Severe traumatic brain injury (STBI) is the most frequent pathology in trauma cases [1]. It has been stated that the mortality rate in cases of STBI is 80%, which is caused by the development of multiple organ failure and sepsis [2].

STBI is a cause of mortality and disability all over the world. It is also one of the main causes of death up to the age of 40 [3]. In Great Britain, STBI frequency is 1500 people per every 100,000; and 9 patients out of 100,000 population die because of traumatic brain injury [1, 2].

The most severe complication of STBI is sepsis [4]. The mortality rate in cases of severe sepsis is still very high, amounting to 50–60%, and the mortality rate for septic shock is 80–90% [5]. Annually, 1.5 million people die and 2.4 million become disabled because of STBI.

The Effectiveness of Corticosteroid Usage in Complex Therapy for Severe Sepsis and Acute Respiratory Distress Syndrome in Cases of Severe Traumatic Brain Injury

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of article
Material and Methods

The present study is a retrospective analysis of treatment results in patients (n = 267) with STBI followed by severe sepsis and ARDS, who were treated in Ternopil University Hospital (Ternopil, Ukraine) between 2008 and 2014. The development of severe sepsis was followed by unstable hemodynamics in almost all the cases. The instability was corrected by administering adrenomimetic drugs and additional infusion of fluids aimed at achieving stable blood pressure. The most frequent complication during the correction was a rise in blood pressure followed by tachycardia. In order to deal with this, stress doses of Solu-Medrol® (Pfizer Manufacturing Belgium NV, Puurs, Belgium) were used: 500 mg/day for 3 days, followed by reductions in dosage by one-half every 3 days. The treatment results were evaluated in relation to the type of respiratory support and presence or absence of CS in complex therapy. The results were evaluated separately for living and dead patients. As the criteria of treatment effectiveness, the duration of mechanical ventilation was used. Two ventilation modes were involved: forced ventilation with controlled volume; and ventilation with two phases of positive pressure in the airway, known as biphasic positive airway pressure (BiPAP, equivalent to pressure-support ventilation or PSV). For the volume-controlled ventilation the Bryz ventilation device (Kyiv State Enterprise "Burevisnyk", Kyiv, Ukraine) was used. For BiPAP ventilation the Draeger Carina ventilator was used (Draeger Medical GmbH, Lübeck, Germany).

During the period from 2008 to 2014, 1120 patients with STBI were treated at Ternopil University Hospital. Severe sepsis developed in 325 of the patients (29.01%); 267 patients (82.15%) with STBI followed by severe sepsis also suffered from ARDS, which necessitated mechanical ventilation. ARDS diagnoses were established on the basis of the Berlin criteria [22]. Among the patients with STBI, severe sepsis and ARDS, the number of people who died was 152 (46.7%).

For the statistical analysis, nonparametric methods were used. The hypothesis about the equality of averages was verified using the Mann-Whitney test. Averages and standard errors were calculated. A p-value under 0.001 was treated as statistically significant. The analysis was carried out using STATISTICA v. 10 software (StatSoft Inc., Tulsa, USA).

Results

The patient mortality rate depended on the type of mechanical ventilation used; mortality decreased by 1.24 times when BiPAP mechanical ventilation was used, as opposed to volume-controlled forced ventilation of 5–7 mL/kg. The dead patients who had had forced ventilation with volume control lived for a shorter time than patients on BiPAP ventilation (p = 0.01). Among the patients who survived, the duration of BiPAP ven-
Corticosteroids in the Treatment of SS and ARDS

Discussion

Despite the view that CS usage in case of STBI and ARDS has negative effects [15], there have been clinical trials that proved the positive effect of CS therapy in such patients. In particular, there are some data about the effectiveness of CS based on a reduction in fibrosis activity [12]. Meduri [10, 11, 13] stated that CS use in ARDS reduces leukocyte extravasation, inhibits leukocyte adhesion to endotheliocytes, increases lymphocyte migration from blood circulation to lymphoid tissue, stops macrophage activity and phagocytosis, stops production of interleukin-1, stops expression of cyclooxygenase-2, stops prostaglandin synthesis and also slows down the fever reaction.

The data from the present study also confirms the experience of Ternopil University Hospital during the treatment of patients with the H1N1 influenza virus epidemic in 2009. At that time, 26 patients with flu entered the anesthesiology and intensive care unit within 12 days. In all of these patients the disease was complicated by the development of ARDS. All 26 patients were put on low volume (5–6 mL/kg) mechanical ventilation with volume control. This group of patients died within 3–4 days, after which this mode of ventilation was no longer given. Instead, ARDS patients got BiPAP ventilation with stress doses of CS, and patient life expectancy considerably increased. Even the patients who died had longer survival period, which increased from 3–4 days to 7–10 days. Approximately 50% of the patients that got ventilation in BiPAP mode along with stress doses of CS survived. The total number of flu patients who got ARDS was 80.

The number of cases observed in 2009 was too low to form judgments about the treatment results depending on the type of respiratory support and CS prescription. But based on that experience and the results of the present study the authors have come to the conclusion that stress doses of CS therapy are effective in flu patients followed by ARDS. Additionally, at the beginning of the flu epidemics in the autumn of 2009, CS treatment was not prescribed, based on research pointing to the harmfulness of CS for treating the flu [19].

The present authors are convinced that the results of this research reveal that there is no final verdict about the effectiveness of CS therapy in cases of STBI followed by severe sepsis and ARDS. The presence of severe sepsis may be an important indication for using CS treatment. Further research analyzing the treatment results of such patients in other clinics is needed.

Table 1. The duration of ventilation and the survival of patients with severe traumatic brain injury followed by severe sepsis and acute respiratory distress syndrome in relation to the use of corticosteroids

<table>
<thead>
<tr>
<th>Ventilation mode</th>
<th>Number of patients</th>
<th>Ventilation period in days</th>
<th>Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACV alive</td>
<td>16</td>
<td>24.18 ± 5.93</td>
<td>31.3</td>
</tr>
<tr>
<td>dead</td>
<td>35</td>
<td>5.29 ± 1.04</td>
<td></td>
</tr>
<tr>
<td>ACV+ k alive</td>
<td>22</td>
<td>20.82 ± 3.13 p = 0.000880</td>
<td>37.9</td>
</tr>
<tr>
<td>dead</td>
<td>36</td>
<td>7.5 ± 1.4 p = 0.000001</td>
<td></td>
</tr>
<tr>
<td>BiPAP alive</td>
<td>30</td>
<td>18.33 ± 1.81</td>
<td>44.7</td>
</tr>
<tr>
<td>dead</td>
<td>37</td>
<td>8.08 ± 1.0</td>
<td></td>
</tr>
<tr>
<td>BiPAP+k alive</td>
<td>47</td>
<td>16.27 ± 3.11 p = 0.006203</td>
<td>51.6</td>
</tr>
<tr>
<td>dead</td>
<td>44</td>
<td>13.09 ± 1.29 p = 0.004674</td>
<td></td>
</tr>
</tbody>
</table>

BiPAP is equivalent to pressure-support ventilation (PSV); +k – with corticosteroid treatment; p – probability calculated according to the relevant value (dead or alive) in the previous column.
References


Address for correspondence:
Oleksandr V. Oliynyk
Department of Anesthesiology
Ternopil State Medical University
46000, Maydan Voli, 1
Ternopil
Ukraine
Tel.: +38 063 266 18 06
E-mail: Alexanderoliynyk8@gmail.com

Conflict of interest: None declared

Received: 30.07.2015
Revised: 10.11.2015
Accepted: 16.12.2015