Meningitis following acute traumatic cerebrospinal fluid fistula

Edwin E. MacGeef, M.D., Joseph C. Cauthen, M.D., and Charles E. Brackett, M.D.
Head Trauma Unit, Department of Surgery, Section of Neurological Surgery, University of Kansas Medical Center, Kansas City, Kansas

The effect of prophylactic antibiotics in preventing meningitis are reviewed in 58 cases of acute traumatic cerebrospinal fluid (CSF) fistula. A summary of the literature plus data from the present series show a total of 402 cases of acute traumatic CSF fistula; there were 46 cases (14%) of meningitis in 325 patients receiving expectant antibiotics, and four cases (5%) in 77 patients treated without antibiotics. No statistically significant conclusion can be drawn from these data regarding the usefulness of expectant antibiotics in acute traumatic CSF rhinorrhea or otorrhea.

Cerebrospinal fluid (CSF) fistulas are occasionally followed by meningitis. The formidable post-meningitic complications of brain abscess, hydrocephalus, mental retardation, and death serve to heighten awareness of this relationship. The CSF fistula is most often associated with head injury, but may occur spontaneously or as a complication of surgery. The rising incidence of head injuries makes the problem relatively common.

The expected incidence of CSF fistula in reported series of head injuries varies from 2% to 9%; this means that there are approximately 150,000 cases in the United States annually. This figure represents 5% of the estimated 3,000,000 head injuries occurring as a result of automobile accidents in the United States each year. The incidence of meningitis following CSF fistula varies widely, from 3% to 50%.

This paper reviews the incidence of meningitis with respect to the presence or absence of expectant antibiotic therapy in 58 cases of acute traumatic CSF fistula.

Case Material

Fifty-eight cases of documented acute traumatic CSF fistula were treated at the University of Kansas Medical Center from 1953 to 1968; 35 patients had otorrhea, and 23, rhinorrhea. The decision to institute prophylactic antibiotic therapy (penicillin, chloramphenicol, or sulfadiazine) was made arbitrarily without any established pattern or specific antibiotic. Generally accepted clinical and laboratory criteria for the diagnosis of meningitis were used; these included fever, stiff neck, Kernig's sign, and the following CSF findings: pleocytosis, low sugar, positive gram stain, and culture of the infecting organism. Four patients who died of extensive injuries on the day of admission were omitted from this study as were all patients with CSF fistula due to causes other than acute trauma.

Results

The incidence of meningitis among the treated and untreated patients in our series is shown in Table 1. Only one of 41 patients...
Meningitis following CSF fistula

who received expectant antibiotics developed meningitis; he had rhinorrhea. Two patients out of 17 patients who did not receive antibiotics developed meningitis (one rhinorrhea and one otorrhea). The results are not statistically significant. Table 2 summarizes the pertinent data on the three patients who developed meningitis. Table 3 shows the antibiotics used in expectant treatment of rhinorrhea and otorrhea; there was no statistically significant difference among the groups.

Discussion

Significant controversy exists regarding expectant administration of antibiotics in patients with acute traumatic CSF fistulas. The

<table>
<thead>
<tr>
<th>TABLE 1</th>
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<tbody>
<tr>
<td>Incidence of meningitis in 58 cases of acute traumatic CSF fistula (our series)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rhinorrhea (23 Cases)</th>
<th>Otorrhea (35 Cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics</td>
<td>(17 Cases)</td>
</tr>
<tr>
<td>no.</td>
<td>%</td>
</tr>
<tr>
<td>Meningitis</td>
<td>1</td>
</tr>
<tr>
<td>No Meningitis</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data on three patients with acute traumatic CSF fistula who developed meningitis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age, Sex</th>
<th>CSF Fistula</th>
<th>Duration of CSF Leak (days)</th>
<th>Cells</th>
<th>CSF Studies</th>
<th>Antibiotics Given</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17 M</td>
<td>otorrhea</td>
<td>9</td>
<td>2200 (98% pmn)</td>
<td>12 positive pseudomonas</td>
<td>none initially, then Polymyxin</td>
<td>died</td>
</tr>
<tr>
<td>2</td>
<td>34 M</td>
<td>rhinorrhea</td>
<td>5</td>
<td>6850 (80% pmn)</td>
<td>0 positive pneumococcus</td>
<td>none initially, then Kefin</td>
<td>died</td>
</tr>
<tr>
<td>3</td>
<td>48 M</td>
<td>rhinorrhea</td>
<td>22</td>
<td>5400 (90% pmn)</td>
<td>14 negative negative</td>
<td>penicillin &amp; Chloramphenicol given expectantly then Sulfadiazine</td>
<td>survived without significant sequelae</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients receiving specific antibiotics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>No Antibiotics</th>
<th>Chloramphenicol or Penicillin + Streptomycin</th>
<th>Penicillin</th>
<th>Sulfadiazine</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinorrhea</td>
<td>6</td>
<td>11</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Meningitis</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Otorrhea</td>
<td>11</td>
<td>14</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>Meningitis</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Meningitis

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meningitis

CSF

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cases

344

314

No

Meningitis

No

Meningitis

Brawley

Table

Table

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CSF

premise

cases

Meningitis

Meningitis

Mincy

reported

54 cases of CSF rhinorrhea with 12 patients developing meningitis while on prophylactic penicillin, and showed that prophylactic penicillin offered no assured protection against future infection. The use of antibiotics before clinical or laboratory evidence of meningitis has been challenged by Krayenbühl,6 Wehrle,17 Sanford,16 Ommaya,10 and Raskind.12-14

The location of the CSF leak is probably significant. As shown in Table 5, in the total series there are 43 cases (17%) of meningitis in 246 patients with rhinorrhea and seven cases (4%) of meningitis in 156 patients with otorrhea. Appelbaum1 has stated that trauma to the frontal area is particularly hazardous since the dura in this region can be easily stripped from the bone and this can result in fistulous communications and contamination. In the temporal region, fractures are less likely to lead to separation of the dura and subsequent infection. The presence of a CSF fistula is not essential for the development of meningitis but, rather, direct access of pathogenic organisms to the meninges is required, as in a complicated fracture

<table>
<thead>
<tr>
<th>Rhinorrhea (223 Cases)</th>
<th>Otorrhea (121 Cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antibiotics</strong> (196 Cases)</td>
<td><strong>Antibiotics</strong> (88 Cases)</td>
</tr>
<tr>
<td><strong>no.</strong></td>
<td><strong>%</strong></td>
</tr>
<tr>
<td>Meningitis</td>
<td>40</td>
</tr>
<tr>
<td>No Meningitis</td>
<td>156</td>
</tr>
</tbody>
</table>

**TABLE 4**

Results of treatment in 344 cases of acute traumatic CSF fistula (taken from the literature)

<table>
<thead>
<tr>
<th>Rhinorrhea (246 Cases)</th>
<th>Otorrhea (156 Cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antibiotics</strong> (213 Cases)</td>
<td><strong>Antibiotics</strong> (112 Cases)</td>
</tr>
<tr>
<td><strong>no.</strong></td>
<td><strong>%</strong></td>
</tr>
<tr>
<td>Meningitis</td>
<td>41</td>
</tr>
<tr>
<td>No Meningitis</td>
<td>172</td>
</tr>
</tbody>
</table>

**TABLE 5**

Summary of 402 cases of acute traumatic CSF fistula (our series combined with those from the literature)
Meningitis following CSF fistula

with herniation of brain into the paranasal
sinuses, a spicule of bone sticking into the
brain, or a dural tear.\textsuperscript{5-4}

Rosebury\textsuperscript{10} has reported the difference in
the normal bacteriologic flora of the naso-
pharynx and the external auditory canal. In
the nasopharynx coagulase negative staphy-
lococci, streptococci, corynebacteria, and
neisseriae are the most prominent aerobes.
Staph. aureus, H. influenza, and pneumo-
occi have been recovered frequently. Enter-
obacteria appear irregularly in the nasophar-
ynx. The presence of obligate anaerobes in
the nasopharynx is established and includes
veillonella alcalescens, bacteroides spp., spi-
rillum sputigenum, and vibro sputorum. The
accessory nasal sinuses are essentially sterile.

The most important bacteria of the exter-
nal auditory canal include corynebacteria ac-
ces, coagulase negative staphylococci, and
aerobic diphteroids. A few coagulase posi-
tive staphylococci, streptococci, and anaero-
bic micrococci are occasionally found as are
several of the candida fungi. Thus, the major
difference in the bacterial content of the na-
sopehrynx and the external auditory canal is
the presence of Staph. aureus, H. influenza,
and pneumococci in the nasopharynx. Con-
spicuously lacking as true members of the
skin flora are neisseria, hemophilii, and certain
anaerobes. Enterobacteria are not character-
istic but may occur as a result of autocontam-
ination. Pseudomonas has been found in the
normal ear.

Certainly, if expectant antibiotic therapy
is employed in cases of rhinorrhea or otor-
rhea, coverage should be obtained against
the anticipated organisms.

Unfortunately, in the reported cases of
meningitis following traumatic CSF fistula,
definite bacteriological data are generally
lacking, and little information is given re-
garding the development of resistant orga-
nisms during antibiotic therapy. In three ar-
ticles\textsuperscript{1,7,8} where bacteriological data were
given, pneumococcus was the most com-
mon infecting organism, followed by staphy-
lococcus, streptococcus, and H. influenze.
However, the time of infection and antibiotic
dosage were not always clearly recorded.

Superficial analysis of Table 6 suggests
that the incidence of meningitis with broad
spectrum antibiotics is half that with no anti-
biotics and that penicillin or sulfadiazone
alone more than doubles the risk. However,
chi-square analysis shows no significant dif-
ference among the groups.

Use of pooled data from the literature
may be unreliable because of the lack of spe-
cific bacteriological data including the time
of infection, type of organism, development
of resistant organisms, paucity of antimicro-
bial information including drug and dosage
used, and the lack of details regarding the
type of injury and time of onset of the CSF
fistula. For these and other reasons, we be-
lieve that at this time no statistically signifi-
cant conclusion can be drawn regarding the
use of prophylactic antibiotics in acute traum-
atic CSF fistula.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
 & No Antibiotics & Chloramphenicol or Penicillin + Streptomycin & Penicillin & Sulfadiazone & Other & Total \\
\hline
Rhinorrhea & 33 & 24 & 103 & 85 & 1 & 246 \\
\hline
Meningitis & 2 & 1 & 24 & 16 & 0 & 43 \\
\hline
% & 6.1\% & 4.2\% & 23.3\% & 18.8\% & -- & 17.5\% \\
X^{2} = 0.081 & X^{2} = 3.75 & X^{2} = 2.09 & -- & -- & -- \\
\hline
Otorrhoea & 44 & 36 & 71 & 1 & 4 & 156 \\
\hline
Meningitis & 2 & 0 & 5 & 0 & 0 & 7 \\
\hline
% & 4.5\% & -- & 7.04\% & -- & -- & 0.05\% \\
X^{2} = 0.33 & X^{2} = 0.026 & X^{2} = 0 & -- & -- & -- \\
\hline
\end{tabular}
\caption{Therapy used in 402 cases of acute traumatic CSF fistula}
\end{table}

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Because of the potentially serious problem of drug resistant organisms developing in the spinal fluid and particularly the respiratory tract during antibiotic therapy, we feel that a full scale bacteriologic study is indicated followed by the use of modern broad spectrum antibiotics specifically chosen with regard to the bacterial flora expected.

Acknowledgments

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References


MacGee, Cauthen and Brackett

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Address reprint requests to: Edwin E. MacGee, M.D., Department of Surgery, Section of Neurological Surgery, University of Kansas Medical Center, Rainbow Boulevard at 39th Street, Kansas City, Kansas 66103.