

Paranasal Sinus CT Scan Changes in Children with Meningitis: A Cross Section Study, Tehran, IRAN

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Abstract

Background: Meningitis is the most common intracranial complication of sinusitis.

Objective: Determine the frequency of sinusitis using CT scans in children with documented meningitis.

Methods and materials: A prospective, cross sectional study was done in pediatric infectious ward of Rasoul Hospital in Tehran, Iran during 2010-2011. In this study 65 cases with meningitis were evaluated for presence of sinusitis (according to symptoms, criteria and paranasal CT scan).

Results: CSF obtained in 112 cases. Cases with meningitis aged 1 month-16 years old with a mean of 4.2 years. Definite bacterial meningitis was the final diagnosis in 40/112 patients (35.7%; missing=5).

Second step: Paranasal sinus CT scan had been performed in 65 cases with final diagnosis of meningitis. Cases were between 1 month to 16 years old (mean age of 4.2 y). 51% of the patients were male and 49% were female. Bacterial meningitis was diagnosed in 55.3% (36/65) and aseptic meningitis in 44.7% (29/65).

Sinuses were reported to be undeveloped in 7.6% (n=5) of younger than 4 months old cases. Sinusitis was diagnosed in 30.7% (20/65) of all cases with meningitis; 3.4% (1/29) in those with aseptic meningitis and 52% (19/36) in those with bacterial meningitis which shows significant difference between the 2 groups (P<0.05).

The involved sinuses included: pan sinusitis with 15% (3/20) case.

Maxillary sinusitis the most common type observed (16/20); on the next places comes; sphenoid sinusitis (7/20); ethmoid sinusitis (4/20) and finally isolated frontal sinusitis was seen in 0% of cases. Chronic type of sinusitis was reported in 50% (n=10) of all cases.

Conclusion: The prevalence of sinusitis in documented cases of meningitis (septic & aseptic meningitis) was 31%, and was more common (25%) in bacterial meningitis. Meningeal manifestations (e.g. meningeal signs and symptoms; or CSF changes) might be due to bacterial sinusitis.

Most cases of meningitis in children are accompanied with sinusitis. Differentiation between the two sources and definition of the initial site of infection is always problematic. Appropriate bacterial sinusitis treatment is needed to prevent meningitis. We recommend sinus tract to be evaluated in every meningitis patient (septic or aseptic). Furthermore, adequate treatment in chronic sinusitis would help prevent readmission.

Introduction

Community acquired sinusitis is one of the most common causes to seek medical attention especially from paediatricians [1,2]. The diagnosis is usually made with the help of specific radiographies or computed tomography scans. The microbiology of sinusitis is depended on patient's age [3]. Given that meningitis is the most common intracranial complication of sinusitis and bacterial meningitis is one of the most potentially serious infections in infants and older children which can be accompanied with a high rate of acute complications and long-term morbidity, an accurate and rapid diagnosis of acute bacterial meningitis is essential for early treatment and good outcome. Signs and symptoms are often non specific and it is not always possible to make a differential diagnosis between bacterial and aseptic meningitis [4-8].

According to a study performed by Younis et al. most cases of meningitis in children are accompanied with sinusitis [9]. Differentiation between the two sources and definition of the initial site of infection is always problematic.

Thorough and precise examination in children with sinusitis and appropriate treatment is needed to decrease the risk of bacteremia and subsequent invasive infections (e.g. meningitis, subdural empyema and brain abscess) [10,11].

Introduction of high-resolution CT scans and magnetic resonance imaging and availability of wide-spectrum antibiotics have improved sinusitis management significantly [11,12]. Bacterial meningitis and antimicrobial resistance is common in Iranian children [13-15]. Community acquired rhino sinusitis is one of the most common causes of hospital visits especially to paediatricians in our hospital [16-19]. Immunologic evaluation of children with sinusitis is necessary, especially in chronic or resistant cases [16]. Not only community acquired but also nosocomial sinusitis was reported in our center [19].

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The main goal of our study was to determine the frequency of sinusitis using CT scans in children with documented meningitis.

Methods and Materials

A prospective, cross sectional study was performed in infectious pediatric ward of Rasul Akram Hospital in Tehran, Iran between 2010 and 2011. This study was approved by the Ethical Committee in the Research Center of Pediatric Infectious Diseases, Tehran University of Medical Sciences.

Cases definition: Every child with documented meningitis and a complete set of para nasal sinuses` CT scan imaging entered our trial.

Exclusion criteria: We excluded all cases with normal CSF analysis (simple febrile seizure) or indications of inflammatory process in CSF (eg: ADEM; Guillan Barre syndrome, leukemia; SLE; brain tumor, etc) from the study.

Data collection: Initially, a check list was completed for each case by an authorized physician, covering different aspects e.g. age, gender, analysis of all CSF samples: Suger; Protein, WBC count, LDH, gram stain, LPA and CSF culture (in both conventional and Bactec medium/ or universal bacterial PCR), Type of meningitis (septic, aseptic), site of sinusitis; type of sinusitis (chronic, acute) according to the CT scans.

CSF samples were examined microscopically for total WBC and differential WBC count. Gram stain was performed on all CSF samples. After centrifugation, deposits were cultured on sheep blood agar and incubated in a candle jar at 37°C for 48 h and then subcultured using standard techniques [1,2].

Latex agglutination tests using the BD Directigen, Meningitis Combo Test (Becton Dickinson, Maryland, USA) Wellcogen bacterial antigen kit were performed on CSF samples suggestive of meningitis.

A Universal PCR assay for the detection of *N. meningitidis*, *H. influenzae* and *S. pneumoniae* was used only when CSF samples suggestive of bacterial meningitis showed negative results using other methods (Culture, gram stain for bacteria in CSF or LPA) [1].

Bacterial meningitis was diagnosed in the presence of clinical signs of meningitis alongwith positive CSF culture, positive blood culture ± CSF culture; or positive universal bacterial PCR of CSF with or without LPA test positive gram stain for bacteria in CSF [4].

Microbiological methods: We used BACTEC Ped Plus medium (Becton Dickenson company) and automated system (BioMerieux) for CSF or blood culture. Bacteria isolates were identified using standard techniques [1].

Statistical analysis: All analyses were conducted using SPSS, version 13.5.

Quantitative variables were summarized as mean ± standard deviation (SD) and qualitative variables were count in percentage. The Student's t test was used to determine significant differences in means of all continuous variables Chi-square values (CI 95%, p<0.05) were calculated for all categories. P value <0.05 was considered statistically significant.

Results

First step: 112 clinically ill patients were admitted to the hospital, who based on clinical manifestations after initial evaluation needed Lumber Puncture to rule out meningitis. Patients were 1-170 months

old with a mean of 25.6 ± 29.3 months. 47.7% of the patients were male and 52.3% were female.

Definite bacterial meningitis was the final diagnosis in 40/112 patients. 4 cases suffering from bacterial meningitis died before any imaging study was performed. (35.7%; missing=5) 16.3% of CSF gram staining tests, 35.3% of cultures and 44.4% LPA tests (which in some cases overlaped with positive gram stain or culture) were positive. The isolated organisms in bacterial meningitis (40 cases) were *S. pneumoniae* (17); *H. influenzae* (9); *N. meningitidis* (3); GBS (1); *E. coli* (1); *S. Aureus* (4); *Acinetobacter* (2); *P. aerogenosa* (1); *Enterococcus spp* (1); *Klebsiella* (1).

A comparison between CSF findings in septic and aseptic meningitis is presented in Table 1.

Second step: Paranasal sinus CT scan had been performed in 65 cases with final diagnosis of meningitis. Cases were between 1 month to 16 years old (mean age of 4.2 y). 51% of the patients were male and 49% were female. Bacterial meningitis was diagnosed in 55.3% (36/65) and aseptic meningitis in 44.7% (29/65) .

Sinuses were reported to be undeveloped in 7.6% (n=5) of younger than 4 months old cases.

Sinusitis was diagnosed in 30.7% (20/65) of all cases with meningitis; 3.4% (1/29) in those with aseptic meningitis and 52% (19/36) in those with bacterial meningitis which shows significant difference between the 2 groups (P<0.05).

Maxillary sinusitis the most common type observed 80% (16/20); on the next places comes; sphenoid sinusitis 35% (7/20); ethmoid sinusitis 20% (4/20) and finally isolated frontal sinusitis were seen in 0% of cases. Chronic type of sinusitis was reported in 50% (n=10) of all cases.

Discussion

In this trial we evaluated paranasal sinuses of 65 cases (mean age=4.2 years) with documented meningitis by CT scan. Sinusitis was reported in 30.7% of all cases with predominance of bacterial type over aseptic meningitis (52 % vs. 3.4 %, P<0.05). 52% of patients with bacterial meningitis (vs. 3.4% of those with aseptic meningitis, p<0.05) had sinusitis. 50% of the patients were diagnosed with chronic sinusitis. Signs and symptoms of sinusitis in infants and young children are often non specific and it is not always possible to make a differential diagnosis between sinusitis and meningitis. Although patient outcome is usually encouraging, permanent sequelae such as seizures and hearing loss are common complications.

Meningeal manifestations (e.g. meningeal signs and symptoms;

Variable (p value)	Non bacterial (n=39)	Bacterial (n=40)	Normal (n=27)	Others (n=6)
Glucose (p=0.002)	63.21 ± 14.56	49.63 ± 20.82	69.9 ± 14.60	45 ± 7.07
Protein (P=0.00)	44.62 ± 33.88	71.69 ± 23.00	38.9 ± 16.74	24 ± 1.41
RBC (p=0.00)	17.7 ± 45.01	494.17 ± 2198.23	1.5 ± 3.37	50 ± 60.83
WBC (p=0.00)	23.09 ± 47.63	1060.11 ± 3394.29	0 ± 0	1.67 ± 2.89
PMN% (p=0.02)	42.07 ± 30.46	63.39 ± 24.84	—	—
Lymphocyte% (p=0.35)	56.88 ± 33.77	36.61 ± 24.84	—	—

P value <0.05 considered statistically significant

Table 1: Comparison of CSF findings between cases (n=112).

or CSF changes) might be due to bacterial sinusitis (para meningeal infection). Probably meningitis happened as one of the most serious complications of previous sinusitis in our cases. The diagnosis of initial infection, as sinusitis or meningitis, is really arduous. In 5 cases younger than 4 months old sinuses were reported to be undeveloped. As expected maxillary and sphenoid sinuses (80 and 25% respectively) were the most common sites of involvement in our cases and none of the cases had isolated frontal sinusitis. Previous studies in Tehran proved sinusitis to be common in Iranian children. Community acquired rhino sinusitis is one of the most common causes to seek medical attention, especially from paediatricians, in our hospital [16-19]. Immunologic evaluation of children with sinusitis is necessary, especially in chronic or resistant cases [16]. These results are similar to those of a previous study in our center which determined the common sites of sinusitis in children [16,17]. Younis et al. study showed that meningitis was the most common intracranial complication of sinusitis, just like our study. Intracranial complications happened in 39/82 cases and amongst them meningitis was seen in 21/39 cases [9].

Bayonne et al. designed a retrospective study to report intracranial complications of rhino sinusitis in adults [11]. Unlike our study in children, involvement of frontal and sphenoid sinuses was more frequent in their study. Diffuse headache or two-step evolution headache and altered mental status were strongly correlated with meningitis and brain abscess. Empyema was the most common complication. Various sequelae occurred in 16% of patients. However, no death occurred with this treatment strategy [11]. Intracranial complications of acute sinusitis are exceptional in children. Meningitis as a complication of sinusitis in children may still pose a serious threat and even lead to death. Early imaging data and aggressive management, including sinus drainage along with combined antibiotic therapy, can limit its morbidity and sequelae [10,11].

Physicians treating children with sinusitis (especially hospitalized cases) should be aware of high risk of meningitis [1,2]. Appropriate treatment of bacterial sinusitis is needed to prevent meningitis [7,8]. Para nasal sinus CT scan is a helpful method to diagnose sinusitis accurately and rapidly [9,10].

Conclusion

The prevalence of sinusitis in documented meningitis cases (septic & aseptic) was 30.7% and it was higher (52%) in bacterial meningitis. Meningeal manifestations (e.g. meningeal signs and symptoms or CSF changes) might be due to bacterial sinusitis. The diagnosis of initial infection, sinusitis or meningitis, is very difficult in children.

Appropriate treatment of bacterial sinusitis is needed to prevent meningitis. We recommend sinus tract evaluation in every case with meningitis (septic or aseptic). Furthermore, adequate treatment of chronic sinusitis would be helpful in preventing readmission.

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