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# Pulse pressure variability as a predictor of volume responsiveness in patients with sepsis

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## Keywords

Hemodynamic, monitoring, pulse pressure, respiratory

# Comments

Michard *et al* have found an excellent correlation between pulse pressure variability and the response to fluid challenge in a group of mechanically ventilated patients with sepsis and circulatory failure. Although there is no gold standard for the assessment of volume status, fluid responsiveness is what actually matters, and an increase in cardiac index (CI) of 15% with fluid challenge seems to be an adequate comparison. Pulse pressure variability of 13% allowed for discrimination between responders and nonresponders, with a sensitivity of 94% and a specificity of 96%. A poor correlation with a commonly used predictor - pulmonary capillary wedge pressure (PCWP) - is notable. These results need further confirmation, and the test needs defining in other groups of critically ill patients. In mechanically ventilated patients with sepsis, pulse pressure variability (easily obtained from bedside monitoring equipment) can be used as a supplement to clinical examination in the assessment of fluid status and responsiveness. It must be stressed that arrhythmias and spontaneous breathing activity can lead to misinterpretation of respiratory changes in arterial pressure.

# Introduction

In patients with sepsis it is very important to assess volume status at the bedside. Inadequacies in physical examination have led to widespread use of the pulmonary artery catheter to determine volume status in a critically ill septic patient. Its use, however, has recently come under scrutiny because of a possible association with adverse outcome. In patients on mechanical ventilation, respiratory variations in pulse pressure waveform, as a consequence of changes in pleural pressure, are increased in states of low cardiac preload and tend to decrease with adequate volume resuscitation. The sensitivity and specificity of such testing is unknown, however.

# Methods

- Study group: 40 patients in septic shock on mechanical ventilation with radial and pulmonary artery catheters in place
- Hemodynamic measurements: cardiac output was measured by standard thermodilution method
- Respiratory changes in arterial pressure: arterial and airway pressures were simultaneously recorded over a period of three breaths. Maximal and minimal values of pulse pressure ($Pp_{max}$ and $Pp_{min}$) and systolic pressure ($Ps_{max}$and $Ps_{min}$) were determined with a single respiratory cycle. The respiratory variations in pulse pressure (δPp) and systolic pressure (δPs) were calculated as the difference between $Pp_{max}$ and $Pp_{min}$ divided by the mean of the two values. The results were expressed as percentages
- Measurements were repeated before, and 30 minutes after, fluid challenge with 500 $cm^3$ of 5% hetastarch infusion

# Results

Sixteen patients had an increase in cardiac output of >15% after the fluid challenge and were considered as responders. Prior to the infusion δPp and δPs were higher in responders than in nonresponders (δPp 24 ± 9 vs 7 ± 3%, $P$ <0.001, δPs 15 ± 5 vs 6 ± 3%, $P$ <0.001). Respiratory change in pulse pressure (δPp) of 13% had a sensitivity of 94% and a specificity of 96% in the prediction of fluid responsiveness. Infusion-induced changes in cardiac output closely correlated with respiratory variation in pulse pressure (δPp) before fluid challenge ($r^2$ = 0.85, $P$ <0.001). Moreover, infusion-induced changes in δPp correlated with infusion-induced changes in cardiac output ($r^2$ = 0.72, $P$ <0.001).

# References

1. Michard F, Boussat S, Chemla D, Anguel N, Mercat A, Lecarpentier Y, Richard C, Pinsky MR, Teboul JL: Relation between respiratory changes in arterial pulse pressure and fluid responsiveness in septic patients with acute circulatory failure. Am J Respir Crit Care Med. 2000, 162: 134-138.