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Multimodal hemoperfusion with Efferon LPS NEO to treat septic shock in children: a case series study

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Introduction: High incidence (>1.2 x10 [6] cases/year) and increased hospital mortality (exceeding 20%) of children with sepsis in the world have made pediatric sepsis a serious challenge to modern healthcare (1). Rapid removal of sepsis key pathogenic molecules, lipopolysaccharide (LPS) and cytokines, from the bloodstream may have a potential to treat septic shock in children. Limited number of clinical studies have demonstrated a promise of hemoperfusion to treat children with sepsis (2,3). Recent studies revealed that multimodal hemoperfusion (HP) with Efferon LPS adsorber significantly and quickly decreased both LPS and cytokines levels and halted septic shock in abdominal sepsis adult patients (4). No studies, however, have been performed so far to determine if the Efferon LPS hemoperfusion device may successfully be employed to treat children with sepsis.

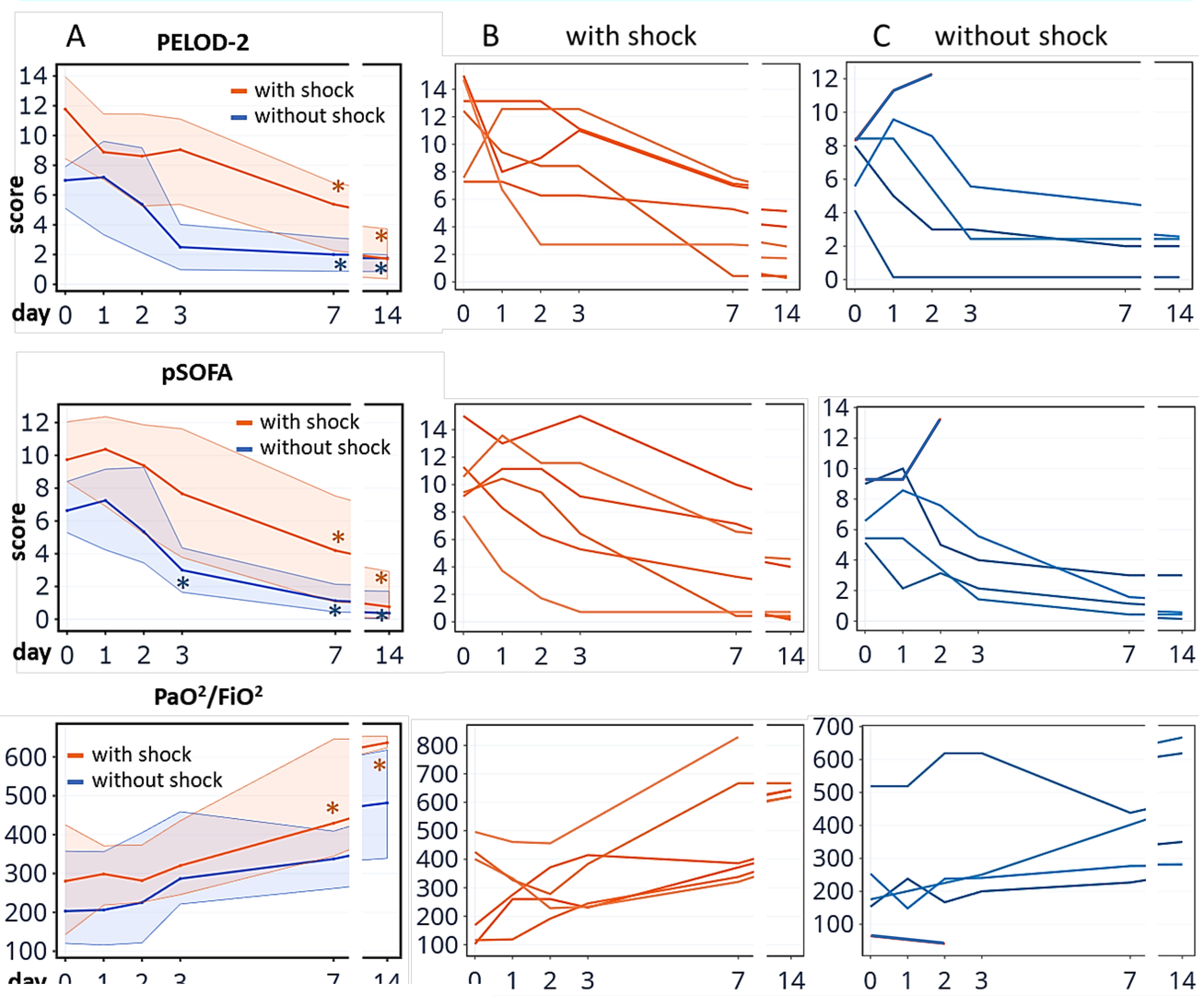
Aim of study: to assess the feasibility and safety of multimodal hemoperfusion with Efferon LPS NEO in children with sepsis.

Materials and methods: Eleven children (6 girls) with sepsis (ACCM, 2017), median age and range: 2,5 (6 – 159) months, were included in the study following local Ethical Committees approval. Eligible children with sepsis (no shock, n=5; septic shock, n= 6) received two treatments lasted 4 and more hours, 24 hours apart, with Efferon LPS NEO adsorbers (pediatric design variant of the medical device). The platelets and immune cells counts, levels of C-reactive protein (CRP), procalcitonin (PCT), creatinine, urea, ALT and AST were monitored on days 0, 1, 2, 3, 5, 7 and 14. Plasma cytokines (IL-1b, IL-6 and TNF) were determined on days 0 and 3 after the inclusion into the study. RStudio was employed for statistical analysis. In the Fig. 2A., data is presented as Me (IQR).

Table 1. Characteristics of children

ID	Age, year	Weight, kg	pSOFA	MV	Shock	Cause of sepsis	Diagnosis
1	0.5	5	9	+	-	Escherichia coli, Klebsiella spp, Human Herpes Virus-5	Ileostoma, cytomegalovirus infection
2	13	37	5	-	-	Streptococcus pyogenes	Meningoencephalitis, hemosinusitis tubootitis, brain oedema
3	1	7	9	+	-	Pseudomonas aeruginosa	Cerebellar abscess, Severe pneumonia, ARDS, stomach ulcer
4	5	22	5	+	-	Eschericha coli, Bacteroides fragilis	Appendicitis, peritonitis, phlegmona
5	1.4	12	6	+	-	unknown	Severe pneumonia, purulent pleuritis
6	0.6	5	15	+	+	Stenotrophomonas maltophila	Chronic renal disease, alterations of CNS, abdominal aortal thrombosis, enterocolitis
7	1.3	13	9	+	+	Klebsiella pneumoniae	Tuberculosis, meningoencephalitis, lymphadenitis, pneumonia, acute liver failure,
8	3	13	11	+	+	Streptococcus pyogenes	Severe pneumonia, pneumothorax
9	4	14	9	+	+	Streptococcus pyogenes	Enteritis, arthritis, pneumonuia
10	11	36	10	+	+	Enterobacter cloacae Candida albicans	Peritonitis
11	4	15	7	+	+	Neisseria meningitidis	Acute meningococcemia
Me	**2.5**	**13**	**9**	**91%**	**55%**		

Fig. 3. Multiorgan deficiency, oxygenation index and VIS during and after treatment with Efferon LPS NEO hemoperfusion

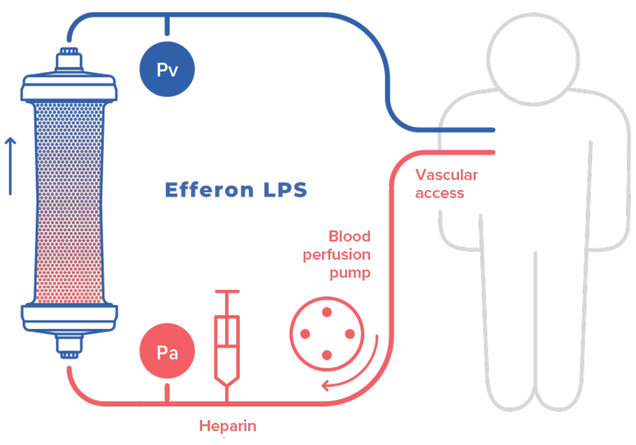


** p < 0.05 paired t-test versus day 0*

VIS 2020 = 100 × (nor)epinefrine dose (μg/kg/min) + dopamine dose (μg/kg/min)

Decreasing the VIS 2020 score values demonstrates the capability of Efferon LPS NEO to shorten and revert the septic shock duration.

Fig.1. Course of hemoperfusion



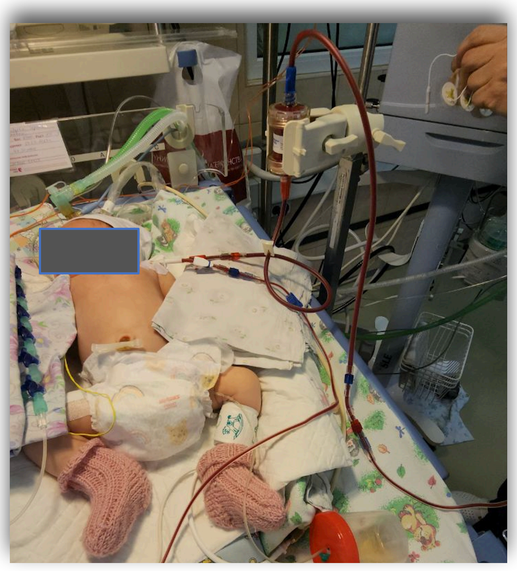
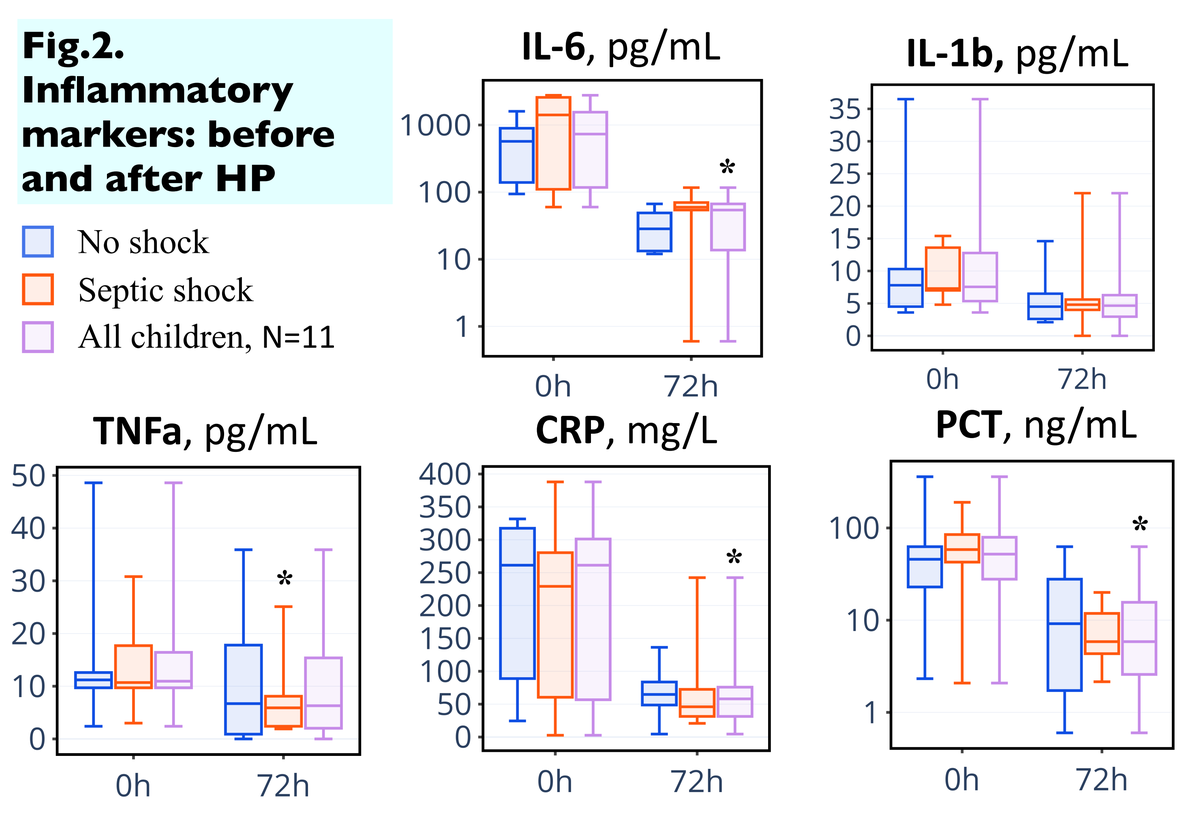


Fig.2. Inflammatory markers: before and after HP



CRP - C-reactive protein; PCT - procalcitonin

CONCLUSIONS:

1. Hemoperfusion with Efferon LPS NEO cartridges yielded improval of the multiorgan deficiency score values (by PELOD-2 and pSOFA, P<0.05), increasing PaO2/FiO2 oxygenation index, decreasing plasma cytokines, CRP and PCT levels, and reverting the shock duration.
2. Ten of eleven children with sepsis including all 6 children with septic shock that started prior to the hemoperfusion survived. No adverse effects were observed.
3. High safety profile of hemoperfusion with Efferon LPS and significant clinical and biomarkers improvements in children with septic shock warrant the extension of clinical study.

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