Abstract

# Physiologic Basis for Use of Small Doses Noradrenalin

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The density of α-adrenergic receptors is much higher in the veins, particularly compliant veins, then in arteries. That difference is responsible for the differences in responses to varying concentrations of noradrenaline infused. The higher density of α-adrenergic receptors in the veins leads to their higher sensitivity to noradrenaline of veins than arteries. Such a difference is reflected in the much higher sensitivity of veins, compared with arteries, to small doses of noradrenaline.

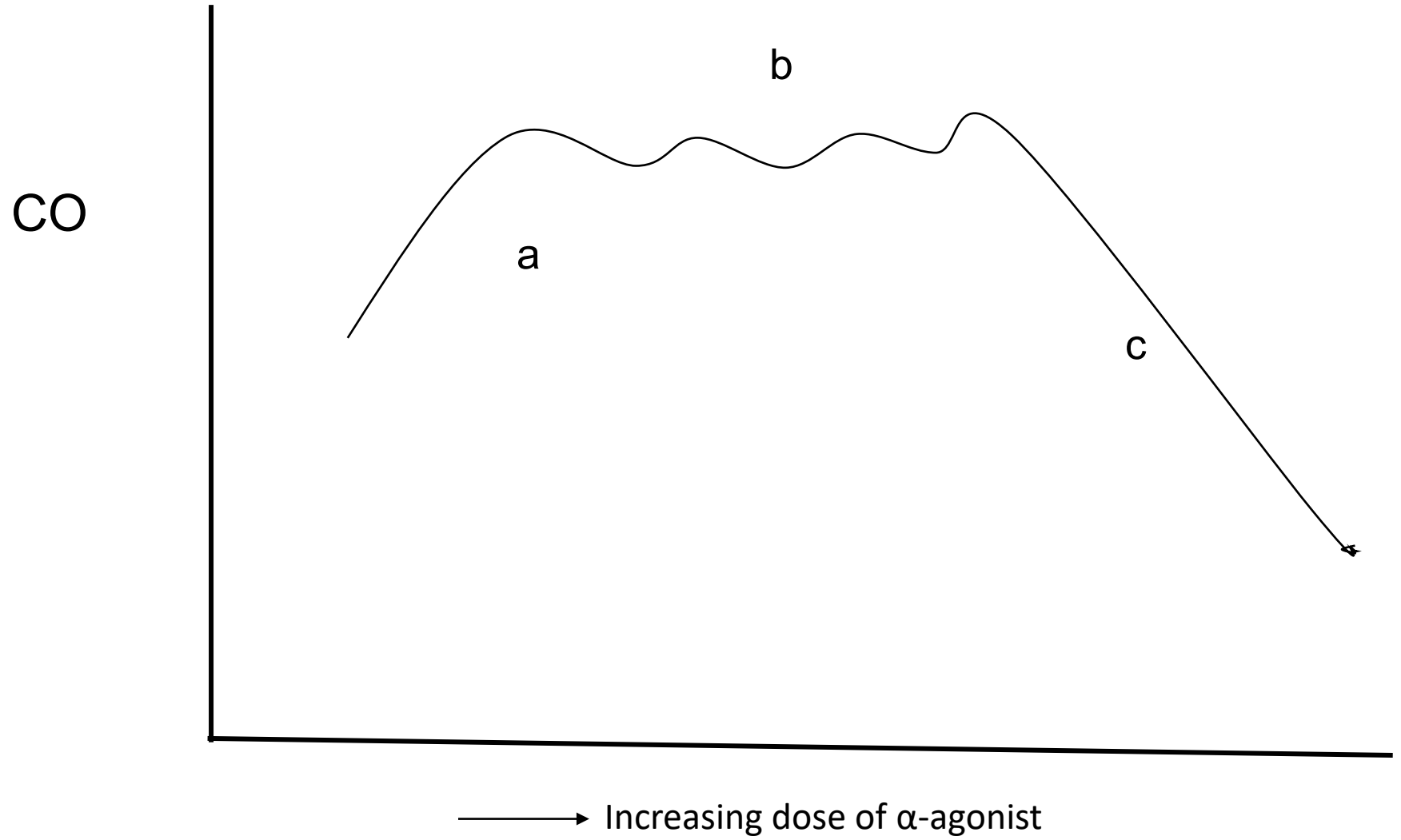
Another important difference between veins and arteries is that constriction of arteries leads to a decrease in flow within such arteries while constriction of complaint

venous wall leads to a decrease in capacitance of these veins and shift of blood volume upstream, increasing venous return and therefore cardiac output.

The described above differences has led to many observations that noradrenaline can increase or decrease cardiac output depending on the dose used and baseline condition. Therefore, in normal physiologic conditions the small doses of noradrenaline do increase venous return and cardiac output while large doses would constrict arteries decreasing flow through the tissues and subsequently venous return and cardiac output.

Thus, there are many observations in the literature to support the notion described above and provide basis for using small doses of noradrenaline to increase venous return and cardiac output without jeopardizing tissue perfusion. Such responses increase sensitivity to fluid challenge and should optimize hemodynamics (adequate cardiac output) at a lower blood volume.

Administration of small doses of noradrenalin may further enhance the postoperative recovery. Future studies can address some specifics, i.e. determination of the “small” doses of the infusions (probably it should be somewhere at the beginning of the part “b” on the enclosed schema. If such a point is selected further on the portion “b”, it would be associated with some overloading if the patient.


CO
b
a
c
Increasing dose of α-agonist

This schema represents the changes in cardiac output induced by different doses of alpha-adrenergic agonists.

a = beginning of infusion of small dose of α-adrenergic agonist (Cardiac Output increases)
b= minor increase in α-agonist concentration (Cardiac Output is not changed)
c = further increase of α-adrenergic agonist concentration (Cardiac Output drastically decreased)

References:

Gelman S. Classic papers revisited: My love affair with the venous system. Anesthesiol. 2018; 129(2):329-332.

Gelman S. What drives venous return?. Eur J Anaesthesiol. 2022; 39(3):196-197.

Gelman S. Using small doses of norepinephrine or phenylephrine during the peri-operative period. Eur J Anaesthesiol. 2022; 39:571-573.

Gelman S. Venous circulation: A few challenging concepts in goal-directed hemodynamic therapy (GDHT). In: Farag E, Kurz A, Troianos C, ed. Perioperative Fluid

Management. Switzerland: Springer Nature. 2020; Chapter 16, p. 365-385.

Feldheiser A, Gelman S, Chew M, Stopfkuchen-Evans M. Vasopressor effects on venous return in septic patients: A review. Eur J Anaesthesiol. 2021; 38(6):659-663.

Simon Gelman, MD, PhD, FANZCA grew up in the Soviet Union, Leningrad; emigrated to Israel in 1973. In 1976 moved to Cleveland, Ohio in the United States. In 1978 moved to Birmingham, Alabama where he finished his residency in anesthesiology in 1979 and became the chairman of the department in 1989. Since 1992 until 2002 was chairman of the department at Brigham and Women's Hospital, Harvard Medical School. He has more than 130 visiting professorships and more than 200 publications. He has been an editor of major anesthesiology journals. He is an honorary member of Israeli Society of Anesthesiologists and Australian and New Zealand College of Anaesthetists. He has a fellowship and named lecture at Brigham and Women's Hospital and two endowed chairs in his name (one in the University of Alabama in Birmingham and another at Harvard Medical School).