To the editors

It was with interest that we read the review of de Wilde and colleagues about the use of the PiCCO device in cardiothoracic patients in relation to their own extensive experience [1]. We are pleased they made the effort to explain how this interesting technique works and what its possible advantages and disadvantages are. However, we do not agree with the authors that the PiCCO system is of limited value in monitoring cardiothoracic patients. We feel that the authors have omitted several potentially beneficial possibilities of the PiCCO device that might be of interest to the readers of the Netherlands Journal of Critical Care.

Determination of cardiac output

As de Wilde et al. correctly mention, despite a small overestimation, transpulmonary thermodilution technology (TPTD) is a reliable method of measuring cardiac output (CO) and also tracks changes in CO over time. We, like many others, have proven this in an animal model [2]. It is even considered the gold standard for measuring cardiac output in critically ill paediatric patients [3].

Using the TPTD technique, the PiCCO device calibrates its arterial pressure driven pulse contour cardiac output method and subsequently provides the clinician with a fast beat-to-beat CO measurement. Although some types of pulmonary artery catheters automatically measure CO, these measurements are not continuous and do not provide insight when fast changes in CO might occur.

The accuracy and precision of the pulse contour method are not as good as the TPTD method, therefore frequent recalibration is needed. However, the accuracy of the pulse contour method of the PiCCO device is comparable to the only other commercially available calibrated pulse contour method (LiDCO system, Cambridge, UK). The uncalibrated techniques mentioned by the authors - namely Modelflow (BMEYE, Amsterdam) and Hemac (from one of the authors) - may perform better but do not have the essential ability to be calibrated against an established and incorporated method. Besides that, they are not commercially available for use in the critical care environment.

The conclusion that accuracy, precision and ability to track changes in CO of the PiCCO device are inferior to its competitors is therefore not substantiated by the authors.

Determination of fluid responsiveness

The authors correctly mention the ability of the PiCCO device to record stroke volume variation (SVV) and pulse pressure variation (PPV), which are potentially useful predictors of fluid responsiveness. The authors state that these measurements are of limited use because “irregular heart rates are quite common in cardiac surgery patients”. We think this is of little clinical consequence since the use of preload parameters is most important on the first or second postoperative day while most rhythm disturbances (e.g. atrial fibrillation) occur after this time period. In a recent series from our own hospital (CORRAD database registration UMC St Radboud), an episode of atrial fibrillation developed in only 7.7% of postoperative cardiac surgery patients during their ICU treatment.

We do not agree with the authors that SVV and PPV are of limited value in patients breathing spontaneously. SVV and PPV appear to have a high specificity in patients breathing spontaneously without mechanical support and only the sensitivity appears to be low. In this case the possibility of a passive leg raising test should be considered. As the PiCCO device provides a fast beat-to-beat CO measurement it enables the determination of fluid responsiveness using the passive leg raising (PLR) test [4].

Although we agree with the authors that measurement of global end diastolic volume (GEDV) is of limited value in predicting fluid responsiveness in patients with reduced myocardial function, we believe this measurement can be of value for many other patients. The opinion that SVV influences the precision of the GEDV measurement is interesting but has never been substantiated. We have never observed this phenomenon, neither can we explain this on the basis of theory. Since stroke volume variation occurs almost beat to beat while the TPTD measurement technique measures GEDV during a time interval of at least 10 seconds and comprises many heartbeats, we find this difficult to accept. We certainly encourage the authors to publish this observation because it can be of importance to clinicians using this device.

Determination of extra vascular lung volume

Using the PiCCO device, extra vascular lung water (EVLW) can reliably be measured by means of the TPTD technique. It offers the clinician the opportunity to quantify the amount of pulmonary oedema [5]. A therapeutic strategy aimed at reducing EVLW has been shown to decrease ventilator- and ICU days [6]. Measurement of EVLW in adults can therefore be regarded as a relevant parameter for the management of critically ill patients [7]. Unfortunately, the authors have left the capability of the PiCCO device to measure EVLW completely unmentioned. We are aware of at least one other ongoing trial comparing a strategy of increasing cardiac output versus a strategy limiting extravascular lung water.

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Conclusion

We consider the PiCCO device as reliable as the PAC in measuring CO using the transpulmonary thermodilution technique. Furthermore, using pulse contour analysis this technology enables the determination of fluid responsiveness using either arterial pressure variations or the passive leg raising test. Also, it offers the possibility of measuring extra vascular lung water thereby quantifying the amount of pulmonary oedema. Potentially the PiCCO system could thus be superior to other devices and useful to all ICU patients, including children. However like the pulmonary artery catheter, its clinical value still needs to be quantified.

As with every other medical device it is not the technology that cures ICU patients, but the doctors and nurses who must interpret the obtained data and translate them into appropriate therapeutic protocols.

References