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Management and outcomes in children with sinogenic intracranial abscesses

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ABSTRACT

Objective: To report our experience of sinogenic intracranial abscesses in the paediatric population and to guide medical and surgical management.
Methods: All children with sinogenic intracranial abscesses presenting to a large university teaching hospital over a five-year period were included in the study. Data on clinical presentation, radiological findings, microbiology, medical and surgical management and follow-up were recorded and analysed.
Results: We identified 27 children aged 12.9 ± 3.4 years of which 56% were male. Fourteen (52%) children had extradural abscesses, nine (33%) subdural abscesses and four (15%) parenchymal abscesses. Early sinus drainage procedures were performed on 24 (89%) patients, and the same number required neurosurgical drainage. *Streptococcus milleri* was isolated in 18 (67%) cases. An initial conservative neurosurgical approach failed in 50% of cases where trialled, and was associated with longer length of stay ($p = 0.025$). In comparison to extradural abscesses, subdural abscesses were more likely to present with neurological deficits ($p < 0.001$) and reduced consciousness ($p = 0.018$), and required multiple neurosurgical procedures ($p < 0.001$), longer stays ($p = 0.017$), and had greater morbidity at six months ($p = 0.017$). A third of children had significant morbidity at six months, which included cognitive and behavioural problems (25%), residual hemiparesis (19%) and expressive dysphasia (7%). There were no mortalities.
Conclusion: Sinusitis complicated by intracranial abscess remains a contemporary problem. We demonstrate good outcomes with an early combined rhinological and neurosurgical approach. *S. milleri* is identified as the causative organism in the majority of cases, and empirical antimicrobial treatments should reflect this.

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1. Introduction

The intracranial complications of sinusitis are potentially life threatening and include venous sinus thrombosis, meningitis and intracranial abscesses. Intracranial extension of infection occurs either directly through the walls of the sinus, or via the valveless venous system which connects the paranasal sinus mucosa to the dural venous sinuses, emissary veins and subdural veins [1].

Various small case series have described heterogeneous groups of adults and children with a variety of surgical and non-surgical intracranial complications of sinusitis. Intracranial abscesses can be considered a unique entity, as they almost always require urgent surgical management with a combined rhinological and neurosurgical approach. Children present an additional challenge, often presenting late to secondary care with established intracranial suppuration and a potentially fulminant clinical course. In the present study we aim to gain an insight into the presentation, management and outcome of children with this life-threatening condition.

2. Materials & methods

2.1. Setting

A tertiary referral centre for Ear, Nose & Throat Surgery, with neurosurgical and paediatric intensive care provision.

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2.2. Study design

A retrospective search of a computer database of electronic patient records was performed. All paediatric (under 18 years) admissions between January 2009 and January 2014 were screened for ICD-10 codes for intracranial abscess. Resulting case notes were scrutinised to identify those patients in whom sinusitis was found to be the cause radiologically and clinically. Data on demographics, clinical presentation, medical history, radiological findings, microbiology, management, complications and follow-up were recorded in a database.

2.3. Statistical analysis

Comparison of means and contingency tests were performed using GraphPad Prism 5 (GraphPad Software Inc., San Diego, CA, USA) and logistic regression performed using SPSS-18 (SPSS Inc., Chicago, IL, USA) with 'significant morbidity at six months' used as a binary outcome measure. Length of stay at our unit was a secondary outcome measure, although we highlight that some children were discharged to local hospitals for on-going care. Data sets were tested for normality and statistical tests performed accordingly.

This retrospective research study was registered with our institution's Clinical Governance Board and carried out under ethical regulations that govern institutional audit and research.

3. Results

3.1. Patients

We identified 27 paediatric patients (under 18 years) with sinogenic intracranial abscesses. The average (mean ± SD) age was 12.9 ± 3.4 years and 56% were male. Twenty (74%) were white Caucasian, two (7%) black African, two (7%) black Caribbean, one (4%) Asian and two (7%) mixed race. No children were diabetic, known to be immunosuppressed, or had suffered recent head injury. None had a diagnosis of chronic rhinosinusitis.

3.2. Clinical presentation

The median (±IQR) duration of symptoms at presentation was 11 (6–17) days. Seven (26%) children presented with reduced Glasgow Coma Scale (GCS), and nine (33%) had evidence of hemiparesis. Fever (93%) and headache (89%) were the most common symptoms (Table 1). Mean tympanic temperature and white cell count were 38.3 ± 1.1 °C and 17.5 ± 7.2 × 10^3 cells/ml respectively. All patients had raised serum C-reactive protein (CRP), with eight (30%) having a level higher than 250 mg/L. The admitting paediatric team performed four lumbar punctures, with two demonstrating high polymorph count, and two being technically unsuccessful. Eighteen (67%) patients had previously been seen by a General Practitioner or an emergency physician in the preceding week and 15 (57%) were taking oral antibiotics.

Table 1
Presenting signs and symptoms.

Presenting sign/symptom	Frequency (%)
Fever	25 (93%)
Headache	24 (89%)
Nasal congestion	13 (48%)
Frontal tenderness	13 (48%)
Vomiting	10 (37%)
Coryza	10 (37%)
Nasal discharge	8 (30%)
Photophobia	8 (30%)
Periorbital swelling	8 (30%)
Neck stiffness	7 (26%)
Reduced GCS	7 (26%)
Seizure	2 (7%)

3.3. Intracranial abscesses

All children had contrast-enhanced computed tomography (CT; 24 patients) or magnetic resonance imaging (MRI; three patients). An intracranial abscess was identified on the initial scan in 25 (93%) cases, or on repeat scanning in two (8%) cases. Abscesses were extradural in 14 (52%) cases, subdural in nine (33%) cases and parenchymal in four (15%) cases. In two cases of parenchymal abscess, there was an associated extra-axial brain abscess.

Abscesses were located in the anterior cranial fossa in 26 (96%) cases, of which 24 were anteriorly located and related to the frontal and/or ethmoid sinuses. Two were in a subfrontal position, closely related to the roof of the sphenoid sinus. There was one case of middle cranial fossa abscess, also closely related to the sphenoid sinus. Therefore, the frontal/ethmoid sinuses were implicated in 24 (89%) cases, and the sphenoid sinus in three (11%) cases.

3.4. Surgical management

All children underwent at least one ENT or neurosurgical procedure (Fig. 1). Pre- or post-septal orbital collections coincided with an intracranial abscess in five (19%) patients and were drained at the same time. 93% of initial surgery was carried out within 24 h of admission to our hospital. Three children had abscesses closely related to the sphenoid sinus (Fig. 2), which were treated with extended endoscopic sinus surgery and sphenoidotomy. One of these children had a 3 cm × 2 cm subfrontal extradural abscess related to a dehiscent sphenoid sinus roof and a 3 cm × 3 cm frontal parenchymal abscess that required CT stealth-guided drainage (Fig. 3).

At the first surgical sitting, the offending frontal/sphenoid sinus was entered in 16 (59%) cases. This was via extended endoscopic sinus surgery (with frontal recess clearance or sphenoidotomy), trephination, or with cranialisation of the frontal sinus. The remaining 11 patients had only a limited endoscopic procedure or inferior meatal puncture, without entry into the frontal sinus by any approach. These patients had longer length of stay (25.7 ± 8.7 vs. 17.3 ± 9.0 days; $p = 0.011$).

3.5. Conservative management

Six (22%) patients with small intracranial abscesses and no focal neurological deficits were initially managed with a conservative neurosurgical approach (Fig. 1). Three of these children would later go on to require craniotomies for abscesses refractory to medical management. The remaining three patients were successfully treated conservatively; two of these patients had small extradural abscesses and one had a 1 cm parcenchymal abscess. Length of stay was longer in patients who were initially treated with a conservative neurosurgical approach, compared to those treated with joint neurosurgical and ENT approach (27.3 ± 13.6 days vs. 18.7 ± 7.4 days; $p = 0.025$). A conservative ENT approach was adopted in three (11%) cases. However, these children had all undergone cranialisation of the frontal sinus by the neurosurgical team.

3.6. Medical complications & management

CT-venograms were performed in four (15%) children in whom there was suspicion of venous sinus thrombosis on initial CT-scan. There were confirmatory findings of non-occlusive superior sagittal sinus thrombosis in three cases (Fig. 4). These children

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