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E D I Z I O N I · M I N E R V A · M E D I C A

Author reply to: Can transthoracic echocardiography be used as a reference method for cardiac output measurement?

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Dear Editor,

We have read with interest the letter by Demirkol *et al.*,¹ who raised significant criticisms about our paper recently published in the Journal.²

The authors stated that the use of thermodilution (ThD) technique, widely considered as the “gold-standard” method for cardiac output (CO) measurement, would have further improved the strength of our results. They also highlighted how it could be difficult, in clinical practice, to obtain a good quality apical five-chamber view in supine patients.¹ Although these observations are appropriate, some clarifications should be considered.

A) First point: Why did we use transthoracic echocardiography (TTE) as the reference method for CO measurement as alternative to ThD technique? It has been shown that the pulmonary artery catheter (PAC) can lead to several complications related to its invasiveness; moreover its impact on outcome remains controversial. Thus, the use of the PAC is not recommended in all trauma patients but it is limited to selected patient populations.² On the other hand, in recent years, ultrasonography has emerged as a useful and non-invasive diagnostic tool in trauma patient, as it can provide a number of information (thoracic, cardiac, and abdominal alterations/pathologies).³ Also, the PAC provides CO values that may be within normal ranges even in the presence of an altered cardiac function, which can be detected by TTE.³ In particular, TTE provides also information on cardiac morphology and it may be useful to evaluate the response to therapy (*e.g.*, fluid management, use of vasopressors and inotropic agents).³ Thus, TTE should be considered as a valid alternative to the PAC in such population, as it has already been shown in other categories of critically ill patients.

B) Second point: is CO easily measurable by TTE in criti-

cally ill patients admitted to intensive care unit? Actually, using TTE as a bedside diagnostic tool in critically ill patients may be challenging, as the supine position and the potential lung hyperinflation secondary to mechanical ventilation may limit the apical five-chamber view to assess CO values.⁴ Recent studies reported that the percentage of echocardiography examinations (including CO measurements), which are successfully completed in an ICU setting, varies from 70% to 100%; patients in supine position or after major trauma were also evaluated.^{3, 4} Some authors suggested that the quality of TTE recordings could be improved by changing patients' position either with the help of backrests (when possible) or by moving the electronic beds.^{4, 5} We excluded from our study patients in whom it was not possible to obtain an adequate apical five-chamber view, despite adjustment of patient's or bed position. A useful manoeuvre, but not applied in this study, could be a temporary reduction of the tidal volume associated with the increase of respiratory rate (in order to maintain adequate minute volume), to reduce lung hyperinflation. However, the safety of this manoeuvre requires further validation.

In conclusion, TTE can be used as a reference technique for CO measurement whenever a PAC is deemed not essential or even harmful. Unfortunately, there are some patients in whom a suitable apical five-chamber view during supine position cannot be obtained. Some simple strategies (*e.g.*, positioning of backrests, tilting the bed) may improve the quality of echocardiographic examination in the majority of them.

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