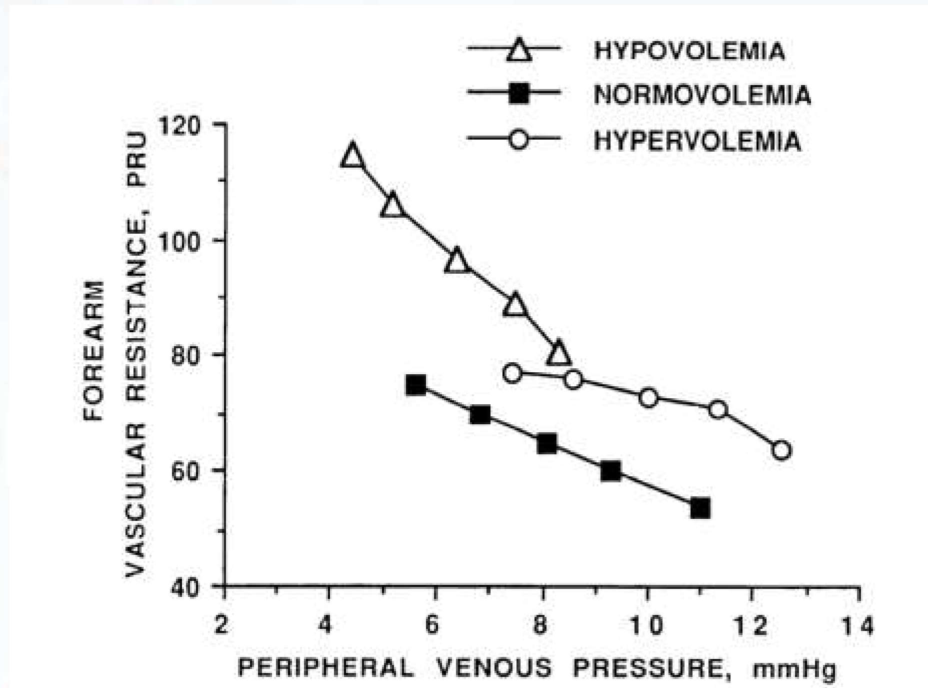


FIG. 3. Relationship between forearm vascular resistance and peripheral venous pressure during hypovolemia, normovolemia, and hypervolemia. Symbols are means ± SE ($n = 8$ men).

- Le « RAMage » et l'arbre artériel

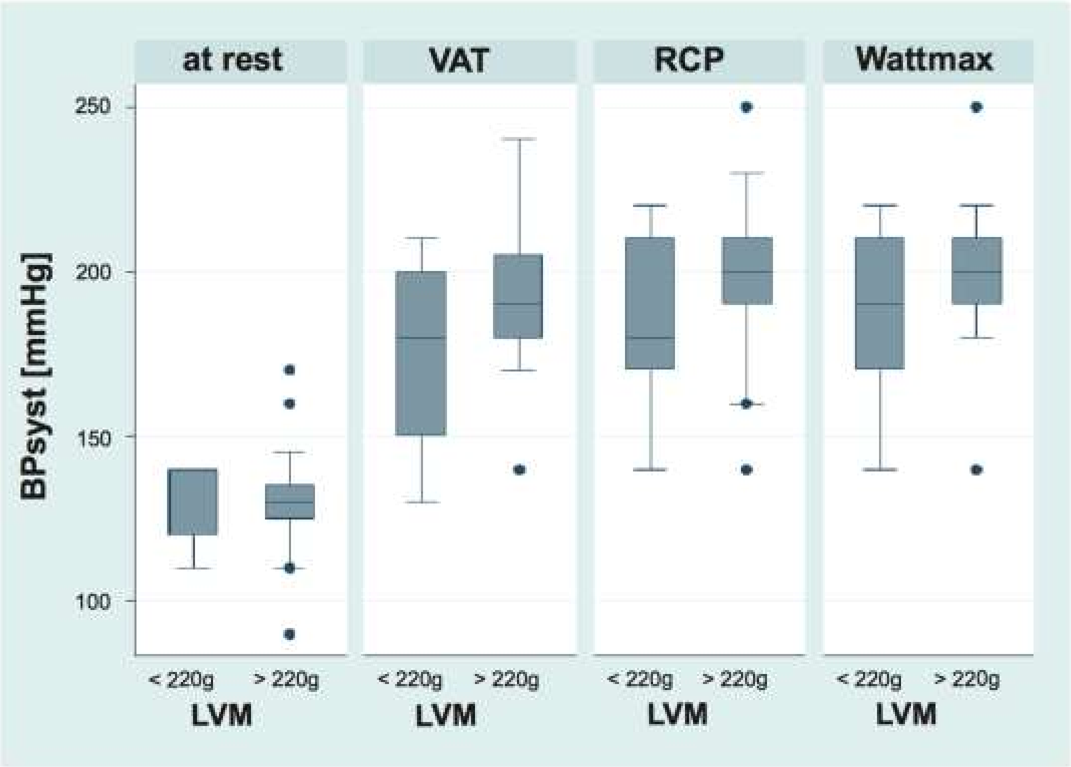
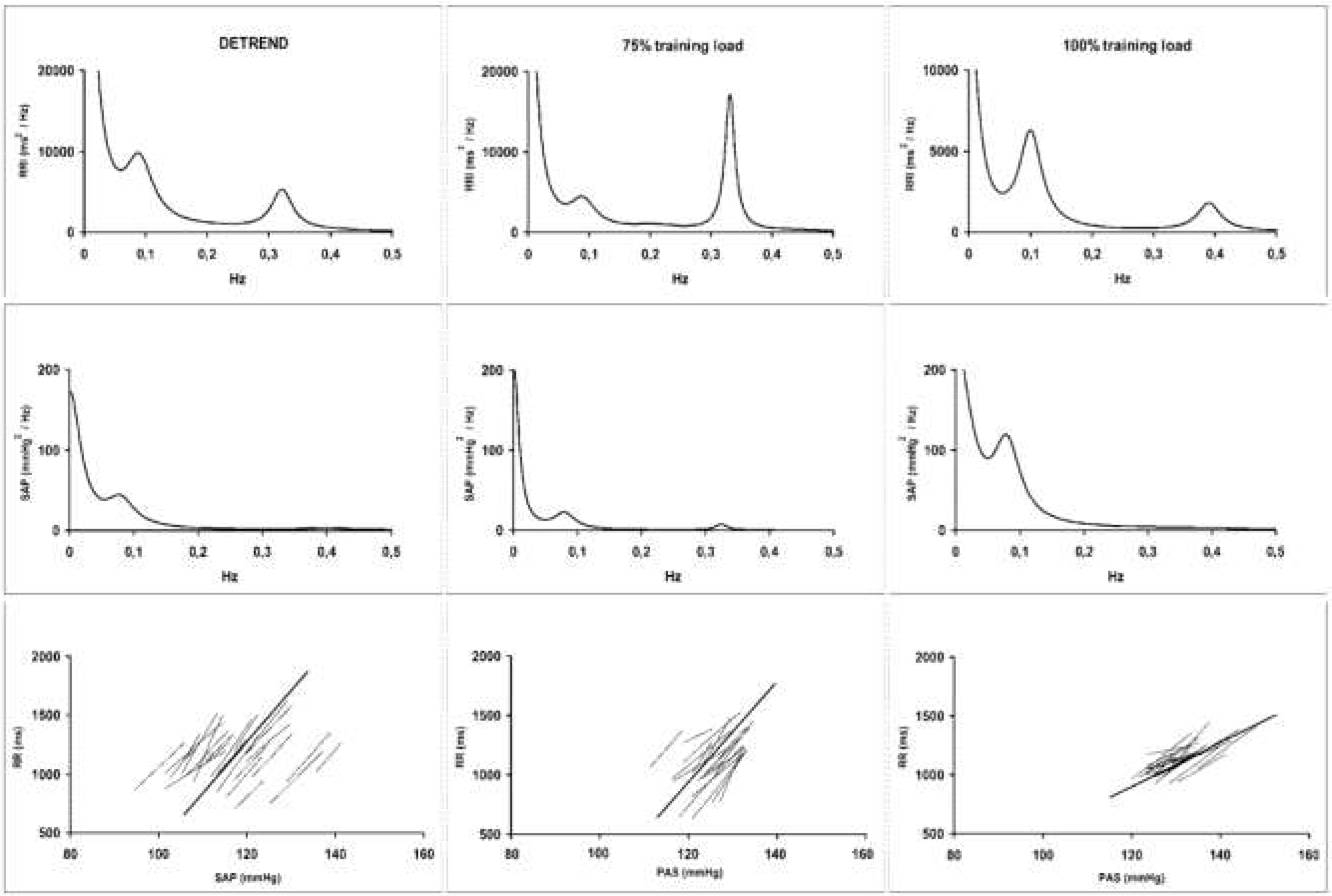


Figure 3. Blood pressure values at rest and at different exercise levels in two groups of triathletes with different LVM. The group with LVM >220 shows significant higher systolic blood pressure (BP) values at the aerobic threshold (VAT), anaerobic threshold (RCP) and at the maximum exercise-level (Wattmax).
BP = Blood pressure. LVM = left ventricular mass. VAT = ventilatore aerobic threshold.
RCP = respiratory compensation point. Wattmax = Maximum exercise-level.

Leischik et al. F1000Res. 2014 May 12;3:105.

Iellamo et al. Conversion from vagal to sympathetic predominance with strenuous training in high-performance world class athletes.
Circulation. 2002 Jun 11;105(23):2719-24.

- Le « RAMage » et l'arbre artériel



Example from one athlete of spectral analysis of RR interval (RRI, top) and SAP (middle) variabilities and of spontaneous baroreflex (bottom) at baseline and at 75% and 100% of training load. Bottom, Thin lines represent regression lines for each baroreflex sequence; thick lines, their mean slopes.

Cook et al. Arterial compliance of rowers: implications for combined aerobic and strength training on arterial elasticity.
Am J Physiol Heart Circ Physiol. 2006 Apr;290(4):H1596-600.

- Le « RAMage » et l'arbre artériel

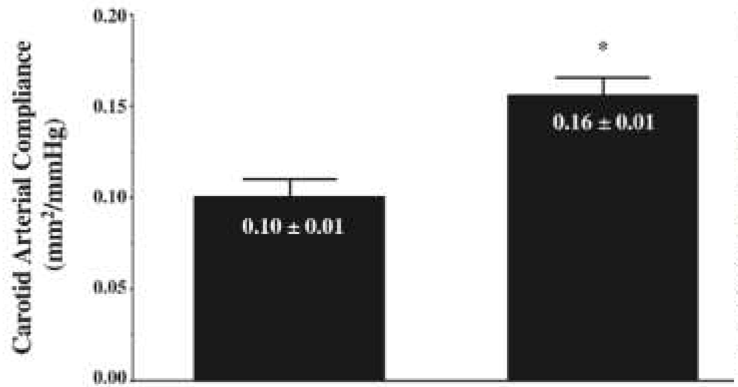


Table 2. *Selected physiological variables at rest*

	Sedentary	Rowers
Heart rate, beats/min	63±7	53±11*
Brachial systolic BP, mmHg	122±10	122±10
Brachial diastolic BP, mmHg	75±13	75±10
Brachial mean BP, mmHg	93±9	92±10
Brachial pulse pressure, mmHg	47±6	49±5
Carotid systolic BP, mmHg	105±9	103±8
Carotid pulse pressure, mmHg	35±6	35±5
Carotid IMT, mm	0.59±0.06	0.61±0.08
ABI	1.10±0.07	1.08±0.07

Values are means ± SD; n = 15. BP, blood pressure; IMT, intima-media thickness; ABI, ankle-brachial pressure index. *P < 0.05 vs. sedentary.

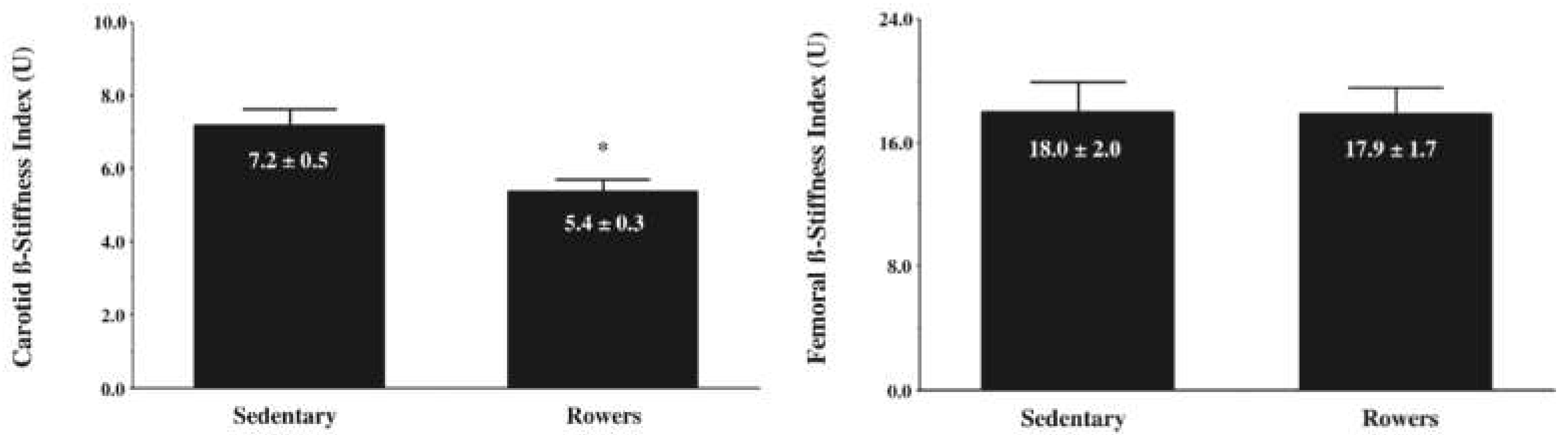


Fig. 1. Arterial compliance and β-stiffness index of the carotid and femoral artery. Values are means ± SE. *P < 0.001 vs. sedentary.

Nybo L et al. <u>Physiological Characteristics of an Aging Olympic Athlete.</u> Med Sci Sports Exerc. 2014

- Mais au final, c'est toujours le sportif qui gagne
  - Maintien de la VO_{2max} et des perf.
  - ➘FC
  - ⃠ LVED : 5.8 vs. 5.5 cm
  - Masse VG: 198 vs. 196 g
  - FE: 0,59 (VS au repos = $100mL.bat^{-1}$)
  - Maintien du volume sanguin

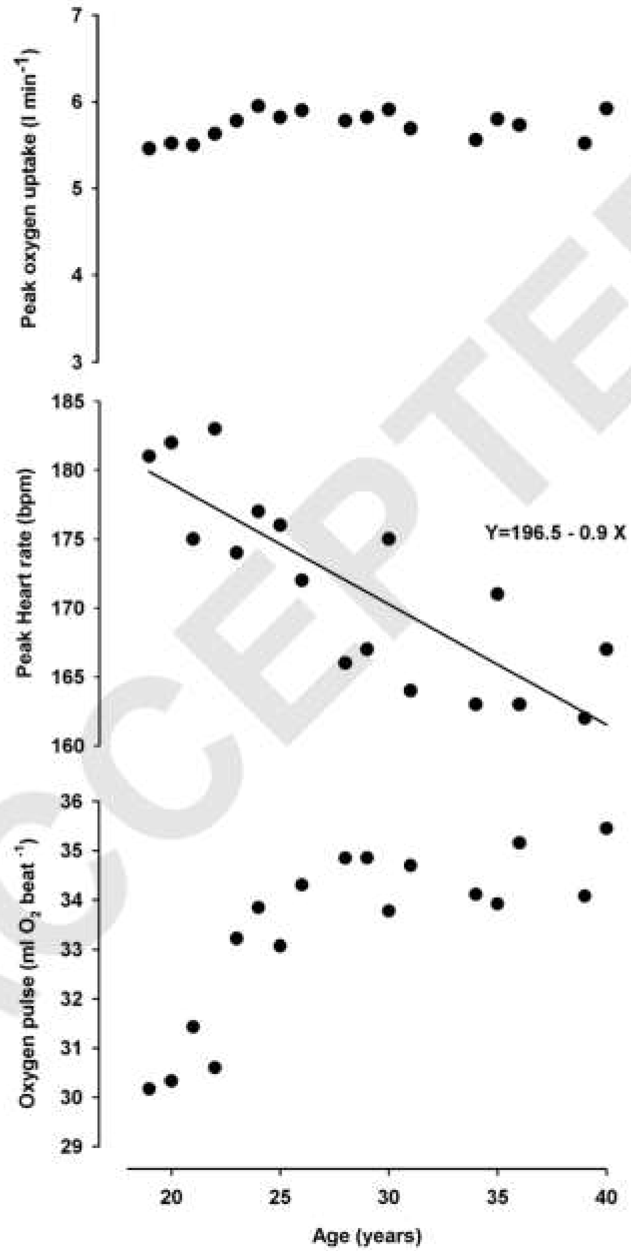


Figure 1. Maximal oxygen uptake (top panel), maximal heart rate (middle) and oxygen pulse (bottom) obtained during 6-min maximal tests from the age of 19 to 40 years. Values are reported from the test eliciting the highest oxygen uptake within the given year. Data from the age 32-33 and 37-38 are missing due to sabbatical breaks from elite rowing (see Methods for explanation)

Plan de l'intervention

- Quelques différences entre *ramer* et *pagayer*
- Aviron & kayak: 2 activités hautement aérobie?
- Des contraintes énergétiques aux risques cardiovasculaires
- En guise de conclusion:
  - *Ramer* avec une déficience motrice
  - Faut-il *ramer* en réadaptation?

Conclusion:
ramer avec une déficience motrice

Laskin et al. Paraplegia. 1993 Aug;31(8):534-41.
Electrical stimulation-assisted rowing exercise in spinal cord injured people. A pilot study.

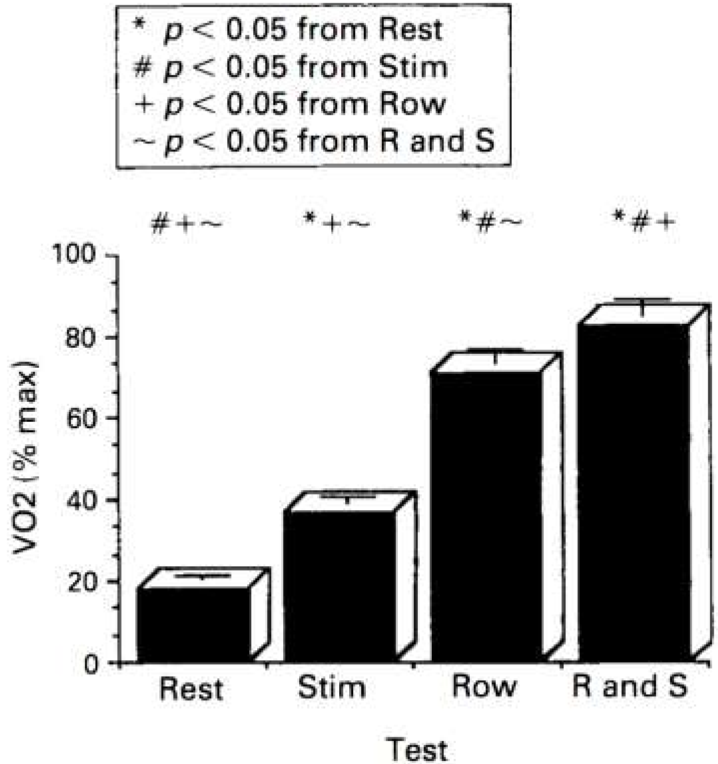


Figure 2 Oxygen uptake expressed as a % of maximum (± SE) for the three tests.

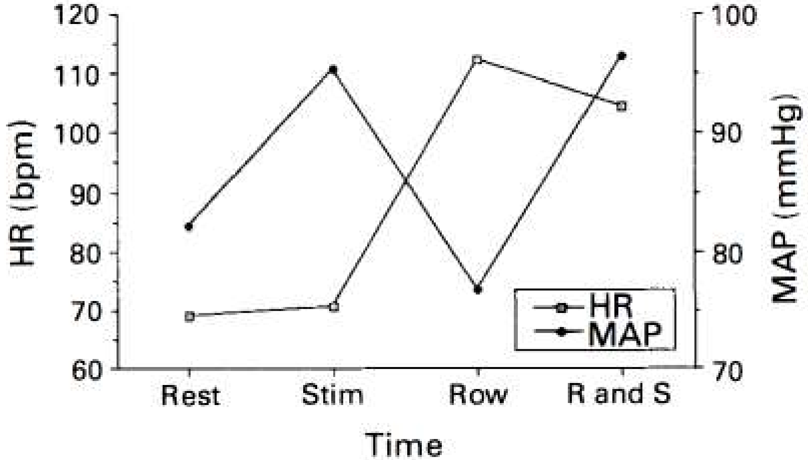


Figure 5 Cardiovascular variables measured immediately post each test.

Plan de l'intervention

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- Exercice et fonction endothéliale
  - Activation mécanique d'eNOS favorisé par le débit sanguin *(Yoshizumi et coll., 1993)* ;
  - Régulation négative l'expression des récepteurs de type 1 à l'angiotensine II (AT1-R) *(Adams et al., 2005)* ;
  - Restauration de la réponse vasodilatatrice à l'adénosine *(Heaps et coll., 2000)* ;
  - Amélioration de la réponse vasodilatatrice coronaire et artérielle pulmonaire *(Hambrecht et al., 2003)*.

ALORS:

Rame, rame. Rameurs, ramez!

A. Souchon