WHICH IS THE CHOICE: FLUID OR INOTROPES IN THE CASE OF SHOCK?

Gökhan Kalkan M.D.
Gazi University
Division of Pediatric Critical Care

First line and ess
Except of severe

In life-threatening
hypotension

- Fluids
- Flui... otropes
- Flu... + Inotropes

First line and essential
Except of severe heart failure &tamponade

- Fluids

Patients with acute body fluid losses and sx of hypovolemia	Patients with severe sepsis or septic shock	The other patients with hemodynamic instability · 50% ☠

Rivers E, et al. N Engl JMed 2001

Will my pati

On which portion of the Frank-Starling curve is my patient?

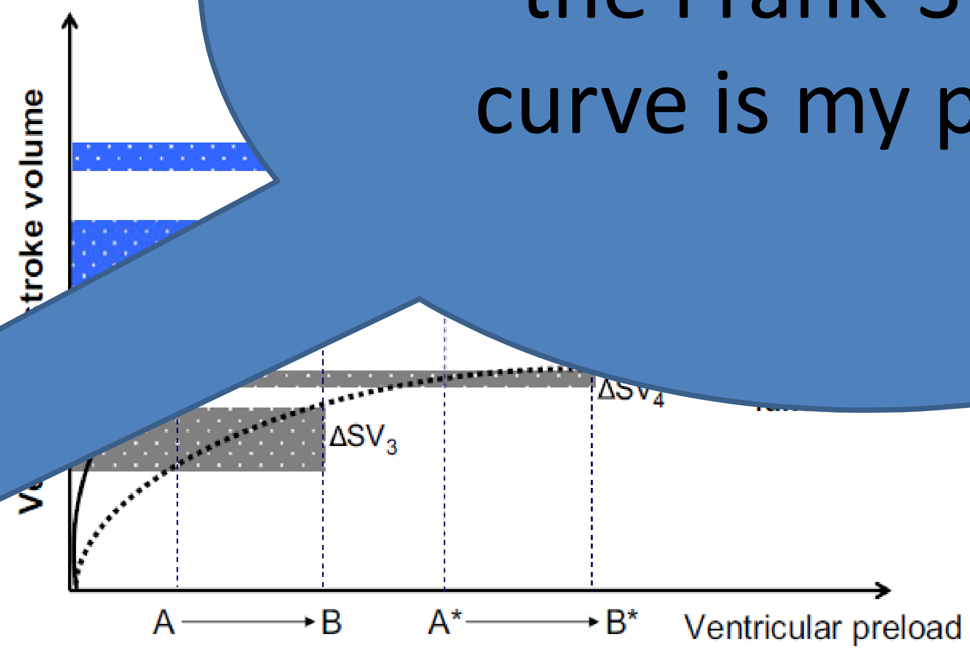


Fig. 1. The Frank-Starling curve representing the non-linear relationship between ventricular preload and ventricular stroke volume (straight curve = normal ventricular function; dashed curve = reduced ventricular function). If the heart is operating on the steep part of the Starling curve, an increase in preload is associated with a relevant increase in stroke volume (preload dependency, ΔSV_1). In contrast, if the heart is operating on the flat part of the Starling curve the same magnitude of change in preload after volume administration (from A* to B*) does not increase SV (preload independency, ΔSV_2). This relationship is strongly affected by cardiac function. In contrast to a normal ventricular function, the same increase in preload will not induce a relevant change in stroke vol

the patient has “recruitable” CO

“flat” part of the Frank-Starling curve

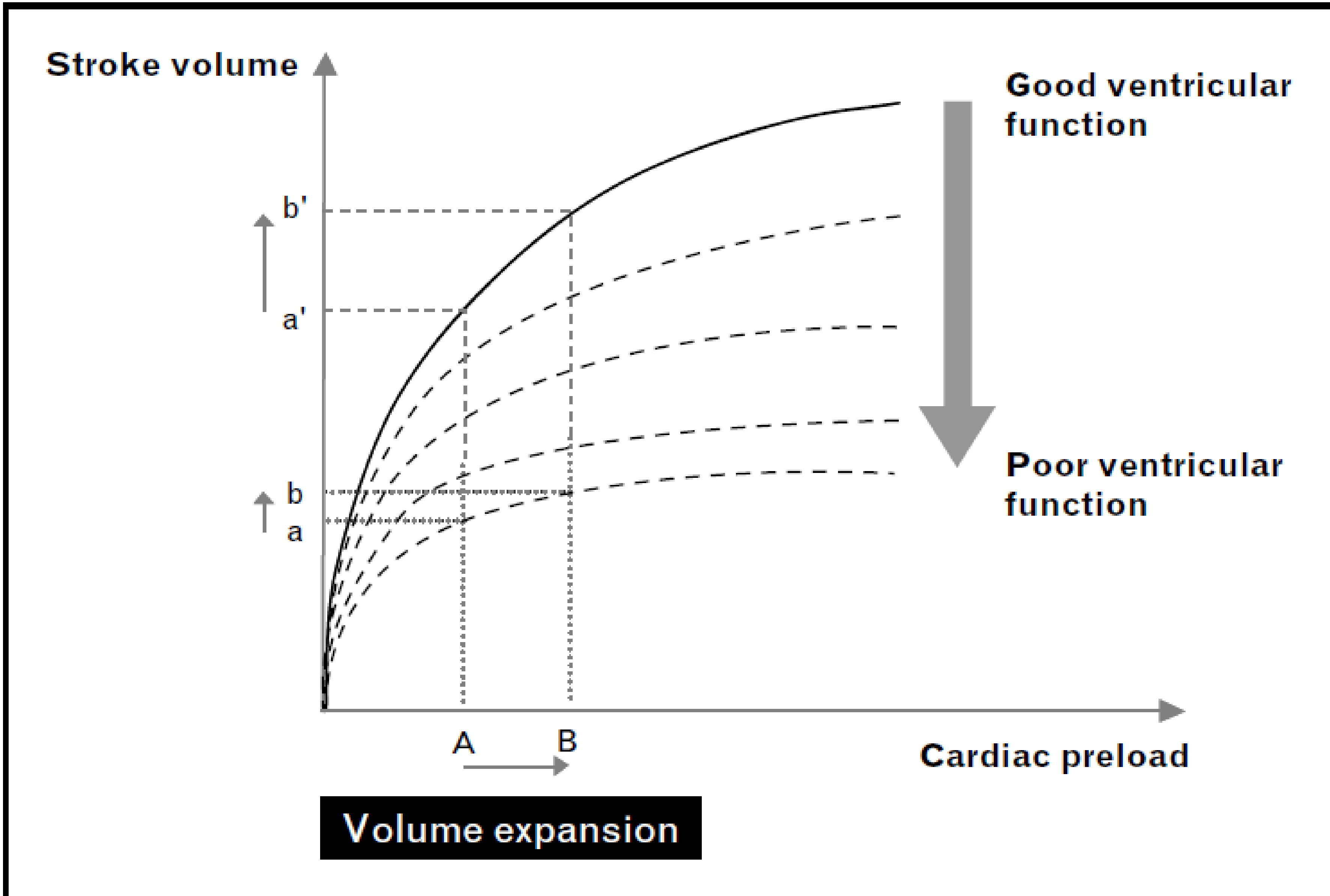
How to determine the preload dependent patient

- The clinical assessment of intravascular volume
  - Skin turgor
  - Blood pressure
  - Pulse rate
  - Urine output
  - Chest examination
  - Chest radiograph
- The clinical assessment is often unspecific and

How to determine the preload dependent patient

- Cardiac filling pressures
  - Central venous pressure & Pulmonary capillary wedge pressure
    - Poorly discriminate between responders and nonresponders to a fluid trial
    - CVP values of <5 mmHg may be helpful

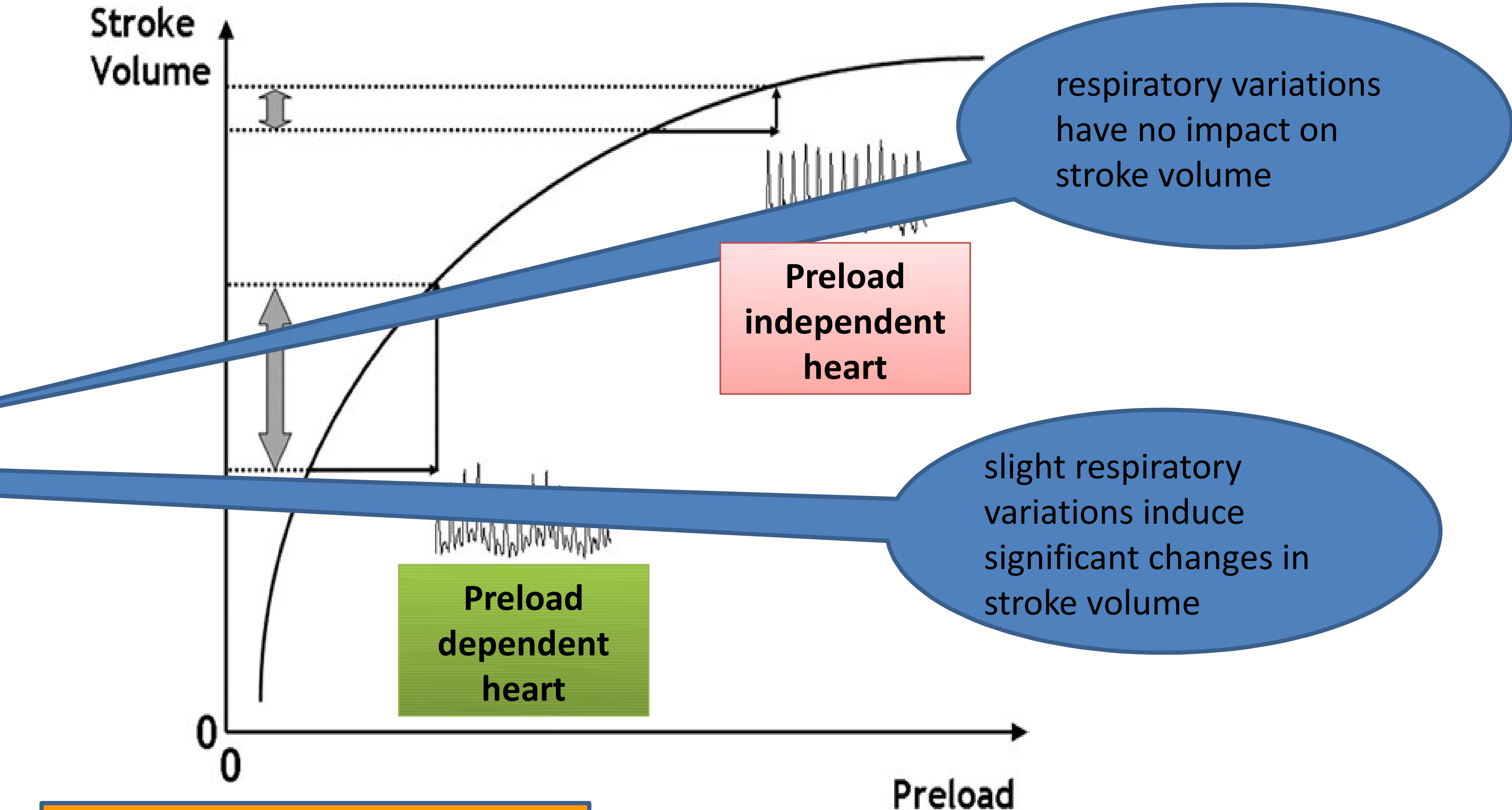
Michard F, Teboul JL. Chest 2002
Coudray A, et al. Crit Care Med 2005
Osman D, et al. Crit Care Med 2007


Stroke volume
Good ventricular function
b'
a'
b
a
Poor ventricular function
A
B
Cardiac preload
Volume expansion

Mechanical ventilation & Frank-Starling curve

- Positive-pressure ventilation induces cyclic changes in vena cava blood flow, pulmonary artery flow, and aortic blood flow- stroke volume
- During inspiration, vena cava blood flow decreases (venous return decreases)

Rick JJ, Burke SS. Respirator paradox. South Med J. 1978



SPV more than 10 mmHg = hypovolemia

Bendjelid K, Romand JA. Intensive Care Med 2003
Cannesson M, et al. Crit Care 2006
Solus-Biguenet H, et al. Br J Anaesth 2006

SPV

- Changes in systolic arterial pressure or pulse arterial pressure caused by positive pressure ventilation can predict which patients respond to fluid loading with an increase in their cardiac output
- Finger arterial pulse pressure monitored noninvasively may represent an alternative
- Even the amplitude of the pulse oximetry plethysmography signal can be used

Natalini G, et al. Anesth Analg 2006
Feissel M, et al. Intensive Care Med 2007
Cannesson M, et al. Anesthesiology 2007

Echocardiography

- Ventricular size
- Systolic performance
- Initial assessment of preload
- Estimation of stroke volume with echo doppler
- Vena-caval diameter measurement

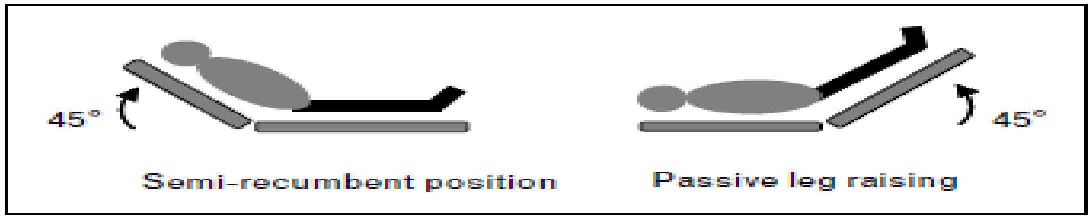
Monnet X, et al. Intensive Care Med 2005

CO monitoring

- Through PAC or any less invasive flow assessment technique (e.g. Transesophageal echocardiogram, esophageal Doppler, or peripheral transpulmonary dilution)
- Fluid challenges to determine the patient's position in the Frank–Starling curve

The passive leg-raising test

Figure 2 Passive leg raising



The passive leg-raising test consists of measuring the hemodynamic effects of a leg elevation up to 45°. A simple way to perform the postural maneuver is to transfer the patient from the semi-recumbent posture to the passive leg-raising position by using the automatic motion of the bed.

- Volume of blood transferred to the heart during PLR is sufficient to increase the left cardiac preload and thus to challenge the Frank-Starling curve
- Beyond its ease of use, the method has the advantage of inducing reversible effects once

Boulain T, et al. Chest 2002

The passive leg-raising test

- Maximal hemodynamic effects of PLR occurred within the first minute of leg elevation
- The response to PLR

Lafanechere et al. Crit Care 2006
Monnet X, et al. Crit Care Med 2006

Thank you