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Review

An Overview of Surgical Approaches to Pediatric Chronic Sinusitis for Primary Care Providers

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Abstract: Pediatric chronic rhinosinusitis is a common condition amongst pediatric patients. Despite its prevalence, debate continues regarding the best treatment strategies. The current paper examines the literature as it pertains to the surgical management of pediatric chronic rhinosinusitis. Adenoidectomy remains the mainstay in the initial surgical management. Both maxillary sinus irrigation and balloon dilation of the sinuses have been studied with disagreement as to the timing and patient selection for those procedures. Functional endoscopic sinus surgery is an accepted treatment modality, especially in initial surgical failures. Further studies will be needed to better delineate patient selection and timing of specific surgical techniques.

Keywords: pediatric chronic rhinosinusitis; adenoidectomy; maxillary sinus irrigation; balloon catheter sinuplasty; functional endoscopic sinus surgery

1. Introduction

Pediatric chronic rhinosinusitis (PCRS) is a common condition encountered in clinical practice. A recent study by Gilani and Shin found 2.1% of ambulatory health care visits involving patients younger than 20 years of age included a diagnosis for PCRS [1]. Despite its prevalence, appropriate treatment remains elusive. Multiple consensus statements are present in the literature, each providing a somewhat different recommendation on the best practices as it pertains to the treatment of PCRS [2–4].

Adding to the uncertainty regarding the treatment is the definition. While specifics may vary, definitions often include 90 days of continuous symptoms (purulent rhinorrhea, nasal obstruction, facial pain/pressure, cough) and endoscopic findings of edema, purulent rhinorrhea, or polyps and/or CT findings of mucosal changes in the sinuses or ostiomeatal complex [2,3]. Pediatric patients present unique challenges when making a diagnosis based on the above criteria. The ability of a child to cooperate with nasal endoscopy or CT can be beyond their developmental capabilities. In addition, his or her ability to identify pain/pressure or nasal obstruction can also be difficult.

After making the diagnosis of PCRS, treatment recommendations can vary based on the source utilized. It is accepted that surgical approaches are indicated after failure of maximal medical therapy. What constitutes maximal medical therapy, however, differs in the literature. It is beyond the scope of the current paper to further define maximal medical therapy. It is also beyond the scope of this paper to examine the treatment of pediatric patients with certain conditions, such as cystic fibrosis or ciliary dyskinesia, which will predispose them to PCRS. The current paper seeks to examine the current literature as it pertains to the surgical management of PCRS.

2. Adenoidectomy

The adenoids are felt to be a bacterial reservoir in PCRS [4]. Adenoidectomy is therefore a commonly performed procedure in the treatment of PCRS. A pediatric clinical consensus statement provided strong support for the use of adenoidectomy in patients under 6 years of age with less

consensus for patients aged 6–12 years of age [2]. Agreement was reached that it can be effective even when done as a standalone procedure [2].

It is also a largely successful operation for PCRS. When adenoidectomy is examined alone in the treatment of PCRS, a meta-analysis showed 69.3% of patients showed an improvement in symptoms [5]. The relatively high success rate and routine nature of the surgery make it a mainstay in the treatment of medically refractory PCRS. A recent survey of both American Society of Pediatric Otolaryngology (ASPO) and American Rhinologic Society (ARS) members reveals it is indeed a commonly employed tool. A total of 94% of respondents include adenoidectomy in the initial surgical management of PCRS [6]. Any surgical management of PCRS, especially in children under age six, should include consideration of adenoidectomy.

Adenoidectomy is a relatively simple operation with minimal morbidity. Multiple techniques exist for adenoidectomy, including curette, electrocautery, microdebrider, and coblator. A recent study compared electrocautery, microdebrider, and coblator [7]. It found electrocautery to be associated with a lower cost and comparable complication rate to the other techniques. A previous meta-analysis compared electrocautery to curettage [8]. It found electrocautery to be associated with decreased intraoperative hemorrhage and time. These studies indicate that suction electrocautery remains the most cost-effective option with comparable to decreased risk profiles when compared to other techniques.

3. Maxillary Sinus Irrigation

An adjunct procedure to adenoidectomy is maxillary sinus puncture and irrigation. A recent study showed it is used in 18% of cases as an addition to adenoidectomy in the initial treatment of PCRS [6]. The goal of this procedure is twofold. One, it is meant to obtain cultures to help direct antibiotic therapy. When compared to endoscopically guided middle meatal cultures with antral biopsy, both were equally effective in obtaining cultures [9]. The second goal of the procedure is therapeutic as it also allows for the irrigation of the trapped mucous within the sinus [9].

Various techniques for this procedure have been described. An inferior meatal puncture can be done by creating a new opening into the maxillary sinus through the inferior meatus. This does not involve the access of any anatomic openings but rather creates a new one. It can also be done using endoscopic guidance using a 45 degree needle through the middle meatus [10]. A more recent procedure involves the use a sinus balloon catheter [11]. This technique involves accessing the maxillary sinus via the middle meatus using endoscopic guidance. Entry into the maxillary sinus is confirmed via transillumination. The authors propose several advantages of the catheter, including no alteration of the normal anatomy and confirmation of entry into the maxillary sinus [11].

A study by Ramadan and Cost showed adding maxillary sinus puncture and irrigation with adenoidectomy improved outcomes when compared to adenoidectomy alone [10]. The authors in this paper utilized a needle to access the maxillary sinus via the middle meatus. At one year, 60.7% of the adenoidectomy alone group showed improvement compared to 87.5% of the adenoidectomy and irrigation group [10].

Maxillary sinus irrigation does carry increased surgical risk, however, when compared to adenoidectomy alone. All techniques carry some risk of epistaxis, pseudoproptosis, and orbital hemorrhage. These complication risks, and the desire to be less aggressive in the surgical management of PCRS, may explain why this is not commonly employed in the initial surgical management of PCRS.

4. Balloon Catheter Sinuplasty

Balloon catheters are a relatively new addition to the treatment armamentarium for PCRS. It involves a similar procedure described above to irrigate the sinus via placement of a catheter through the natural ostium into the sinus. While in its infancy the guidewire position was confirmed radiographically, this is generally no longer required with the addition of the lighted guidewires (transillumination). Dilation is added via a balloon (diameter can vary) to widen a sinus ostium.

The goals of balloon catheter sinuplasty (BCS) are to restore sinus ventilation and drainage pathways while preserving mucosa. It is performed as an adjunct to adenoidectomy in approximately 10% of surgeries for the initial management of PCRS [6].

The procedure is considered minimally invasive as it does not require the removal of any tissue from the patient. The minimally invasive nature of the procedure makes it attractive for PCRS. It does have some limitations. It is typically performed with endoscopic guidance, but placement of the guidewire lateral to the uncinate is done blindly. If accessory ostia are present, these can be inadvertently dilated. The relatively small size of the middle meatus in children can also predispose them to synechia formation.

Studies have shown it to be an effective tool in both the initial treatment of PCRS as well as in patients who have failed adenoidectomy [12,13]. In the initial management of PCRS, BCS, and adenoidectomy was noted to improve symptoms in 80% of patients [12]. It was technically feasible with over 90% of sinuses successfully cannulated. The success rate remained around 80% when revision cases were examined [13]. No complications were noted in either study.

The ultimate efficacy of BCS remains debated [14]. No clinical consensus could be reached regarding its effectiveness [2]. A recent American Academy of Otolaryngology Head and Neck Surgery clinical consensus statement regarding balloon dilation excluded recommendations related to patients under 18 [15]. Thottam et al. compared traditional sinus surgery to BCS with traditional ethmoidectomy [16]. They found similar success rates between the two procedures. The addition of the traditional ethmoidectomy in this study lessens the minimally invasive advantages of BCS and illustrates the limitation BCS offers to address ethmoid disease. Future studies will be needed to better define what role BCS should occupy in the treatment of PCRS.

5. Endoscpic Sinus Surgery

Endoscopic sinus surgery (ESS) is an important tool in the treatment of PCRS. The goals of endoscopic sinus surgery (for all patients) are twofold: open natural sinus pathways and preserve mucosa [3]. While it is utilized in the initial management of PCRS (8%), it is performed nearly 90% of the time when operating after initial surgical management (e.g., adenoidectomy) fails [6].

ESS, when used in appropriate patients, is an effective treatment [2]. A PubMed review of 11 articles regarding ESS outcomes showed a success rate of 82–100% [17]. A second meta-analysis examining the impact ESS has on quality of life measures for pediatric patients with PCRS showed a benefit [17]. The meta-analysis included 15 studies involving 1301 treated patients. They found reported ESS improves the quality of life in 71–100% of operated children [18].

The risks of ESS, however, can be serious. The risks of major complications are low but carry significant morbidity. The PubMed review found a complication rate of 1.4% (6/440). The complications included two orbital entries, two periorbital ecchymosis, one severe bleeding, and one orbital fat extrusion [17]. A second study found the risk of major complications (bleeding, cerebral spinal fluid leak, and meningitis) was 0.6% [18].

Concerns initially existed regarding the potential effects on facial growth. Bothwell et al. compared 67 children, 46 who had undergone ESS and 21 who had not had any surgery. No significant difference was noted in facial growth was seen between the two groups [19]. In sum, concerns regarding facial growth have been "unsubstantiated" [14].

Pediatric patients also present a unique dilemma regarding the appropriate post op management. In adult patients, the surgical area is typically endoscopically debrided under local anesthesia. In older children, debridement can be performed awake. In younger children, however, this is generally not possible. Several studies have looked at the utility of a 'second look' procedure in children. Walner et al. did not find an increased risk of a revision ESS in patients who did not have a debridement when compared to those who did [20]. It is not felt debridement is routinely necessary for pediatric ESS patients [2].

The high success rate but risk of serious complications (albeit rare) in ESS creates a clinical dilemma. Agreement exists that ESS is the treatment of choice if initial surgical management fails [6]. The relatively high success rates of adenoidectomy alone make any decision to include ESS in the initial surgical management a difficult one. The clinical consensus statement agrees, concluding that while ESS is effective it should be reserved until after adenoidectomy [2].

6. Conclusions

PCRS presents multiple diagnostic and clinical challenges. Despite the prevalence of PCRS, the optimal management protocol, both medical and surgical, remains elusive. Agreement exists that surgery should be reserved for patients who fail medical management. Agreement also exists that for children under age 6 the initial surgical management should include adenoidectomy. ESS is an effective surgical option and is the treatment of choice for surgical failures. The use of other procedures (e.g., maxillary irrigation, balloon sinuplasty) in the initial management of PCRS is currently debated in the literature. Further studies are needed to determine the timing and patient selection for specific surgical techniques.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Gilani, S.; Shin, J. The Burden and Visit Prevalence of Pediatric Chronic Rhinosinusitis. *Otolaryngol. Head Neck Surg.* **2017**, *157*, 1048–1052. [CrossRef] [PubMed]
2. Brietzke, S.E.; Shin, J.J.; Choi, S.; Lee, J.T.; Parikh, S.R.; Pena, M.; Prager, J.D.; Ramadan, H.; Veling, M.; Corrigan, M.; et al. Clinical consensus statement: Pediatric chronic rhinosinusitis. *Otolaryngol. Head Neck Surg.* **2014**, *151*, 542–553. [CrossRef] [PubMed]
3. Fokkens, W.J.; Lund, V.J.; Mullol, J.; Bachert, C.; Alobid, I.; Baroody, F.; Cohen, N.; Cervin, A.; Douglas, R.; Gevaert, P.; et al. EPOS 2012: European position paper on rhinosinusitis and nasal polyps 2012. *Rhinology* **2012**, *50*, 1–12. [PubMed]
4. Orlandi, R.R.; Kingdom, T.T.; Hwang, P.H.; Smith, T.L.; Alt, J.A.; Baroody, F.M.; Batra, P.S.; Bernal-Sprekelsen, M.; Bhattacharyya, N.; Chandra, R.K.; et al. International consensus statement on allergy and rhinology: Rhinosinusitis. *Int. Forum Allergy Rhinol.* **2016**, *6*, S22–S209. [CrossRef] [PubMed]
5. Brietzke, S.E.; Brigger, M.T. Adenoidectomy outcomes in pediatric rhinosinusitis: A meta-analysis. *Int. J. Ped. Otorhinolaryngol.* **2008**, *72*, 1541–1545. [CrossRef] [PubMed]
6. Beswick, D.M.; Messner, A.H.; Hwang, P.H. Pediatric chronic rhinosinusitis management in rhinologists and pediatric otolaryngologists. *Ann. Otol. Rhinol. Laryngol.* **2017**, *126*, 634–639. [CrossRef] [PubMed]
7. Sjogren, P.P.; Thomas, A.J.; Hunter, B.N.; Butterfield, J.; Gale, C.; Meier, J.D. Comparison of Pediatric Adenoidectomy Techniques. *Laryngoscope* **2018**, *128*, 745–749. [CrossRef] [PubMed]
8. Reed, J.; Sridhara, S.; Breitzke, S.E. Electrocautery adenoidectomy outcomes: A meta-analysis. *Otolaryngol. Head Neck Surg.* **2009**, *140*, 148–153. [CrossRef] [PubMed]
9. Deckard, N.A.; Kruper, G.J.; Bui, T.; Coticchia, J. Comparison of two minimally invasive techniques for treating chronic rhinosinusitis in the pediatric population. *Int. J. Pediatr. Otorhinolaryngol.* **2011**, *75*, 1296–1300. [CrossRef] [PubMed]
10. Ramadan, H.H.; Cost, J.L. Outcome of Adenoidectomy with Maxillary Sinus Wash for Chronic Rhinosinusitis in Children. *Laryngoscope* **2008**, *118*, 871–873. [CrossRef] [PubMed]
11. Zeiders, J.W.; Dahya, Z.J. Antral lavage using the Luma transillumination wire and vortex irrigator—A safe and effective advance in treating pediatric sinusitis. *Int. J. Pediatr. Otorhinolaryngol.* **2011**, *75*, 461–463. [CrossRef] [PubMed]
12. Ramadan, H.H.; Terrell, A.M. Balloon Catheter Sinuplasty and Adenoidectomy in Children with Chronic Rhinosinusitis. *Ann. Otol. Rhinol. Laryngol.* **2010**, *119*, 578–582. [CrossRef] [PubMed]
13. Ramadan, H.H.; Bueller, H.; Hster, S.T.; Terrell, A.M. Sinus Balloon Catheter Dilation after Adenoidectomy Failure for Children with Chronic Rhinosinusitis. *Arch. Otolaryngol. Head Neck Surg.* **2012**, *138*, 635–638. [CrossRef] [PubMed]

14. Sedaghat, A.R.; Cunningham, M.J. Does Balloon Catheter Sinuplasty Have a Role in Surgical Management of Pediatric Sinus Disease. *Laryngoscope* **2011**, *121*, 2053–2054. [CrossRef] [PubMed]
15. Piccirillo, J.F.; Payne, S.C.; Rosenfeld, R.M.; Baroody, F.M.; Batra, P.S.; DelGaudio, J.M.; Edelstein, D.R.; Lane, A.P.; Luong, A.U.; Manes, R.P.; et al. Clinical Consensus Statement: Balloon Dilation of the Sinuses. *Otolaryngol. Head Neck Surg.* **2018**, *158*, 203–214. [CrossRef] [PubMed]
16. Thottam, P.S.; Metz, C.M.; Kieu, M.C.; Dworkin, J.; Jagini, J.; Bangiyev, J.N.; Mehta, D. Functional Endoscopic Sinus Surgery Versus Balloon Sinuplasty with Ethmoidectomy: A 2-year Analysis in Pediatric Chronic Rhinosinusitis. *Indian J. Otolaryngol. Head Neck Surg.* **2016**, *68*, 300–306. [CrossRef] [PubMed]
17. Markary, C.A.; Ramadan, H.H. The Role of Sinus Surgery in Children. *Laryngoscope* **2013**, *123*, 1348–1352. [CrossRef] [PubMed]
18. Vlastarakos, P.V.; Fetta, M.; Segas, J.V.; Maragoudakis, P.; Nikolopoulos, T.P. Functional Endoscopic Sinus Surgery Improves Sinus-Related Symptoms and Quality of Life in Children with Chronic Rhinosinusitis: A Systematic Analysis and Meta-Analysis of Published Interventional Studies. *Clin. Pediatr.* **2013**, *52*, 1091–1097. [CrossRef] [PubMed]
19. Bothwell, M.R.; Piccirillo, J.F.; Lusk, R.P.; Ridenour, B.D. Long-term outcome of facial growth after functional endoscopic sinus surgery. *Otolaryngol. Head Neck Surg.* **2002**, *126*, 628–634. [CrossRef] [PubMed]
20. Walner, D.L.; Falciglia, M.; Willging, J.P.; Myer, C.M., 3rd. The role of second-look nasal endoscopy after pediatric functional endoscopic sinus surgery. *Arch. Otolaryngol. Head Neck Surg.* **1998**, *124*, 425–428. [CrossRef] [PubMed]