

Iraqi Children with Acute Bacterial Meningitis... Who May Need Ventilatory Support?

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ABSTRACT:

BACKGROUND:

Acute bacterial meningitis (ABM) is one of the most potentially serious infections occurring in infants and older children. Indications for PICU admission are shock, markedly elevated intracranial pressure (ICP), coma, and refractory seizures⁽¹⁾.

METHODS:

This cross sectional study enrolled children 2 months-12 years of age presented with (ABM) who were admitted to Children Welfare Teaching Hospital (CWTH) -Medical City- Baghdad, including those who needed Pediatric Intensive Care Units (PICUs) admission in CWTH Unit and Surgical Specialty Hospital (SSH) Unit in the period from the 1st of Feb 2004 to the 1st of Feb 2006. The diagnostic inclusion criteria of (ABM) were clinical symptoms and signs of meningitis plus a CSF neutrophilic pleocytosis with a CSF cells count of more than 5 cells/mm³⁽¹⁾. Data included history, clinical examination, investigations, complications, PICU management, and outcome. Statistical analysis was done by using SPSS version 13.0 computer facility, Chi-square test and T test were used when needed and a P.value < 0.05 was considered significant.

RESULTS:

In the present study (ABM) in children 2 months -12 years constituted 7% of cases admitted to PICUs. The majority of cases (77.2%) were below 2 years of age. The mean age of children with (ABM) was 18.3±6.80 months. The PICU cases of (ABM) differed from the neurological ward cases in their more acute onset, higher body temperature, higher peripheral WBCC, lower CSF glucose, and higher CSF cell count, higher CSF protein, lower serum calcium and longer duration of stay and all these characteristics showed highly significant differences. The case fatality rate of children with (ABM) is 13.3%.

CONCLUSION:

The study concluded the need for PICU admission in children with (ABM) with acute onset, higher body temperature, higher peripheral WBCC, lower CSF glucose, and higher CSF cell count, higher CSF protein, lower serum calcium, and recommended laboratory and PICU service expansion.

KEYWORDS: meningitis; children; picu, Iraq.

INTRODUCTION:

Bacterial meningitis is one of the most potentially serious infections occurring in infants and older children. This infection is associated with a high rate of acute complications and risk of long term morbidity. Meningitis is a serious public health problem demanding early diagnosis, effective treatment, prevention and control. Risk factors for meningitis include lack of immunity to specific pathogen, recent colonization with pathogenic bacteria, close contacts with individuals having invasive disease, crowding, poverty, black race, and male gender.⁽¹⁾Fifteen-eighteen percent of

children presenting with status epilepticus and fever have acute bacterial meningitis.⁽²⁾ For meningitis caused by *S.pneumoniae* and *H.influenzae* type b, the incidence and peak age of infection has been dramatically altered after the introduction of vaccination against both types of bacteria.⁽³⁾The onset of meningitis may be sudden or more commonly it occurs gradually over several days.Non-specific findings like fever, anorexia and poor feeding, symptoms of upper respiratory tract infection, myalgia, arthralgia, and various cutaneous signs. Specific findings are meningeal irritation signs; nuchal rigidity, back pain, Kernigs sign, and Brudzinski sign, increased intracranial pressure; headache, emesis, bulging fontanel's, diastases of the sutures, oculomotor and abducens nerve paralysis, hypertension with

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CHILDREN WITH ACUTE BACTERIAL MENINGITIS

bradycardia, apnea or hyperventilation, decorticate or decerebrate posture, stupor, coma or signs of herniation.⁽¹⁾

The statement that children under the age of one year (often extended to 18 months) can have meningitis without displaying any of the classical signs seems to be based on clinical experience and some early published case reports but it is not born out by formal studies.^(4, 5, 6)

Meningitis is diagnosed by cerebrospinal fluid (CSF) analysis, Gram stain, and culture, CT scan for evidence of brain abscess or increased intracranial pressure (ICP), Blood culture should be performed in all patients with suspected meningitis, and it reveals the responsible bacteria in 80-90% of cases of meningitis.⁽⁷⁾ Lumbar puncture (LP) may precipitate cerebral herniation in some severe cases of acute bacterial meningitis.⁽⁸⁾

So it would be unwise to undertake a lumbar puncture immediately after cessation of convulsive status epilepticus associated with acute bacterial meningitis.⁽⁹⁾

Treatment in the absence of increased ICP, the patient should receive antibiotic immediately after an LP is performed. If there are signs of increased ICP or focal neurological findings, antibiotics should be given without performing an LP and before obtaining a CT scan.

Increased ICP should be treated simultaneously. Immediate treatment of associated multiple organ system failure. Corticosteroids should be given simultaneously with antibiotics. The recommended empirical therapy is vancomycin plus a third generation cephalosporin (cefotaxime or ceftriaxone) Patients allergic to beta-lactam antibiotics can be treated with chloramphenicol. For infants 1-2 mo. ampicillin should be given with ceftriaxone or cefotaxime. For immunocompromised patients ceftazidime is given plus an amino glycoside. Duration of antibiotic therapy For uncomplicated cases of penicillin-sensitive *S.pneumoniae* meningitis, therapy should be completed with a 3rd generation cephalosporin or i.v. penicillin for 10-14 days. If the isolate is resistant to penicillin or 3rd generation cephalosporin therapy should be completed with vancomycin. For uncomplicated *N. meningitidis* meningitis, i.v. penicillin for 5-7 days. For uncomplicated *H. influenzae* type b meningitis, ampicillin for 7-10 days (if the isolate is sensitive). For Gram negative bacillary meningitis, it should be treated for 3 weeks or for at least 2 weeks after CSF sterilization. Dexamethasone given every 6 hours for 2 days with acute bacterial meningitis caused by

H.influenzae type b, however, data are inconclusive regarding the benefit, if any, of corticosteroids in the treatment of meningitis caused by other bacteria.⁽¹⁰⁾

Indications for ICU admission are shock, markedly elevated ICP, coma and refractory seizures. Prevention by vaccination and antibiotic prophylaxis of susceptible at-risk contacts represent the two available means of reducing the likelihood of bacterial meningitis.⁽¹⁾

Respiratory failure occurs when the lungs are unable to Oxygen to the blood to meet the metabolic demands. It may develop insidiously or may have an abrupt onset and laboratory findings include PaCO₂ > 50mmHg, PaO₂ < 60mmHg or O₂ saturation < 90%.⁽¹¹⁾

PATIENTS AND METHODS:

This cross sectional study enrolled children 2 months-12 years of age with acute bacterial meningitis who were admitted to Children Welfare Teaching Hospital, Medical City-Baghdad including those who were admitted to PICUs in CWTH Unit and SSH Unit the period from the 1st of Feb 2004 to the 1st of Feb 2006.

The PICU in Children Welfare Teaching Hospital consists of an average of 4 beds with a nurse to patient ratio is 1.5:1 and Surgical Specialty Hospital consists of 12 beds with nurse to patient ratio of 1:1. The unit is staffed by a pediatrician, an anesthetist, pediatric residents, nurses, and supported by pediatric sub specialists. Ventilators are handled by the pediatrician or the anesthetist with back up support of the medical engineers for any technical faults. Suction and nebulizer therapy are routinely handled by PICU nurses. Physiotherapists and nurses provide chest physiotherapy as instructed by the attending pediatrician. These two hospitals do not have a separate laboratory for the PICUs but a central laboratory. Results of arterial blood gases analysis, electrolytes are not available on immediate basis round the clock.

The diagnostic inclusion criteria of acute bacterial meningitis were clinical symptoms and signs of meningitis (e.g., fever, severe headache, severe irritability, photophobia, vomiting, drowsiness, neck stiffness, bulging fontanel, Kernig and Brudzinski signs plus a CSF neutrophilic pleocytosis i.e., cells count of > 5 cells/mm³ ⁽¹²⁾. The data included age, sex, residence, duration of illness before admission to hospital, body temperature, CSF cells, glucose, and protein, increased ICP, seizures, coma and disease outcome. Additional data for patients who were

CHILDREN WITH ACUTE BACTERIAL MENINGITIS

admitted to the PICU included duration of ventilation and stay in PICU.

Statistical analysis was done by using SPSS version 13.0 computer facility,

Chi-square test and T test were used when needed and a P.value < 0.05 was considered significant.

RESULTS:

Children diagnosed as cases of acute bacterial meningitis were found to constitute 2.2% (269/125*0) of total hospital admissions of children 2 months -12 years of age to Children Welfare Teaching Hospital (CWTH) in the study period. Out of these 24(7%) patients were admitted to Pediatric Intensive Care Units (PICUs).

Acute bacterial meningitis was noted to be more frequent in males than females in different age groups with a male: female ratio of 1.24:1.

It was found that male predominance was more prominent in older children with acute bacterial meningitis than younger age groups, and this difference is statistically significant (p.value 0.01), table -1.

16 boys and 8 girls with (ABM) were admitted to the PICUs (cases) compared to 133 boys and 112 girls admitted to the neurological ward (controls), the sex difference here is not significant (p.value 0.39). The mean age of children with (ABM) was 18.3±6.80 months. The mean age of children admitted to the PICUs was 18.3± 9.9 months and that of the controls was 19.6±3.7 months, and this difference showed no statistical significance (p.value 0.17). The mean duration of fever before admission to hospital in children with (ABM) was 12.4 + 4.22days. The mean duration of fever before admission was significantly shorter in children who were admitted to the PICUs than controls, (4.7±1.8 days and 12.4±6.2days respectively). The mean body temperature was significantly higher in cases than controls

(38.9±0.13 C ° and 38.2±0.34 C ° respectively). While random blood glucose was not significantly different between the two groups (124.6±35 mg/dl for cases and 120.5±5.9 mg/dl for controls), the CSF glucose was very low in PICUs admitted children with (ABM) compared to the ward patients with the same diagnosis (16.0±7.1 mg/dl and 63.7±8.7 mg/dl) scoring a highly significant difference . CSF cell count were significantly higher in cases than controls (1136±1124 cells/ml and 151±30 cells/ml) and CSF protein showed 150±24 mg/dl for cases and 67±34.5 mg/dl for controls, and this difference is also significant.

Peripheral WBCC was significantly higher in cases than controls (11993±757 x10⁻⁹/L and 10880±1450 x10⁻⁹/L respectively). Serum calcium was also significantly lower in PICUs patients (2.2±0.07mg/dl in cases and 2.06±0.05 mg/dl in controls).

The duration of hospitalization for patients who were admitted to PICUs was significantly longer than those treated in the neurological ward (13.7±0.8 days and 11.5±3 days respectively). Increased ICP was diagnosed and treated in 20/24(83%) of PICUs cases and in 107/245(43.7%) of ward patients .The difference is also highly significant, table-2.

Forty three patients (16%) developed coma with a mean duration of (4.4±2.1 days). Convulsions and administered anticonvulsant therapy were recorded in 116(43.1%) of studied children with (ABM) and refractory seizures were recorded in 16/269(5.95%) of the patients, all of them were admitted to the PICUs .The mean O₂ % saturation for PICUs cases was 92.5±4.1%.

The mean stay in PICUs was (8.8 ±1.8 days) and the mean duration of artificial ventilation was (6.6 ±1.4 days).

The case fatality rate of children with (ABM) was 13.3% (36/269).

Table-1: Sex distribution of children with acute bacterial meningitis in different age groups

Age group	Males No (%)	Females No (%)	Total NO. (%)	Male to female ratio
2 mo.- <2 yr.	105 (54.1%)	89 (45.9%)	194 (72.2%)	1.18:1
2 yr.- < 5 yr.	19 (55.9%)	15 (44.1%)	34 (12.6%)	1.27:1
5 yr.-12 yr.	25 (60.9%)	16 (39.1%)	41 (15.2%)	1.56:1
Total	149 (55.4%)	120 (44.6%)	269 (100%)	1.24:1

Chi-square =8.817, df. : 2, P. value: 0.01

CHILDREN WITH ACUTE BACTERIAL MENINGITIS

Table-2: Comparison of children with acute bacterial meningitis admitted to the PICU and those treated in the neurological ward

Characteristics		Cases (PICUs) No. (Mean±SD)	Controls (ward) No. (Mean±SD)	P. Values
Sex	Males (No.)	16	133	0.39
	Females (No.)	8	112	
Age (months)		18.3±9.9	19.6±3.7	0.17
Duration of fever before admission (days)		4.7±1.8	12.4±6.2	0.001
Body temperature (C° corrected)		38.9±0.13	38.2±0.34	0.001
With Increased ICP (No.)		20(83%)	107(43%)	0.001
Random blood glucose (mg/dl)		124.6±35	120.5±5.9	0.09
CSF glucose (mg/dl)		16.0±7.1	63.7±8.7	0.001
CSF cell count (cells/ml)		1136±1124	151±30	0.001
CSF protein (mg/dl)		150±24	67±34.5	0.001
WBCC x10 ⁹ /L		11993±757	10880±1450	0.001
Serum calcium (mg/dl)		2.2±0.07	2.06±0.05	0.001
Duration of hospitalization (days)		13.7±0.8	11.5±3	0.009

DISCUSSION:

The etiology of bacterial meningitis and its treatment during the neonatal period are generally distinct from those in older infants and children. Nonetheless, the etiology of meningitis in the neonatal and post-neonatal periods may overlap, especially in 1-2 months old patients, in whom Group-B-Strep. *S. pneumoniae*, *N. meningitidis*, and *H. influenzae* type b all may cause meningitis.⁽¹⁾

In the present study (ABM) in children 2 months - 12 years constituted 2.2% of total admission to the CWTH, and 7% of cases were admitted to PICU. The majority of children with (ABM) (77.2%) were below 2 years of age.

Acute bacterial meningitis occurred more in males than in females. Farag HF et al⁽¹²⁾ had recorded a male: female ratio of 2:1 in an Egyptian study done in 2005. This is also noted by other authors who stated that bacterial meningitis occurs more in males than in females, and most often between 2 months and 2 years of age.⁽¹⁰⁾

The mean age of children with (ABM) was 18.3±6.80 months. The mean age of bacterial meningitis in the United States was 15 months in 1986 and that was before the widespread use of *H. influenzae* type b vaccine and subsequent to the implementation of universal immunization against this bacterium, beginning at about 2 months of age, the incidence of *H. influenzae* type b meningitis dropped precipitously and the mean

age of bacterial meningitis increased from age 15 mo in 1986 to 25 yr in 1995⁽¹⁾.

The mean duration of fever before admission to hospital in children with (ABM) was 12.4 ± 4.22 days. This agrees with other authors who stated that the onset of meningitis may be sudden or more commonly it occurs gradually over several days.⁽¹⁾

The PICUs cases differed from the ward cases in their more acute onset, higher body temperature, higher peripheral WBCC, lower mean CSF glucose, and higher CSF cell count, higher CSF protein, lower serum calcium and longer duration of stay and all these characteristics showed highly significant differences.

The indications of Pediatric Intensive Care Unit admission in patients with meningitis include markedly elevated ICP which was diagnosed and treated in 40% (107/269) of children with acute bacterial meningitis, half of them were admitted to the PICUs, and these constitute 50% of PICUs admitted cases.

Coma was noted in 16% (34/269) of children with (ABM), 12 of them had the chance to be admitted to PICUs constituting 50% of PICUs cases and this reflected the limited capacity of PICUs in Medical City Complex to accommodate children with critical illnesses.

Seizures were recorded to occur in 43% (116/296) of children with (ABM), 16 of them were

CHILDREN WITH ACUTE BACTERIAL MENINGITIS

admitted to PICUs under the diagnosis of refractory seizures constituting 66.6% of PICUs cases.

The mean O₂ % saturation for PICUs cases was 92.5±4.1% as respiratory failure is diagnosed when the patient is unable to ventilate adequately which leads to hypoxemia and hypercarbia.

⁽¹¹⁾Therefore prediction of respiratory failure in infants and young children with (ABM) with sudden onset of signs and symptoms low CSF glucose and high CSF cell count is mandatory to avoid eventual hypoxic brain injury which might augment morbidity and mortality of the disease.

From the clinical point of view, (ABM) appeared more prone to an aggressive course and outcome. It had a case fatality of 13.3% in the present study which is close to that (13%) reported by Shembesh et al in Libya ⁽¹³⁾ yet much lower than that (24%) detected by Youssef et al in Egypt. ⁽¹⁴⁾ In developed countries, in spite of availability of all facilities, the case fatality rate of meningitis in early childhood approaches 10% ⁽¹⁵⁾ Adequate laboratory service and cultures for the type of the pathogenic bacteria responsible for (ABM), and expansion of the PICUs in Children Welfare Teaching Hospital and Surgical Specialty Hospital are the most important and urgent recommendations of the present study.

In UK, as a result of introduction of *H.influenzae* vaccine in 1992, number of cases of *H.influenzae* meningitis in children under five years has fallen by 87% ⁽¹⁶⁾.

The present study concluded the need for PICU admission in children with acute bacterial meningitis with acute onset, higher body temperature, higher peripheral WBCC, lower CSF glucose, and higher CSF cell count, higher CSF protein, lower serum calcium, and recommends laboratory and PICU service expansion.

CONCLUSION:

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CHILDREN WITH ACUTE BACTERIAL MENINGITIS

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