

# Suppurative Bacterial Meningitis: A 6 Year Study\*

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## SUMMARY

In this study, 54 of 7304 patients admitted at MCU-FDTMF Hospital were clinically diagnosed to have suppurative meningitis. Of this, 40 had CSF cytology suggestive of bacterial meningitis with 27 cases confirmed by culture.

The clinical signs and symptoms commonly present in all age groups were fever, seizures and meningeal signs regardless of the etiologic pathogen isolated. In 77%, CSF showed leukocytosis with predominance of polymorphonuclear cells, decreased sugar and increased protein content. A positive cellular and chemical analysis of spinal fluid yielded a high sensitivity and a specificity of 34 and 54 per cent respectively.

There was no significant difference in the incidence of suppurative meningitis between well-nourished and malnourished infants and children. [*Phil J Microbiol Infect Dis* 1986; 73-76]

*Key Words:* meningitis, suppurative bacterial meningitis

## INTRODUCTION

Suppurative meningitis remains one of the most dreadful infectious diseases, which pose a threat to the well being of children even with the introduction of newer antimicrobial agents and improvement in supportive care. It constitutes a significant cause of morbidity and mortality in infants and children in the Philippines thus requiring early confirmation for institution of appropriate management. Several factors are known to play important roles in the causation of this illness.

The present study was undertaken to determine the proportion of clinically diagnosed and laboratory confirmed suppurative meningitis, to correlate the clinical and laboratory findings of admitted suppurative meningitis, to correlate the cytology and culture result of patients with admitting diagnoses of suppurative meningitis and to determine the constitutional factors that may be related to the cases of suppurative meningitis admitted.

## MATERIALS AND METHODS

Clinical records of 54 patients from January 1980 to December 1985 with age range of 0 to 12 years admitted at MCU-FDTMF Hospital Department of Pediatrics clinically diagnosed to have suppurative meningitis were reviewed. The following information was obtained: (1) Age and sex of the patient, (2) Clinical manifestations and onset of symptoms, (3) Cerebrospinal fluid findings particularly the cellular and chemical features, (4) Etiologic agents, and (5) Nutritional status of the patient.

Sensitivity and specificity of the cytological examination in relation to the spinal fluid culture were computed and analyzed. Frequency and proportion were employed in the analysis of results.

## RESULTS

### *Overview of Data*

During this 6-year period, 7304 patients were admitted at MCUH Department of Pediatrics. Of this number, 54 (0.73%) were clinically diagnosed as suppurative meningitis. Of

the 54 cases, 40 (0.54%) showed a spinal fluid cytology suggestive of suppurative etiology. Twenty seven (0.36%) of these were confirmed by culture (Table 1).

**Table 1. Proportion of clinically diagnosed and laboratory confirmed suppurative meningitis**

1. Proportionate Morbidity (clinical)	= 54/7304* x 100 = 0.73%
2. Proportionate Morbidity (cytology)	= 40/7304* x 100 = 0.54%
3. Proportionate Morbidity (Cytology -Culture)	= 27/7304* x 100 = 0.369%

\*7304 = Total number of admissions from 1980-1985

1. Clinically diagnosed suppurative meningitis
2. Cytology suggestive of suppurative meningitis
3. Cytology suggestive and confirmed by culture

### *Age and Sex Incidence*

In this study, 31 (57%) were males and 23 (43%) were females. Ten patients were neonates, 26 patients were 2 months to one year of age and 18 patients were 2 to 10 years old (Table 2).

**Table 2. Age and Sex Distribution**

Age	Male	Female	Total
Neonates	7	3	10
2 months - 6 months	8	5	13
7 months - 1 year	5	8	13
2 years - 5 years	8	4	12
6 years - 10 years	3	3	6
Total	31	23	54
%	57	43	

### *Clinical Manifestations*

The various signs and symptoms in all age groups included fever (28%), and CNS dysfunction (31%) such as meningeal signs (bulging of the anterior fontanelle, nuchal rigidity, pathologic reflexes and abnormal behavior like irritability and lethargy (Table 3). As shown in this series, fever and CNS dysfunction were seen in almost all patients regardless of etiologic agent (Table 4).

**Table 3. Signs and Symptoms in 54 Infants and Children with Suppurative Meningitis**

Signs and Symptoms	Neonates	1 month -1 year	2-10 years	Overall
Fever	4	18	8	30 (28)
Seizures	4	16	13	33 (31)
Meningeal Signs	3	11	5	19 (18)
Vomiting	3	4	0	7 (6.6)
Poor suck	1	0	0	1 (.94)
Diarrhea	0	3	0	3 (2.8)
Abnormal Behavior	0	4	1	5 (4.7)
Respiratory Infection	1	6	0	7 (6.6)
Headache	0	0	12	2 (1.8)
Aural Discharge	0	0	1	1 (.94)

( ) = percentage

### Cerebrospinal Fluid Findings

Of the 54 cases, 40(80%) had a positive gram stain and/or culture of the spinal fluid. Thirteen (24%) were positive on gram stain, 4 (7.4%) on culture alone, and 23 (42%) in both smear and culture. In 14 cases, spinal fluid examination was negative.

**Table 4. Signs and Symptoms of 27 Infants and Children with Suppurative Meningitis in Relation to Etiologic Organism**

Organisms	Signs/Symptoms									
	Fever	Seizure	CNS Dysfunction	Vomiting	Poor Suckling	Diarrhea	Abn. Behavior	Headache	A D	R I
Enteric Gram (-) organisms										
A. faecalis	2	2	1	1	0	0	0	0	0	0
E. coli	3	2	3	0	0	1	0	0	0	0
Enterobacter sp.	1	0	1	1	0	0	0	0	0	0
Salmonella sp.	2	2	2	0	0	0	1	0	0	0
Pseudomonas sp.	1	1	1	0	1	0	0	0	0	0
H. influenzae	1	0	1	0	0	0	0	0	0	0
N. meningitidis	1	3	3	2	0	0	0	0	0	1
Gram positive organisms										
S. pneumoniae	1	0	0	0	0	0	0	0	0	1
Staphylococcus sp.	9	9	8	4	1	2	1	1	0	1
Streptococcus sp.	2	2	1	0	0	0	1	0	0	0
Unknown organisms	10	9	12	7	3	1	1	1	2	2

A.D. = aural discharge

RI = respiratory infection

CSF cytology showed cell counts ranging from 52 to 4162/mm<sup>3</sup> with a predominance of polymorphonuclear cells in 42 (77%) patients and lymphocytosis in 12 (23%). Protein determination ranged from 750 mg to 4 gms: Spinal fluid glucose concentration was low in all subjects. In 13 patients, a simultaneous blood sugar determination was done and showed a ratio of 0.3 (Table 5 and 6).

Table 5. CSF Cytology in Relation to Culture

Cytology	Culture		Total
	Positive	Negative	
Positive	22	27	49
Negative	5	14	19
Total	27	41	

Table 6. Gram Stain Result in Relation to Culture

Smear	Culture		Total
	Positive	Negative	
Positive	23	13	36
Negative	4	14	28
Total	27	27	

The above tables showed that 27 of 54 cases with cytological examination suggestive of suppurative meningitis were confirmed by culture (81.4% sensitivity and a specificity of 34.1%). A positive gram stained smear gave a sensitivity of 85% and a specificity of 51%.

Gram-negative organisms isolated in this study were *Alkaligenes spp* and *E. coli* in 3 cases each, *Enterobacter* in 1, *pseudomonas* and *salmonella* in 2 cases each and *Neisseria*

*meningitides* in 3. Among the gram-positive organisms, *Staphylococcus coagulase negative* were isolated in 9 cases, *Streptococcus sp.* in 2, and *Streptococcus pneumoniae* in 1 (Table 7).

### Nutritional Status

Nutritional status was defined according to Gomez System based on the percentile of the actual body weight with that of the ideal body weight (IBW).<sup>1</sup> For analysis patients were grouped into two categories: (1.) Well-nourished group: children with actual body weight of more than 90% of the expected body weight for age. (2.) Malnourished group: children with actual body weight of less than 90% of the expected body weight for age.

Of the 54 subjects included in the study, 33 (61%) were well-nourished and 27 (39%) were malnourished (Table 8).

**Table 7. Organisms Isolated in Relation to Age**

Organisms	Neonates	2 - -6 mo	7 - 1 yr.	2 - 5 yr.	6 -10 yr.	Total
<b>I. Gram Negative Organisms</b>						
A. faecalis	0	1	1	1	0	3
E. coli	0	1	1	1	0	3
Salmonella sp.	0	0	2	0	0	2
Pseudomonas sp.	1	0	1	0	0	2
H. influenzae	0	1	0	0	0	1
N. meningitidis	1	1	0	0	1	3
<b>II. Gram Positive Organisms</b>						
S. pneumoniae	0	1	0	0	0	1
Staphylococcus	2	5	2	0	0	9
Streptococcus sp.	0	0	0	1	0	1
<b>III. No organism</b>						
	1	2	4	2	4	13

**Table 8. Nutritional Status**

Age	Well-Nourished	Malnourished
Neonates	23	3
2 months - 6 months	12	0
7 months - 1 year	2	5
2 years - 5 years	6	4
6 years - 10 years	2	2
Total	25	15
%	62.5	37.5

## DISCUSSION

Though suppurative meningitis is not even 1% of the total admissions, it poses a great threat to the individual. In this study, suppurative meningitis was found to occur more frequently in the first year of life. Our result is similar to the study done by Reyes et al and other foreign authors showing that the age incidence of bacterial meningitis has remained unchanged in the past years.<sup>2,3,4</sup>

In patients who present with headache, lethargy, vomiting and CNS dysfunction, the likelihood of meningitis must be considered particularly if upper respiratory tract infection preceded the symptoms. However, the signs and symptoms of bacterial meningitis may be subtle and non-specific especially in infants where fever may be the only presenting sign.<sup>5,6</sup> As shown in this study, fever, seizures and meningeal involvement are the most frequent signs encountered in all age groups regardless of the etiologic organisms isolated on culture. Other symptoms in the older age group are respiratory in nature, vomiting, headache and aural discharge.

Outcome of meningitis relates directly to the persistence of bacteria in the spinal fluid hence the primary goal of therapy is prompt sterilization of the spinal fluid as soon as infection is suspected. To attain this objective, the causative pathogen should be known for the appropriate choice and institution of antimicrobial therapy. However the major problem presented by patients with meningitis is early recognition of its etiology. The importance of CSF examination has been proven by years of clinical experience. A number of laboratory of the spinal fluid are strikingly similar in most, if not all, of suppurative bacterial meningitis.<sup>3,7,8</sup>

In this study, almost all of the spinal fluid examined had leukocytosis with a predominance of polymorphonuclear cells. Only a small percentage showed lymphocytosis. The presence of lymphocytosis, generally considered typical of viral, fungal and tuberculous meningitis, has been used to differentiate these entities from bacterial meningitis. Powers<sup>4</sup> in his study found out that almost 1/3 of patients with bacterial meningitis and a CSF WBC count had CSF lymphocytosis. Coexistent findings of low sugar level and marked elevation in CSF protein level help distinguish patients with bacterial meningitis from those with viral disease, but their absence does not exclude the bacterial cause. Furthermore, hypoglycorrhachia and elevated CSF protein level are also characteristic of fungal and TB meningitis and must be differentiated from suppurative bacterial meningitis.

Careful examination of a properly prepared gram stained smear cannot be overemphasized. Although this procedure suggests the causative organism, this is not always the case. A positive gram stain examination as revealed by our study showed an 85% sensitivity and 51% specificity, which means that a positive gram stained smear in most cases can predict the etiologic pathogen. A positive cytology of the CSF specimen likewise gave an 81% sensitivity and a 34% specificity in this series of 54 clinically diagnosed suppurative meningitis. This indicates that a positive cytological examination in most cases will be associated with a positive culture. This also shows that without a culture, a positive cytology and well-prepared gram stained examination can be guides in the diagnosis of pyogenic meningitis.

Gram negative bacilli comprise more than 50% of the reported cases from North America and Australia indicating that it is still the commonest organism causing neonatal meningitis. *E. coli* is the most common gram negative organism causing neonatal meningitis in both continents.<sup>8</sup> Review of local data also showed similar results. In contrast to these data, gram-positive organisms were the most common pathogens isolated in our series, during the neonatal period. This is probably due to the relatively smaller number of cases admitted during the course of the study.

Both foreign and local statistics have shown that *H. influenzae* is the most common cause of meningitis in children between the ages of 3 months and 5 years.<sup>3,7,8</sup> In contrast only one case of *H. influenzae* was isolated among infants below 5 years who were included in this study. The infrequency of *H. influenzae* in this study is a finding shared by the observation of Gonzaga et al,<sup>8</sup> in a series of 85 patients with suppurative meningitis. Since this study is retrospective, it has certain inherent limitations including the inability to detect other factors, which may influence the growth of this organism. The influence of the technique used in the isolation of this organism is worthy of further investigation before a definite statement can be made on the frequency or infrequency of infection due to this organism.

The most common pathogen isolated in this service were gram positive cocci with 7 cases of coagulase-negative staphylococcus. This organism is a part of a normal skin flora and the possibility of its being a contaminant must always be considered. However, it may also invade the blood stream under certain condition and produce bacteremia, septicemia and other disease pictures including meningitis which have been reported.<sup>10</sup>

The nutritional status of an individual, especially infants and young children, is a common factor in the prognostication of an infectious disease. In this series, about 70% of the total number of admissions were undernourished. It is reasonable to think that malnutrition may contribute to the incidence and outcome of bacterial meningitis. However, the study of Rosen et

al<sup>5</sup> has found no association between meningitis and malnutrition. This is further supported by a recent study made by Mulla et al.<sup>6</sup> Our study also showed that 57% of the patients with bacterial meningitis were well-nourished and 43% were malnourished. This shows that not only malnourished infants are prone to develop suppurative meningitis, but not that well-nourished infants are more prone to develop pyogenic meningitis.

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