A 7-year-old boy with toxic epidermal necrolysis, heart failure, and sepsis treated with the guidance of invasive hemodynamic monitoring: A case report

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Abstract
Toxic epidermal necrolysis is a rare immunological disease that is secondary to some medications or upper respiratory infections, with more than 30% involvement of skin and mucosa. Herein, we describe a 7-year-old boy with TEN, heart failure, and sepsis treated with the guidance of an invasive hemodynamic monitoring device.

Keywords
case report, heart failure, invasive hemodynamic monitoring, sepsis, skin, Toxic epidermal necrolysis

1 | INTRODUCTION

Toxic epidermal necrolysis is a rare immunological disease that is secondary to some medications or upper respiratory infections, with more than 30% involvement of skin and mucosa. Herein, we describe a 7-year-old boy with TEN, heart failure, and sepsis treated with the guidance of an invasive hemodynamic monitoring device.

TEN is commonly present with fever and flu-like symptoms and then skin and mucosal involvement are seen. The incidences of TEN were reported 0.4 cases per million children per year in the United States.2

Although the mortality rate of TEN is lower than adult patients,3,4 these patients are prone to multiple organ failure and infection due to extensive skin involvement; so they should be treated like burn patients and in cases with extensive skin involvement, they need to be treated in an intensive care unit (ICU).

Here, we describe a 7-year-old boy that presented with TEN following to viral infection (Chickenpox) that was complicated with infection and treated with the guidance of Pulse Contour Cardiac Output (PiCCO) and survived without any sequelae.

2 | CASE PRESENTATION

A patient was a 7-year-old boy that presented with fever and following fever developed vesicles and blisters on body, visited by a pediatrician in his town and with the diagnosis of chickenpox got some emulsion for skin and antihistamine for itching, but after 2 days his conditions deteriorated to extensive involvement of skin and mucosa, so admitted in his town's hospital. On the 3rd day, due to worsening of his condition, transferred to the pediatric intensive unit (PICU) of Namazi Hospital (Namazi Hospital is a main tertiary referral center located in Shiraz city in the south of Iran). on arrival
to PICU, his vital signs were as follows: Glasgow coma score (GCS): 13/15, blood pressure: 120/80, heart rate: 145, temperature: 36.5, respiratory rate: 42, and arterial blood gas: PH: 7.20, PCO2: 20, PO2: 52, HCO3: 11, base excess: -18, O2 saturation: 86% (Figures 1,2). In physical examination, capillary refill time was more than three seconds, redness and detachment of the top (epidermal) layer of the skin in the whole body (>90% BSA), involvement of mucosa (oral and genitalia) and ocular involvement, Nikolsky’s sign was also positive; so with the diagnosis of TEN + sepsis; admitted and broad-spectrum antibiotic, intravenous immunoglobulin (IVIG) started and because of refractory decreased O2 saturation, he was intubated and mechanical ventilation started (Figures 1,2).

For continuous hemodynamic monitoring, an arterial line inserted in femoral artery and a central venous catheter was inserted in the subclavian vein connected to an invasive monitoring device; PiCCO (Pulse Contour Cardiac Output). PiCCO is one of invasive hemodynamic monitoring that uses a combination of two techniques for advanced hemodynamic and volumetric monitoring: transpulmonary thermodilution for volumetric measurements of preload and cardiac output and Pulse contour analysis to provide continuous cardiac output and stroke volume variation (cardiac index (CI), systemic vascular resistance (SVR), mean arterial pressure (MAP), pulse pressure variation (PPV), and stroke volume variation (SVV)).

The initial hemodynamic variables and laboratory data were as noted in Table 1 and 2. Echocardiogram report was as follows: dilated right atrium and right ventricle, poor right ventricular systolic function. According to hemodynamic data, laboratory findings, and clinical evaluation, the patient management proceeded. During the PICU admission, the patient had frequent daily dressing for skin and eye care. After 9 days, the patient was extubated, O2 was delivered via non-rebreathing mask, and 16 days later discharged to home with good condition and without any sequella (Figure 3).

3 DISCUSSION

Wound care, fluid and electrolyte management, eye care, nutritional support, and temperature control are the mainstay of treatment of TEN.

**TABLE 1** Hemodynamic parameters

| Parameter          | 1st day | 6th day |
|--------------------|---------|---------|
| Heart rate (bpm)   | 145     | 92      |
| CVP (mm Hg)        | 23      | 10      |
| SCVO2 (%)          | 90%     | 80      |
| Sys BP (mm Hg)     | 123     | 124     |
| Dia BP (mm Hg)     | 84      | 74      |
| MAP (mm Hg)        | 97      | 91      |
| CI (L/min/m2)      | 12.6    | 3.64    |
| ITBI               | 1556    | 462     |
| ELWI (cc/kg) (3-7) | 19      | 8       |
| GEDI (cc/m2) (680-800) | 1245  | 580    |
| SVRI (1700-2400)   | 472     | 1724    |
| PPV (%) (0-10)     | 9       | 9       |
| SSV (%) (0-10)     | 11      | 12      |
| PVPI (1-3)         | 1.6     | 2.1     |

Abbreviations: CI, cardiac index; CVP, central venous pressure; dBP, diastolic blood pressure; EVLWI, extravascular lung water index; GEDI, Global end-diastolic index; ITBI, intrathoracic blood volume index; MAP, mean arterial blood pressure; PPV, pulse pressure variation; PVPI, Pulmonary vascular permeability index; SBP, systolic blood pressure; SCVO2, central venous O2 saturation; SVRI, β systemic vascular resistance index; SVV, stroke volume variation.
There are some criteria for predicting prognosis such as increased blood urea nitrogen (BUN) and serum creatinine level, respiratory failure, and sepsis, but the Score of Toxic Epidermal Necrosis (SCORTEN) is a good tool for prediction of mortality in TEN; although at first it was used in adult patients, some studies showed its validity in pediatric patients; our patient's SCORTEN was 5 that was equal to about 90% mortality, but our patient had some additional risk factors such as respiratory failure, infection, and heart failure that are not listed in SCORTEN, but hemodynamic parameter-guided therapy, nutritional support, and infection control help us to cure this patient.

Fluid loss in TEN is estimated one-third of patients with burn, but the estimation of the amount of fluid to resuscitate has been always challenging; we can use clinical and laboratory data such as heart rate, blood pressure, urine out, or hemodynamic monitoring. In our patient, we used clinical and laboratory data in addition to hemodynamic parameters to guide us for hydration and according to parameters of volume, he did not need fluid as hydration.

Our patient was in high cardiac output failure (high cardiac output state is defined as cardiac index of greater than 4.0/min/m² and decreased systemic vascular resistance index [SVRI]), according to hemodynamic parameters; the treatment focused on fluid restriction, treatment of sepsis, monitoring for volume overload, and frequent usage of diuretics (the parameters of 6th day’s improvement were impressive [Table 1]).

4  |  CONCLUSION

Although it is recommended for aggressive fluid treatment in patients with TEN, in severe cases; the amount of fluid can not only be evaluated with clinical data and advanced hemodynamic monitoring is needed to guide the treatment.

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CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

AS: planned the study and wrote the manuscript and submitted the manuscript. NM: gathered patients' data and edited the manuscript. Both authors contributed to the final manuscript.

| Laboratory data (normal range) | Result |
|--------------------------------|--------|
| White blood cells (count/mL)  | 25 900 |
| platelet                      | 63 000 |
| Procalcitonin ≤0.3            | 8.8    |
| C-reactive protein <6 (mg/L)  | 136    |
| Creatine phosphokinase (U/L)  | 1620   |
| F: <145                       |        |
| Lactate dehydrogenase (U/L)  | 3250   |
| <480                          |        |
| Aspartate transaminase (U/L)  | 71     |
| M: < 37 F: < 31               |        |
| Alanine aminotransferase (U/L)| 84     |
| M: <41 F: <31                 |        |
| Albumin                       | 2.4    |
| Blood urea nitrogen (mg/dL)   | 79     |
| 8 - 20                        |        |
| Creatine M: 0.8-1.3 F: 0.6-1.2| 0.7    |
| Pt/INR                        | 18.9/1.96 |
| Skin culture                  | Candida non albicans |
| Blood culture                 | pseudomonas |
| ESR                           | 84     |
| Serum glucose                 | 380    |
| Serum bicarbonate             | 11     |
| Sodium                        | 153    |
| Potassium                     | 7      |
| Chloride                      | 111    |
| Total bilirubin               | 6.1    |
| Direct bilirubin              | 3.8    |

FIGURE 3  The last day of PICU admission

TABLE 2  Laboratory findings

CONCLUSION

Although it is recommended for aggressive fluid treatment in patients with TEN, in severe cases; the amount of fluid can not only be evaluated with clinical data and advanced hemodynamic monitoring is needed to guide the treatment.
ETHICAL APPROVAL
This study was approved by the ethics committee of Shiraz University of Medical sciences with approval ID: IR.sums.med.rec.1398.133. Written informed consent was obtained from the parents and sent to the ethics committee.

CONSENT FOR PUBLICATION
Obtained.

DATA AVAILABILITY STATEMENT
The data that support this case report are available from the author upon reasonable request.

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