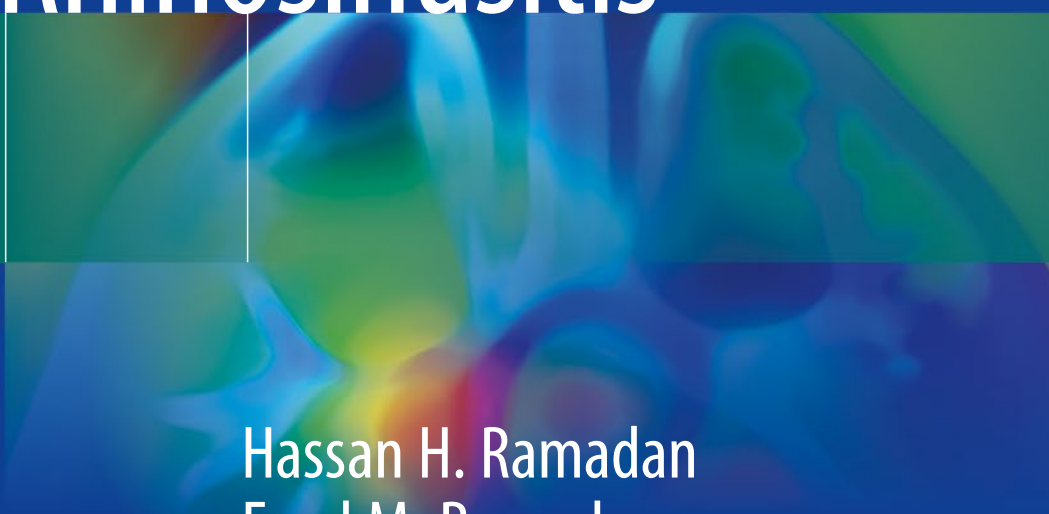
Pediatric Rhinosinusitis



Hassan H. Ramadan
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Editors

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Part I
Definitions and Basics

Chapter 1
Definitions and Clinical Signs and Symptoms

Andrea Shogan and Fuad M. Baroody

Rhinosinusitis (RS) in pediatric patients can be difficult to diagnose due to its similarity with other common conditions such as allergic rhinitis, viral upper respiratory infections, and adenoiditis. It is more broadly defined as inflammation of the nose and paranasal sinuses and has a negative impact on the quality of life of patients and can substantially impair their daily function [1]. The study by Cunningham et al. in 2000 demonstrates that parents of children diagnosed with RS perceived their children to have more bodily pain and to have more limited physical activity than other children with chronic diseases such as asthma or juvenile rheumatoid arthritis [1].

Current guidelines state that a clinical diagnosis of RS can be made in children if they have two or more of the following symptoms, with one of them being either nasal blockage, obstruction, congestion, or nasal discharge and either facial pain or cough [2]. The clinical symptoms have to be accompanied with objective signs that are determined by either nasal endoscopy, with signs of nasal polyps, mucopurulent discharge from the middle meatus, or edema/mucosal obstruction from middle meatus, or computed tomography (CT) of the sinuses demonstrating mucosal changes within the ostiomeatal complex and/or sinuses [2, 3].

RS is further classified, based on the duration of the illness itself. Acute rhinosinusitis (ARS) lasts less than 4 weeks with complete resolution of symptoms, and chronic rhinosinusitis (CRS) is defined as inflammation of the nose and paranasal sinuses with symptoms that last greater than 12 weeks without complete resolution. Recurrent acute rhinosinusitis is defined as four of more episodes of ARS per year with resolution of symptoms between each episode.

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Acute Rhinosinusitis

Acute rhinosinusitis (ARS) often occurs after a viral upper respiratory illness (URI). Pediatric patients can experience up to seven to ten URIs per year and approximately 5–13% of viral URIs will progress to acute bacterial rhinosinusitis [4]. The peak age of occurrence of bacterial rhinosinusitis is between 3 and 6 years which correlates with the peak incidence of viral upper respiratory infections [5]. A study by Marom et al. also found that girls more frequently developed acute bacterial rhinosinusitis (ABRS) and had more recurrent bouts of ABRS [6]. ARS is defined as the sudden onset of two or more of the following symptoms: nasal blockage/obstruction/congestion, discolored nasal drainage, and/or cough [2].

ARS can be further subdivided into acute viral rhinosinusitis, acute post viral rhinosinusitis, and acute bacterial rhinosinusitis. Patients with acute viral rhinosinusitis have the signs and symptoms of acute rhinosinusitis that commonly last for 5–7 days but less than 10 days, just as do the symptoms of a URI [7–9]. An important point in this context is that the paranasal sinuses are involved even during routine URIs, thus the term, rhinosinusitis, to describe this clinical entity. Kristo and colleagues investigated 60 children (mean age = 5.7 years) who had acute URI symptoms for an average of 6 days before MRI scanning [10]. Approximately 60% of the children had abnormalities in their maxillary and ethmoid sinuses, 35% in the sphenoid sinuses, and 18% in the frontal sinuses. In 26 children with major abnormalities, a follow-up MRI scan taken 2 weeks later showed a significant reduction in the extent of abnormalities irrespective of resolution of clinical symptoms. Similarly, sinus involvement occurs in over 50% of adults evaluated during a URI with spontaneous improvement after symptom resolution [11]. These studies reinforce the notion that every upper respiratory tract infection is essentially a self-limited episode of rhinosinusitis with common involvement of the paranasal sinuses by the viral process. A few of these episodes will evolve into acute bacterial rhinosinusitis as outlined above and those will usually require more than expectant management (Fig. 1.1).

Acute post-viral rhinosinusitis is seen when there is worsening of symptoms after 5 days or persistent symptoms longer than 10 days (Fig. 1.2). ABRS is defined as a persistent illness for more than 10 days, worsening course, double sickening (deterioration after an initial milder phase of illness or a new fever after the sixth or seventh day of illness) [7], or severe onset of fever and purulent nasal discharge for at least 3 consecutive days [8]. The symptoms of ABRS include purulent anterior or posterior nasal discharge, nasal congestion, or and daytime or nighttime cough [9]. ABRS is the fifth most common condition for which an antibiotic is prescribed in the United States [12]. The most common pathogens involved in acute bacterial rhinosinusitis are *Streptococcus pneumonia*, *Haemophilus influenzae*, and *Moraxella catarrhalis* [13].

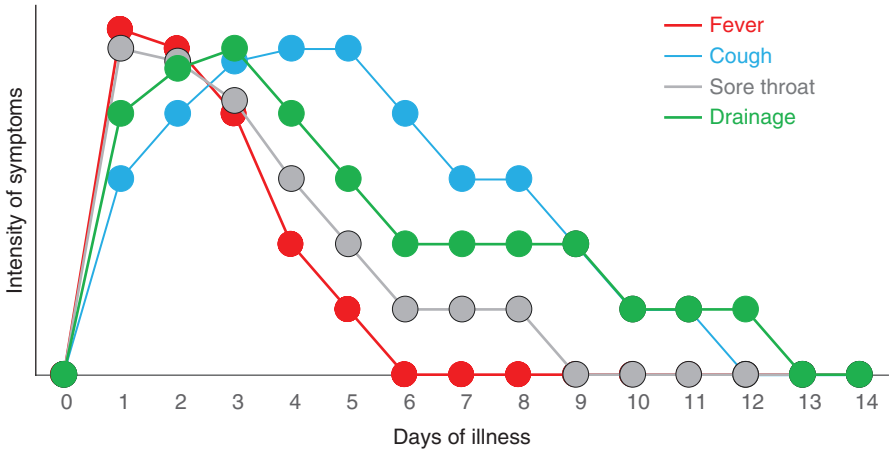

Fig. 1.1 Chronology of symptoms during viral upper respiratory tract infections. Fever and sore throat peak earliest and are the shortest lasting. Cough and nasal drainage peak later in the course of a viral URI and last longer. In uncomplicated URIs, most symptoms resolve within 10–12 days of onset

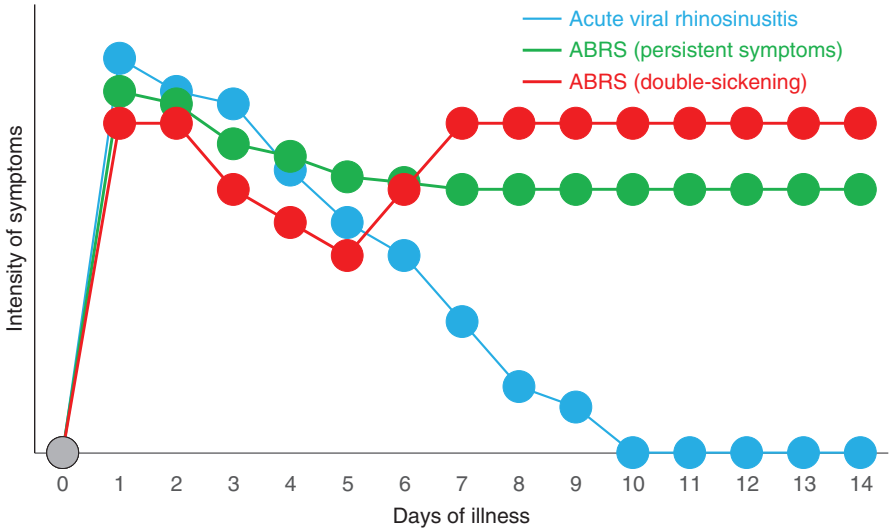

Fig. 1.2 Symptom chronology in viral URI and acute bacterial rhinosinusitis (ABRS). Most of the symptoms of a viral URI resolve within 10 days of illness. Two scenarios justify making the clinical diagnosis of ABRS: symptoms of an URI lasting longer than the typical 10 days and the double-sickening scenario where symptoms of a viral illness start to resolve only to re-exacerbate

Recurrent Acute Rhinosinusitis

Recurrent acute rhinosinusitis (RAR) is defined as multiple episodes of acute sinusitis in which the signs and symptoms of infection resolve completely in between episodes. It is most commonly four or more episodes of ARS per year with episodes separated by at least 10 days. During these periods of at least 10 days, the patient is asymptomatic with no signs and symptoms of ARS. The episodes themselves must meet the definition of ARS [14]. Factors that seem to predispose patients to RAR are older pediatric patients, allergy, atopy, and asthma. These factors are also associated with an increase chance of developing chronic rhinosinusitis [15]. A study by Brooks et al. in 2004 found that the most common pathogens identified in patients with RAR were the same as those isolated in individuals with ARS, *Streptococcus pneumonia*, *Haemophilus influenzae*, and *Moraxella catarrhalis*, yet there was an increase in antimicrobial resistance [16].

Treatment for RAR can be both medical as well as surgical. A literature review by Michalowski and Kacker found that patients with four to six episodes of acute sinusitis that last for 4 weeks or less would benefit from surgical intervention [14]. They recommended that the patients be seen in the office during one of these episodes to confirm the diagnosis and be treated with both intranasal and oral steroids and have a CT scan done prior to proceeding with endoscopic sinus surgery. The extent of the surgery can be limited to bilateral maxillary antrostomies as well as anterior ethmoidectomies and addressing any additional abnormalities identified on the CT scan [14].

Chronic Rhinosinusitis

Chronic rhinosinusitis (CRS) in pediatric patients can often be mistaken for other common clinical entities just like ARS. It is defined as at least 90 days of two or more symptoms of purulent rhinorrhea, nasal obstruction, facial pressure/pain, or cough. You must also have either endoscopic signs of mucosal edema, purulent drainage, or nasal polyposis and/or CT scan showing mucosal changes within the ostiomeatal complex and/or sinuses [4]. Patients with immune deficiency, cystic fibrosis, ciliary dyskinesia, and anatomic abnormalities often have chronic rhinosinusitis [17]. After obtaining either endoscopic and/or CT scan findings, CRS can be further subdivided into chronic rhinosinusitis with nasal polyposis or chronic rhinosinusitis without nasal polyposis. Polyps are not a common occurrence in children in the United States and prompt further evaluation to rule out cystic fibrosis or allergic fungal rhinosinusitis. They do sometimes occur in the context of severe asthma. The most common clinical symptoms of pediatric CRS are cough, rhinorrhea, nasal congestion, and postnasal drip.

It is often difficult to distinguish chronic rhinosinusitis from adenoiditis based on symptoms and physical exam findings only. CT scan findings have been shown to

be useful and a Lund Mackay score of 4 or more is considered more consistent with CRS [18]. In a chart review from a tertiary care facility with pediatric patients who presented with symptoms consistent with CRS, Purnell and colleagues identified those with CRS vs those with adenoiditis based on their CT scores as mentioned above [19]. They then analyzed the symptoms to see if any specific symptom complex was likely to differentiate the two entities. Of the 99 pediatric patients included, 22 patients had a diagnosis of adenoiditis and 77 had a diagnosis of CRS. When purulent rhinorrhea was present with facial pain, CRS was statistically more prevalent than chronic adenoiditis. Other symptoms including cough, rhinorrhea, and facial pressure were not predictive of one diagnosis over the other. The authors concluded that purulent rhinorrhea in the presence of facial pain is more indicative of CRS versus chronic adenoiditis.

The age when a patient develops CRS helps to determine contributing factors as well as their management. For example, adenoiditis is a prominent factor in CRS in younger pediatric patients while allergic rhinitis is more important in older children. Unlike ABRS, a study by Brooks et al. identified that CRS is most commonly caused by anaerobic organisms in adult patients. However, aerobic organisms that cause ABRS can appear in some acute exacerbations of CRS [20]. Studies to determine the microbiology of chronic sinusitis have been done in adult patients and have yet to be reproduced in the pediatric population.

The clinical consensus statement on pediatric CRS states that medical treatment consists of 20 days of an appropriate broad-spectrum antibiotic (culture-directed choice is encouraged when possible) in addition to daily intranasal steroids and saline irrigations. For patients who fail medical therapy, adenoidectomy should be considered the first-line surgical treatment in patients up to 12 years of age and then endoscopic sinus surgery should be considered [4]. Clearly individualized care decisions are guided by the treating otolaryngologist within these general guidelines.

Being able to correctly identify and categorize a patient's RS will help the clinician to better treat both the patient and their family. ARS responds well to conservative management and antibiotic treatment once it becomes bacterial. For CRS, culture-directed antibiotic treatment as well as daily intranasal steroids and irrigations are first-line treatment. Identifying any underlying medical problems that are contributing to a patient's RS will help to guide treatment as well.

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Chapter 2
Burden and Health Impact of Pediatric Rhinosinusitis

Aimee A. Kennedy and Mark E. Gerber

Prevalence of Pediatric Rhinosinusitis

The exact prevalence of pediatric rhinosinusitis is difficult to estimate. The reason for this difficulty is twofold. First, many episodes of rhinosinusitis will resolve without the patient seeking medical attention, and therefore, these cases will not be captured by reviews of office- or emergency-based visits. Secondly, for the patients who do present for medical care, there is a high potential for misdiagnosis as the signs and symptoms of rhinosinusitis mimic other common pediatric conditions such as allergic rhinitis, adenoiditis, and other upper respiratory tract infections. According to the consensus statement from the American Academy of Otolaryngology, in order to definitively diagnose chronic rhinosinusitis, there must be 90 consecutive days with 2 or more subjective symptoms (nasal congestion, nasal discharge, facial pressure/pain, or cough) and objective evidence of inflammation either on endoscopy or computed tomography (CT) scan [1]. Differentiating between recurrent upper respiratory infections and persistent sinusitis symptoms over 90 days in duration can be difficult in children. In addition, depending on the healthcare setting in which the patient presents, obtaining objective evidence of inflammation may not be possible. In these cases, the diagnosis of rhinosinusitis must be made on symptoms and other exam findings alone.

Most episodes of acute rhinosinusitis (ARS) develop from an upper respiratory tract infection (URI). The average child will experience between 6 and 8 URIs per

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year, of which 5–13% will be complicated by acute sinusitis [2]. Numerous factors increase the likelihood of developing rhinosinusitis either through increased exposure to pathogens or disruption of normal immune functions. One factor consistently linked with increased risk in young children is daycare attendance. Children in daycare have a 2.2 times higher likelihood of being diagnosed with acute sinusitis, which is significant considering that at least 65% of children in the United States attend some form of daycare [3, 4]. Cigarette smoke exposure has also been linked to the development of both ARS and chronic rhinosinusitis (CRS) [5, 6]. Smoke exposure increases local inflammatory mediators, alters the ciliary beat in sinonasal epithelium [3], and aids in the formation of robust biofilms [7]. Many studies have sought to find a link between allergic rhinitis and development of acute and chronic rhinosinusitis; however, no consistent increased risk has been found. Recent cohort studies have concluded that a history of atopy does not predict an increased risk of ARS or CRS development [8, 9]. For CRS, a positive family history can significantly increase a patient's risk for developing the disease. The likelihood of developing CRS is approximately 57.5-fold higher if a sibling has been diagnosed, 5.6-fold higher if a parent has been diagnosed, and ninefold higher if a first cousin has been diagnosed [10]. Several other risk factors have been examined as likely contributors to development of sinusitis and chronic rhinosinusitis, including anatomic abnormalities, gastroesophageal reflux, and systemic medical conditions such as cystic fibrosis, primary ciliary dyskinesia, and immune deficiency [11].

Several large database and cohort-based studies have sought to quantify the prevalence of ARS in the pediatric population. In a prospective cohort study following over 3000 children at a primary care pediatric practice, 9.3% of children over 5 years old and 7.2% of children less than 5 years old were noted to develop ARS [6]. Similarly, a separate cohort study which screened over 1300 patients presenting to a primary care clinic for sinonasal symptoms found that 10% of children between 1 and 5 years of age met clinical criteria for sinusitis, and of the patients presenting specifically with URI symptoms, 17% of those patients had sinusitis [12]. A Swedish cohort survey of 13–14-year-olds found a 12% prevalence of current ARS symptoms [13]. With respect to databases, both the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) have been used. Both are comprised of large surveys administered annually by the National Center for Health Statistics. The NAMCS includes data related to ambulatory care visits to office-based physicians, while the NHAMCS includes data on visits to hospital- and outpatient-based emergency centers. A review of these databases from 2005 to 2012 found an average of 1.6 million visits per year for ARS, which comprised approximately 0.6% of the total visits for all pediatric encounters [14]. For comparison, the visit rate for other common pediatric conditions were 2.6% for allergic rhinitis, 8% for upper respiratory infections, and 6.7% for otitis media [14]. In summary, despite the difficulty with estimating prevalence of ARS, based on the literature, the rate falls somewhere between 7% and 12%, with a lower annual visit burden when compared to other more common pediatric conditions.

For patients with ARS, if the symptoms persist for over 12 weeks, they are considered to have chronic rhinosinusitis (CRS). The prevalence of CRS is well documented in the adult literature, with estimates between 8% and 10% of adults being affected [15, 16]. In the pediatric literature, a prospective cohort study following 3112 Swedish children from birth until 16 years of age, found 1.5% of patients had symptoms of CRS on self-reported survey [17]. At the time of follow-up, only 0.8% had continued symptoms of CRS, and of those patients, endoscopic evidence of CRS was seen in 0.3% [17]. Despite the overall low prevalence of CRS, findings from the NAMCS and NHAMCS database review found between 3.7 and 7.5 million visits per year, which comprised 2.1% of all pediatric ambulatory encounters [14]. Visits for CRS were more common than for ARS across all age groups and became more common than visits for otitis media in the 15–20-year-old age groups. In a study of children with chronic respiratory complains, 63% of them were noted to have sinus disease on CT imaging, with lower age being the most significant predictor of positive CT findings [18]. Similarly, a review of CT scans performed on 196 children with sinonasal symptoms showed that the severity and number of involved sinuses decreased with increasing age [19]. In summary, while CRS is less prevalent than ARS, with less than 1.5% of children meeting criteria, the number of ambulatory visits and healthcare utilization is higher.

Quality of Life Impact

Rhinosinusitis is an inflammatory disease of the nose and paranasal sinuses which may present with purulent nasal discharge, cough, headache, irritability, facial pain, fevers, and/or postnasal drip. In younger patients, the predominant symptoms tend to be purulent rhinorrhea and congestion, whereas in older patients, congestion, postnasal drip, and sore throat related to chronic drainage tend to predominate. Even with adequate treatment of an acute episode, these symptoms can last up to 3 weeks. For patients with CRS, these symptoms can last for years. For patients with rhinosinusitis, particularly CRS, they can have a significantly impaired health-related quality of life. In a study by Cunningham et al. in 2000, the Child Health Questionnaire (CHQ) was given to patients with CRS and their caregivers [20]. These responses were then compared to previously reported healthy controls. The caregivers reported significant reductions in the child's ability to participate in physical activities, perception of overall health, bodily pain, limitations in personal time due to the condition, guardian distress regarding the child's condition, and mental health problems. The children with CRS reported significantly worse body pain scores and limitations in school-related activities and activities with friends. The differences between the CHQ data for the caregivers versus the patients indicates that there is a discrepancy in perception of how significantly CRS is affecting the health-related quality of life. Interestingly, when CRS was compared to other common chronic pediatric conditions such as attention-deficit/hyperactivity disorder (ADHD), psychiatric disorders, juvenile rheumatoid arthritis, epilepsy, and asthma, the CRS children and