Does Balloon Catheter Sinuplasty Have a Role in the Surgical Management of Pediatric Sinus Disease?

Ahmad R. Sedaghat, MD, PhD; Michael J. Cunningham, MD

BACKGROUND

The surgical management of chronic recurrent sinusitis (CRS) recalcitrant to medical therapy in the pediatric population has traditionally consisted of adenoidectomy and functional endoscopic sinus surgery (FESS), depending on age and imaging findings. Adenoidectomy relieves nasopharyngeal airway obstruction as well as potentially eradicates a bacterial reservoir. FESS, as in adults, promotes paranasal sinus ventilation and drainage. Pediatric FESS most commonly consists of uncinectomy, maxillary antrostomy, and/or ethmoidectomy due to the relative underdevelopment of the sphenoid and especially the frontal sinuses in preadolescent children. FESS is generally considered to be safe, with major complications such as cerebrospinal fluid leak, meningitis, or orbital violation occurring in <1% of cases. Initial concerns that FESS in the pediatric population may lead to retardation of facial growth have proven to be unsubstantiated.

Balloon catheter sinuplasty (BCS) was first introduced as a therapeutic modality of CRS in adults in 2006. In BCS a guidewire, passed into the target maxillary, sphenoid, or frontal sinus under endoscopic visualization with either fluoroscopic or fiberoptic light confirmation, is used to position a deflated oblong balloon across the natural sinus ostium. This balloon is subsequently inflated to a maximum diameter of 5 to 7 mm, dilating the natural ostium.1 In contrast to FESS, BCS does not involve tissue removal and theoretically is mucosal sparing. Purported limitations of BCS include the inability to address alternative predisposing anatomical abnormalities (the uncinate process, for example, is not removed in maxillary procedures) or to treat concomitant ethmoid sinus disease. The efficacy of BCS in adults with frontal, sphenoid and maxillary sinus disease is reported to be on par with FESS, suggesting a potential role for BCS in the treatment armamentarium of pediatric rhinosinusitis as well.

LITERATURE REVIEW

Several studies have evaluated the safety,2 feasibility,2 and efficacy3,4 of BCS in children with computed tomography-confirmed CRS who did not have cystic fibrosis, ciliary dysfunction, or obvious anatomic derangements. Each of these studies involved a single prospective cohort of children undergoing BCS. In those studies assessing efficacy,3,4 clinical outcomes were measured using a previously validated sinonasal (SN)-5 questionnaire evaluating five symptom categories: sinus infection, nasal obstruction, allergy symptoms, emotional distress, and activity limitations. SN-5 scores were reported at the 52-week time point with successful intervention defined as a 0.5 score reduction.

In the first of these studies,1 30 children (mean age, 8 years; range, 4–16 years) underwent BCS directed at 48 maxillary, six sphenoid and two frontal sinuses. Over 90% (51/56) of these sinuses were successfully cannulated and dilated; the failures consisted of four hypoplastic maxillary sinuses.1 Radiation exposure during fluoroscopic confirmation of guidewire placement averaged 0.18 mGy per child in this study.2 Such radiation exposure was a major safety concern associated with the performance of BCS in children; the current availability of illuminated guidewires has, however, eliminated this fluoroscopy-associated risk.

Efficacy was evaluated in the second study of this prospective case series3 involving 32 children (mean, 6.5 years; range, 2–11 years) who underwent BCS for CRS.
Successful reduction of SN-5 scores by at least 0.5 was achieved in 87% of these patients at 1 year postoperatively. Fifteen of these children, however, also underwent adenoidectomy, and six patients had a partial (n = 5) or total (n = 1) ethmoidectomy. The study does not account for the potential beneficial effect of these concurrent procedures.

A subsequent nonrandomized assessment$^4$ of this same prospectively maintained cohort of children compared those who underwent both BCS and adenoidectomy (n = 30) to a group of pediatric CRS patients who underwent adenoidectomy alone (n = 19). A 0.5 reduction in SN-5 scores was successfully achieved in 80% of the BCS with adenoidectomy cohort in contrast to only 52.6% of the adenoidectomy alone cohort. However, these results may have been biased by the fact that the adenoidectomy alone group was less symptomatic preoperatively with an average SN-5 score that was 0.4 lower than the BCS with adenoidectomy cohort.

Notably, the above-reported success rate of BCS plus adenoidectomy$^4$ is comparable to a previously reported success rate of standard maxillary sinus irrigation plus adenoidectomy performed for children with CRS. Using a similar sinonasal questionnaire assessing symptoms of nasal obstruction, purulent drainage, cough, and headache, 87.5% of children who had undergone adenoidectomy with maxillary sinus lavage experienced improvement at 1 year postoperatively.$^5$ Such data suggests the clinical benefit afforded by BCS is equivalent to traditional CRS management techniques in the pediatric population.

The approximate per patient cost of BCS exceeds $1,500 for the guide catheter, illuminated guidewire, sinus balloon, and inflation device necessary. This cost is additive to standard sinus surgical costs, especially when the concomitant performance of FESS is necessary for concurrent ethmoid sinus disease.

**BEST PRACTICE SUMMARY**

BCS appears to be safe for use in the pediatric CRS population. The combination of BCS plus adenoidectomy does appear to reduce rhinosinusitis symptoms beyond that achieved with adenoidectomy alone, but does not appear to confer additional benefit over the more traditional combination of adenoidectomy and maxillary sinus lavage. There is no data to date truly comparing the efficacy of BCS with FESS in the pediatric population. In the common setting where FESS is necessary to address the ethmoid sinuses, the additional routine use of BCS for concurrent maxillary and sphenoid sinus disease is difficult to justify from a cost-benefit standpoint. The potential beneficial therapeutic role of BCS for isolated maxillary, sphenoid, or rare frontal sinus disease in the pediatric population remains to be answered.

**LEVEL OF EVIDENCE**

The case series reporting safety, feasibility, and efficacy of BCS$^{2,3}$ are level 4 evidence. The cohort studies comparing adenoidectomy to BCS with adenoidectomy$^4$ and adenoidectomy to adenoidectomy with maxillary sinus wash$^5$ are level 2 evidence. Notation should also be made that all studies assessing BCS efficacy in the pediatric population to date are based on case series from one institution.

**BIBLIOGRAPHY**