CARDIOVASCULAR IMPACT OF SPORT IN EXTREME CONDITIONS

Sport's Cardiology Webinar

June 19th 2020

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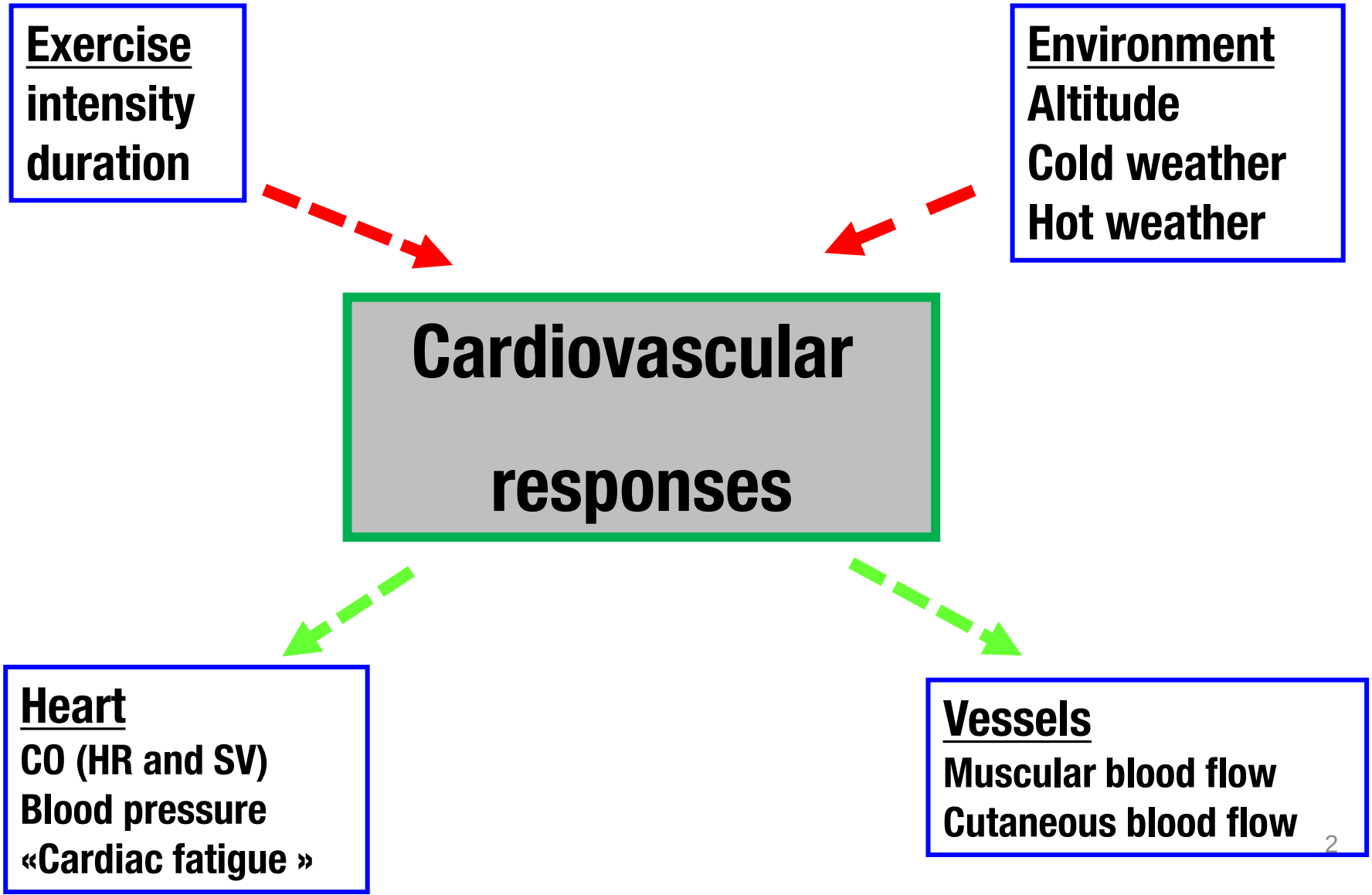
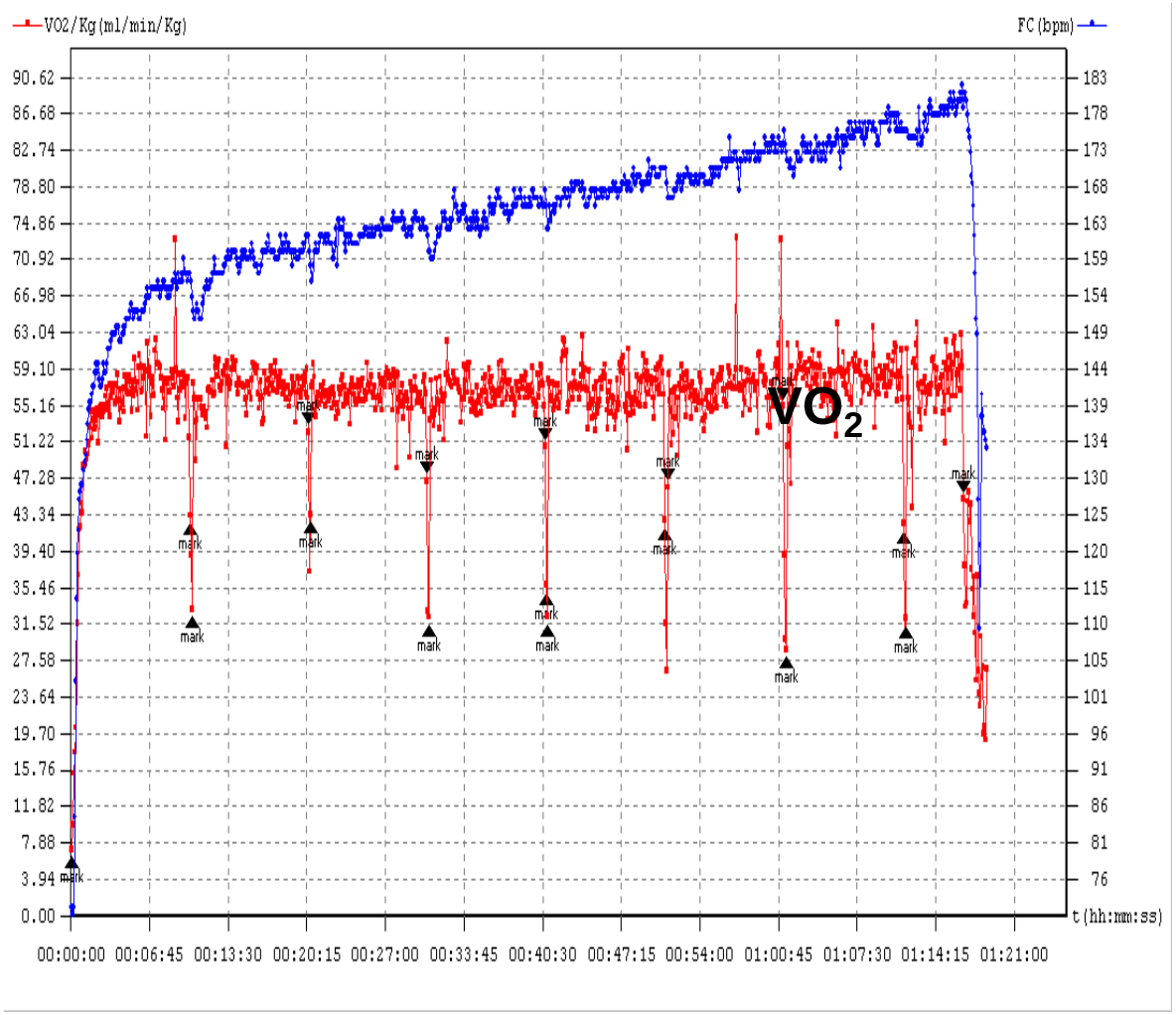
Sport's and environment cardiovascular stresses



Selection of environment conditions

Long distance running

Endurance heart rate drift



Dehydration

Thermoregulation

Neuro-hormonal changes

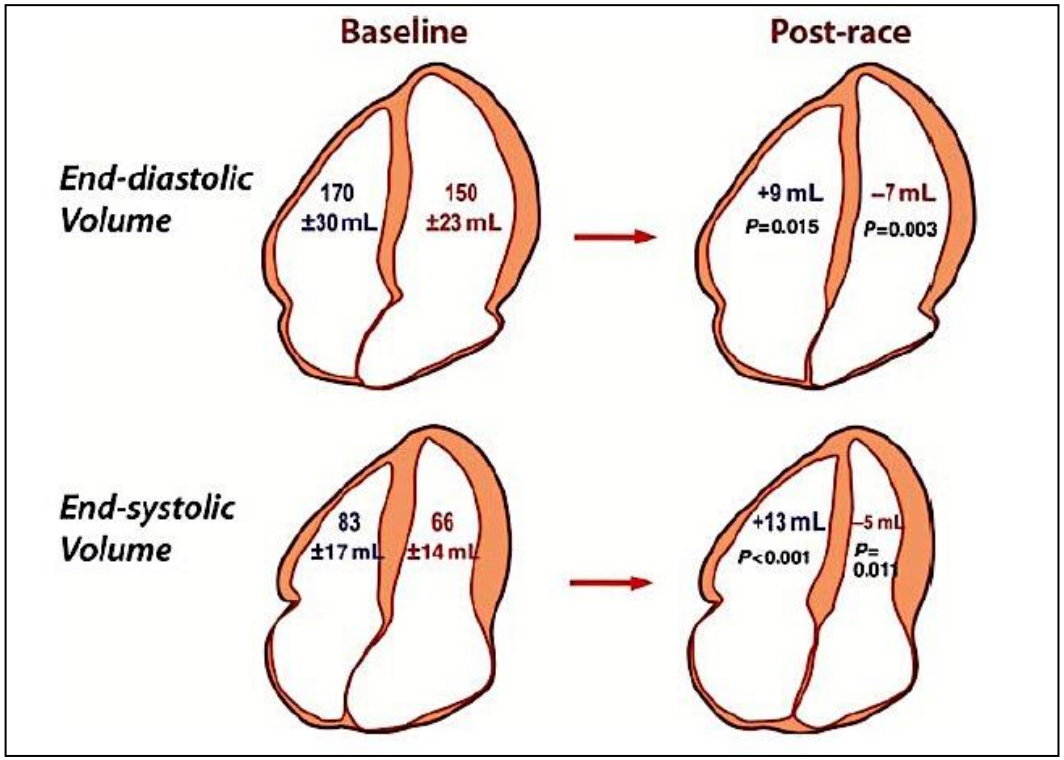
Cardiac fatigue

Energy cost of running ↑

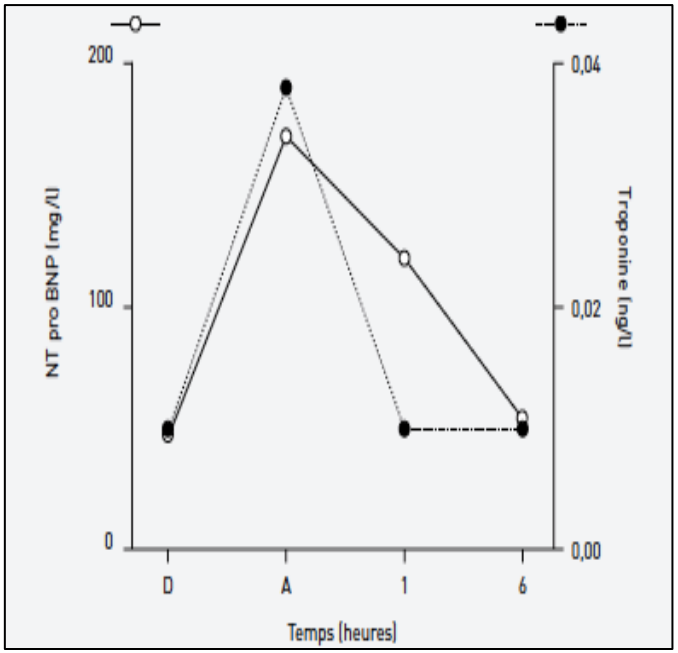
Paris semi-marathon 2005, Courtesy from V. Billat PhD

Cardiac fatigue, signs

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



Echocardiographic signs



Carré F in cardiologie du sport 2013

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

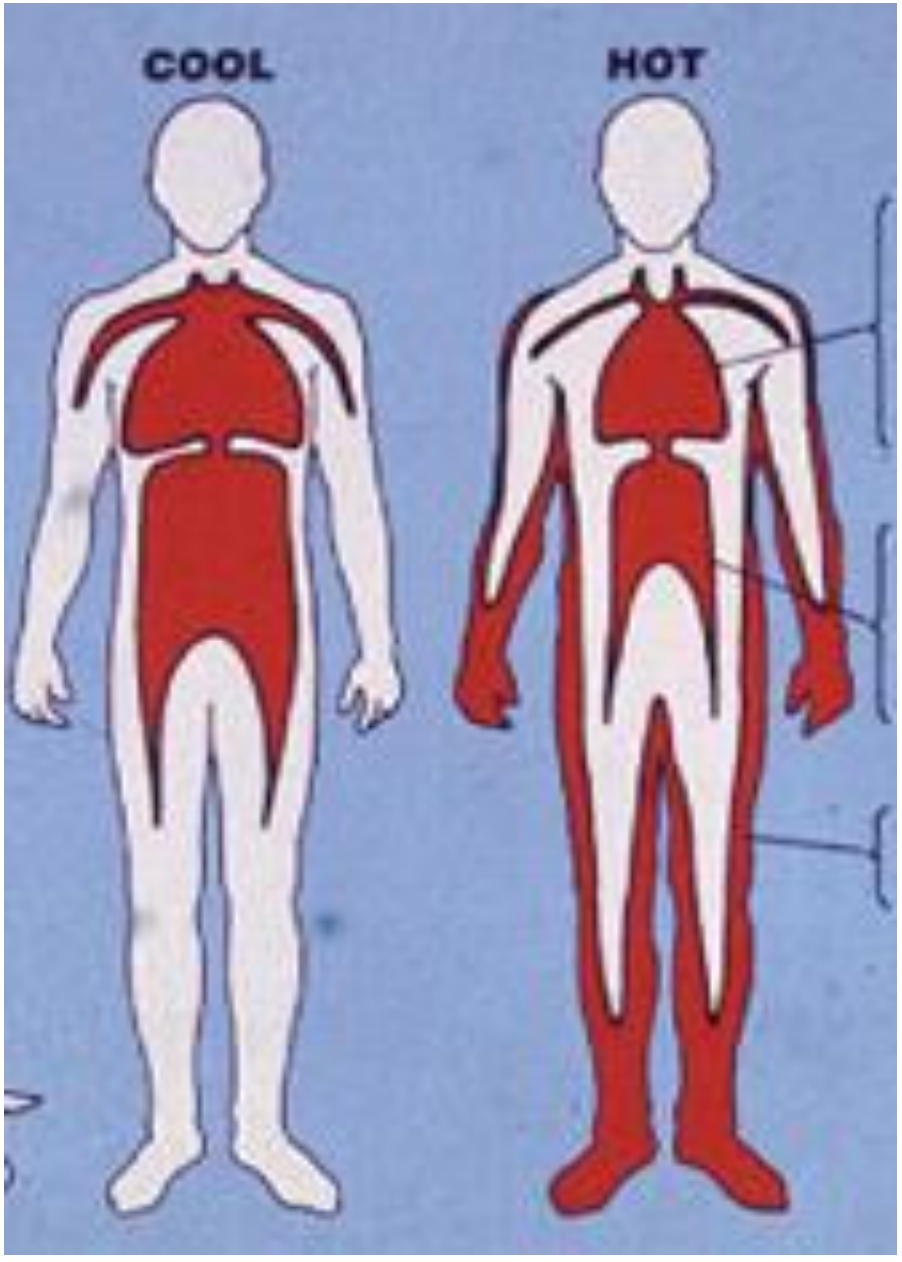
THESE OBSERVATIONS LOOK PHYSIOLOGICAL

EVEN IF WE HAVE NO LONGITUDINAL STUDY

Long distance running AND hot weather

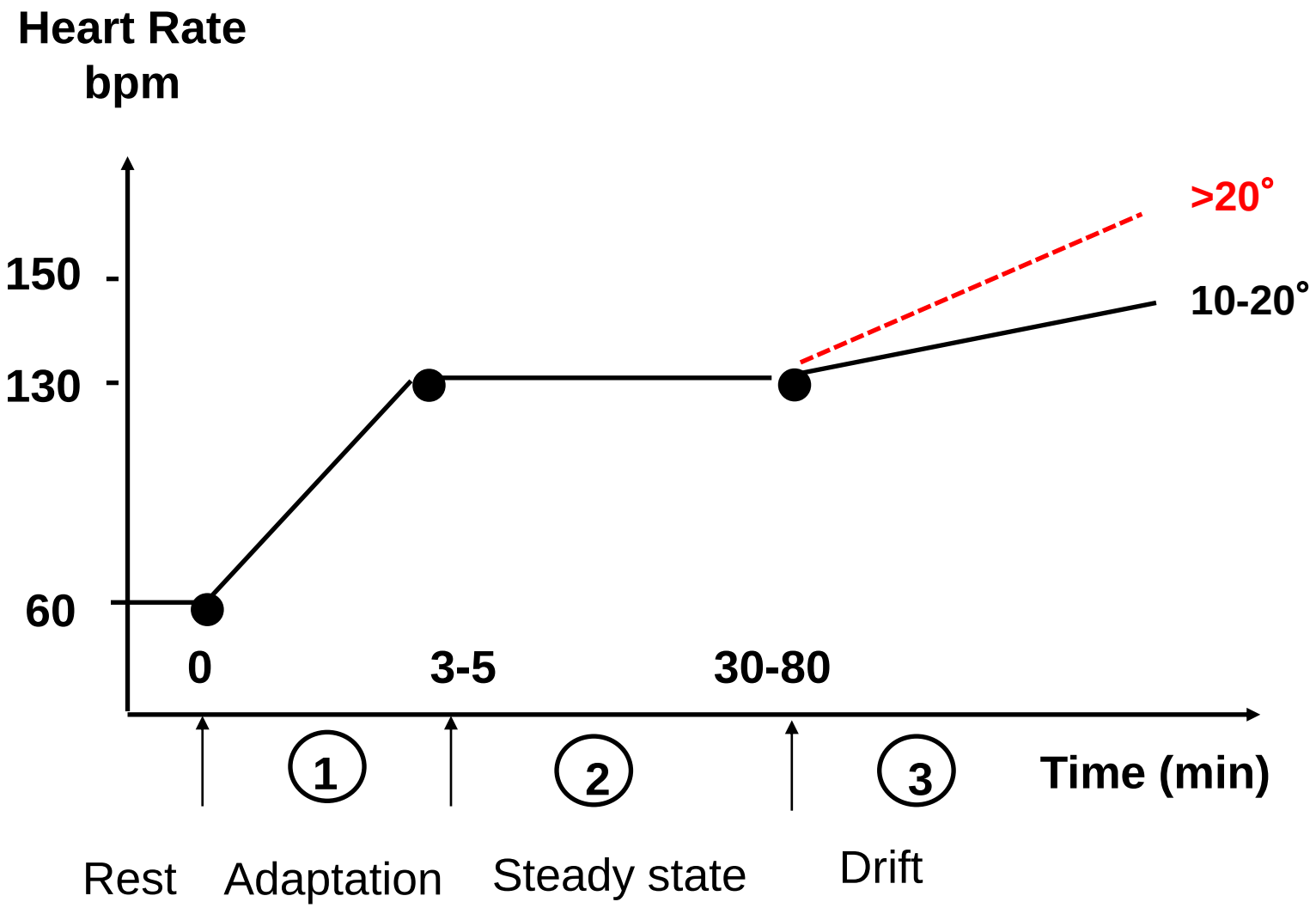
Bad Water Race

Hyperthermia and body blood distribution

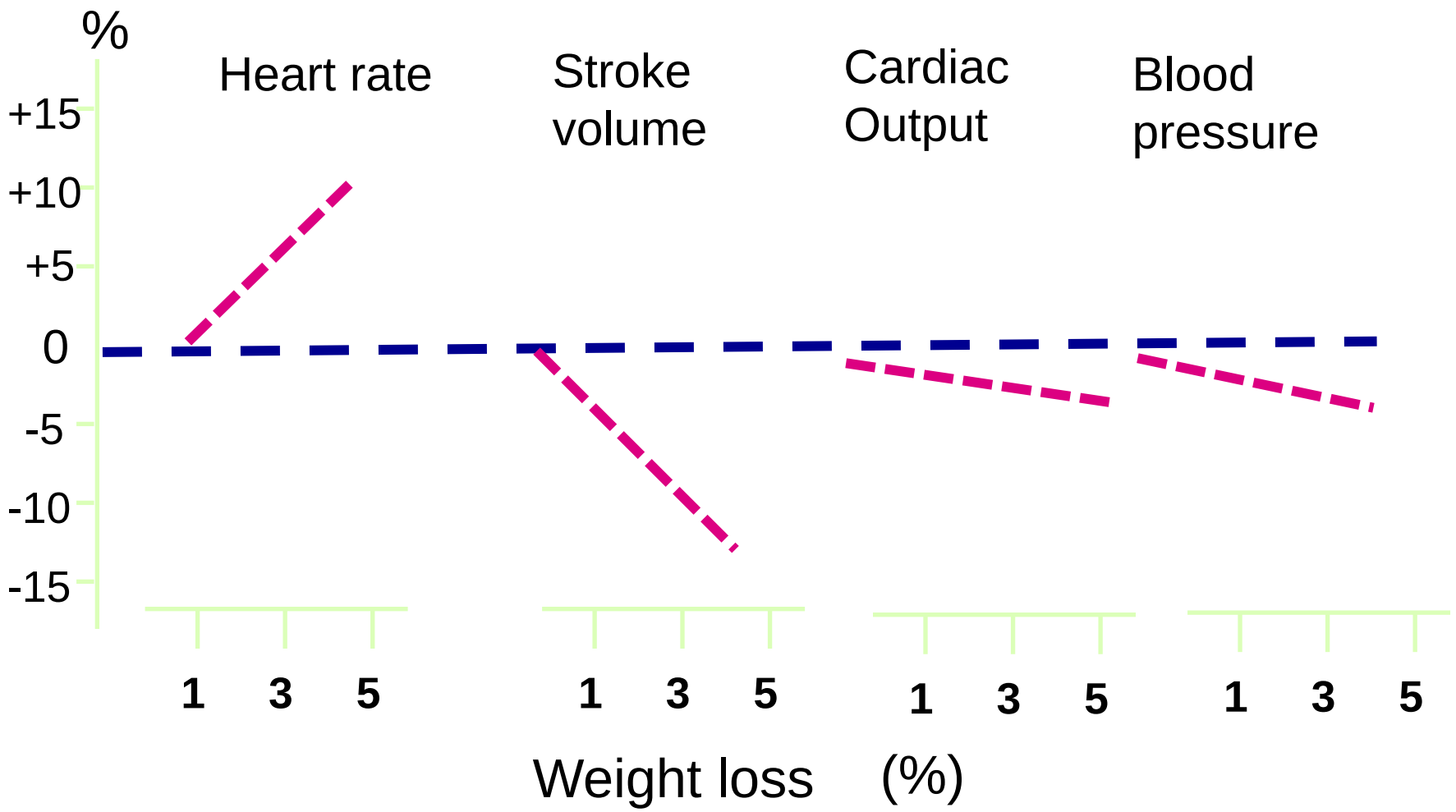


: Rowell L B. *Human circulation*. Regulation during physical stress. OUP, 1986.

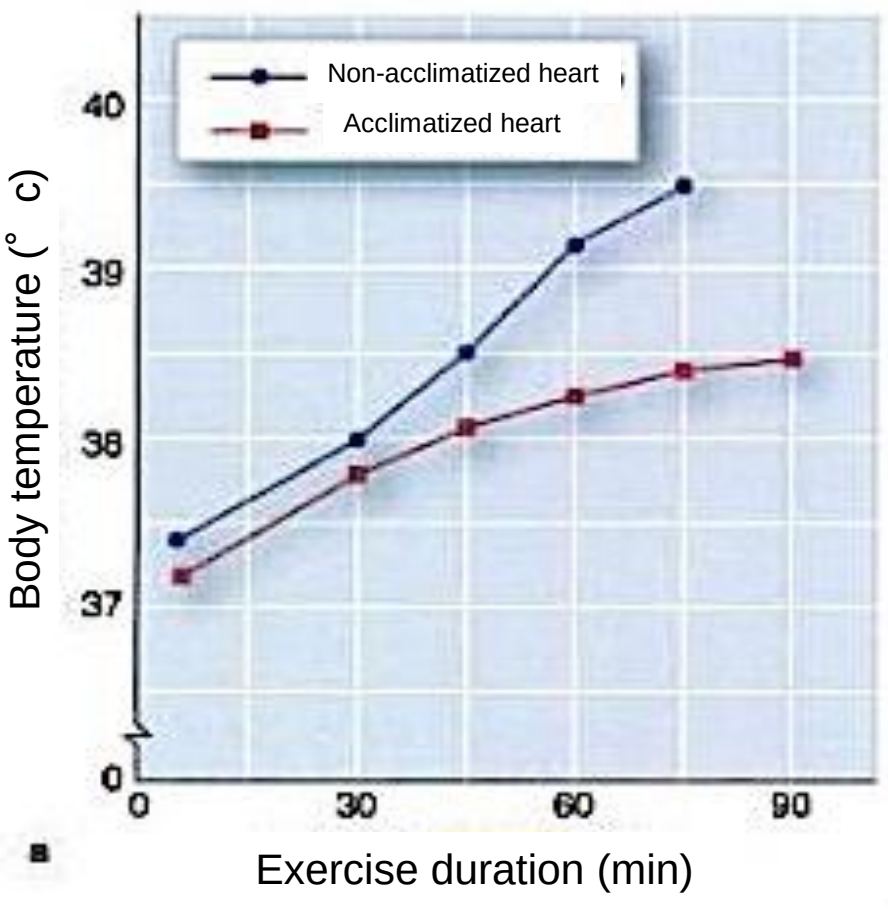
Cardiovascular drift

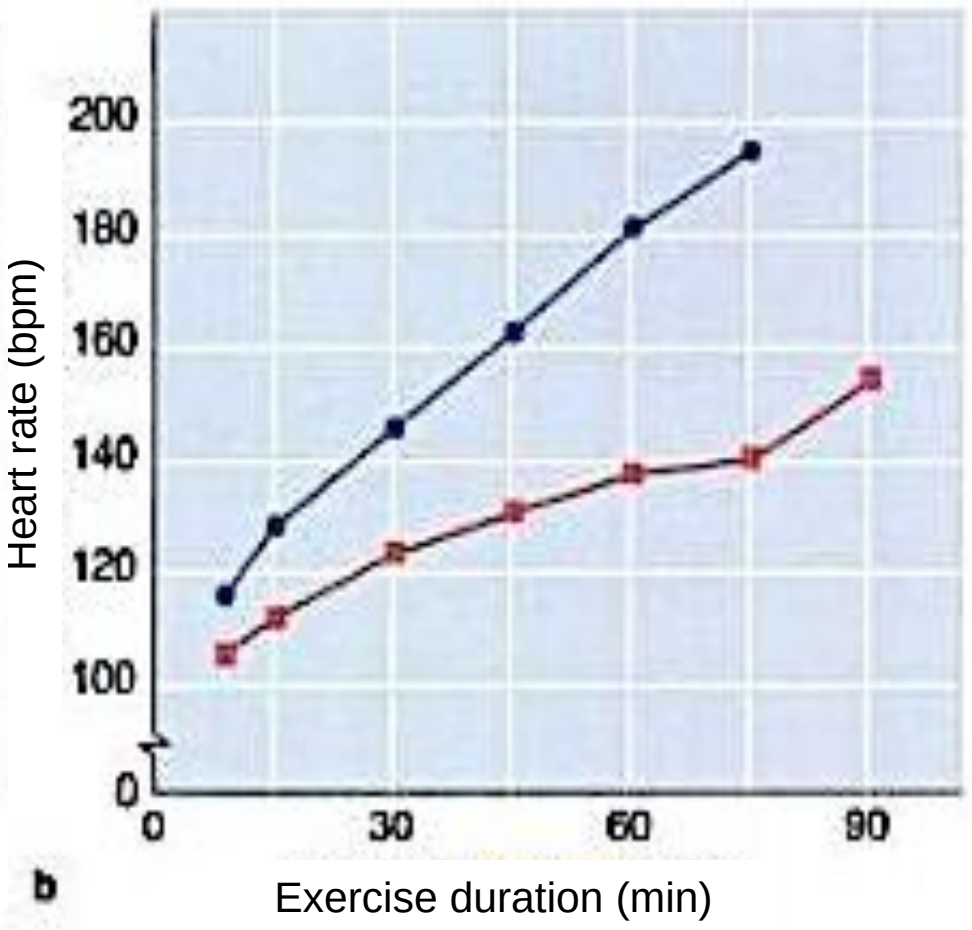


Cardiovascular effect of dehydration



Heat acclimatization





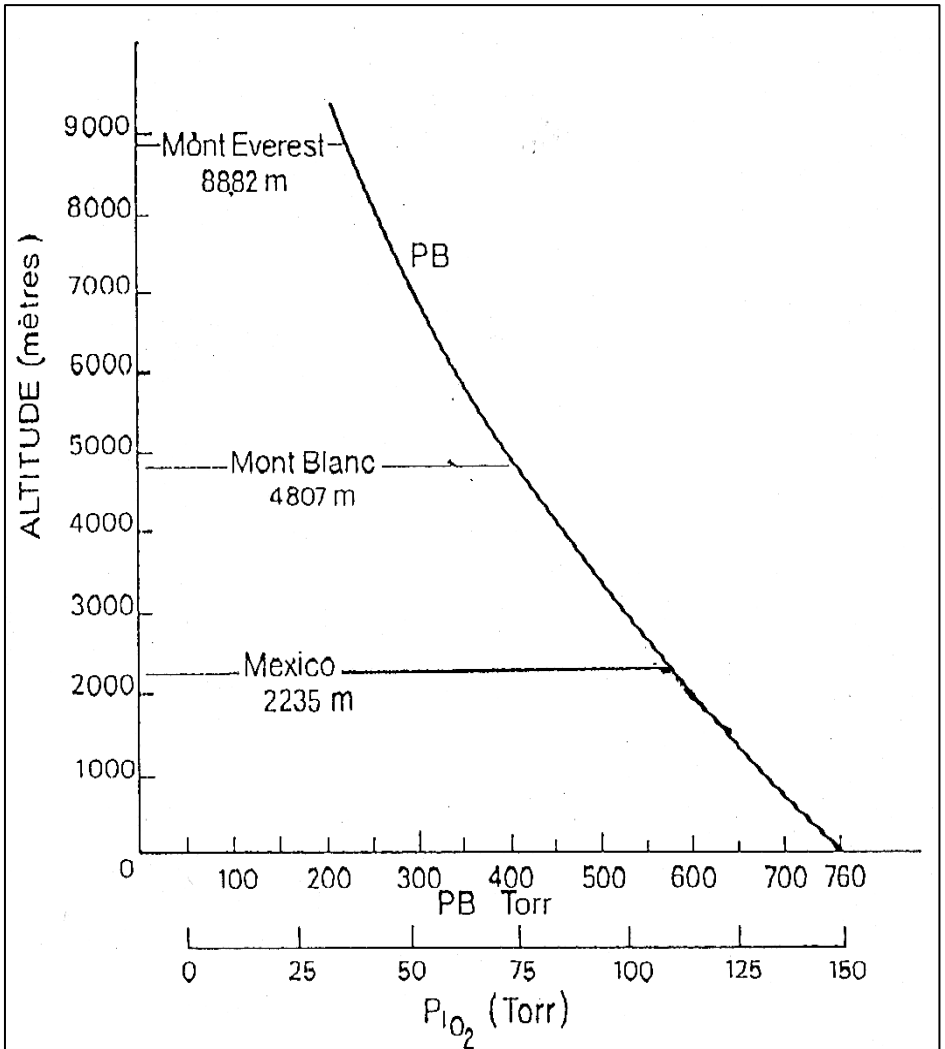
Altitude

Environmental constraints of altitude

Barometric pressure decrease

↓

Inspiratory O_2 pressure decrease



Température

- **Decrease**
- **Wind effect ++**

Humidity

- **Désydration ++**

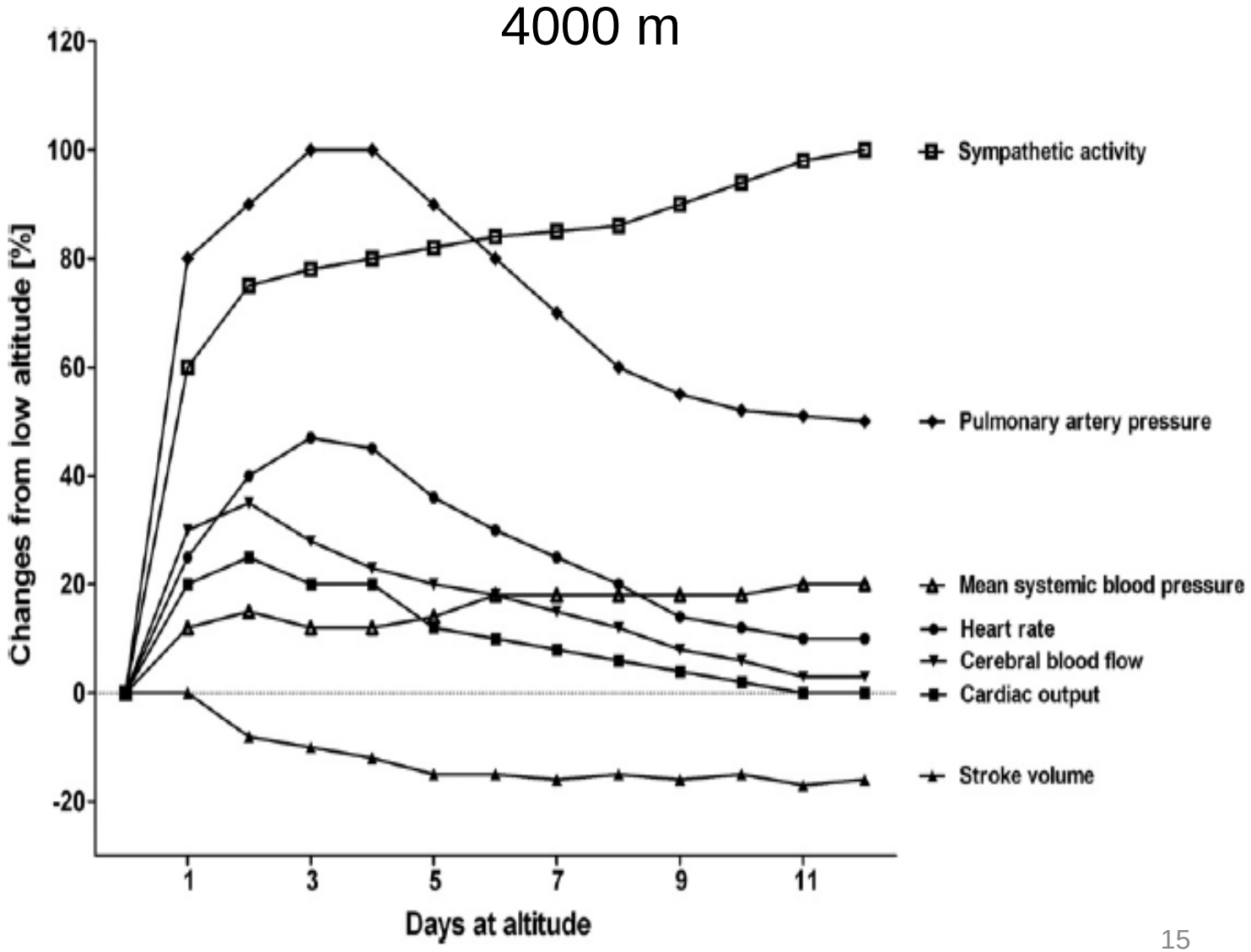
Radiation

- **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.

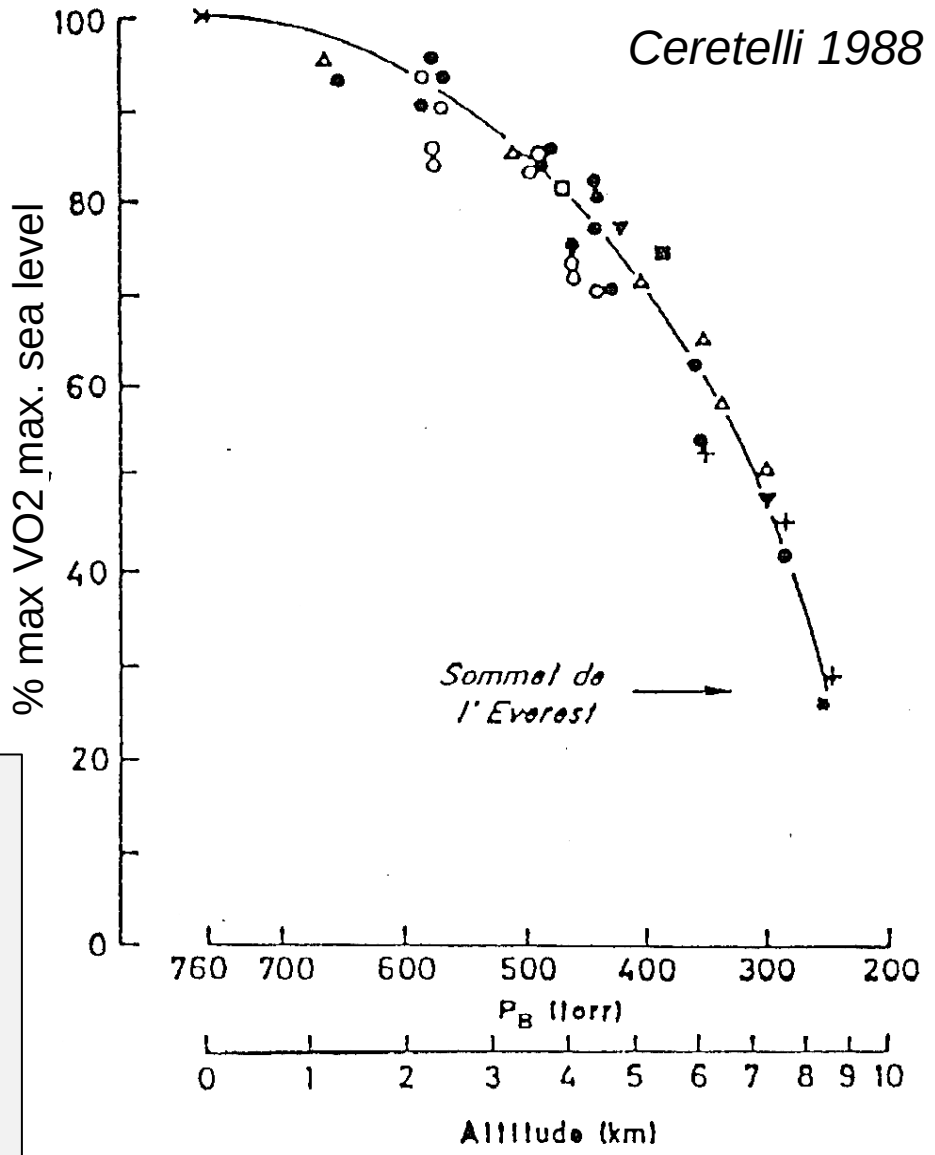
SV is decreased

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

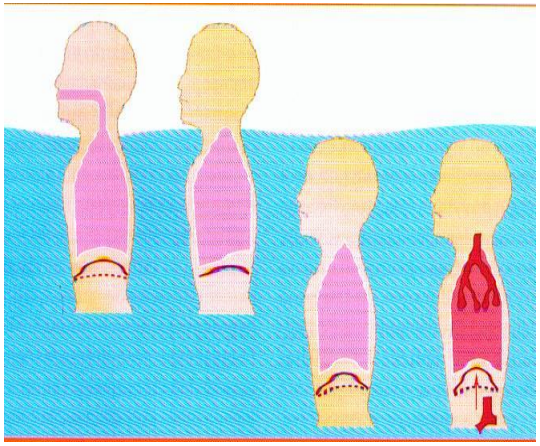
Equilibrated cardiac patients ≤ 2000 m rest and moderate exercise OK

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

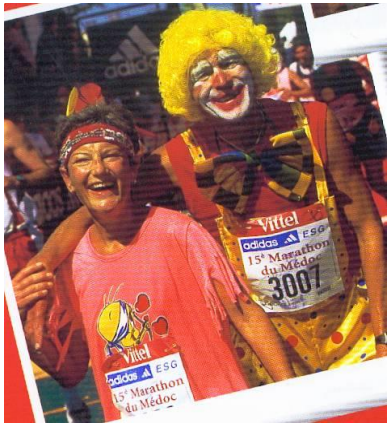
Take home messages

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