

Conflicts of interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Authors' contributions

Atsushi Kobayashi and Hiroyuki Kinoshita have given substantial contributions to the manuscript draft. All authors read and approved the final version of the manuscript.

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Supplementary data

For supplementary materials, please see the HTML version of this article at www.minervamedica.it

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Perfusion Index monitoring to help assessing changes in perfusion after administration of inodilator drugs in cardiac surgery patients

Cardiogenic shock following weaning from extracorporeal circulation (ECC) during cardiac surgery and in the postoperative period in the ICU is a critical concern. Selecting the appropriate inotropic agent is vital for achieving a positive clinical response. Enoximone, an inhibitor of cyclic adenosine monophosphate-phosphodiesterase type III, has shown important inotropic and vasodilative effects, especially in cases of right heart dysfunction.¹

The recent resurgence of enoximone's popularity in clinical practice, particularly in case of right heart failure, can be attributed to its vasodilative effects on the pulmonary arteries, enhancing right ventricle output and finally rectifying hemodynamic dysfunction.² However, caution is required when using enoximone in patients with significant hypotension and systemic vascular dysfunction. In such cases, the addition of a peripheral vasoconstrictor like norepinephrine can help maintain adequate mean arterial pressure (MAP) and

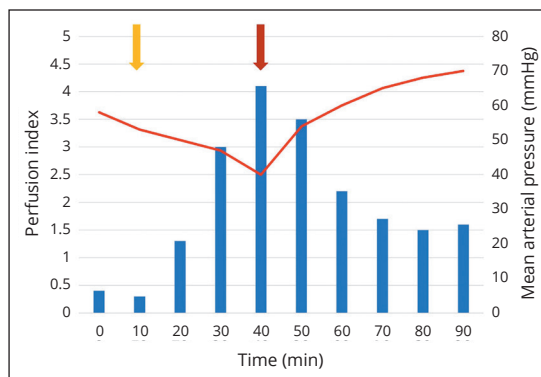


Figure 1.—Example of perfusion index and blood mean pressure variation and consequent guided therapy on a patient in ICU after cardiac surgery. Time is expressed in minutes. The red line indicates mean arterial pressure trend. The blue columns indicate the perfusion index at different times. The yellow arrow indicates starting of enoximone infusion at 5 $\mu\text{g}/\text{kg}/\text{min}$. The red arrow indicates starting of norepinephrine infusion at 0.1 $\mu\text{g}/\text{kg}/\text{min}$.

PI: Perfusion Index; MAP: mean arterial pressure (in mmHg).

counteract vasoplegia, which frequently accompanies cardiogenic shock in critically ill patients after cardiopulmonary bypass.

In cardiac surgery and ICU settings, echocardiography is probably the most reliable method to assess cardiovascular drug efficacy and guide inotropic and vasopressor therapy. Nonetheless, the perfusion index (PI), derived non-invasively from the pulse oximeter, is a valuable parameter to assess peripheral perfusion and its response to changes in vascular tone and hemodynamics.³ Numerous studies have demonstrated PI's correlation with hemodynamic changes, postoperative complications, and its reliability in monitoring shock.⁴⁻⁶

We propose measuring the PI value immediately before initiating enoximone administration. An improvement or positive trend in PI could indicate a favorable response to therapy, leading to improved peripheral perfusion.⁷ In cases where PI increases alongside hypotension, adding a peripheral vasoconstrictor may be a suitable therapeutic decision to normalize PI values. Conversely, no change or a decrease in PI might suggest the need for a modification in therapy, such as increasing enoximone dosage or considering alternate inotropic drugs. However, it is crucial to consider other monitored hemodynamic parameters, such as central venous pressure, lactate levels, and urine output, to make comprehensive clinical decisions.

Figure 1 demonstrates an example of PI and mean blood pressure modifications during enoximone infusion and subsequent guided therapy in an ICU patient shortly after cardiac surgery with ECC.

It is important to acknowledge that vasoconstrictors can alter peripheral flow and potentially lower PI values. In severe cases requiring high dosage of vasoactive drugs before initiating enoximone infusion (*e.g.*, severe

distributive shock), the interpretation of PI changes may be challenging. Moreover, conditions like severe peripheral vascular diseases, hypothermia, hyperthermia, and intense postoperative pain can influence peripheral perfusion and complicate PI interpretations.⁸

To better comprehend the role of monitoring PI in guiding enoximone administration, particularly in cardiac surgery patients, further studies involving a larger patient cohort are necessary.

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Authors' contributions

Alessandro Strumia, Annalaura Di Pumpo, Maria C. Conti, Stefano Rizzo, Lara Mortini: conceptualization, methodology, and writing - original draft preparation. Giuseppe Pascarella, Alessandro Ruggiero, Eugenio De Quattro, Mariapia Stifano: data curation, investigation, and visualization. Domenico Sarubbi, Rita Cataldo, Felice E. Agrò, Massimiliano Carassiti: resources, supervision, and project administration. Vincenzo Citriniti, Lorenzo Schiavoni, Alessia Mattei: review and editing. All authors have read and approved the final version of the manuscript.

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