


REVIEW

Existing fluid responsiveness studies using the mini-fluid challenge may be misleading: Methodological considerations and simulations

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Abstract

Background: The mini-fluid challenge (MFC) is a clinical concept of predicting fluid responsiveness by rapidly infusing a small amount of intravenous fluids, typically 100 ml, and systematically assessing its haemodynamic effect. The MFC method is meant to predict if a patient will respond to a subsequent, larger fluid challenge, typically another 400 ml, with a significant increase in stroke volume.

Methods: We critically evaluated the general methodology of MFC studies, with statistical considerations, secondary analysis of an existing study and simulations.

Results: Secondary analysis of an existing study showed that the MFC could predict the total fluid response (MFC + 400 ml) with an area under the receiver operator characteristic curve (AUROC) of 0.92, but that the prediction was worse than random for the response to the remaining 400 ml (AUROC = 0.33). In a null simulation with no response to both the MFC and the subsequent fluid challenge, the commonly used analysis could predict fluid responsiveness with an AUROC of 0.73.

Conclusion: Many existing MFC studies are likely overestimating the classification accuracy of the MFC. This should be considered before adopting the MFC into clinical practice. A better study design includes a second, independent measurement of stroke volume after the MFC. This measurement serves as reference for the response to the subsequent fluid challenge.

1 | INTRODUCTION

The term *mini-fluid challenge* (MFC) was coined by Muller et al about a decade ago¹ as a new way to predict fluid responsiveness. At the time, common fluid infusion practice consisted of 'let's give some fluid and see what happens' as highlighted by the accompanying editorial.² That 'some fluid' was a fluid challenge of around 500 ml as identified by the FENICE study.³ Motivated by the finding that fluid is not harmless and may induce fluid overload, Muller et al suggested the MFC: the haemodynamic effect of a rapid infusion of a small

amount of fluid could guide whether or not a larger amount of fluid should be given. The authors tested whether the change in aortic velocity time integral (VTI; an echocardiographic measure correlated with stroke volume [SV]) induced by the MFC (100 ml within 1 min) could predict the effect of a 'normal' fluid challenge of 500 ml, specifically, the combined effect of the MFC and another 400 ml. The method was highly predictive (area under the receiver operating characteristic [ROC] curve, AUROC, of 0.92).¹ Others have since investigated and validated the MFC, and a recent systematic review including seven MFC studies (368 fluid challenges in 324 patients)^{1,4-9}