

CARDIOVASCULAR IMPACT OF SPORT IN EXTREME CONDITIONS



Sport's Cardiology Webinar

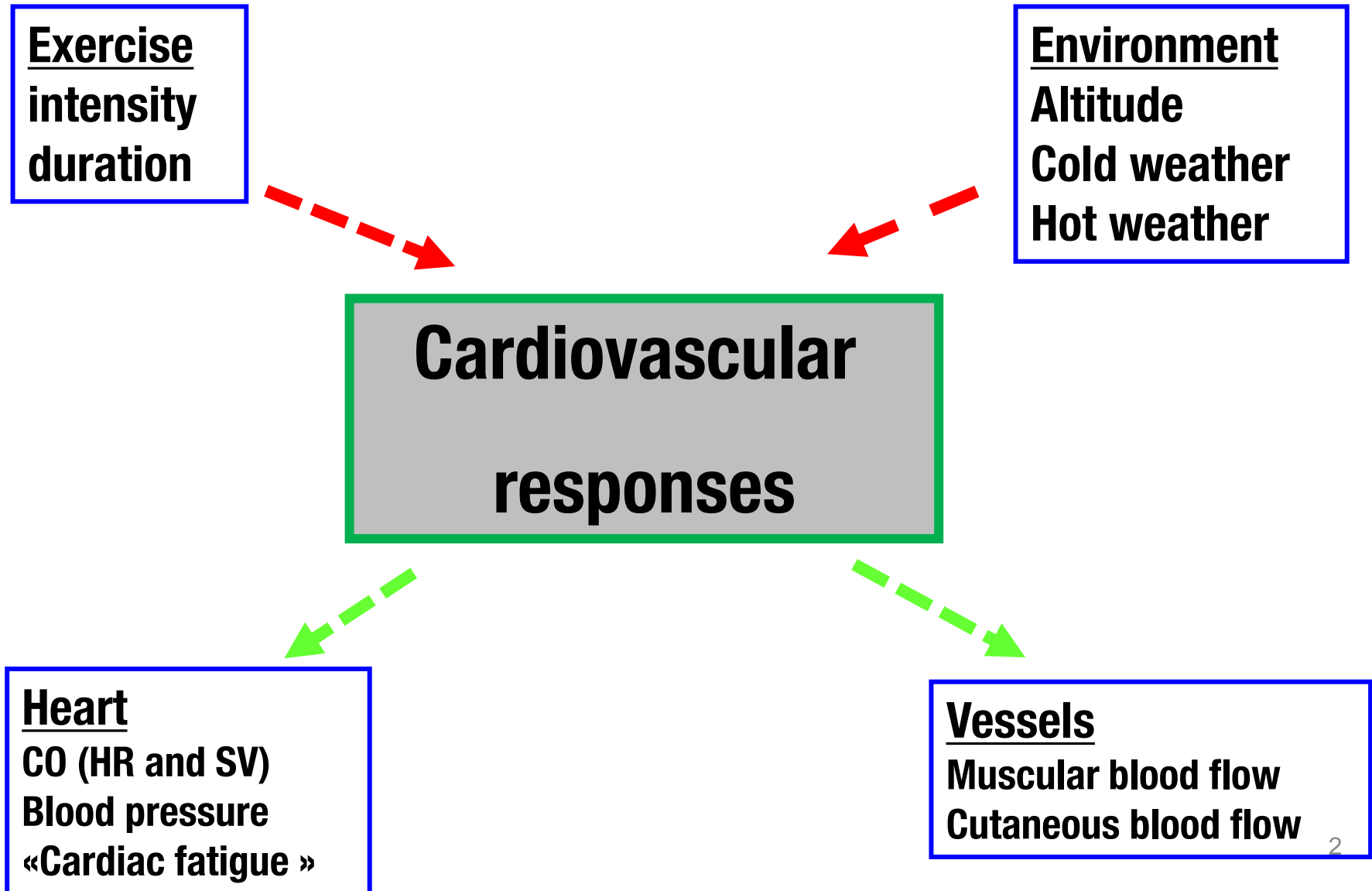
June 19th 2020

F. Carré

Pontchaillou Hospital - Université Rennes 1 - INSERM UMR 1099



Sport's and environment cardiovascular stresses



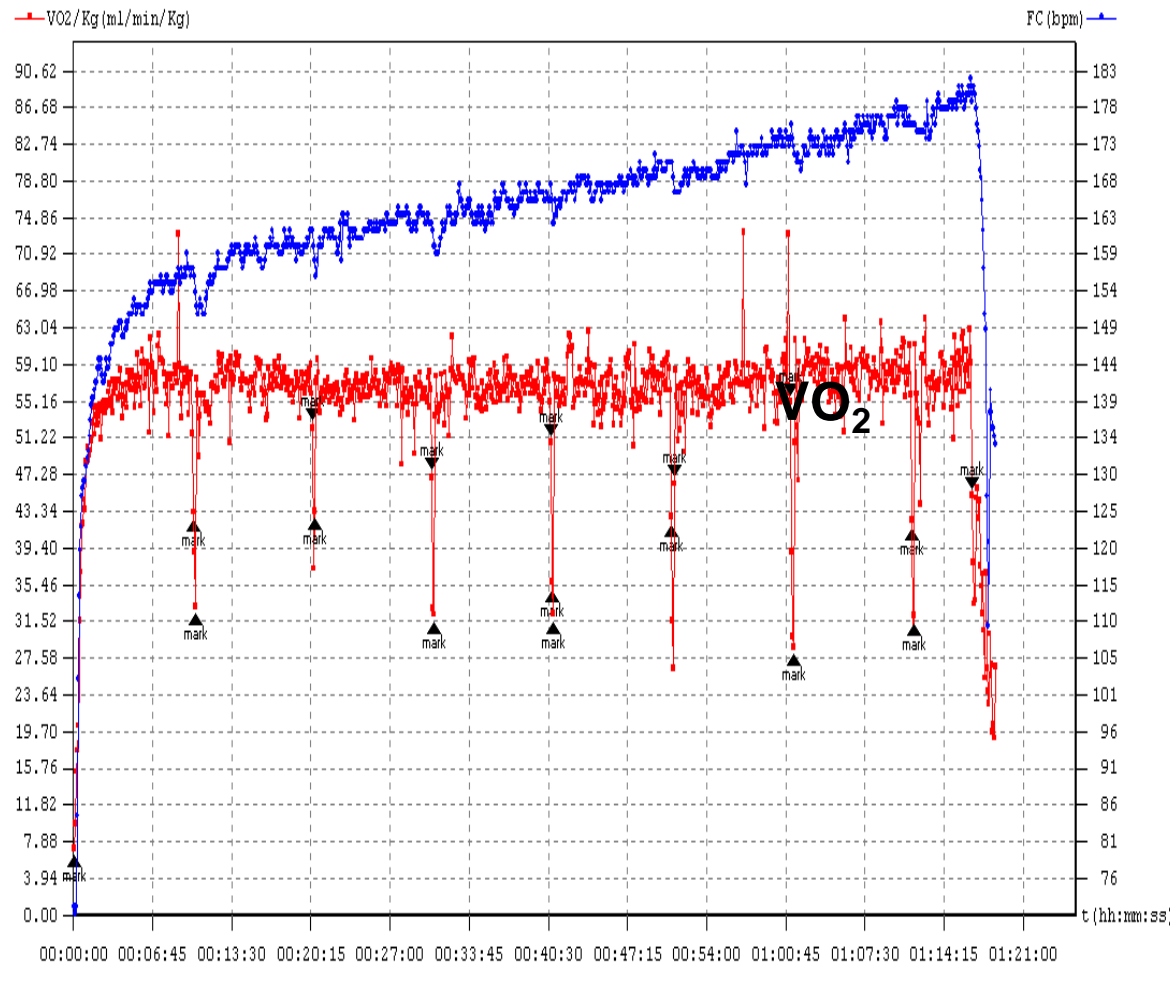
Selection of environment conditions



Long distance running



Endurance heart rate drift



Dehydration

Thermoregulation

Neuro-hormonal changes

Cardiac fatigue

Energy cost of running

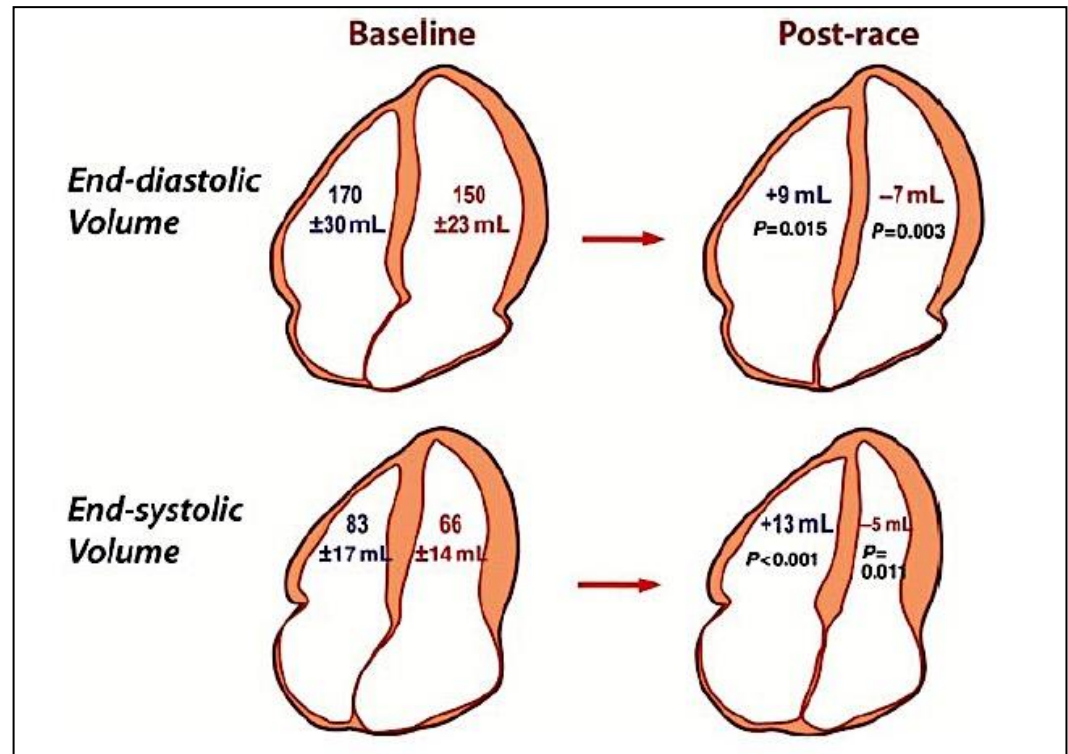


Paris semi-marathon 2005, Courtesy from V. Billat PhD

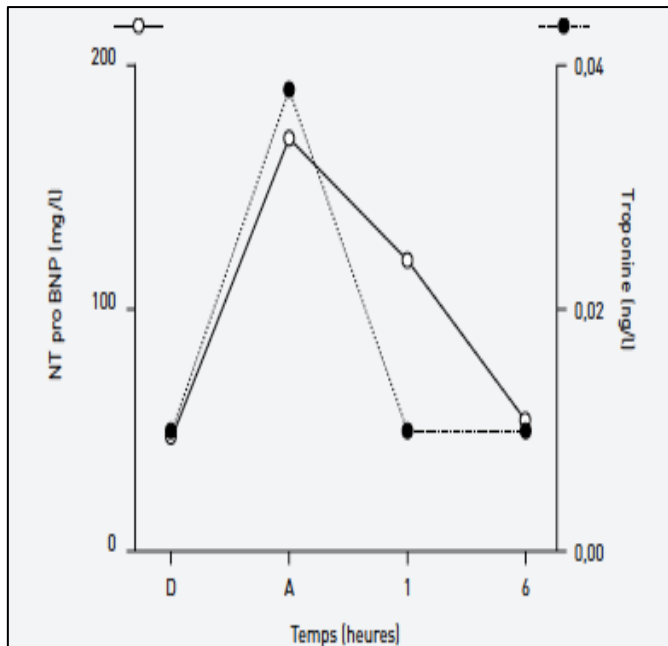
Cardiac fatigue, signs

La Gerche A et al. Eur Heart J 2012; 33:998–1006

Echocardiographic signs



Cardiac biomarkers



Cardiac fatigue, summary

Echocardiographic signs

Inconsistent, transient and mild changes of LV and RV systolic and diastolic functions with quickly correction



LOW
CORRELATION

Cardiac biomarkers

Moderate elevation with quick normalisation (<24 h)

They present with a poor repetability

They are more marked if low training level

ISOLATED ALTERATIONS WITHOUT ANY ABNORMAL CLINICAL OR ECG SIGN

THESE OBSERVATIONS LOOK PHYSIOLOGICAL

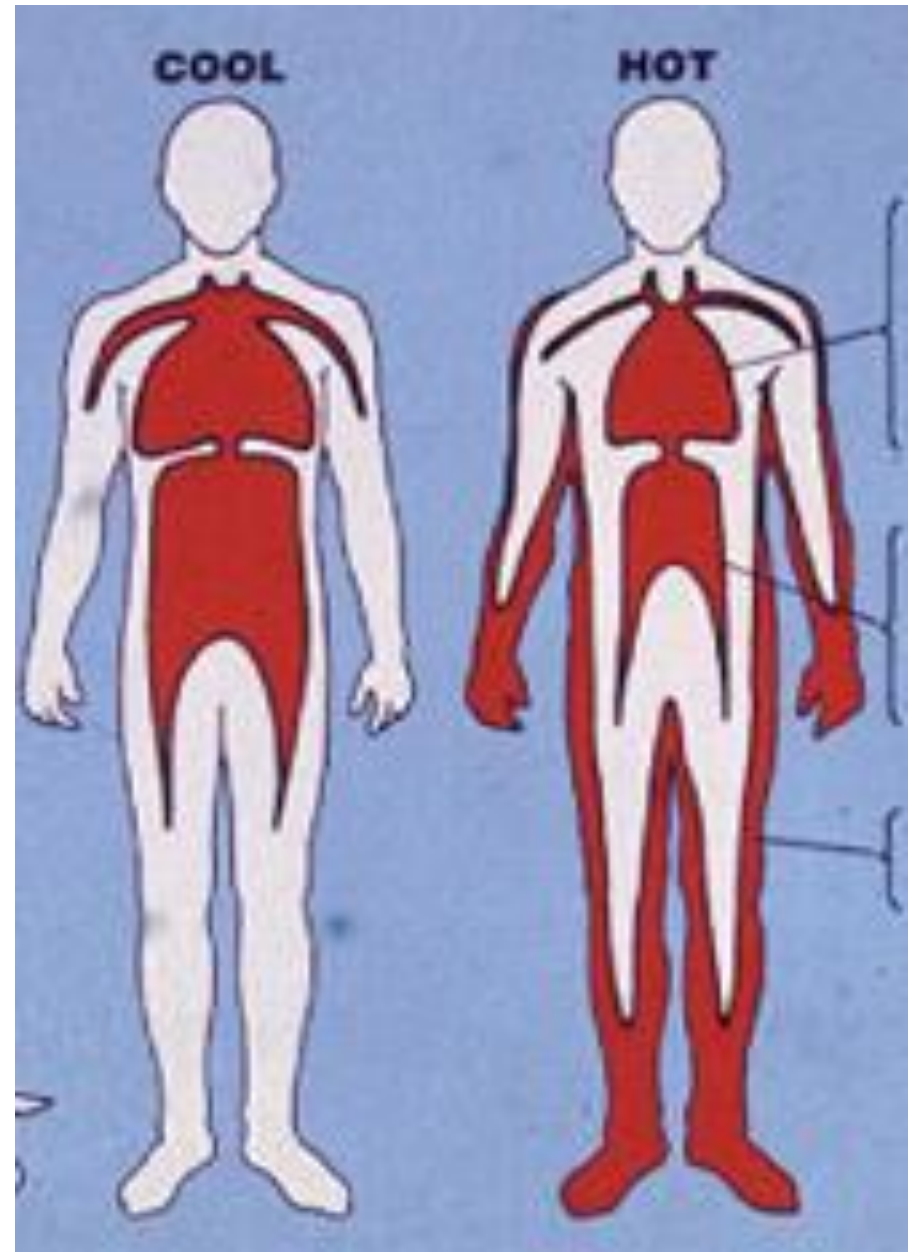
EVEN IF WE HAVE NO LONGITUDINAL STUDY

Long distance running AND hot weather



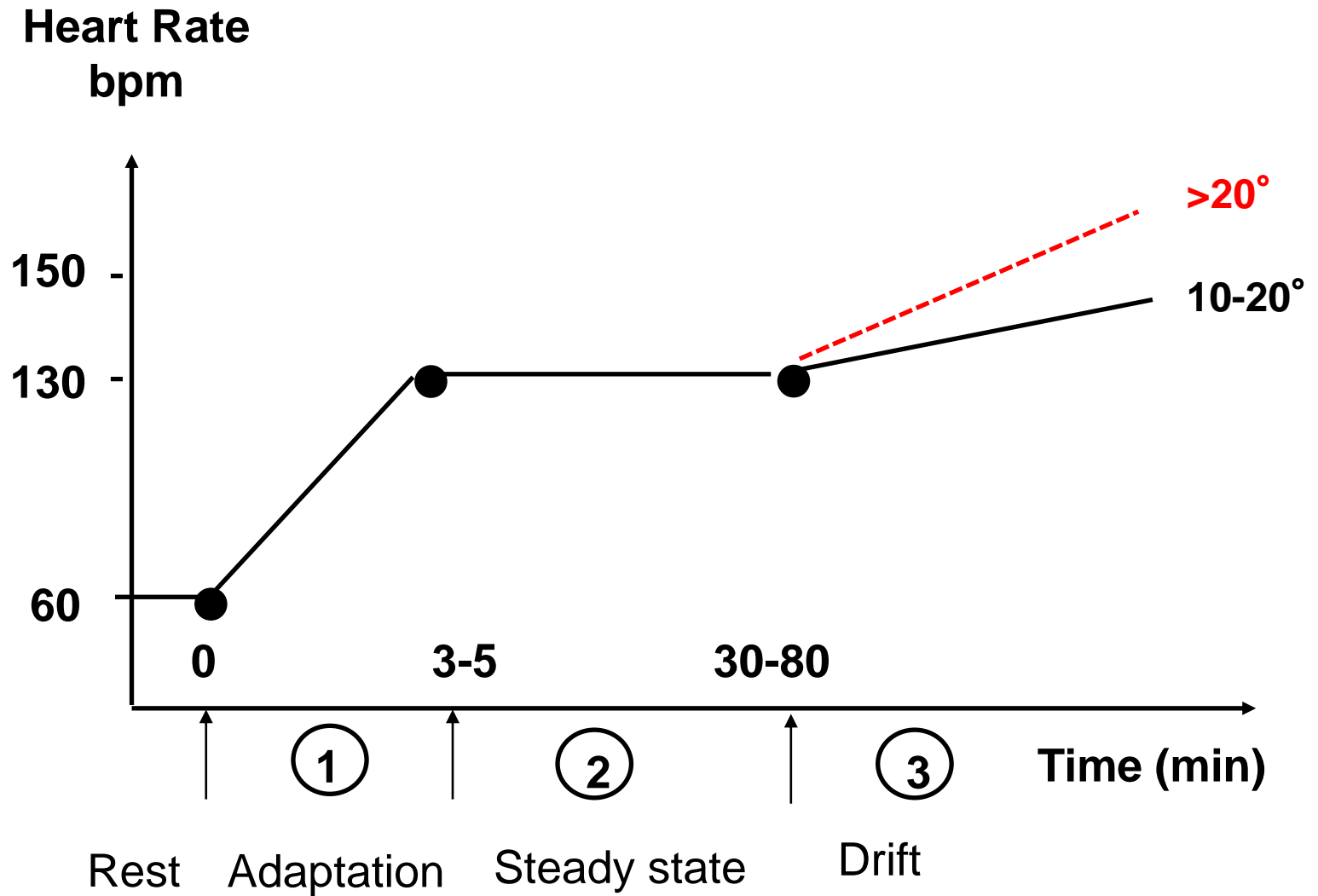
Bad Water Race

Hyperthermia and body blood distribution

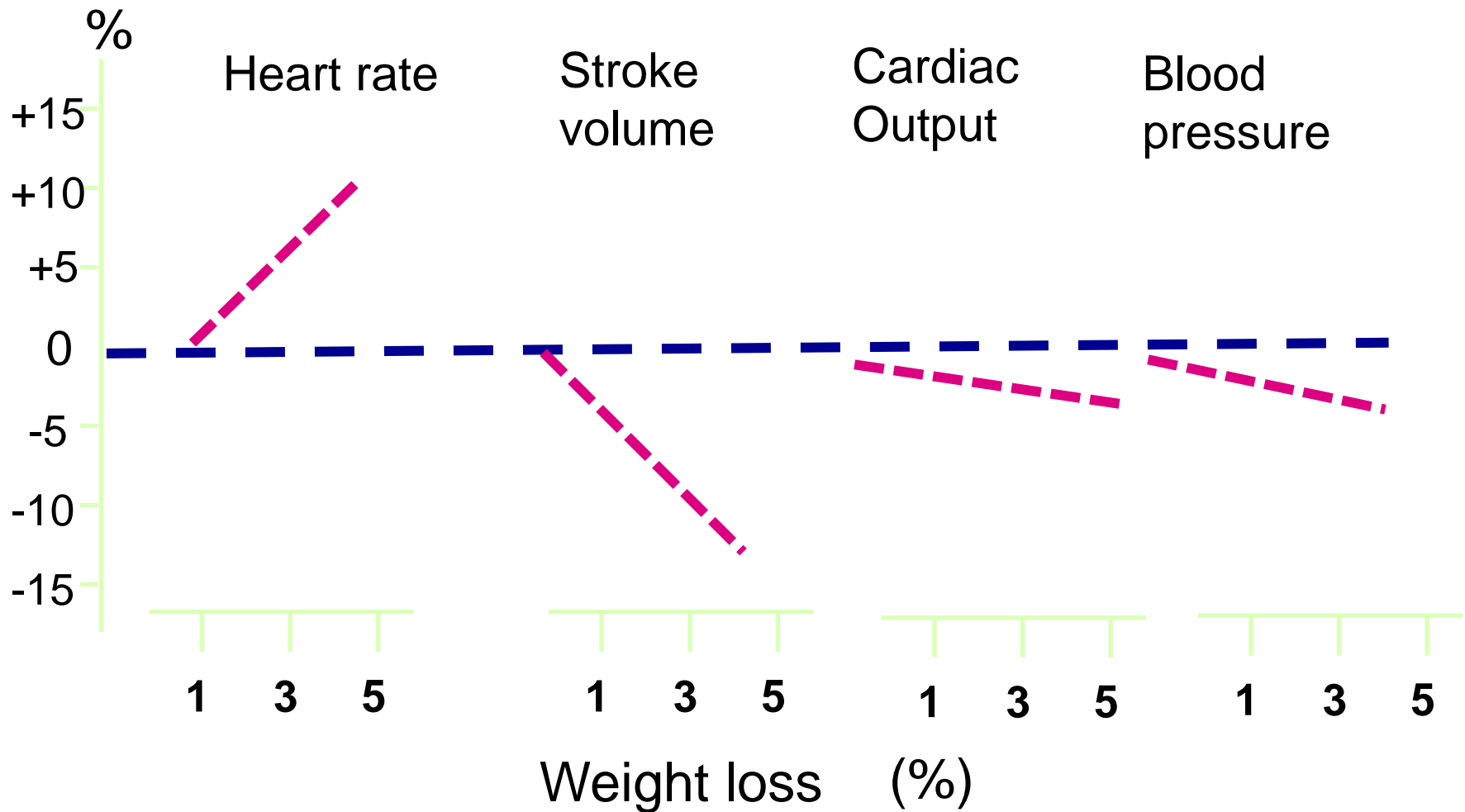


: Rowell L. B. *Human circulation. Regulation during physical stress.* OUP, 1986.

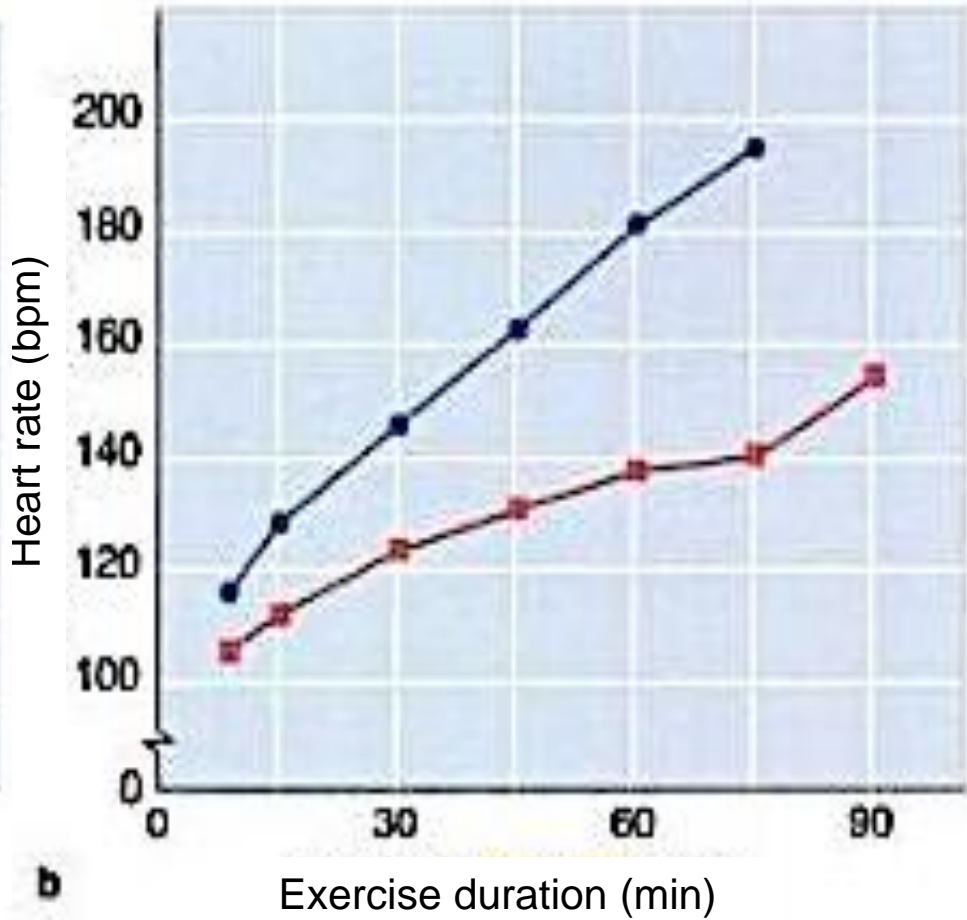
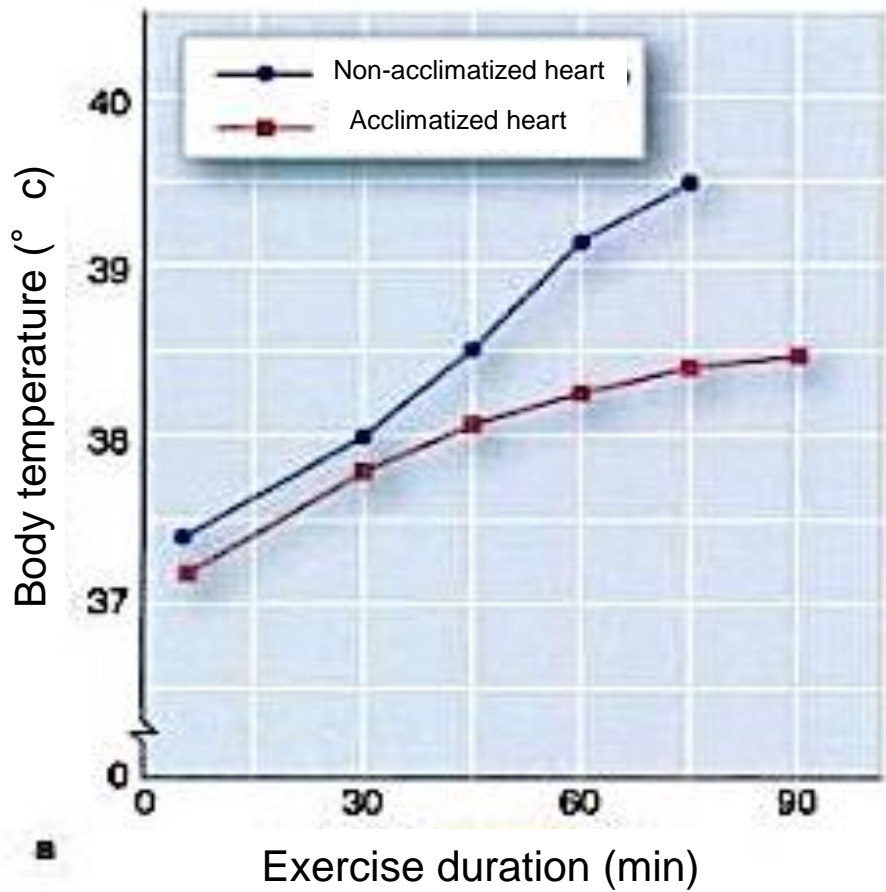
Cardiovascular drift



Cardiovascular effect of dehydration



Heat acclimatization



Altitude

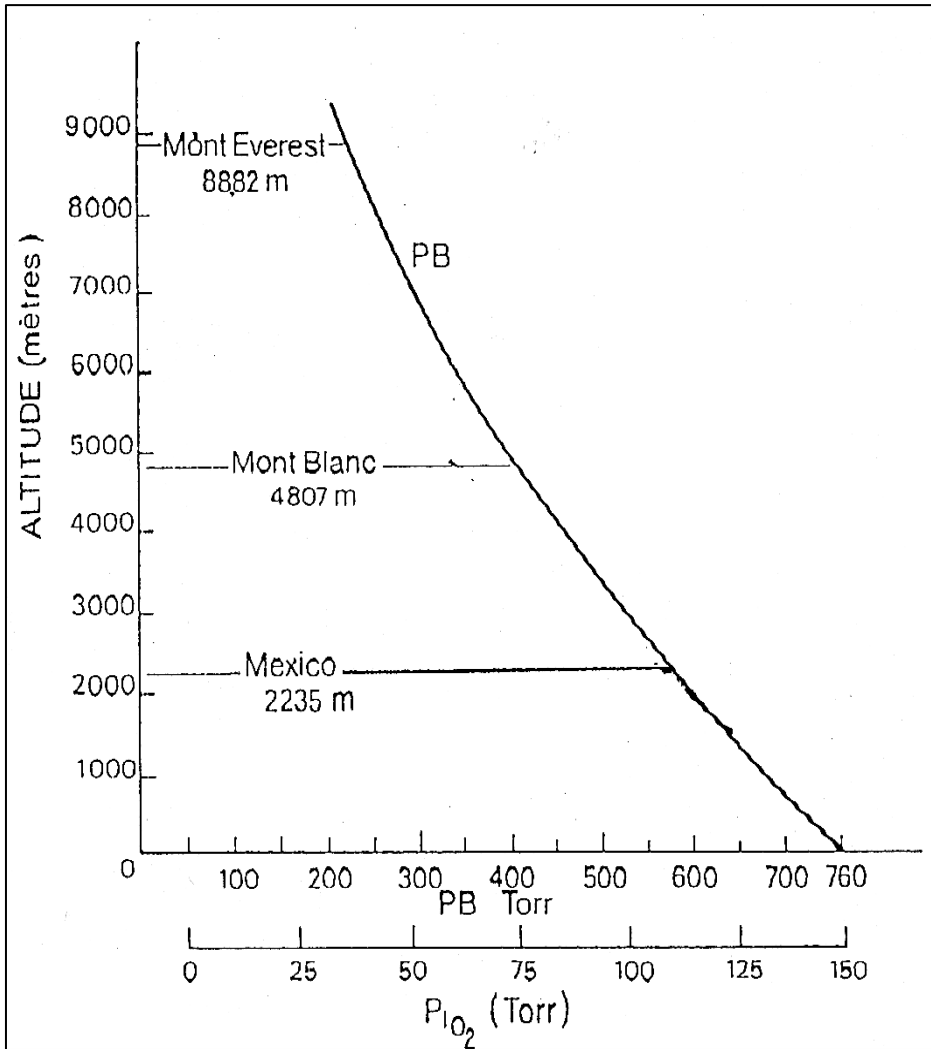


Environmental constraints of altitude

Barometric pressure decrease



Inspiratory O₂ pressure decrease



Température

Decrease

Wind effect ++

Humidity

Désydratation ++

Radiation

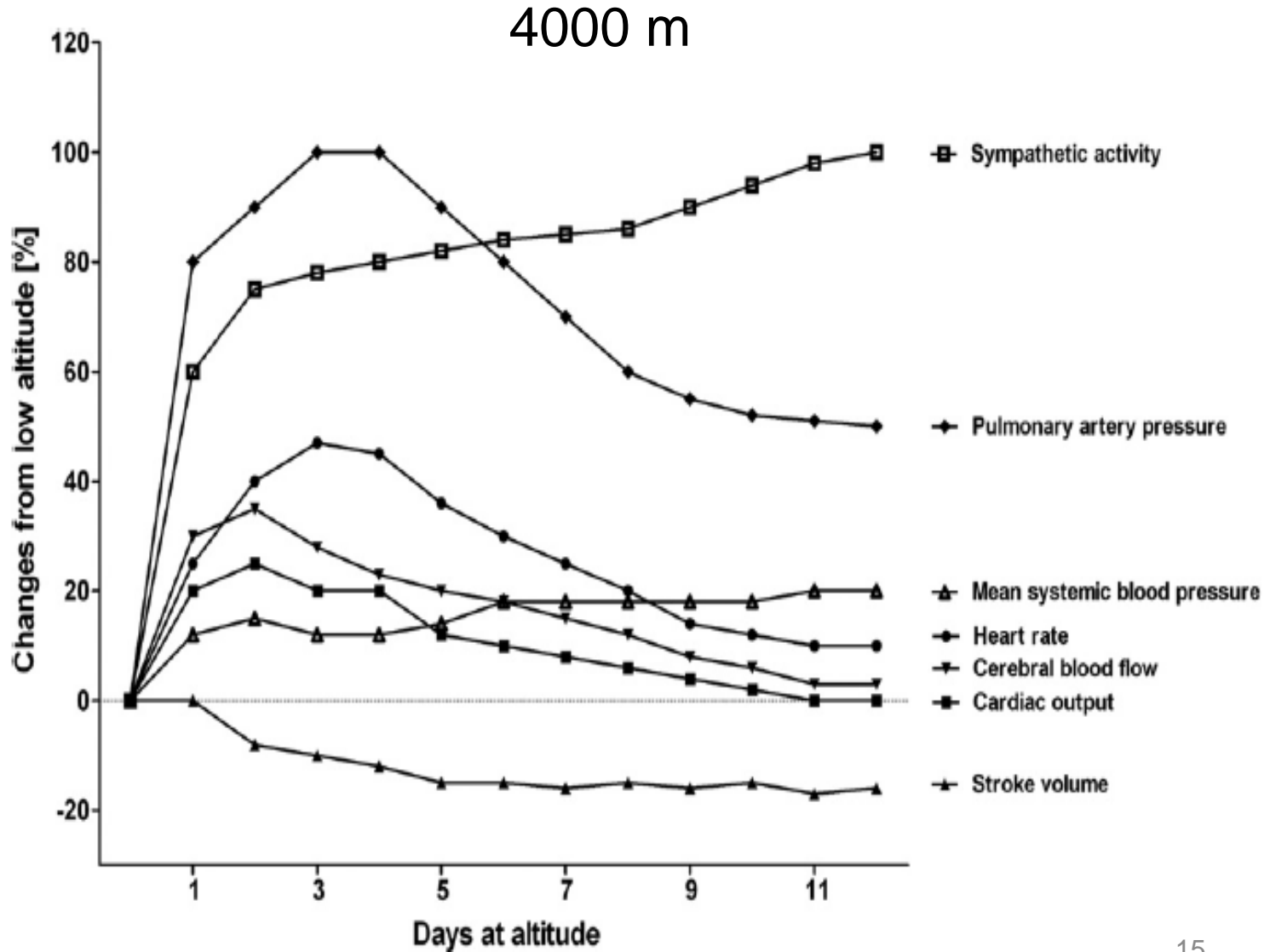
UV

Ionizing

Air density decrease

Cardiovascular and nervous adaptations during altitude exposure

Rimoldi F et al
Prog Cardiovasc Dis
2010;52: 512-24



Cardiovascular responses to altitude

Tachycardia with decreased HR max.

SV is decreased

Maximum cardiac output decreases

VO₂ max decrease with altitude level

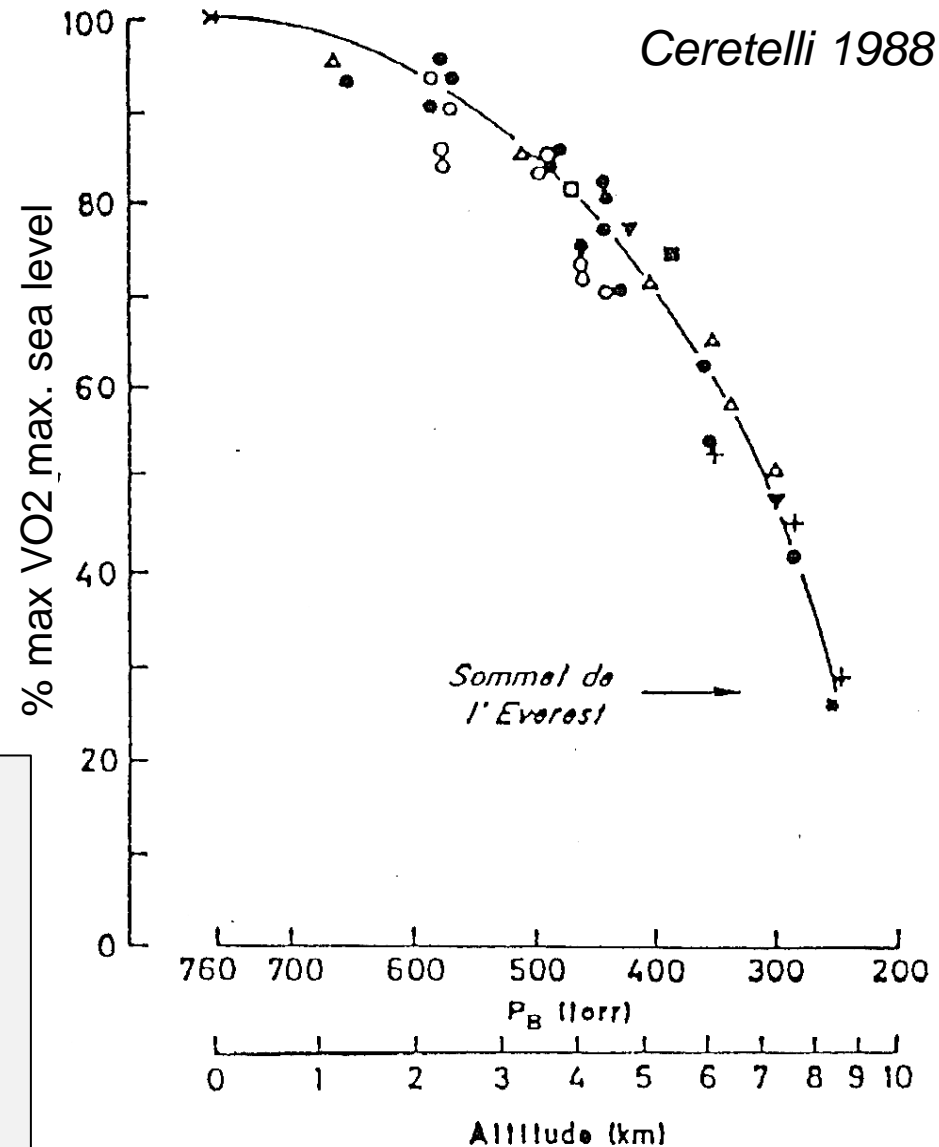
Arterial hypertension with acute exposure
Systolo-diastolic hypertension during exercise

Pulmonary hypertension at rest and ++ during exercise → chronic pulmonary hypertension

Unbalanced cardiac patients and altitude, caution

Equilibrated cardiac patients ≤ 2000 m rest and moderate exercise OK

Cardiac patients > 2000 m → specific test



Snorkeling and scuba diving



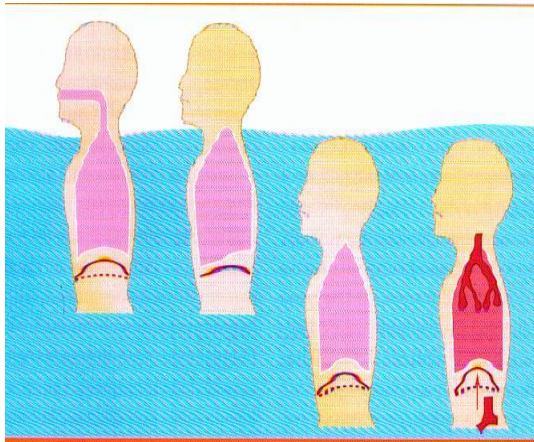
Snorkeling

Immersion :

Blood Shift → Preload' increase

Facial stimulation → Bradycardia

Cold → Bradycardia ↑
→ Vasoconstriction ↑
→ BP and afterload increase



« The blood shift »

Descent :

Bradycardia

Preload ↑ ↑

Stabilized level

Hypoxia

Acidosis ↑

Ascent :

Intense exercise

Preload increase

Mild tachycardia

Surface :

Marked tachycardia

Blood acidosis

**No snorkeling with cardiac disease
including arterial hypertension**

Scuba diving

Immersion

Descent:

Bradycardia

Hyperoxia

Coronary and peripheral vasoconstriction

Stay in depth:

Ventilatory work ++

After load increase

Ascent:

Must be slow and progressive

Oxygen desaturation

**Heart disease or
unbalanced HTA
= caution**

**Low depth =
false security**

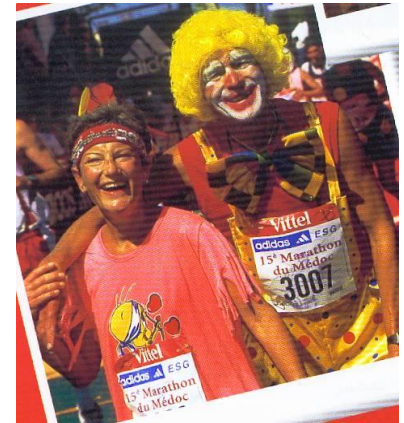
Take home messages

Extreme conditions specific constraints on cardiovascular system are added to the exercise one.

Some alterations induced by extreme conditions can simulate pathologies. We must therefore first keep a clinical analysis and not be limited to biological and/or imaging data.

However, if normal cardiovascular system well supports these constraints, cardiovascular pathology can limit their tolerance specially during physical exercise which reveals the limits of the patient's adaptations.

Sport participation ?



YES



NO