Brief Report

Surgical Treatment of Neurologic Complications of Bacterial Meningitis in Children in Kosovo

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Summary

Neurologic complications of bacterial meningitis can occur any time during the course of the disease and some of them need neurosurgical aproach. Objective: to determine the incidence of neurologic complications of bacterial meningitis in children requiring neurosurgical treatment. Material and methodology: a total of 277 children were followed and treated for bacterial meningitis at the Clinic of Infectious Diseases in Prishtina. The authors have analyzed cases who developed acute neurologic complications and treatment procedures. Results: of the 277 children treated for bacterial meningitis, due to the suspicion for neurologic complications, 109 children underwent a head computerized tomography scan. About 47 cases (43%) had evident structural abnormalities while only 15/277 cases (5%) required neurosurgical treatment; 9/38 cases with subdural collections, 5 cases with hydrocephalus and 1 case of spinal abscess. Conclusion: Neurosurgical intervention were not common in pediatric bacterial meningitis cases (5%) but were highly significant in cases complicated with acute neurologic complications (32%).

Key words: bacterial meningitis, subdural effusion, neurologic complications, outcomes.

Introduction

Bacterial meningitis is a devastating infectious disease, with a worldwide mortality rate of 5 to 30% despite available antibiotic treatments [1–13]. As many as 50% of survivors experience neurological sequelae, such as hearing impairment, seizure disorders and learning and behavioral problems [14–16]. Neurological complications can occur any time during the course of the disease as acute structural and clinical complications and some of them can persist as long-term clinical sequelae. Impaired mental status and seizures are more likely seen during the acute phase of the illness [17–19].

Material and methodology

Our study was observational and retrospective. We included 277 children <16 years of age (males 162 cases, females 115 cases), treated for BM at the Infectious Diseases Clinic in Prishtina (Kosovo) during a 6-year period (1997–2002). The patients were evaluated by head computerized tomography in weeks 1 or 2 and after 1 month. Due to the clinical suspicion for neurologic complications following bacterial meningitis, a head CT was performed in 109 children. Magnetic resonance imaging (MRI) was not available during a 6-year study period.

Statistical analysis

Data were analyzed with Stata 9.0. The statistical parameters analyzed were the structure index,
mean, standard deviation and relative risk with 95% confidence intervals (CI).

Results
During the 6-year study interval, 277 children were treated for bacterial meningitis at the Clinic of Infectious Diseases in Prishtina. Of these cases, 60 (22%) developed neurologic complications, while there were 15 deaths, resulting in an overall mortality rate of 5%. The neurologic complications observed were acute neurologic complications: subdural effusion (35/277, 13%), hydrocephalus (7/277, 3%), subdural empyema (2/277, 1%) and single case: spinal abscess, cerebritis, subdural hematoma and intracerebral hemorrhage. Also were observed long-term clinical sequelae: late seizures (24/277, 9%), hearing impairment (3/277, 1%), intellectual impairment (2/277, 1%) and single case: quadriplegia and loss of vision.

Due to the clinical suspicion for neurologic complications following bacterial meningitis, a head CT was performed in 109 children; 62 cases had abnormalities, most commonly subdural effusion (35/109). Other subdural collections included two cases of subdural empyema and one case of subdural hematoma. Seven cases were diagnosed by CT scan as internal hydrocephalus and one case as intracerebral hemorrhage in occipital region.

Subdural effusion occurred most often in infants (29/108) and relative risk 7.6 (3.2–17.6, 95% CI), was the highest for this age group (Table 1). There were only six cases of subdural effusion in older children including four cases in age group of 1–2 years (Fig. 1). Repeated head CT scans in 29 children treated conservatively showed spontaneous remission of subdural effusion (Figs 2 and 3).

Of the 35 cases with subdural effusion, 6 cases (17%) underwent surgical treatment during the first week of treatment (mean time, day 5) due to worsening clinical presentation with space-occupying symptoms and signs (Fig. 4). The surgical techniques applied were surgical burr hole drainage in five cases and the placement of a subduroperitoneal shunt in one case.

The etiology of cases with subdural effusion was confirmed in 27/35 cases (77.1%). Causative pathogens were: *Neisseria meningitidis* (11/35), *Haemophilus influenzae* (6/35), *Streptococcus pneumoniae* (6/35), *Staphylococcus aureus* (2/35) and Gram negative bacilli (2/35). All 35 children with subdural effusion were observed for 5 years, and the only complication

### Table 1

<table>
<thead>
<tr>
<th>Age-group</th>
<th>N(^\circ) of patients</th>
<th>SE</th>
<th>%</th>
<th>Relative risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1 months</td>
<td>7</td>
<td>–</td>
<td>–</td>
<td>0.47 (0.03–7.10)</td>
</tr>
<tr>
<td>2–11 months</td>
<td>108</td>
<td>29</td>
<td>27</td>
<td>7.56 (3.24–17.61)</td>
</tr>
<tr>
<td>1–2 years</td>
<td>37</td>
<td>4</td>
<td>11</td>
<td>0.83 (0.31–2.22)</td>
</tr>
<tr>
<td>3–5 years</td>
<td>56</td>
<td>1</td>
<td>2</td>
<td>0.12 (0.01–0.82)</td>
</tr>
<tr>
<td>6–10 years</td>
<td>45</td>
<td>1</td>
<td>2</td>
<td>0.15 (0.02–1.10)</td>
</tr>
<tr>
<td>11–16 years</td>
<td>24</td>
<td>–</td>
<td>–</td>
<td>0.14 (0.00–2.26)</td>
</tr>
</tbody>
</table>

![Fig. 1. Number of subdural effusion cases by age group.](image1)

![Fig. 2. CT scan of the head: subdural effusion week 1.](image2)

![Fig. 3. CT scan after 1 month: reduction of subdural effusion without surgical treatment.](image3)
and sequellae observed were late seizures in 15 children.

Of the 277 cases treated for bacterial meningitis, 7 cases (3%) were diagnosed by head CT scan as internal hydrocephalus (Fig. 5). In consultation with neurosurgeon 5 cases underwent external drainage and later placement of permanent ventriculoperitoneal shunt. Two cases were diagnosed as communicating hydrocephalus and were treated with conservative treatment. The etiology of bacterial meningitis cases complicated with hydrocephalus was proven in four cases; *N. meningitidis* (two cases) and *H. influenzae* (two cases).

There were two cases diagnosed for subdural empyema. Both cases underwent surgical burr hole drainage and the causative pathogen agent of both cases was *S. aureus*.

There was only one case of spinal intramedullary abscess in thoraco-lumbar region (Th 12, L 1–2) following bacterial meningomyelitis. The diagnose was confirmed by myelography and the case underwent successfully surgical treatment (laminectomy and evacuation of abscess).

One case was confirmed for cerebritis by head CT scan and was treated with conservative treatment. Subdural hematoma was confirmed by head CT scan in one case and underwent surgical burr hole drainage. There was only one case of bacterial meningitis diagnosed for intracerebral hemorrhage in occipital region caused by *H. influenzae*.

All cases who underwent surgical treatment were transferred to Neurosurgery Clinic for 72 h and transferred back to our ward and continued antibiotic treatment.

Of the 277 cases treated for bacterial meningitis, 47 cases developed acute neurologic complications confirmed by head CT scans; 32% of those cases (15/47) underwent surgical intervention respectively, 5% of all bacterial meningitis cases (15/277).

**Discussion**

In this study, the most common neurologic complications following bacterial meningitis in children were subdural collections (14%) and hydrocephalus (3%). Subdural effusion was the most common complication of bacterial meningitis in infants (27%) and there were only six cases of subdural effusion in older children (4%). The other subdural collections complicating bacterial meningitis were rare in children; subdural empyema occurred in two cases caused by *S. aureus*, and subdural hematoma occurred in one case caused by *H. influenzae*.

Prolonged fever, focal neurologic deficit, convulsions, worsening of consciousness level and worsening of clinical presentation following meningitis were the absolute indications for performing a head CT scan in the children. Due to its availability to detect subdural collections, and the relative ease with which sick infants can be scanned, the CT should be the first imaging procedure done during an attempt at diagnosis. MRI should be performed as a second test and for follow-up [5, 20, 21].

Based on previous publications, subdural effusion is usually found in 40–60% of infants with bacterial meningitis with *H. influenzae* as the most common causative pathogen [14–16, 22].

Based on a review of the literature, *H. influenzae* was found to be the most common pathogen to cause subdural effusion, although some reports describe subdural effusion cases occurring after the use of the anti-*H. influenzae* vaccine to be most often caused by *N. meningitidis* [15, 16]. In Kosovo vaccination was not implemented against three major pathogens of bacterial meningitis in children (*meningococcus, H. influenzae* and *pneumococcus*) during the years of our study. *N. meningitidis* is the leading cause of bacterial meningitis in children and the cases complicated with subdural effusion. In all
cases of bacterial meningitis in children complicated with neurologic complications, in which a significant mass effect is apparent on imaging and by clinical presentation, an adequate treatment consists of prompt systemic administration of antibiotics combined with surgical drainage. From 47 cases diagnosed for neurologic complications following bacterial meningitis, surgical treatment was required in 15 cases (32%). A poorer prognosis and outcome had cases with obstructive hydrocephalus. Our surgical procedures have been successful in all space occupying lesions. No major operative and postoperative complications occurred.

Conclusion
Although neurosurgical intervention were not common in pediatric bacterial meningitis cases, they were highly significant in cases complicated with acute neurologic complications. Surgical treatment is required in all cases in which a significant mass effect is apparent on imaging and by clinical presentation.

References
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