SPECIFICITY AND SENSITIVITY OF SIGNS AND SYMPTOMS IN BACTERIAL MENINGITIS

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ABSTRACT

In a prospective study extended along an 8 months period from July 2006-Feb .2007 , 116 patients were collected , from the admission to the department of pediatrics , Maternity and children hospital in Nassiryia city (MCH), with suspicion of meningitis .they were clinically evaluated for the signs and symptoms of meningitis , and the CSF analysis was the final diagnostic tool for meningitis .the patients were divided into 6 age groups ,and the sensitivity , specificity ,positive predictive value and the accuracy for the symptoms and signs of meningitis were calculated for each age group .

In the age group <1 month of age :convulsion was the most sensitive symptom, while lethargy was the most sensitive sign .

In age group 1-6 months : fever and convulsion were the most sensitive symptoms , while bulging fontanel , lethargy and irritability were the most sensitive signs .

In the age group 7-12 months : vomiting ,fever and convulsion were the most sensitive symptoms , while bulging fontanel, lethargy and neck rigidity were the most sensitive signs .

In the age group 1-5 years : vomiting headache ,fever and anorexia were the most sensitive symptoms , while lethargy and neck rigidity were the most sensitive signs .

In the age group 6-10 years : vomiting ,headache and fever were the most sensitive symptoms , while neck rigidity was the most sensitive sign .Irritability ,Kernig sign and back pain were less sensitive signs .

In the age group 6-15 : vomiting ,headache and fever were the only sensitive symptoms while lethargy, Kering sign and neck rigidity were the only sensitive signs

From this study we can conclude that for each age group there are some signs and symptoms sensitive for the diagnosis of meningitis different from the other age groups ..Performing lumber puncture in doubtful cases of meningitis is better than missing a case of meningitis with it is sequelae.

INTRODUCTION

Practitioners who see children must frequently diagnose and treat pediatric infectious disease . they must decide which children have relatively benign illnesses and which have septicemia or meningitis .the presentations of serous may not be obvious .Practitioner must be able to rabidly recognize and manage meningitis . this diagnosis should be considered in any child with thermal instability and /or CNS dysfunction. The practitioner manage febrile infant must perform a certain percentage of negative lumber punctures in order to ovoid missing cases of meningitis [1].

The first step in providing appropriate therapy is to recognize signs and symptoms that suggest a high probability of meningitis .

Neonates with meningitis lack specific manifestations; diagnosing these patients can be formidable problem .parents may state that the infant feed poorly or has a fever ,but even these signs may be absent .Restless and

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irritability that is inconsolable mat be the only clues .Neurologic manifestations include lethargy (50-90%);bulging or full fontanel (20-30%);focal ,generalized or subtle seizures (30-50%);nuchal rigidity 10-20%);and , rarely at initial presentation ,signs of increased intracranial pressure [2].

In older infants and children ,meningitis may be more easily diagnosed by presenting signs and symptoms .Fever ,irritability ,disturbance of sensorium , generalized seizure activity ,focal neurological signs ,photophobia ,anorexia and vomiting are frequently seen in children with meningitis .After the first year of life , nuchal rigidity is reliably seen in the acute phase of meningitis .The absence of nuchal rigidity at any age , however , does not rule out intracranial infection .[4]

Nuchal rigidity should always provoke strong consideration of meningitis .However, many other conditions may present with an apparent "stiff neck", including both very serous (pneumonia ,peritonsillar abscess, brain tumor)and less serous (cervical adenitis and torticollis)conditions. [3]

Infants and young children are particularly vulnerable because of immature immune response and lack of previous exposure to the organism commonly causing meningitis .[5]

Hemophilus influenza ,Nisseria meningitidis and Streptococcus pneumonae acount for about three quarters of those cases of bacterial meningitis in which the responsible agent is isolated .In those patients who have the illness , post mortem examination reveal clouding of the meninges with opalescent streak surrounding the cortical veins overlying the hemisphere convexities , the cranial nerves often engulfed in the exudates .[6].A petecheal rash is particularly associated with meningococcal meningitis , where it is occur in about 50% of cases , but is seen with meningitis due to other organism (e.g Escherichia coli).[6]

The clinical presentation of bacterial meningitis may be altered slightly by prior antibiotic therapy in the pediatrics age group . children who have been treated with oral antibiotics for URI or Otitis media prior to the development of signs and symptoms of meningitis may have a longer duration of symptoms .[7]

Seizure occur in 40% of children with bacterial meningitis typically during the first few days of illness [8] .The majority of seizure have a focal onset .Seizure activity that a focal onset which is caused by :

1. **focal arterial ischemia or infarction .**
2. **cortical venous thrombosis with hemorrhage .**
3. **focal edema**
4. **mass effect from expanding subdural effusion**

Or generalized seizure activity and status epilepticus which is caused by :

1. **fever.**
2. **hyponatremia**
3. **anoxia from decreased cerebral perfusion .**
4. **spread from a focal onset to a generalized tonic –clonic convulsion [8].**

Lumber puncture for evaluation of the CSF remain the mainstay of diagnosis .The CSF pressure usually elevated . The protein concentration is raised in most patients ,though seldom above 5 gram /L.The cell count ,predominantly polymorphonuclear may reach 100,000 cells/mm^3. glucose concentration below 2,2 mmol/l are found in about half the cases [6].

Papilledema is uncommon in uncomplicated meningitis and should suggest a more chronic process , such as the presence of an intracranial abscess ,sub dural empyema , or occlusion of a dural Venus sinus [9]

As most CNS infections are serous and may are treatable , it is often more important that a CSF test be a highly

sensitive so that the diagnosis of CNS infection is not missed .[10][11][12][13]

AIM OF THE STUDY

The aim of this study is to evaluate several commonly used clinical signs and symptoms in diagnosing meningitis by calculating the sensitivity , specificity ,positive predictive value and accuracy for each symptom and sign of meningitis.

PATIENTS & METHODS

The study included the children admitted to the Maternity and children hospital in Nassiryia city with the suspicion of meningitis .

116 patients were collected and evaluated prospectively along 8 months period from July 2006- Feb.2007 .

After initial clinical assessment ,a forma was filled in detailing the history and examination , patients were divided into 6 age groups:

1. below 1 month
2. 1-6 months
3. 7-12 months
4. 1-5 years
5. 6-10 years
6. 11-15 years

The symptoms stressed upon in the history as predictors of meningitis were vomiting , headache, fever , anorexia ,convulsion and UTRI (upper respiratory tract infection).

The signs which were looked for a predictors of meningitis , were irritability , lethargy , neck stiffness ,Kering "s ,Brudzniski"s sign pappiledema and bulging fontanel .

The classical signs of meningitis were defined as follow :

Neck rigidity :

was regarded as present when the neck resists passive flexion .

Kernig"s sign

:is elicited with the patient in supine position .The thigh is flexed on the abdomen , with neck flexed . Attempts to passively extended the leg elicit pain when meningeal irritation is present .

Brudzniski"s sign :

Is positive when passive flexion of the neck (with the patient in supine position) result in spontaneous flexion of the hip and knees .[7]

The fundi of all the patients , excluding neonates were examined and their state was fixed as having pappiledema or not .Lumber puncture was done for all the patient to decode whether the patient is having bacterial meningitis or not .The patients who received antibiotics prior to the admission to the hospital were excluded from the study.

The classical CSF abnormalities in bacterial meningitis were regarded as follows :

1. Increase opening pressure .
2. A pleocytosis of polymorphonuclear leukocytes (100,000 cell/mm^3)or more PMNs predominant).
3. Decrease glucose concentration (<40 mg/dl.
4. n increased protein concentration(100-500 mg/dl).[14]

SESITIVITY : . measure the ability of symptom or sign to detect cases of meningitis .It is defined by the no .of true positives divided by total patients with meningitis .

SPECIFICITY_: measure the ability of a symptoms or sign to exclude patients without meningitis , it is defined by the number of true negatives divided by the total patients without meningitis .

POSITIVE PREDICTIVE VALUE the positive predictive value of symptom or sign gives a measure of significance of a positive result .it is defined by the proportion of true cases of meningitis among all those with positive symptom or sign .

ACCURACY _: It is defined by the number of true positives and negatives divided by the number of patients tested .[15]

RESULTS

116 patients were collected with the suspicion of meningitis . The median age

of the patients was 7.5 months (range 1 week-15years). There were 76male and 40 female patients ,with a male : female ratio 1.9:1Taking into account the result of lumber puncture and CSF analysis for the definitive diagnosis of meningitis , there were 44(38%)patients with meningitis . The patients were distributed according to age groups with the definitive diagnosis of meningitis table 1 .The median length of history was 3.5.days(range 6 hours - 10 days) for patients with meningitis and 5.5 days (range 1-12 days) for the remainder .

For the patients in the age group <1month:

Convulsion was the most sensitive symptom (sensitivity 0.50%) with a PPV of 0.66 and accuracy of 40 . Lethargy was the most sensitive sign (sensitivity 1 ,specificity 0,PPV 0.8,and accuracy 80)Neck rigidity was less sensitive (sensitivity 0.25 and accuracy 40) table 2.

For the age group 1-6 months:

fever and convulsion was the most sensitive symptoms (sensitivity 0.88,0.75 respectively) .While bulging fontanel , lethargy and irritability were the most sensitive signs (sensitivity 1, 0.63,0.5respectivly). Table 3

For the patients in the age group 7-12 months :

Convulsion ,vomiting ,fever and anorexia were the mo0st sensitive symptoms (sensitivity 0.75,0.75,0.75 ,0.50 respectively).While bulging fontanel, lethargy, and neck rigidity were the most sensitive signs for meningitis (sensitivity 0.8,075,0.50 respectively) .table 4. For the patients in the age group 1-5 years : Vomiting , headache ,fever and anorexia were the most sensitive symptoms (sensitivity 1, 0.66,0.66 respectively) While lethargy and neck rigidity were the most sensitive signs for meningitis (sensitivity 0.66 for each) . table 5 .

For the patients in the age group 6-10 years :

Vomiting ,headache and fever were the most sensitive symptoms (sensitivity (100% for each), While anorexia , convulsion and URTI were less sensitive (sensitivity50% for each).For the signs ,neck rigidity was the most sensitive sign for meningitis (sensitivity 1), while irritability ,lethargy , Kernig"s sign and back pain were less sensitive signs(sensitivity 50% for each). Table 6.

For the patients in the age group11-15years :

The only sensitive symptoms, were vomiting ,fever and headache (sensitivity 100%,100%,80% respectively). While lethargy , neck rigidity and Kernig"s sign were the only sensitive signs (sensitivity 1 for each). Table 7.

DISCUSSION

Bacterial meningitis is one of the potentially serous infection s in infants and older children .This infection is associated with a high rate of acute complications and risk of chronic morbidity. The pattern of bacterial meningitis and it is treatment during the neonatal period (0-28days) are generally distinct from those in older infants and children .Nonetheless .the clinical pattern of meningitis in the neonatal and post neonatal period may overlap especially in the 1-2 months old patient in whom group B Streptococcus , H .influenza type b , meningococcus and pneumococcus may all produce meningitis .[16] For the age group below 1 month of age we found that convulsion was the most sensitive symptom, while all the other symptoms showed much lower figures .As well lethargy was found to be the most sensitive sign . table 2. Fleisher mentioned that (neonate with meningitis lack specific manifestation and diagnosing these patients can be problem)[1]

The initial signs and symptoms in the neonates with meningitis may be indistinguishable from those of other infectious and noninfectious diseases of the newborn infants .[2]

Unfortunately ,most of the symptoms and signs in this age group are quite non specific . [16].

Yet convulsion and lethargy in our study showed some importance in diagnosing meningitis in neonates .

For the patients in the age group 1-6 months ,we have found that fever and convulsion were the most sensitive symptoms , while bulging fontanel and lethargy were the most sensitive signs .Table 3 . In fact signs and symptoms of meningitis may overlap in the age group < 1 month and 1-6 months especially , in 1-2 months old infants in whom group B streptococcus , H.influenza type b ,meningococcus and pneumococcus may all produce meningitis .[16]. In the age group7-12 months convulsion and fever where the most sensitive symptoms of meningitis , while lethargy and bulging fontanel where the most sensitive signs . Table 4 .Klein stated that increased intracranial pressure is common in meningitis and may be reflected by a bulging fontanel [17]. Rennick G.et al .mentioned that seizure occur in 40% of children with bacterial meningitis typically during the first few days of illness .[8].

For the age group 1-5 years and 6-10 years ,vomiting ,fever , anorexia and headache were the most sensitive symptoms .Table 5,6 . These symptoms although in our study were of significance but still are shared in other diseases which makes them as vague presentations .For the signs again neck rigidity and lethargy were the most sensitive .Table 5. Kernig sign ,Brudzniski "s sign and papilledema are of less importance . For the age group 11-15 years ,vomiting , headache and fever were the most sensitive symptoms , but still these are general symptoms and seen in many conditions .For the signs again neck rigidity and alteration of the state of consciousness and Kering:s sign were the only sensitive signs for the diagnosis of meningitis , Table 7 .

McCarthy mentioned that after the first year of life ,neck rigidity is reliably seen in the acute phase of meningitis .It is not seen immediately after seizure activity when both Kernig:s and Brudzniski"s signs are also blunted .The absence of Kernig "s sign at any age , however does not rule out intracranial infection .[4].

CONCLUSION

1-The principal diagnostic problem in this study was that there were some sensitive and specific signs and symptoms reliable to detect meningitis especially in the young age groups ,<1month and 1-6 months .Yet , convulsion , lethargy ,irritability and bulging fontanel should raise the suspicion of the diagnosis of meningitis .While there is no place for the signs of meningeal irritation , in these 2 age groups .in the diagnosis of meningitis .

2-For the age group 7-12 months , convulsion , lethargy and bulging fontanel are more dependable in the diagnosis of meningitis , while the sign of meningeal irritation are not dependable .

3-In the older age groups 1-5 ,6-10,11-15 years vomiting , headache , lethargy and neck rigidity should raise the possibility of meningitis .

4-The absence of neck rigidity at any age does not rule out intracranial infection .

RECOMMENDATION

Performing a lumber puncture with a CSF analysis , in any case with a doubtful diagnosis of meningitis ,with a negative result is far better than missing a case of meningitis with subsequent brain damage or death .

Tables

Table 1 : distribution of the patients according to age groups and the cases of meningitis.

Age group	No. of patients	Cases of meningitis	%
<1 month	10	8	80
1-6 months	40	16	40
7-12months	28	8	28
1-5 years	18	6	33
6-10 years	14	4	28
11-15	6	2	33
Total	116	44	38

Table 2 :sensitivity ,specificity , positive predictive value ,and accuracy of symptoms and signs in predicting meningitis in the patients aged <1 month suspected to have meningitis .

Symptoms	Sensitivity %	Specificity %	Positive predictive %	Accuracy %
Vomiting	0	100	0	20
Headache	0	100	0	20
Fever	25	0	50	20
Anorexia	0	100	0	20
Convulsion	50	0	66	40
URTI	25	100	100	40
Signs				
Irritability	0	100	0	20
Lethargy	100	0	80	80
Neck rigidity	25	100	100	40
Kernig sign	0	100	0	20
Brudzniski sign	0	100	0	20
Papilledema	0	100	0	20
Back pain	0	100	100	20

Table 3: sensitivity ,specificity ,positive predictive value and accuracy of symptoms and signs in predicting meningitis in the patients aged 1-6 months suspected to have meningitis .

Symptoms	Sensitivity %	Specificity %	Positive predictive %	Accuracy %
Vomiting	63	33	38	45
Headache	0	100	0	60
Fever	88	25	47	50
Anorexia	50	83	57	70
Convulsion	75	33	80	80
URTI	38	50	33	45
Signs				
Irritability	50	58	44	55
Lethargy	63	33	38	45
Neck rigidity	0	42	0	25
Kernig sign	13	83	33	55
Brudzniski sign	13	75	25	50
Papilledema	0	100	0	60
Back pain	0	100	0	60
Bulging fontanel	100	60	80	60

Table 4: sensitivity ,specificity ,positive predictive value and accuracy of symptoms and signs in predicting meningitis in the patients aged 7-12 months suspected to have meningitis .

Symptoms	Sensitivity %	Specificity %	Positive predictive %	Accuracy %
Vomiting	75	40	33	50
Headache	0	90	0	64
Fever	75	30	30	43
Anorexia	50	80	50	71
Convulsion	75	50	38	57
URTI	25	33	13	28
Signs				
Irritability	0	50	0	35
Lethargy	75	60	42	64
Bulging font	80	53	44	65
Neck rigidity	50	60	33	57
Kernig sign	0	80	0	57
Brudzniski sign	0	70	0	57
Papilledema	0	100	0	50
Back pain	0	100	0	71

Table 5: sensitivity ,specificity ,positive predictive value and accuracy of symptoms and signs in predicting meningitis in the patients aged 1-5years suspected to have meningitis .

Symptoms	Sensitivity %	Specificity %	Positive predictive %	Accuracy %
Vomiting	100	50	50	66
Headache	80	83	0	55
Fever	66	0	25	22
Anorexia	66	33	33	44
Convulsion	33	50	25	44
URTI	0	66	0	44
Signs				
Irritability	0	66	0	4
Lethargy	66	50	40	55
Neck rigidity	66	16	28	55
Kernig sign	33	83	50	66
Brudzniski sign	0	100	0	66
Papilledema	33	100	100	77
Back pain	0	83	0	55

Table 6: sensitivity ,specificity ,positive predictive value and accuracy of symptoms and signs in predicting meningitis in the patients aged 6-10years suspected to have meningitis .

Symptoms	Sensitivity %	Specificity %	Positive predictive %	Accuracy %
Vomiting	100	60	50	71
Headache	100	60	50	71
Fever	100	0	28	28
Anorexia	50	60	33	57
Convulsion	50	40	25	42
URTI	50	80	50	71
Signs				
Irritability	50	100	100	85
Lethargy	50	40	25	42
Neck rigidity	100	40	40	57
Kernig sign	50	100	100	85
Brudzniski sign	0	100	0	71
Papilledema	0	100	0	71
Back pain	50	80	50	71

Table 7: sensitivity ,specificity ,positive predictive value and accuracy of symptoms and signs in predicting meningitis in the patients aged 11-15years suspected to have meningitis .

Symptoms	Sensitivity %	Specificity %	Positive predictive %	Accuracy %
Vomiting	100	50	50	66
Headache	80	0	60	55
Fever	100	0	33	33
Anorexia	0	100	0	66
Convulsion	0	100	0	66
URTI	0	100	0	66
Signs				
Irritability	0	100	0	33
Lethargy	100	100	100	100
Neck rigidity	100	0	100	33
Kernig sign	100	50	50	66
Brudzniski sign	0	50	0	33
Papilledema	0	50	0	33
Back pain	0	100	0	66

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دراسة حساسية وخصوصية العلامات المرضية و الأعراض السريرية في مرض داء السحايا البكتيري

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خلاصة البحث:

في دراسة مستقبلية على امتداد ٨ أشهر من تموز ٢٠٠٦ إلى شباط ٢٠٠٧ حيث تمت دراسة ١١٦ مريضا ادخلوا ردهة الأطفال في مستشفى الولادة والأطفال في الناصرية ، حيث يشتبه إنهم مصابون بالتهاب السحايا البكتيري . تم تقييم المرضى سريريا لعلامات وأعراض التهاب السحايا البكتيري . اجري لهم تحليل سائل النخاع الشوكي كوسيلة نهائية لتشخيص المرض واستبعد المرضى الذين تناولوا مضادات حيوية قبل الفحص من الدراسة .حيث قسم المرضى إلى ٦ فئات عمريه.

الحساسية، الخصوصية، القيمة الموجبة المتوقعة مع الدقة للعلامات والأعراض تم حسابها لكل فئة عمريه وظهرت النتائج التالية:

١. اقل من شهر :وجد ان التشنج والخمول أكثر العلامات والأعراض حساسية
٢. من عمر ١-٦ اشهر وجد أن ارتفاع درجة الحرارة والتشنج أكثر الأعراض حساسية بينما انتفاخ اليافوخ الأمامي ،الخمول والتهيج المفرط أكثر العلامات حساسية .
٣. من عمر ٧-١٢ شهر وجد أن التقيؤ ،ارتفاع درجة الحرارة مع التشنج أكثر الأعراض حساسية بينما انتفاخ اليافوخ الأمامي ،الخمول مع صلابة الرقبة أكثر العلامات حساسية .
٤. من عمر ١-٥ سنوات وجد أن الصداع، ارتفاع درجة الحرارة مع فقدان الشهية أكثر الأعراض حساسية بينما الخمول وصلابة الرقبة أكثر العلامات حساسية.
٥. من عمر ٦-١٠ سنوات وجد أن التقيؤ ، الصداع مع ارتفاع درجة الحرارة أكثر الأعراض حساسية ، بينما صلابة الرقبة أكثر العلامات حساسية .
٦. من عمر ١١-١٥ سنة وجد أن التقيؤ ،الصداع مع ارتفاع درجة الحرارة أكثر الأعراض حساسية بينما الخمول ، علامة كيرنك مع صلابة الرقبة أكثر العلامات حساسية .

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