A modified version of the bioreactance device reliably detects preload responsiveness through the end-expiratory occlusion test

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Introduction:
The Starling-SV bioreactance device (Cheetah Medical) reliably detects passive leg raising (PLR)-induced changes in cardiac index ($\Delta CI$). We tested whether it can also track the small and short-time $\Delta CI$ induced by the end-expiratory occlusion (EEXPO) test, and whether shortening the time over which it averages cardiac output (24 s in the commercial version) improves the detection.

Methods:
In 42 mechanically ventilated patients, during a 15-sec EEXPO, we measured $\Delta CI$ (in absolute value and in percentage) through calibrated pulse contour analysis ($\Delta CI_{\text{pulse}}$, PiCCO2 device) and Starling-SV. For the latter, we considered both $\Delta CI_{\text{Starling-24}}$ provided by the commercial version and $\Delta CI_{\text{Starling-8}}$ obtained by averaging the raw data over 8 s. We calculated the correlation between $\Delta CI_{\text{pulse}}$ and both $\Delta CI_{\text{Starling-24}}$ and $\Delta CI_{\text{Starling-8}}$, and the area under the receiver operating characteristic curve (AUROC) to detect preload responsiveness, defined by a PLR test.

Results:
When considering absolute values, the correlation coefficient $r$ between $\Delta CI_{\text{pulse}}$ and $\Delta CI_{\text{Starling-24}}$ was 0.362 ($p=0.02$), which was lower than the one between $\Delta CI_{\text{pulse}}$ and $\Delta CI_{\text{Starling-8}}$ ($r=0.714; p<0.0001$) ($p=0.02$ for $r$ comparison). When considering percentage changes, no correlation was observed between $\Delta CI_{\text{pulse}}$ and $\Delta CI_{\text{Starling-24}}$. Conversely, the correlation coefficient between $\Delta CI_{\text{pulse}}$ and $\Delta CI_{\text{Starling-8}}$ was 0.402 ($p=0.01$), but it was lower than the one obtained for absolute values ($p=0.04$ for $r$ comparison). EEXPO-induced $\Delta CI_{\text{Starling-8}}$, both in absolute values and in percentage, detected preload responsiveness with AUROCs of 0.90 (sensitivity 83%, specificity 87%) and 0.89 (sensitivity 83%, specificity 79%), respectively.

Conclusion:
Shortening the averaging time of the bioreactance signal increases the reliability of the Starling-SV device to detect EEXPO-induced $\Delta CI$. Moreover, the accuracy of the method is increased when absolute rather than percentage changes of CI are considered.