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Clinical presentation of acute rhinosinusitis in children reflects paranasal sinus development*

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SUMMARY

Background: *Acute rhinosinusitis (ARS) usually presents with respiratory symptoms that persist for more than 10 days without improving. The aim of the study was to establish whether age may have any influence on the clinical presentation during childhood.*
Methods: *This prospective study evaluated 287 consecutive children (152 males and 135 females, aged between 2 and 15 years), in whom mild-moderate ARS was clinically suspected. Nasal endoscopy was performed in all of them to confirm the diagnosis.*
Results: *Endoscopy confirmed clinical diagnosis of ARS in 256 patients (89.2%). The age has shown to have significant influence on the clinical presentation pattern.*
Conclusions: *This study provides evidence that age significantly influences the clinical presentation in children with mild-moderate ARS.*

Key words: acute rhinosinusitis, clinical presentation, age, nasal endoscopy, nasal obstruction

INTRODUCTION

Acute rhinosinusitis (ARS) represents a common disorder, associated with consistent morbidity and large prescription of antibiotics [1-10]. ARS has a significant impact on clinical practice; it frequently occurs as a consequence of infectious rhinitis, which is generally caused by viral agents. It is well known that young children experience 6 to 8 viral upper respiratory infections per year, 5-10% of which may be complicated by ARS [5].

ARS is characterized by symptoms that may last several days or even up to 12 weeks. In addition, the severity may be classified as mild-moderate or severe [3,4]. The main symptoms include purulent rhinorrhea (both anterior and posterior), nasal obstruction, cough, headache and halitosis [1,3-7,10]. Unless ARS is adequately diagnosed and treated, it may lead to both chronic rhinosinusitis and severe complications (potentially also life-threatening), even though it is initially mild-moderate. Thus, it is important for the pediatrician to promptly recognize ARS. In this regard, the 10-day mark, that is to say the presence of respiratory symptoms for longer than 10 days without any improvement, is considered a reliable criterion to clinically differentiate simple upper respiratory viral infection from ARS [12].

The development pattern of paranasal sinuses has to be considered as very important too. Indeed, it widely varies according to the subject as well as to his age, the ethmoid sinuses being the first to fully develop, sequentially followed by maxillary, sphenoid, and frontal sinuses. Each sinus has a rapid rate of development during specified age cohorts [2,9].

Thus, the aim of this study was to establish whether age may have any influence on the clinical presentation of ARS in children.

MATERIALS AND METHODS

Patients

This prospective study evaluated 287 children (152 males and 135 females, aged between 2 and 15 years), initially seen by a general paediatrician and then sent to our Paediatric Department, with suspected diagnosis of mild-moderate ARS. Acute cases of ARS were not studied but directly referred to the Emergency Room or to an ENT specialist.

Diagnosis

Diagnostic criteria were based on the presence of two major symptoms or one major and at least two minor ones according to validated guidelines [1,3,4,10]. Major symptoms include mucopurulent anterior rhinorrhea, posterior nasal discharge (i.e. the post-nasal drip), and nasal obstruction, whereas minor symptoms include headache, cough, and halitosis [1,3,4,10]. Dry cough was defined by the presence of an attack of non-productive cough, whereas wet cough was characterized by the presence of productive cough associated with phlegm. Mucoid rhinorrhea was characterized by clear mucus discharge, whereas purulent rhinorrhea was characterized by yellow-green material. The post-nasal drip was characterized in smaller children by

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the need of clearing up the throat. Nasal obstruction was characterized by oral breathing and rhinolalia, and in youngest by bothering respiration and perturbation.
Very young children obviously do not verbalize headache, but the pain and discomfort adults call headache is often manifested by various behavioural changes in these patients; nevertheless, if a parent of a 2-year-old patient wasn't sure whether the child had been experiencing headache or not, the answer was counted as "no" or "cannot evaluate" in the data analysis.
Specific requirements were that their symptoms had to persist for at least 10 days, no treatment (including antibiotic, decongestant, antihistamine, and nasal steroid) had been prescribed yet, and symptoms severity had to be mild-moderate.
On admission, a detailed clinical history was recorded for each patient (reported symptoms are summarized in Table 1), and a complete physical examination was carried out by an allergist-paediatrician. Patients were also evaluated by an ENT specialist, who performed nasal endoscopy with optical fibers according to validated criteria [11]. Endoscopic diagnosis of ARS was based on the evidence of purulent discharge from the ostiomeatal and/or spheno-ethmoidal complex, according to validated criteria [8,11]. The presence of pus on the adenoids led to the diagnosis of adenoiditis [11].

Plain radiographs were not performed, as they are not sensitive enough to formulate a clear diagnosis of ethmoiditis, sphenoiditis and adenoiditis [2,5]. According to the EEACI position paper, CT scanning was not performed as a primary step in the diagnosis of the condition but rather considered to corroborate history and endoscopic examination after medical therapy failure [3,4]. Moreover, cultures were not performed, being expensive and considered not pathognomonic.

This study was approved by our Ethical Committee and we obtained informed consent from the parents of each patient enrolled in the study.
Children were subdivided into 3 groups according to age: 120 were aged from 2 to 5 years (pre-scholar), 88 from 6 to 10 (primary school) and 79 from 11 to 15 (secondary school).

Statistics
Continuous variables were summarized as median and interquartile range (IQR) and categorical variables as counts and percentages. The Fisher exact test was used to assess the association between age group and specific signs and symptoms. The Kruskall Wallis U test was used to compare the different NS between age groups. Stata 9.1 (StataCorp, USA) was used for computation. A 2-sided p-value < 0.05 was considered statistically significant. The Bonferroni correction was applied for the post-hoc pair wise comparisons between age groups ($p < 0.017$ for statistical significance).

RESULTS
Endoscopy confirmed the clinical diagnosis of ARS in 256 out of 287 patients (89.2%). Particularly, 207 children had ARS and 49 ARS associated with adenoiditis, whereas 20 patients had isolated adenoiditis and 11 allergic rhinitis.
The individual symptoms distribution was significantly different between the 3 age groups in all instances (Table 1 and Figure 1). Cough was present in all three age groups: still, it was typically wet and at awakening for children aged from 2 to 5. This precise datum was on the other hand typical only of 9% of children aged 11-15. Clear rhinorrhea was pointed out in all three groups, but, as the youngest patients significantly presented also with mucoid and purulent rhinorrhea, this symptom tended to lower as age increased. Post nasal drip, nasal obstruction and halitosis were noticed in more than 8 out of 10 children aged 6-10 and this datum is not comparable with those collected for the groups 2-5 and 11-15 for the same symptoms. For sure, headache becomes more frequently referred as age increases.

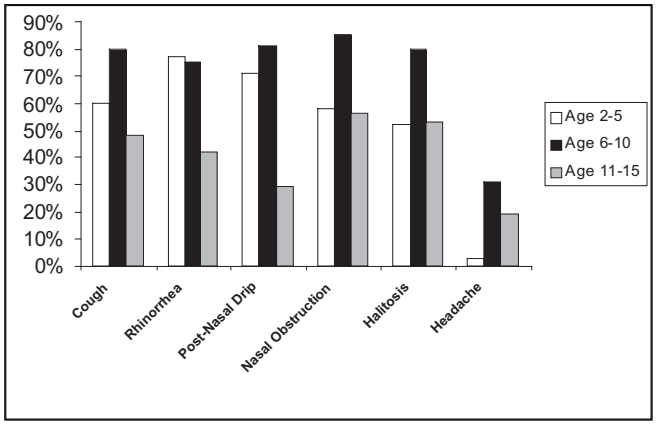

Figure 1. Acute rhinosinusitis - Clinical presentation in the three different age groups.

Table 1. Distribution of symptoms according to age groups.

	Age 2-5	Age 6-10	Age 11-15	*p-value*
MAJOR SYMPTOMS				
Rhinorrhea	93 (77%)	66 (75%)	33 (42%)	<0.001
Clear rhinorrhea	*43 (36%)*	*40 (45%)*	*26 (33%)*	*0,2*
Mucoid rhinorrhea	*35 (29%)*	*19 (22%)*	*4 (5%)*	*<0.001*
Purulent rhinorrhea	*28 (23%)*	*7 (8%)*	*3 (4%)*	*<0.001*
Post-nasal drip	85 (71%)	71 (81%)	23 (29%)	<0.001
Nasal obstruction	70 (58%)	75 (85%)	44 (56%)	<0.001
MINOR SYMPTOMS				
Halitosis	62 (52%)	70 (80%)	42 (53%)	<0.001
Headache	4 (3%)	27 (31%)	15 (19%)	<0.001
Cough	72 (60%)	70 (80%)	38 (48%)	<0.001
Dry cough	*42 (35%)*	*32 (36%)*	*29 (37%)*	*0,96*
Wet cough	*77 (64%)*	*39 (44%)*	*7 (9%)*	*<0.001*
At awakening cough	*73 (61%)*	*42 (48%)*	*7 (9%)*	*<0.001*

DISCUSSION
This study confirms that clinical diagnosis is a simple and practical way to suspect ARS, given that in 90% of the cases, this suspicion is confirmed by nasal endoscopy. Endoscopy directly

visualizes purulent discharge from the ostiomeatal complex through which the frontal, anterior ethmoid and maxillary sinuses drain. It also allows to visualize the spheno-ethmoidal complex into which the posterior ethmoid and the sphenoid drain. A clear anatomic diagnosis can thus be made. Therefore, this study strengthens a previous report, as nasal endoscopy gives a more reliable diagnosis of rhinosinusitis than X-ray. Indeed, we must emphasise that plain radiological examination is inadequate in diagnosing ethmoiditis, sphenoiditis, and adenoidits, besides being unsafe for children [3,4,12].

Moreover, this study provides evidence that age significantly affects clinical presentation. This phenomenon may be partially due to the dynamic growth of paranasal sinuses. Indeed, children's nasal cavity and paranasal sinuses, if compared to adults' ones, differ not only in size but also in proportion. Knowing the peculiar anatomy and the pneumatization of children's sinuses is an important prerequisite to understand the pathogenesis as well as the presentation and the complications of rhinosinusitis.

The development of the maxillary and ethmoidal sinuses begins during the third month of gestation, so that these sinuses are normally present when the baby is born. In small children, thus, the ethmoid and the maxillary sinuses are the most frequent infection sites. On the other hand, considering the frontal and sphenoidal sinuses, they begin to develop at the age of 3, but they are only rudimentary until the child is 5 or 6 years old. Indeed, the frontal and sphenoidal sinuses are not completely developed until late adolescence [2,9]. It comes with these considerations that even paranasal sinus complications vary with age and sinus development; we could actually notice subperiosteal ophthalmic abscess from ethmoid sinus in younger children or epidural and brain abscesses from frontal sinuses in pre-teens and adolescents. As a matter of fact, we have detected the prevalence of "nasal" symptoms in younger children (2-5 and 6-10 years old), in which only maxillary and ethmoidal sinuses are already fully developed. Nasal symptoms are associated with cough because of the persistence of mucus in the nasal cavity and the post nasal drip. Although complete development of the sinuses does not occur until late adolescence, as soon as there is a sinus cavity it can become infected and generate complications. Indeed, this is usually the case for frontal and sphenoid sinus complications which begin in late childhood/pre-adolescence years, as we have noticed by the presence of headache that is more evident in the 6-10 and 11-15 years old patients groups.

Also, another important issue is that it is difficult to define ARS in children 2-6 years old. This study demonstrates that a detailed clinical history should be careful recorded and that parents must be questioned with attention over those symptoms that are prevalent at this age.

In conclusion, this study provides evidence that age significantly influences clinical presentation in children with mild-moderate ARS. This statement may help the physician to better manage children with ARS.

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