Background: The subject of subdural empyema (SDE) is reviewed on the basis of experience with 45 cases.

Methods: Records of 45 patients with SDE were analyzed. There were 35 males and 10 females in the series. The majority of the patients were either infants (22.2%) or in their second and third decade of life (37.8%). For supratentorial SDE, craniotomy was done in 5 cases (11.1%). In six cases (13.3%) two burr-holes and in the rest of the cases multiple burr-holes were done to evacuate the empyema. Craniectomy was done in three cases (6.7%), of which two had posterior fossa SDE. All patients received appropriate preoperative and postoperative broad-spectrum antibiotics.

Results: There was good recovery in 35 (77.8%) patients, six patients (13.3%) had moderate disability, two patients (4.4%) had severe disability, and two (4.4%) died. Three patients who developed recollection at operation site required evacuation of residual SDE. Median follow-up was 3½ years (range 4 months to 3½ years). Conclusion: Emergent evacuation of SDE using multiple burr-holes and irrigation of the subdural cavity with saline for 24 hours results in a satisfactory outcome in cases with SDE.

Key Words: Subdural hemorrhage, surgery, burr hole, treatment outcome

Introduction

SDE is a relatively rare clinical entity and accounts for approximately 13-23% of all intracranial infections. It was a fatal condition before the advent of antibiotics. With wide availability of computer-based imaging, better medical facilities, and with the possibility of prompt surgical intervention, mortality dropped to 40% by 1980 and presently it is around 12.2%. Bammister et al projected that prompt diagnosis and treatment should bring down the mortality to less than 10%. The subject is reviewed on the basis of an experience with 45 patients having SDE.

Materials and Methods

Records of 45 patients with intracranial SDE presenting with acute symptoms and not having any intra-cerebral abscess, admitted between July 1994 and February 2003 were analyzed. As per the protocol, patients of SDE with Glasgow Coma Scale (GCS) 8 or less were intubated and ventilated before transferring to our hospital. All patients underwent a complete fever work-up consisting of the assessment of total and differential white cell counts, blood culture, chest X-ray and otolaryngological examination. The time lag between the arrival of the patient in the hospital and for taking up for surgery was 1½ hours (range 1-3½ hours). Pus evacuated at surgery was sent for culture and sensitivity and the subdural cavity was irrigated using a silastic ventricular catheter with normal saline continuously for the next 24 hours using gravity.

Soon after the diagnosis, all patients were placed on intravenously instituted ceftriaxone, amikacin and metronidazole and the antibiotics were subsequently changed as per the results of the pus culture and sensitivity reports. Antibiotic therapy was continued for six weeks. All patients were put on anticonvulsant drugs for at least three years.

Results

There were 35 males and 10 female patients. Age ranged between 4 months and 77 years, mean age being 21.05 years. There were ten infants (22.2%) and 17 patients were in their second or third decade of life (37.8%). Four diabetic male patients (8.9%) were in their fourth and fifth decade of life (Table 1). Paranasal sinusitis was probably responsible for SDE in 20 cases (44.4%). Meningitis probably progressed into SDE in 10 infants (22.2%). Neglected middle ear infection was probably the cause in 7 cases (15.6%). SDE developed after trauma in three patients (6.7%). It was secondary to septicemia in two patients (4.4%), and developed as a post-neurosurgical complication in three patients (6.7%).

Common presentation was headache and fever (32 patients),
Tewari MK, et al: Spectrum of intracranial subdural empyemas

Discussion

Stephanov described SDE “as the most imperative of neurological emergencies”, which, if not treated immediately, is associated with high risk of status epilepticus, spreading cortical venous and cortical venous sinus thrombosis, fulminating cerebritis, brain swelling, cerebral coning and ultimately leads to death.

Causes and Incidence: Chronic paranasal sinusitis, otitis media and mastoiditis are the main causes of SDE. Other causes include spread of infection from distant sites viz. lungs. SDE can develop following a cranial surgery or following a trauma, particularly in cases where there is a com-

Table 1: Results of cultures from pus, blood, nasal wash and antigen positivity in blood

<table>
<thead>
<tr>
<th>Organism</th>
<th>Pus</th>
<th>Blood</th>
<th>Nasal wash</th>
<th>Antigen positivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus milleri</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Haemophilus Influenzae</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Salmonella typhi</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Salmonella enteridis</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E coli</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Multiple organisms</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sterile</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 1: Contrast CT showing subdural empyema over interhemispheric area.

Figure 2: Contrast CT showing empyema over right convexity.

seizures (23 patients), altered sensorium (10 patients), hemiparesis and monoparesis (three patients each). Out of the 10 patients presenting with seizures and altered sensorium, six were children. No patient was in septic shock at the time of presentation.

Median time from the onset of symptoms to the time of presentation was 2½ days (range 8 hours to 7 days). Inter-hemispheric SDE (Figures 1, 2) was seen in 21 patients (46.7%). Fourteen patients (31.1%) had SDE over the convexity. The SDE over the convexity was bilateral in 5 children and was unilateral in 3 children and 6 adults. In no case loculations or septations were seen within the SDE cavity. Following contrast administration, dural and gyral enhancement was seen in 90% cases. In four cases where the SDE was located over the frontal convexity on one side, infection in the paranasal air sinuses was identified. Three patients had bilateral frontal and inter hemispheric SDE. One of these patients who had paranasal sinusalitis presented with clinical features suggestive of cavernous sinus thrombosis. One patient had SDE over the parietal convexity as well as in the interhemispheric region. Two patients had unilateral cerebellar convexity posterior fossa SDE, both having evidence of mastoiditis. All patients had raised white cell count.

Five patients underwent craniotomy and in six patients two burr holes were made to evacuate the pus. Craniectomy was done in three patients, two of which were in posterior fossa SDE cases. The remaining 31 patients underwent multiple burr holes, which were more often three in number. After making a small dural opening, pus was collected (about 25-60 ml) through a ventricular catheter and sent for examination (Table 1). Two of the three patients who required evacuation of residual frontal SDE on two occasions, had diabetes and paranasal sinitis. The third, a child, had SDE following excision of compound depressed fracture. Recurrent collections occurred at the operation site. There was no bone flap infection in any case.

Thirty-five patients (77.8%) made a good recovery. They were symptom-free in the follow-up period ranging from 4 months to 6 years with a median of 3½ years. Six patients (13.3%) had moderate disability, and two patients (4.4%) had severe disability. Two male patients who arrived in GCS 4/15 with dilated fixed pupils died (Table 6). Overall morbidity was 17.8% and mortality was 4.4%.
pound depressed fracture. SDE have been reported after secondary infection of a subdural effusion or hematoma. Facial or scalp infections, dental sepsis or meningitis\(^1\) have been reported to result in SDE. SDE can be in either the supra or infratentorial compartment or may extend into both the supra and infratentorial compartments.

**Age and sex:** Young males are commonly affected. In this study 42.2% patients were young (second to fourth decade) and of this 75% were males. Development of large air sinuses during the second decade with rapid growth of frontal sinuses in males, more vigorous nose blowing have been cited as the causes of SDE. Middle-aged male diabetics accounted for 8.9% of SDE, which is significantly higher than the reports in the literature.\(^9\)

**Clinical Presentation:** The commonest clinical presentation is a triad of fever, sinusitis, and neurological deficits, with a fulminant and rapid downhill course. About 50% of the patients present with altered sensorium.\(^8\) It is difficult to clinically differentiate between meningitis and SDE. The diagnosis of SDE is based on a strong clinical suspicion.\(^9\)

Nathoo et al\(^9\) reported seasonal variation in the occurrence of SDE. It could be when SDE is a result of super-added bacterial infection following viral upper respiratory infection, which generally has a seasonal occurrence. SDE, in the majority of cases, results from direct or indirect spread of infection from the paranasal sinuses. The infection can spread from mastoid or middle ear infections by eroding the tegmen tympani\(^7\) and from the frontal air sinuses by erosion of its posterior wall.\(^8\) The infection can also spread by retrograde septic thrombophlebitis.

**Radio-imaging investigations:** On CT scan, SDE usually appears as a thin rim of fluid slightly hyperdense to cerebrospinal fluid (CSF) with surrounding enhancement, adjacent disproportionate cortical edema and effacement of cortical sulci. Subfrontal and subtentorial SDE which are sometimes missed on axial CT scans are better appreciated on MRI. Increased protein content of SDE, appears as higher signal intensity as compared to CSF on both T1 and T2 weighted images which differentiates SDE from subdural effusion. Cranial ultrasound can substitute for CT in infants, where images which differentiates SDE from subdural effusion.

**Micro-organisms:** The rate of success in culturing bacteria from surgically evacuated pus varied from 54-81%. It was 33.3% (15 cases) in this study, but there was clue to offending organisms in 60% (27 cases). Use of broad-spectrum antibiotics for treating sinusitis and meningitis could be the reason for low culture positive in this study. In children, SDE is commonly secondary to H. influenzae or S. pneumoniae meningitis. Non-typhoidal Salmonella organisms (NTSO) have been reported in SDE in children recently but in adults NTSO have been found in the setting of advanced AIDS infection. SDE secondary to paranasal sinusitis is usually caused by aerobic and microaerophilic streptococci. In this study streptococci were isolated in 5 cases (11.1%). Staphylococcus aureus is seen in 7% cases of SDE associated with sinusitis and is commonly seen in postoperative/post-traumatic SDE.\(^9\)

**Choice of surgical procedure:** Complete evacuation of pus and eradication of the source of infection is the goal of treatment. Occasionally, medical management may suffice. Feuerman et al\(^3\) reported incidence of recurrence of SDE following a burr hole and evacuation of pus in about 40% cases. Other authors have shown that results of burr hole, craniectomy and craniotomies are comparable. Nathoo et al, found superiority of craniotomy over burr holes in the management of SDE, but recommend burr holes and craniectomies for children, in adults with parafalcine SDE, or in patients with septic shock. Recently, some authors have reported good results with a mini craniotomy or use of endoscope after a burr hole.

**Role of continuous irrigation of subdural cavity:** Glausner et al\(^1\) and Joubert et al\(^1\) reported that instillation of wash solution or antibiotics in the presence of brain swelling contributes to higher mortality. However, in our series we observed satisfactory recovery and no worsening following this protocol of treatment.

**Timing of surgery and role of simultaneous Neurosurgical and ENT intervention:** SDE requires operative evacuation of infected material irrespective of its volume. Delay in surgery leads to clinical worsening and poor results. Patients operated within 72 hours had 10% disabled as against 70% if the surgery took place after 72 hours.\(^4\)

**Role of simultaneous neurosurgical and ENT intervention:** Urgent evacuation of infected material by a neurosurgeon and otolaryngologist team either simultaneously or at the earliest possible opportunity for eradicating the source of infection results in cure and a significant decrease in recollection and re-exploration. In this study 3 patients required re-exploration, where the otolaryngological procedures were not performed simultaneously with the neurosurgical procedures.

**Outcome:** Outcome is dependent on the preoperative level of consciousness, timing and aggressiveness of treatment and the rapidity of progress of disease.\(^14\)

References

5. Nathoo et al, reported incidence of recurrence of SDE following a burr hole and evacuation of pus in about 40% cases. Other authors have shown that results of burr hole, craniectomy and craniotomies are comparable.
6. Nathoo et al, found superiority of craniotomy over burr holes in the management of SDE, but recommend burr holes and craniectomies for children, in adults with parafalcine SDE, or in patients with septic shock. Recently, some authors have reported good results with a mini craniotomy or use of endoscope after a burr hole.
7. Nathoo et al, found superiority of craniotomy over burr holes in the management of SDE, but recommend burr holes and craniectomies for children, in adults with parafalcine SDE, or in patients with septic shock.
8. Nathoo et al, found superiority of craniotomy over burr holes in the management of SDE, but recommend burr holes and craniectomies for children, in adults with parafalcine SDE, or in patients with septic shock.
10. Nathoo et al, found superiority of craniotomy over burr holes in the management of SDE, but recommend burr holes and craniectomies for children, in adults with parafalcine SDE, or in patients with septic shock.
11. Nathoo et al, found superiority of craniotomy over burr holes in the management of SDE, but recommend burr holes and craniectomies for children, in adults with parafalcine SDE, or in patients with septic shock.
12. Nathoo et al, found superiority of craniotomy over burr holes in the management of SDE, but recommend burr holes and craniectomies for children, in adults with parafalcine SDE, or in patients with septic shock.


Accepted on 19.03.2004.