Original Article

Subdural Empyema

Subdural Empyema: How effective is The Burr Hole Drainage?

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ABSTRACT

Background: Subdural empyema is a collection of pus between the dura mater and the arachnoid mater, usually unilateral and spreads rapidly through the subdural space until limited by specific boundaries (eg, falx cerebri, tentorium cerebelli, base of the brain, and foramen magnum). It is present in about 20% of all cases of intracranial abscesses.

Aim and Objective: The aim was to identify the best mode of surgical treatment for SDE

Study Design: Experimental study

Place and Duration of Study: This is a personal long term study of seventeen emergency patients of subdural Empyema admitted in Frontier Medical college/Women medical College Abbottabad and Private clinics at Abbottabad over seven years period from September 2006 to August 2013.

Materials and Methods: All were operated soon after stabilization and proper investigations. There were 10 male and 7 female ratio(1.3:1). The majority of patients were between 10 and 20 years of age. The most common clinical presentation was headache, fever, neck stiffness, seizures or peri-orbital swelling; only seven patients had status epilepticus, While the erythrocyte sedimentation rate and white blood cell count were invariably elevated, the cerebrospinal fluid showed nonspecific pleocytosis in the patients who underwent lumbar puncture. The definitive per-operative diagnosis was made by contrast enchanced CT in all cases.

Surgical treatment was by multiple burr holes in 8 patients, burr holes and small craniectomy in one, burr holes with catheter drainage in seven, and a large craniotomy in one.

Results: The Success rate was 86% while 76% making an excellent recovery.

Conclusion: These results compare favorably with those reported in other studies using craniotomy alone, and suggest that burr holes drainage is equally good a method treating subdural empyema.

Key Words: Subdural Empyema, Surgical Management, Burr holes, Craniotomy

INTRODUCTION

Subdural empyema (SDE) is a life-threatening condition, a focal collection of pus within the potential space between the dura mater and the arachnoid matter. It accounts for about 30% of intracranial infections. Before the era of antibiotics, this condition was actually fatal.

Unlike most first world countries where infection of the brain and its coverings is relatively rare, subdural empyema is still a common neurosurgical problem in developing countries.[1,2,3,9]

From 1950 to 1975, mortality was about 25 to 40%. However, with the advent of computed tomography (CT) scan and improvement in antibiotics and intensive care facilities, mortality is reduced to about 10 to 20%. It is actually caused by neglected para-nasal sinusitis (usually frontal sinusitis), meningitis, otitis media, and post-trauma. It is not unusual to get a sterile culture, but the major pathogens include Streptococci, anaerobic organsims, Staphylococcci, Haemophilus influenza and Proteus mirabiilis.

They are anaerobic or micro-aerophilic streptococci. Although these bacteria are part of the normal flora in the oval cavity, urogenital region and intestinal tract, they frequently cause purulent infections in various body sites[3,4]. Subdural empyema is a neurosurgical emergency, requiring immediate neurosurgical drainage either by craniotomy, or burr hole with drainage Together with debridement or removal of the primary source of infection.

In this prospective series, our aim was to analyze the effectiveness of surgical approach selected, based on patient outcome of SDE depending upon the surgical procedure performed.

MATERIALS AND METHODS

This is a personal series of seventeen patients of Subdural Empyema admitted in private clinics at Abbottabad over seven years period from April 2006 to March 2013. All were operated to analyze the most effective surgical treatment available. Out of Eighteen patients, one died before surgery and hence not included in the study.

RESULTS

Seventeen (17) cases with Subdural Empyema were included in this study (Table 1)

Age Incidence: The mean age was 21.5 years. Two patients were less than 12 months old. Out of these, 6 were under 15 years, and another 8 were between 16 and 34 years. Nine patients were diagnosed with meningitis.

Sex incidence: Out of the 17 patients, 10(62.5%) were male and 7(37.5%) were female (Ration 1.4:1).

Clinical Features (Table 1): Most presented with severe headache(14), neurological deficit (10), deteriorating conscious level (09) and epilepsy (09). On presentation, four were alert, five were drowsy and two was deeply comatose, often leading to an initial diagnosis of bacterial meningitis. Convulsions (predominantly focal) were also common, but status epilepticus occurred in only seven patients. All patients had a long period of illness before diagnosed with subdural empyema expect 7 patients (29.2%) who were diagnosed after less than 5 days of illness. All patients had seizures at presentation expect two. Of those, 3 had focal seizures and 8 had generalized seizures.

For level of consciousness at presentation, most patients were 'drowsy and disorientated'. Only Two patients were 'alert and orientated'.

Twelve had a focal neurological deficit: 8 a hemiparesis, three hemiparesis and dysphasia, two a hemianopia and one cerebellar dysfunction.

Radiology: Contrast-enhanced CT invariably showed hypo-or isodense extra-axial collections as well as evidence of fluid in or opacification of the sinuses. Almost all (95.8%, 15 patients) patients had a frontal subdural empyema, expect for one. Ten (79.2%) had a parietal extension; 5 (25.0%) had a temporal extension; while 2 (12.5%) had a parafalcine extension of the subdural empyema with none having occipital extension of the subdural empyema.

Six Patients (45.7%) had a subdural empyema less than 10 mm thick. In 4 patients (12.5%), the thickness was less than 15 mm, all having evidence of midline shift.

Most of the patients (75.0%, 09 patients) had a volume of subdural empyema of less than 100mls.

Management: From the time of diagnosis, all patients received a regimen of three intravenous antibiotic medications consisting of Cloxacillin, a third generation Cephalosporin(Claforon) and Metronidazole (200 mg 8 hourly for adults, 7.5 mg/kg 8 hourly for infants and young children). Intravenous therapy was continue for a minimum of 2 weeks after surgery. If the patient's body temperature, the erythrocyte sedimentation rate showed response, regimen could be changed to oral medication. This was further continued for a minimum of 1 month, and until there was no evidence of bacterial reactivity as measured by blood and CT parameters. Fifteen patients received 4-16 mg dexamethasone daily in the first week after surgery.

Surgery: Fifteen patients were treated with one or more burr holes as their definitive surgical procedure from two to four separate operations each and 8 had subdural catheters drains for 48 hours, positioned to allow drainage and administration of antibiotics into the subdural space. Craniotomy was subsequently required in one case for persistent collection of fluid. There was one death (6.25%). One underwent primary craniotomy and one craniectomy (for parafalcine collections parallel to the sagittal sinus). The type of surgical management was selected according to CT picture. Surgery was performed once antibiotic therapy had been commenced.

If the source of infection was known, either the sinuses were trephined or washed out or a radical mastoidectomy was performed with the patient under the same anesthesia or after removal of pus. With the help of imaging, accurate localization of the pus collection was done, which was evacuated by burr hole placement. Wide craniotomy with irrigation was the procedure of choice when outcome was assessed to be less then optimal by allowing wide exposure, adequate exploration, and better evacuation of subdural purulent material. Complete evacuation of pus and eradication of the source of infection was the goal of treatment.

Table No.1: All patients Data

Age/Sex	Presentation	Duration of Symptoms	Location	Treatment
0-10=2 11-20=3 21-30=3 31-40=5 41-50=2 51-60=2 Male (10) Female (07)	Headache (14) Neurology Hemiplegia (05) Hemiparesis (08) Dysphasia (03) Hemianopia (05) Inco- ordination (06) Seizures (09) Generalized (05) Focal Seizure (04) Fever (10) Sinusitis (07) Otitis media (03) Mastoiditis (02) Comatose (02) Stupor (01)	<2 weeks=05 >2 weeks=08 >3 weeks=04	Unilateral=12 Bilateral=05 Parafalcine=04 Frontal=11	-multiple burr holes (08) -burr holes and small craniectomy (01) - burr holes with catheter drainage (07) -Large Craniotomy(01)

Table No.2. Outcome

	Alert	Drowsy	Comatose	Recovery	Deficits	Deaths
Burr holes	09	01	-	10	01	-
Burr holes, Aspiration, Small Craniectomy	04	01	-	03	01	-
Craniotomy, Reopening	-	01	-	-	01	-
Posterior Fossa Craniectomy	-	01	01	-	01	01
Total	13	04	01	13	04	01

Outcome (Table 2): Final outcome was assessed at the time of discharge, after completion of intravenous antibiotics and during the follow-up period in the outpatient neurosurgical clinic. Outcome was described as excellent for a patient who was neurologically normal and functioning at the premorbid level, neurologically handicapped if any neurological abnormality was detectable but the patient could function at work or school independently, or severely neurologically handicapped if assistance was needed to perform daily functions.

One of the 18 patients died due to pre-existing meningitis, for an overall mortality rate of 6.25%. Thirteen patients (79.5%) had excellent results, Two had good result and two (6.25%) had residual neurological signs.

Table No.3: Microbiology details

Source of infection	No. of cases	Bacteria cultured (no. of cases)
Para nasal sinuses	7	Non-haemolytic strep (2) Microaerophilic strep (1) Staph. Aureus (2) Strep. Viridans (1) no growth (1)
Mastoid Sinuses/SOM	4	Anaerobes (2) Positive cocci (1) No growth (1)
Previous head injury	2	E. Coli (1), Anaerobes (1)
Previous surgery	1	Staph albus.
Previous abscess	I	Staph albus.
Metastic Spread	I	Non-haem strep.(Strep.Milleri)
Unknown	1	Strep, Pneum.

DISCUSSION

Pathophysiology: Subdural empyema is a collection of pus that spreads rapidly through the subdural space until limited by specific boundaries (e.g. falx cerebri, tentorium cerebelli, base of the brain, and foramen magnum). It is about 20% of all cases of intracranial abscesses. The infection is more common in men, who may account for as many as 80% cases. Most of the patients are aged between 10 and 40 years. In infants, SDE is most commonly a complication of purulent meningitis[7,8]. In older children, the source of SDE is typically direct extension of sinusitis or otitis media[3,5,7-11]. It can also be a spread of infection from distant sites (e.g. lungs), after a cranial surgery or after a trauma, particularly in compound depressed fracture[3,4,6,12], or after secondary infection of a subdural effusion or hematoma[3,4,7].The infection can spread from mastoid or middle ear infections by eroding the tegmen tympani[13] and from the frontal air sinus by erosion of its posterior wall and by retrograde septic thrombophlebitis[12] causing Cerebral abscess or infarction, Subdural empyema may also occur after surgery; septicemia spreading due to valve less diploic veins.[17] SDE behaves like an expanding mass lesion and causes cerebral edema and hydrocephalus.

Microbiology: Common causative organisms are anaerobes, aerobic streptococci, haemophilus influenza, Streptococcus pneumonia, and other gram-negative bacilli[19]. The rate of success in culturing bacteria from surgically evacuated pus varies from 49% to 85%.[5,14,19] The most common organisms in intracranial SDE secondary to paranasal sinusitis are anaerobic and microaerophilic streptococci , in particular those of the Streptococcus milleri group (S.milleri and Streptococcus anginosus).[6,9,11,20,21] Staphylococcus aureus is the cause in sinusitis and in postoperative/ posttraumatic SDE.[3,11,22] Spinal SDEs are mostly caused by streptococci or by S. aureus.[11] SDE is commonly secondary to H. influenza or S. pneumoniae meningitis in children.

Clinical Features: SDE has been described “as the most imperative of neurological emergencies”.[23] It is difficult to clinically differentiate between meningitis and SDE. The commonest clinical presentation is a triad of fever, sinusitis, and neurological deficits, with a rapid downhill course.[3,9-11] Other symptoms includes headache, nausea, vomiting, first-time seizures, and mental-status changes.[10,11,22] Headache, initially focal, becomes diffuse, focal neurological signs appears. If untreated symptoms may progress over several days to include drowsiness, increasing stupor and eventually, coma. Seizures, either focal or generalized, Hyperpyrexia, Aphasia, Meningismus, palsies of the third and sixth cranial nerves and contralateral motor deficits can occur.

Investigations:

Laboratory Studies: White blood cell count, erythrocyte sedimentation rate, and C-reaction protein level can be markedly elevated and may be useful screening tools to decide which patient may be at increased risk for intracranial empyema.[5,23] Lumbar puncture will be helpful to rule out meningeal infection when increased intracranial pressure has been excluded.

CT Scan and Magnetic Resonance Imaging: High-resolution, contrast-enhanced CT scanning is the standard technique for quick and noninvasive diagnosis of SDE. A contrast-enhanced CT with axial and coronal planes shows empyema by a hypo-dense area over the hemisphere or along the falx. Computed tomographic scan is the modality of choice if the patient is comatose or critically ill, and MRI is not possible or is contraindicated.[23] CT scan may miss intracranial SDEs detectable by MRI. Conversely, occasional spinal SDEs may be detected by CT myelography where MRI finding is negative.[11]

The diagnostic procedure of choice for intracranial and spinal SDE is MRI with gadolinium enhancement.[11,24] The MRI is superior to CT in demonstrating extra-axial fluid and its rim enhancement.[5] Diffusion-weighted imaging has proved to be more sensitive than conventional MRI in detecting the intra-axial involvement.[24] Magnetic resonance imaging studies demonstrated convexity and inter hemispheric collections that have a low signal on T1 weighted images and a relatively high signal on T2 weighted images. Related cerebral edema seems hyper intense on T1 weighted scans.[7]

Surgical Management: Our analysis shows that the preference for the more conservative burr-hole or craniectomy method worked for our patients as it did for other workers. Hence in our environment, comparatively excellent results (survival rate 90%) are obtainable using predominantly more conservative treatment. Other factors thought to effect outcome, such as the age of patient, type of organism, level of consciousness at the time of operation, and site of the infection, are comparable with the experience reported in the literature.

In our opinion, the single most significant figure in the successful surgical management of subdural empyema, as in cerebral abscess, is the accurate initial localization of pus and of any reaccumulation, which can be reliably achieved today with contrast enhanced CT if interpreted together with systemic parameters such as body temperature and erythrocyte sedimentation rate, this diagnostic combination can be provide an accurate indication for the need ans site of operation. This accuracy in diagnosis has contributed dramatically to the lowering of our mortality rate due to brain abscess.[9]

Early and accurate diagnosis, timely surgical intervention, and appropriate antibiotic therapy are the keys to a more favorable clinical outcome. Treatment in virtually all cases of intracranial or spinal SDE requires prompt surgical drainage and antibiotic therapy. Pus from the empyema should always be sent for anaerobic and aerobic culture.[16] subdural empyema should be treated surgically except where there are contraindications. Imaging can accurately localize the collection pus that can be evacuated by burr hole placement. Complete evacuation of pus and eradication of the source of infection in the goal of treatment.[3,22] 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 reexploration.[3]

Most studies evaluating burr holes or craniectomy as a treatment method of subdural empyema in large series include the period from 1946 to 1972, before CT evaluation was available.[4,5,14] There is no doubt that determination of the precise site of pus, particularly of inter-hemispheric collections, by means of arteriography or localization of posterior fossa accumulations using ventriculography would result in many such collections being missed and would undoubtedly result in a higher mortality rate if burr holes alone were used. If CT is not available, we would agree that a large craniotomy would be the only safe

Method of adequately assessing all locations of pus. When both CT and magnetic resonance (MR) imaging are available to exclude any locales of remaining or reaccumulating pus, the outcome of burr-hole or small craniotomy drainage of subdural empyema is the same as that of craniotomy. In patients with no or slight impairment of conscious level, Craniotomy may be the preferred mode of operations whereas in superpose or comatose patients, Burr-holes may be the preferred mode of operation.

What then are the advantages or disadvantages of any particular surgical method? With the Burr-holes or craniotomy approach, there is a greater likelihood of multiple operations than with a craniotomy. If a craniotomy is performed primarily, fewer initial procedures ant CT investigations are needed, but the magnitude of the procedure and the fact that a delayed cranioplasty is often required mitigates against it. Another disadvantage of craniotomy is that a large bone deficit remains for 12 to 18 months before cranioplasty can be performed; secondary loss of the bone flap occurred in two of our patients with craniotomy. Subdural empyema is sometimes bilateral, as in seven of our patients, which would necessitate two large bone flaps if the craniotomy method were chosen; considerable danger to the brain and a very serious cosmetic deformity would result if both flaps were lost because of infection.

In the third-world environment in which we practice, it is often the most junior staff members who perform these operations at night. For this reason, in our opinion it is far safer to advocate multiple burr-hole procedures than a large craniotomy where possible catastrophic brain swelling, infraction, or hemorrhage may result from an injudicious aggressive opening of the dura.

CONCLUSION

Accurately located burr-holes are adequate for satisfactory treatment in the majority of cases. There need be no overt signs of raised intracranial pressure of infection associated with subdural empyema, although paranasal or mastoid sinus sepsis is common and should alert the clinical to the possibility of this development. Subdural empyema appears to arise in the setting of subacute rather than acute frontal sinusitis. There may be an under-diagnosis and delay in treatment of patients with frontal sinusitis, resulting in subsequent intracranial complications.

Improved survival during this decade reflects earlier referral more accurate diagnosis achieved by the use of computed tomography combined with better understanding of the surgical techniques.

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