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0590. Impact of arterial tone changes on dynamic arterial elastance and the arterial pressure response to fluid administration

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Introduction

Dynamic arterial elastance (Ea_{dyn}), the relationship between pulse pressure variation (PPV) and stroke volume variation (SVV), has been suggested as a functional assessment of arterial load for predicting the arterial pressure response after volume expansion (VE)[1]. Although changes in Ea_{dyn} have been related with variations in arterial load[2], the effect of acute arterial tone changes on Ea_{dyn} and the impact on its performance for predicting the arterial pressure response after VE has not yet been determined.

Objective

To evaluate the effect of acute arterial tone changes on Ea_{dyn} and the influence on its performance for predicting arterial changes after fluid administration.

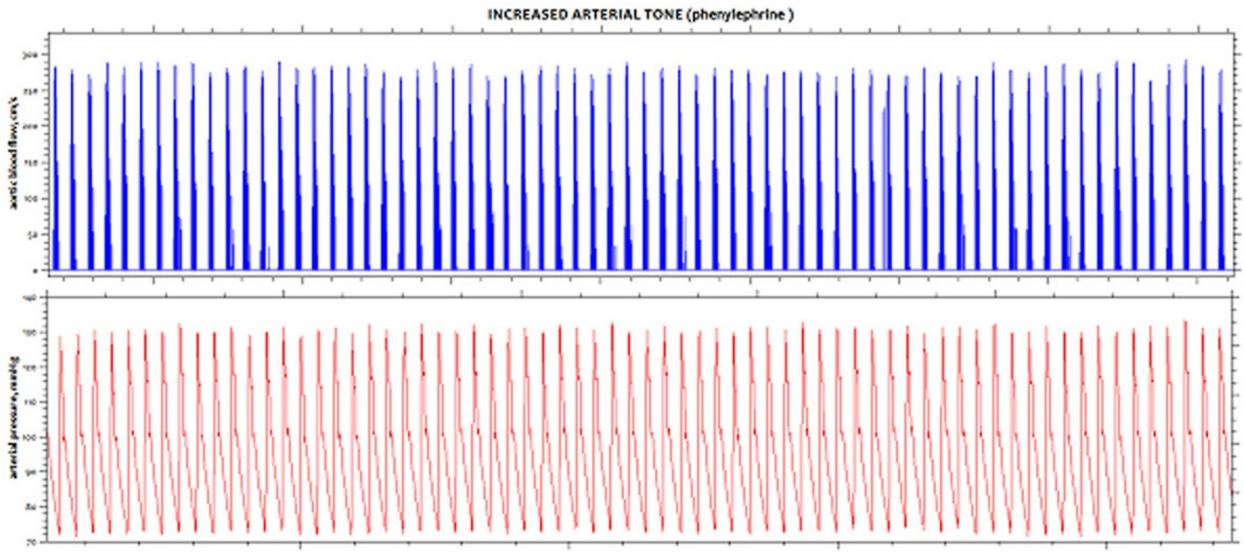

Figure 1 SW and PPV example on HighMAP group.

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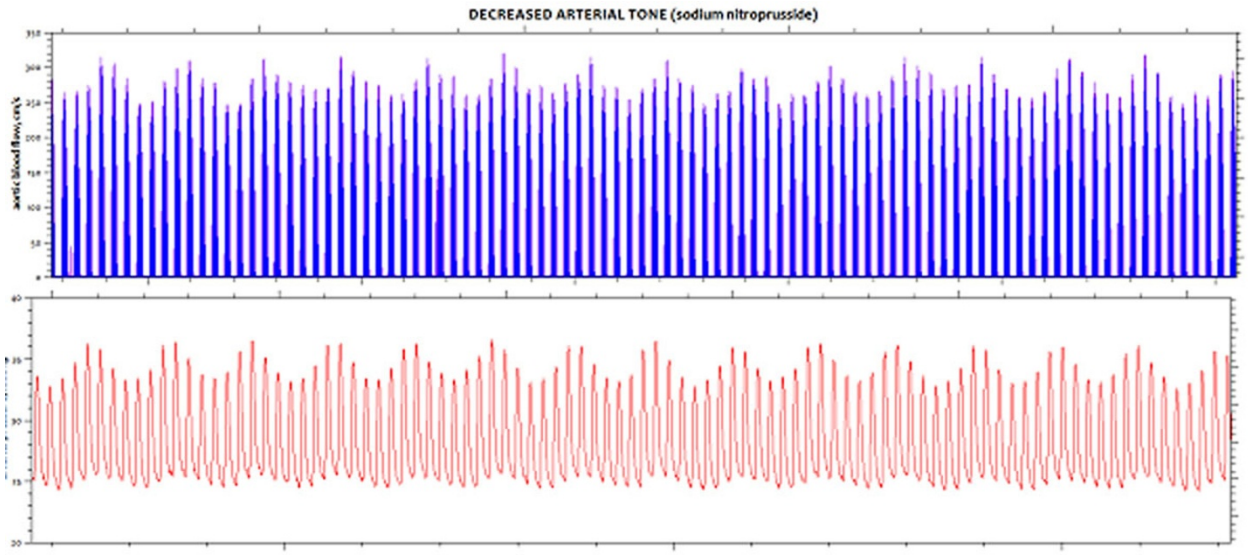

Figure 2 SVV and PPV example on LowMAP group.

Table 1 Comparison of arterial load parameters during different experimental conditions in HighMAP abnd LowMAP groups (n=6 on both experimental arms).

	Baseline	After change in arterial pressure	Postinfusion	P value[a]
EA_{dyn}				
HighMAP	0.92 ± 0.12	0.52 ± 0.23*	0.49 ±.0.18	<0.001
LowMAP	0.91 ± 0.16	1.64 ± 0.44*	1.26 ± 0.22†*	
Ea, cmHg/mL				
HighMAP	3.99 ± 0.93	5.42 ± 1.46*	4.45 ± 1.11†	<0.001
LowMAP	4.50 ± 1.44	1.80 ± 0.63*	1.52 ± 0.50†*	
C, mL/cmHg				
HighMAP	0.66 ± 0.13	0.41 ± 0.10*	0.48 ± 0.08†*	<0.001
LowMAP	0.53 ± 0.16	1.92 ± 0.86*	1.83 ± 0.58*	
TVSR, $MPa's/m^3$				
HighMAP	1514 ± 453	3157 ± 1299*	3372 ± 1306*	<0.001
LowMAP	1814 ± 585	709 ± 215*	720 ± 218*	

C: new arterial compliance; Ea: effective arterial elastance; Eadyn: dynamic arterial elastance; TSVR: total systemic vascular resistance. Data are presented as mean ± standard deviation. Data normally distributed according to Kolomogorov-Smirnov test. Note that pressure units are expressed as cmHg for convenience. *p<0.05 vs baseline. †p<0.05 vs. change in arterial pressure. *p value refers to ANOVA test for time and group interaction

Methods

12 anesthetized and mechanically ventilated rabbits. Arterial tone changes were induced by phenylephrine (PHENY) infusion on 6 animals (HighMAP group) and by sodium nitroprusside (SNP) on the other 6 animals (LowMAP group), until reach a 50% of change on mean arterial pressure (MAP) from its baseline value. A volume challenge (10 mL/Kg) was then performed on all animals. Animals were monitored with an indwelling femoral arterial catheter and an esophageal Doppler (CardioQ-Combi). Arterial load was assess by the systemic vascular resistance, net arterial compliance and effective arterial elastance. Ea_{dyn} was calculated as the simultaneous ratio between PPV and SVV obtained from the Doppler monitor.

Results

At baseline, Ea_{dyn} and other arterial load parameters were similar on both groups. In the LowMAP group, SNP significantly decreased arterial load, reduced MAP by 44%, and consistently increased Eadyn by 75% (Figure 1). In the HighMAP group, PHENY increased arterial load, raised MAP by 58%, and significantly reduced Ea_{dyn} by 41% (Fig. 1 and 2). Overall, VE increased cardiac output by 10%, stroke volume by 21% and MAP by 15%, and decreased Ea_{dyn} from 1.08 ± 0.67 to 0.88 ± 0.45 (Fig.1).

There was a significant relationship between Ea_{dyn} after arterial tone changes and increases in all components of arterial pressure after VE: systolic (R^2=0.89), diastolic (R^2= 0.41), mean arterial (R^2=0.61) and pulse pressure (R^2 = 0.67), respectively. Animals with a MAP increase ≥ 10% after VE had a higher preinfusion Ea_{dyn} value (1.54 ± 0.49 vs. 0.46 ± 0.15; P < 0.001).

Conclusions

In this experimental settings acute modifications on arterial tone induced significant changes on Ea_{dyn}: arterial vasodilation increased Ea_{dyn}, whereas vasoconstriction decreased it. Nevertheless, preinfusion Ea_{dyn} still determined the arterial pressure response after volume administration.

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