La sincope vasovagale come difesa

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Vasovagal reflex

↓

Vasovagal syncope

Vasovagal reflex

Afferent part – Central processing

Unknown

Efferent part

Inhibition of the sympathetic system

↓

Hypotension

Activation of the vagal system

↓

Bradycardia

Vasovagal syncope

Typical

Atypical

2009 ESC Guidelines

TYPICAL VASOVAGAL SYNCOPE

1) Trigger

Emotional (emotional distress, fear, threat, disgust, pain)

or

Orthostatic (prolonged standing)

2) Typical autonomic prodromes

2009 ESC Guidelines

Vasovagal reflex

↓

Typical vasovagal syncope

Manifestation of a non-pathological trait

«Defense mechanism» for the organism

For the heart? For the brain?

Clin Auton Res (2008) 18:170–178
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REVIEW ARTICLE

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Marco Alboni
Giorgio Bertorelle

The origin of vasovagal syncope: to protect the heart or to escape predation?

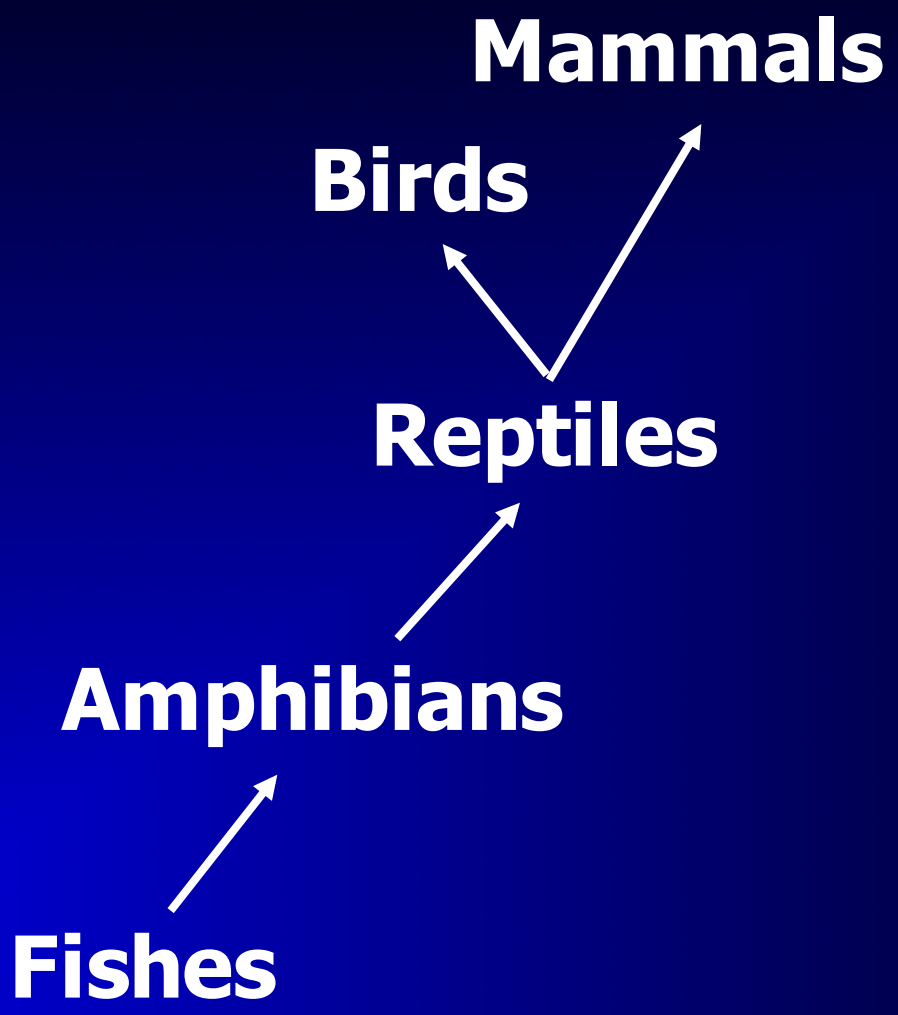
Animals

Invertebrates

Vertebrates

Cordates

VERTEBRATES – EVOLUTION



Vasovagal reactions in vertebrates

- Fear and threat bradycardia ("alarm bradycardia"), mainly during tonic immobility
- Vasovagal reflex during severe hemorrhage

Tonic immobility - Opossum

Tonic immobility - Frog

"Alarm bradycardia" during tonic immobility in vertebrates

Mammals

Deer, ground squirrel, chipmunk, mouse, opossum

Birds

Willow grouse

Reptiles

Caiman

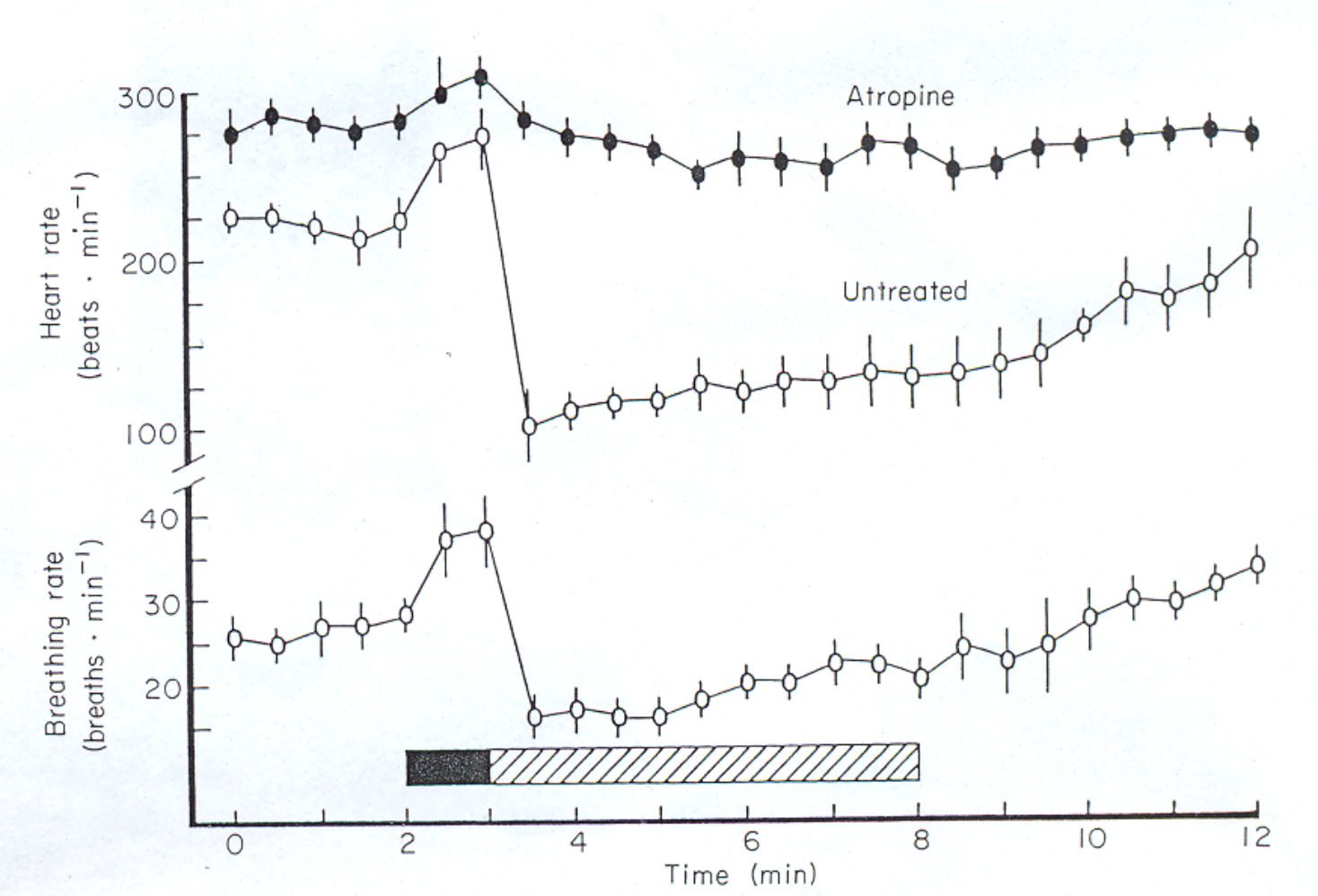
Amphybians

Salamander

Fishes

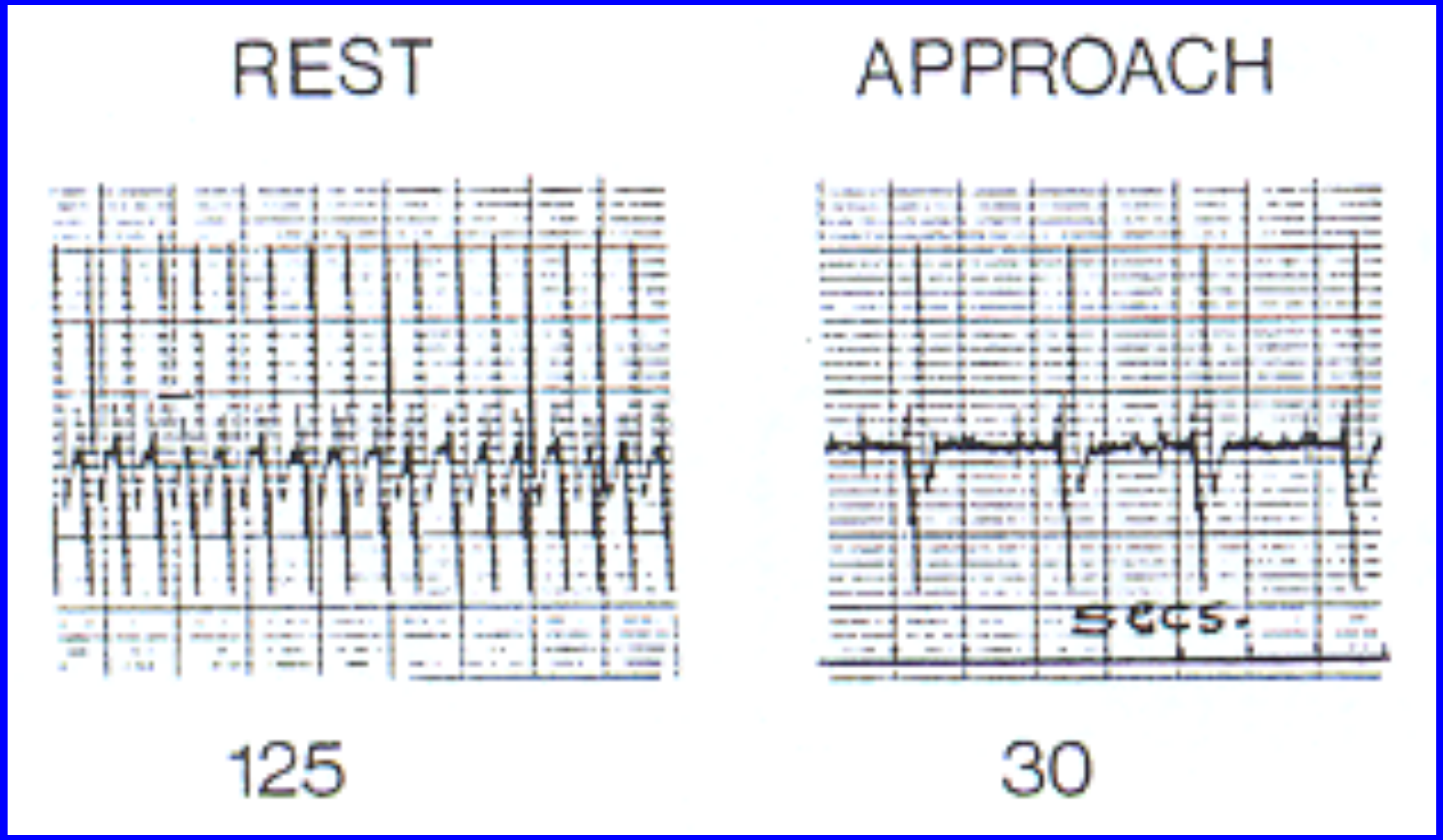
Plaice, cod, salmon

Mammals. Opossum. "Alarm bradycardia" during tonic immobility



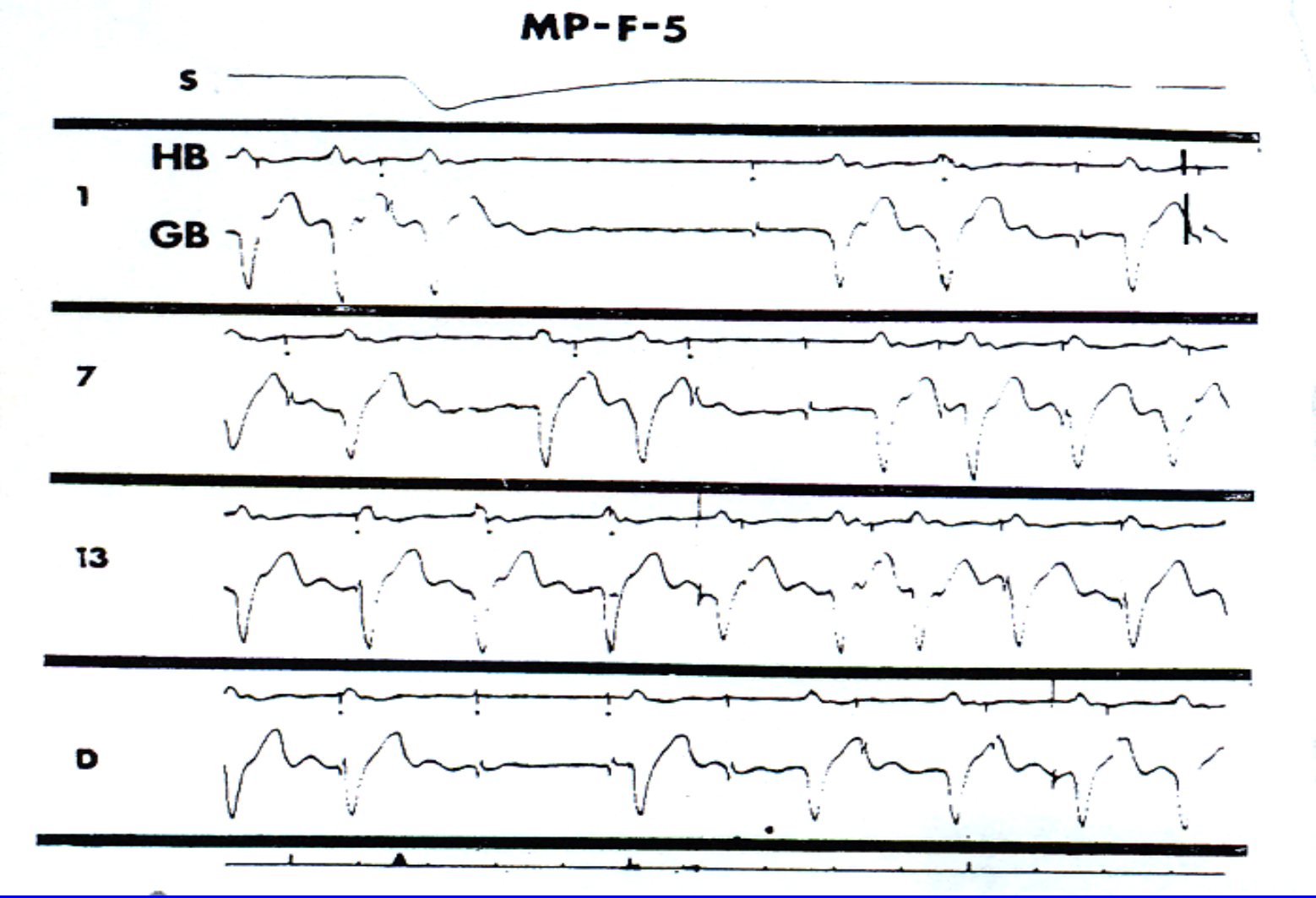
Gabrielsen GW et al, Acta Physiol Scand 1985

Birds. Wild grouse hen. “Alarm bradycardia” during tonic immobility



Gabrielsen G et al, Acta Physiol Scand 1977

Amphibians. Salamander. “Alarm bradycardia” during tonic immobility



Goodman DA et al, Nature 1970

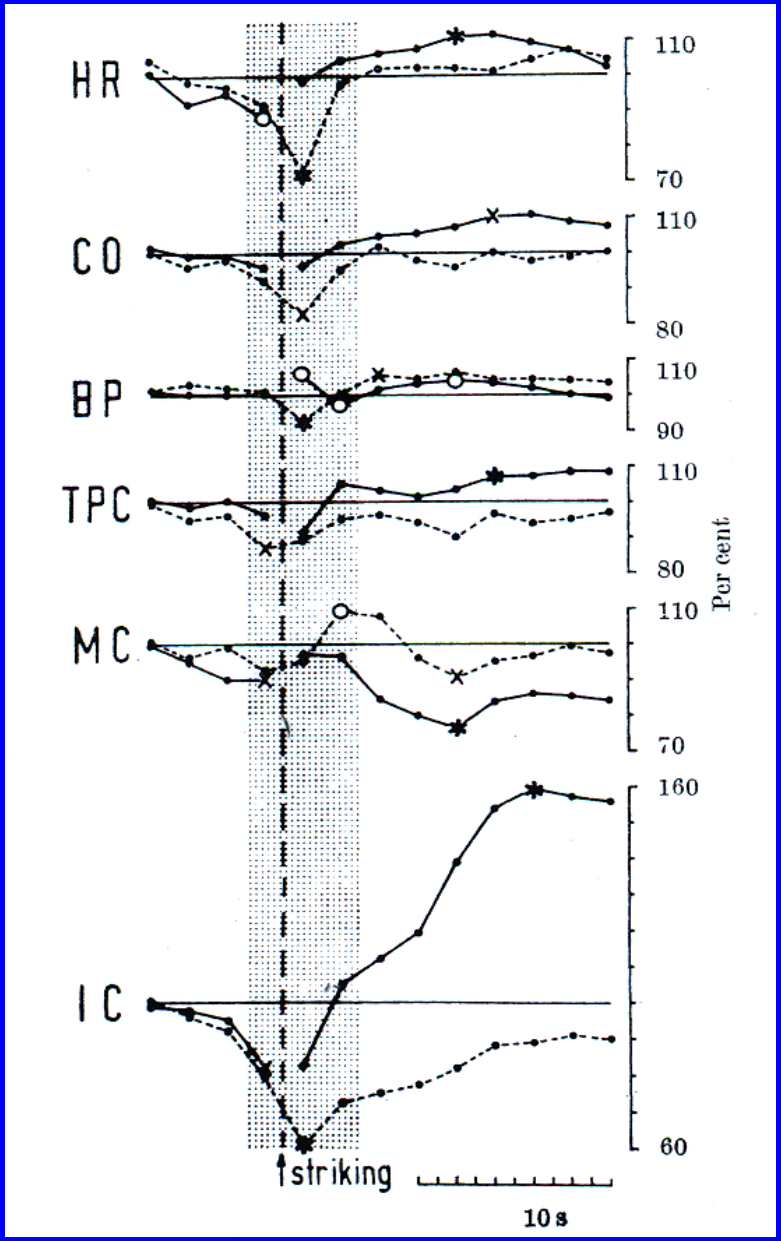
"Fear and threat bradycardia" in carnivores

Investigation carried out in 3 cats during an emotional situation: preparation for fighting just before the attack by another cat

Variables: HR, intra-arterial BP

Adams DB et al, Nature 1968

Cat – Vasovagal reflex during emotional distress



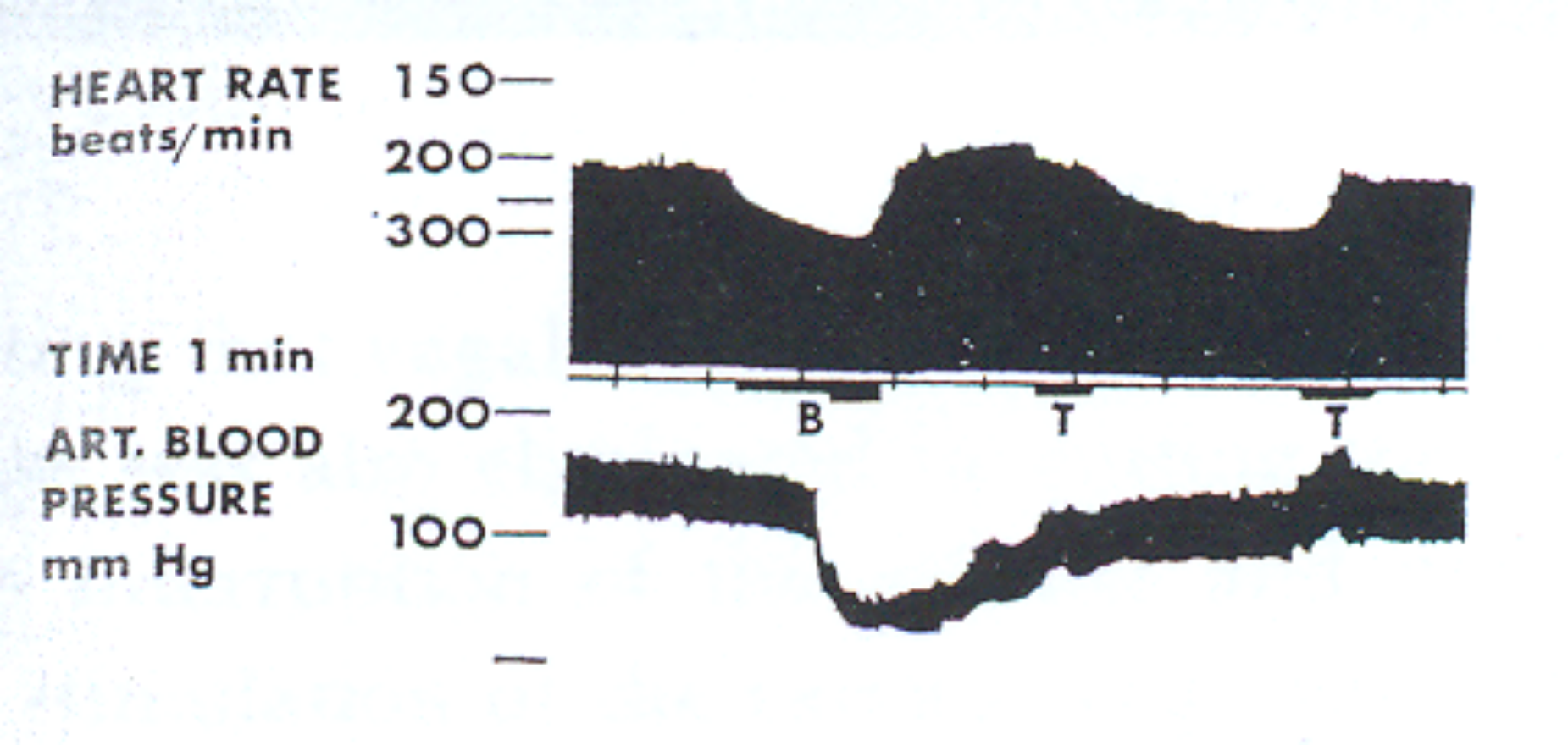
Adams DB et al, Nature 1968

Similarities between emotional VVS in humans and "alarm bradycardia" in animals

1. The same trigger (emotion/threat) evokes the same response (bradycardia)
2. Both emotional VVS in humans and "alarm bradycardia" in animals are more frequent in young individuals
3. Both emotional VVS in humans and "alarm bradycardia" in animals are generally preceded by an increase in sympathetic activity (shown by an increase in HR)
4. The few available data suggest that in animals the slowing in HR is associated with a decrease in BP as in emotional VVS in humans

Vasovagal reflex during severe hemorrhage

Cat - Vasovagal reflex during severe hemorrhage



Oberg B et al, Acta Med Scand 1970

Vasovagal reflex during severe hemorrhage

Triggered by **thoracic hypovolemia**, as orthostatic VVS

Vasovagal reflex during severe hemorrhage

Observed in humans

and

other mammals

(rat, rabbit, cat, dog, monkey)

Burke SL et al, J Physiol 1988
Victor RG et al, Circ Res 1989
Morgan DA et al, Am J Physiol 1988
Schadt JC et al, Am J Physiol 1991

Vasovagal reflex during severe hemorrhage

In humans and other mammals

The vasovagal reflex is secondary to transient inhibition of the sympathetic system (micro-neurographic recording)

The transient inhibition of the sympathetic system is preceded by overactivity of the same system

Sander-Jensen K et al, Br Med J 1986
Victor RG et al, Circ Res 1989
Morgan DA et al, Am J Physiol 1988
Scadt JC et al, Am J Physiol 1991

Similarities between vasovagal reflex during severe hemorrhage in animals and orthostatic VVS in humans

1. **Same trigger:** thoracic hypovolemia

2. **Same efferent pathways:** activation of the vagal system (documented by bradycardia) and transient inhibition of the sympathetic system (documented by both hypotension and micro-neurographic recording)

3. **The transient inhibition of the sympathetic system is preceded by overactivity of the same system**

Origin and evolution of vasovagal reflex

The vasovagal reflex appears to be predisposed in mammals and, likely, in the other vertebrates

These similarities suggest a common evolutionary root for the vasovagal reflex

What is the meaning of vasovagal reflex?

If the vasovagal reflex has persisted for millions of years along the vertebrates evolutionary history, we can reasonably assume that it is not dangerous

What is the meaning of vasovagal reflex?

Is the vasovagal reflex neutral or beneficial?

Vasovagal reflex as a «defense mechanism»

Vasovagal reflex occurs sporadically

The paradox of high adrenaline levels associated to transient inhibition of the sympathetic nervous system

Vasovagal reflex as a «defense mechanism» for the organism

mainly for the heart:

«**Heart defense hypothesis**»

Vasovagal reflex

"Defense mechanism"

Emotional stress

Orthostatic stress
(thoracic hypovolemia)

High sympathetic activity

Increase in myocardial O_2 consumption

Inhibition of sympathetic activity
Increase in vagal tone

Vasovagal reflex

Decrease in myocardial O2 consumption and improvement in diastolic filling

Durig the vasovagal reflex, humans can loose consciousness, but not the animals (or extremely rarely)

Why?

No loss of consciousness (LOC) in animals during the vasovagal reflex

1. Quadruped or recumbent position reduces the risk of cerebral hypoperfusion and, consequently, of LOC Alexander RM, 1991

2. The metabolic demand for the brain is lower in monkeys than in humans (4-7% of cardiac output is destined for the brain in monkeys versus ~ 20% in humans) and lower in the other animals. van Dijk G, 2003

3. Monkeys' legs are relatively much more thinner than those of man and muscle pump appears more active. van Dijk G, 2003

Loss of consciousness (LOC) in man during the vasovagal reflex

As a by-product due to the **erect position** and the **large brain** evolved in our species

LOC appears to be an **acquired disadvantage** during the evolutionary process

Vasovagal Syncope: Hypothesis Focusing on Its Being a Clinical Feature Unique to Humans

JEAN-JACQUES BLANC, M.D.* and DAVID G. BENDITT, M.D.†

J Cardiovasc Electrophysiol 2016

«Brain self-preservation theory»

«Brain self-preservation theory»

«Cerebral blood supply decreases some min before syncope but not at all, or in a more limited way, in non syncopal individuals»

(Bondar RL, Stroke 1995 Dan D, JACC 2002 Cheng R, J Biomed Opt 2014)

↓

Decrease in BP and HR

↓

Loss of both consciousness and postural tone

↓

Restoration of adequate cerebral blood flow

«Loss of consciousness as a protective mechanism»

Limitations of the «Brain self-preservation theory»

- **Reflex syncope does not appear to be a feature unique to humans**
- **The decrease in cerebral flow before syncope is not constant and is not specific for incoming syncope**
- **This theory does not explain emotional VVS**

Reflex syncope in animals

- Observed during venipuncture in chimpanzees
  van Dijk, Clin Auton Res 2003

- ECG recorded during syncope in dogs

Porteiro Vazquez DM, J Vet Cardiol 2016

Limitations of the «Brain self-preservation theory»

- **Reflex syncope does not appear to be a feature unique to humans**
- **The decrease in cerebral flow before syncope is not constant and is not specific for incoming syncope**
- **This theory does not explain emotional VVS**

Conclusion

The vasovagal reflex seems to be a «defense mechanism»for the heart

LOC appears to be an **acquired disadvantage** during the evolutionary process