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ORIGINAL ARTICLE

Role of echocardiography in reducing shock reversal time in pediatric septic shock: a randomized controlled trial☆

Ahmed A. EL-Nawawy[a], Aly M. Abdelmohsen[b], Hadir M. Hassouna[a,*]

[a] Alexandria University, Faculty of Medicine, Department of Pediatrics, Alexandria, Egypt
[b] Alexandria University, Faculty of Medicine, Pediatric Cardiology Unit, Alexandria, Egypt

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KEYWORDS
Echocardiography;
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Abstract

Objective: To evaluate the role of echocardiography in reducing shock reversal time in pediatric septic shock.

Methods: A prospective study conducted in the pediatric intensive care unit (PICU) of a tertiary care teaching hospital from September 2013 to May 2016. Ninety septic shock patients were randomized in a 1:1 ratio for comparing the serial echocardiography-guided therapy in the study group with the standard therapy in the control group regarding clinical course, timely treatment, and outcomes.

Results: Shock reversal was significantly higher in the study group (89% *vs.* 67%), with significantly reduced shock reversal time (3.3 *vs.* 4.5 days). PICU stay in the study group was significantly shorter (8 ± 3 *vs.* 14 ± 10 days). Mortality due to unresolved shock was significantly lower in the study group. Fluid overload was significantly lower in the study group (11% *vs.* 44%). In the study group, inotropes were used more frequently (89% *vs.* 67%) and initiated earlier (12[0.5–24] *vs.* 24[6–72] h) with lower maximum vasopressor inotrope score (120[30–325] *vs.* 170[80–395]), revealing predominant use of milrinone (62% *vs.* 22%).

Conclusion: Serial echocardiography provided crucial data for early recognition of septic myocardial dysfunction and hypovolemia that was not apparent on clinical assessment, allowing a timely management and resulting in shock reversal time reduction among children with septic shock.

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* Corresponding author.
E-mail: hadirelrouby@yahoo.com (H.M. Hassouna).

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PALAVRAS-CHAVE
Ecocardiografia;
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Inotrópicos

Papel da ecocardiografia na redução do tempo de reversão do choque no choque séptico pediátrico: ensaio controlado randomizado

Resumo

Objetivo: Avaliar o papel da ecocardiografia na redução do tempo de reversão do choque no choque séptico pediátrico.

Métodos: Um estudo prospectivo conduzido em uma UTIP de um hospital universitário de cuidados terciários de setembro de 2013 a maio de 2016. 90 pacientes com choque séptico foram randomizados na proporção 1:1 para comparar a terapia guiada por ecocardiografia em série à terapia padrão no grupo de controle com relação ao curso clínico, tratamento oportuno e resultados.

Resultados: A reversão do choque foi significativamente maior no grupo de estudo (89% em comparação a 67%) com redução significativa do tempo de reversão do choque (3,3 em comparação a 4,5 dias). A permanência na UTIP no grupo de estudo foi significativamente mais curta (8 ± 3 em comparação a 14 ± 10 dias). A mortalidade devido ao choque não resolvido foi significativamente menor no grupo de estudo. A sobrecarga de fluidos foi significativamente menor no grupo de estudo (11% em comparação a 44%). No grupo de estudo, os inotrópicos foram utilizados com mais frequência (89% em comparação a 67%) e foram administrados antecipadamente (12 [0,5-24] em comparação a 24 [6-72] horas), e o menor escore inotrópico máximo dos vasopressores (120 [30-325] em comparação a 170 [80-395]) revela o uso predominante de milrinona (62% em comparação a 22%).

Conclusão: A ecocardiografia em série forneceu dados fundamentais para o reconhecimento precoce da disfunção miocárdica séptica e hipovolemia não evidente na avaliação clínica, possibilitando o manejo tempestivamente adequado e resultando na redução do tempo de reversão do choque entre crianças com choque séptico.

Introduction

Sepsis is the leading cause of death worldwide in the pediatric population, resulting in an estimated 7.5 million deaths annually.[1,2] Globally, point prevalence of severe sepsis among pediatric intensive care units (PICUs) is 8.2%, ranging from 6.2% in developed countries to 23% in developing countries.[3]

Despite advances in understanding the pathophysiology of septic shock, mortality due to septic shock in children is still high, reaching 10–13% in developed countries, 18–24% in resource-restricted countries; in few other countries, this rate reaches 34–58%.[3,4]

Based on the International Pediatric Sepsis Consensus, septic shock is defined as sepsis with cardiovascular organ dysfunction.[5,6] Circulatory instability and myocardial dysfunction are the leading causes of death.[7] During treatment, physical examination may not be sensitive enough to detect early and subtle changes in pathophysiology that can have important implications for treatment and outcomes. Inadequate/inappropriate or delayed onset of supportive care may worsen outcomes. Bedside echocardiography overcomes this problem by allowing direct visualization of the heart and great veins to optimize therapy.[8,9] However, reports of the use of echocardiography in pediatric septic shock are limited.

The latest international management guidelines included fluid resuscitation in bolus over 5–10 min, titrated to reverse hypotension, increase urine output, and attain normal capillary refill, peripheral pulses, and level of consciousness without inducing hepatomegaly or rales. In cases of hepatomegaly or rales development, inotropic support should be implemented.[6,10]

Some investigators believe that the current pediatric guidelines are still preliminary and require review by large multi-institutional prospective studies.[1] The present study aimed to assess the use of echocardiography in the reduction of shock reversal time in pediatric septic shock by optimizing fluid and vasoactive/inotropic therapy. The study aims to provide useful data to be incorporated in future pediatric sepsis guidelines.

Methods

This prospective randomized clinical study was conducted in the PICU of Alexandria University Teaching Hospital, from September 2013 to May 2016. The study was approved by the ethical committee of Alexandria University, and informed consent was obtained from the patients' parents.

Eligibility criteria

Consecutive patients aged 1 month to 11 years were eligible if they had a new episode of septic shock upon admission to the PICU. Pediatric septic shock was defined based on the American College of Critical Care Medicine and International Pediatric Sepsis Consensus.[5,6]