Plethysmography Variability Index: A New Fluid Responsiveness Parameter

Introduction
New predictors of fluid responsiveness have been obtained from plethysmographic waveforms displayed on pulse oximeters. However, they require recordings on a PC and offline operator-dependent analysis. A new parameter called the plethysmography variability index (PVI) has been proposed by a pulse oximetry manufacturer to be used for the purpose of fluid responsiveness. Its advantage is that it can be automatically calculated and displayed on the screen of the pulse oximetry monitor. The aim of the study is to test the accuracy of this parameter to predict fluid responsiveness in critically ill patients.

Methods
Inclusion criteria were septic shock patients fully adapted to their respirator and on sinus rhythm. Methods involved simultaneous recording of the following tracings: invasive blood pressure, plethysmography pulse oximeter (Philips™), ECG, airway pressure and digit values inscribed on the device (Masimo™). Echocardiography was used to calculate the velocity–time integral (VTI). We infused fluid (500 ml saline) in patients with pulse pressure variation (ΔPP) ≥ 15% and performed passive leg raising (PLR) in patients with ΔPP <15%. We compared the PVI with ΔPP and with the variability of pulse oximeter wave amplitude (ΔPleth) and sought the best threshold PVI value that predicted ΔPP >15%. Patients who increased their VTI by more than 15% in response to fluid or to PLR were defined as responders. The significance of the PVI threshold to distinguish between responders and non-responders was examined.

Results
In the first step 25 patients were enrolled. Fifty paired values were analysed. The $r^2$ coefficients between ΔPP–PVI, ΔPleth–PVI and ΔPP–ΔPleth were 0.81, 0.79 and 0.74, respectively. A threshold PVI value of 20 identified patients with ΔPP >15% with a sensitivity of 84% and specificity of 90%. In a second step 18 other patients were enrolled. All patients with PVI >20 (n = 8) were fluid responders and 10 patients with PVI <20 were PLR non-responders.

Conclusion
The PVI automatically obtained from a pulse oximetry device seems an accurate index of fluid responsiveness. The numerical value of 20 distinguished responders from non-responders with good sensitivity and specificity.