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Unilateral choanal atresia: surgical technique and long-term results

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Abstract

Although transnasal techniques to treat choanal atresia have become the standard, risks remain of restenosis of the opened choana requiring dilatations. In addition, a new technique without stenting and requiring less invasive post-operative care would be an improvement. With this in mind, in a non-randomized trial, a modification of the transnasal surgical repair was used in eight patients with unilateral choanal atresia by which no stents were used. While the standard procedure consists of partial resection of the bony septum and the atretic plate, we additionally removed lower parts of the anterior wall and the floor of the sphenoid sinus, creating a new airway canal from the nasal cavity to the sphenoid into the epipharynx. Post-operative care by the patient and the surgeon was noted. The success of choanal patency was followed by nasal endoscopy and rhinomanometry with a mean post-operative follow-up time of 1.9 years. In all patients, both choanae remained patent confirmed by nasal endoscopy and rhinomanometry showing almost symmetric resistance. Post-operative care comprised antibiotic prophylaxis and nasal douching with saline solution by the patient; no further treatment by the surgeon was necessary. According to these long-term results we would recommend this type of surgery for two reasons: the use of stents no longer necessary and post-operative care by the surgeon can be minimized.

Key words: Nose; Choanal Atresia; Surgical Treatment, Operative; Treatment Outcome

Introduction

The introduction of the high-powered endoscope with separate light source in the early 1950s by Harold Hopkins and Karl Storz revolutionized endonasal surgery. In the mean time, the transnasal approach to bilateral choanal atresia became the procedure of choice,[1–4] while the transpalatinal technique was slowly replaced. The historical development of transnasal repair of congenital choanal atresia is reviewed by Josephson and co-workers[5] and Cumberworth and colleagues.[6] Since the early descriptions of transnasal treatment of choanal atresia, it has been considered that stents are necessary to keep the choana open due to the up to 36 per cent risk of restenosis.[4,7–10] Three studies[11–13] showed that better results can be achieved by preserving nasal mucosa as much as possible and using it for pedicled flaps.

Unilateral choanal atresia (UCA) occurs more frequently than its bilateral variant[5] and only 10 per cent are purely membranous.[1] Although fewer studies have been conducted on UCA, one can assume that a very similar surgical technique is adopted as for bilateral atresia. Because UCA patients become symptomatic at around school age,[14] endonasal surgery is even easier than surgery in newborns with bilateral atresia.

If the literature is reviewed, some questions would remain unsolved: Are stents indicated and, if so, for how long should they remain in place? Children frequently do not cooperate well for nasal care in the outpatient clinic during the post-operative period. Hence, an ideal technique would not require either stents or manipulation in the child's nose post-operatively. The aim of our study was to demonstrate a modification of transnasal surgical repair and to present the long-term results regarding nasal patency, stenting and post-operative care.

Patients and methods

Between 1995 and 2000, eight children (two male and six female) with UCA were treated and prospectively followed-up in the Department of Otorhinolaryngology, Head and Neck Surgery, University Hospital of Zurich. They were 5.3–18.1 years old (mean 11.4 years) at the time of surgery. All patients underwent a CT scan to determine the localization and thickness of the atretic plate, its relation to the pterygoid plate, the sphenoid sinus and the nasal septum. Five were on the right and three on the left side.

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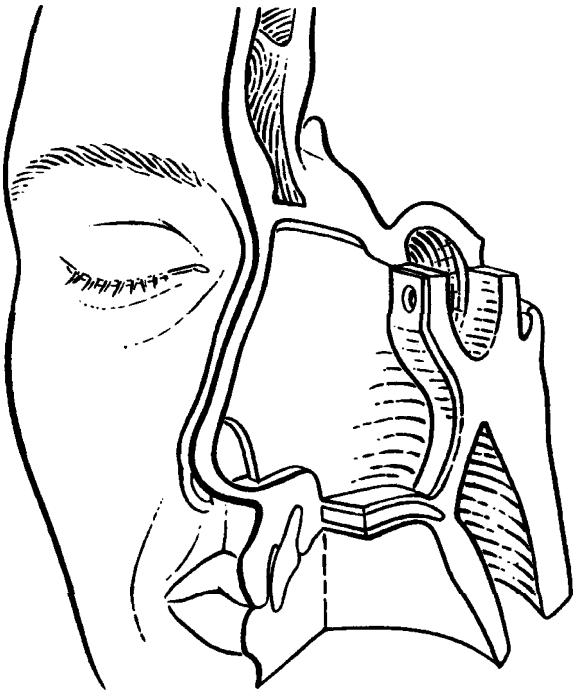
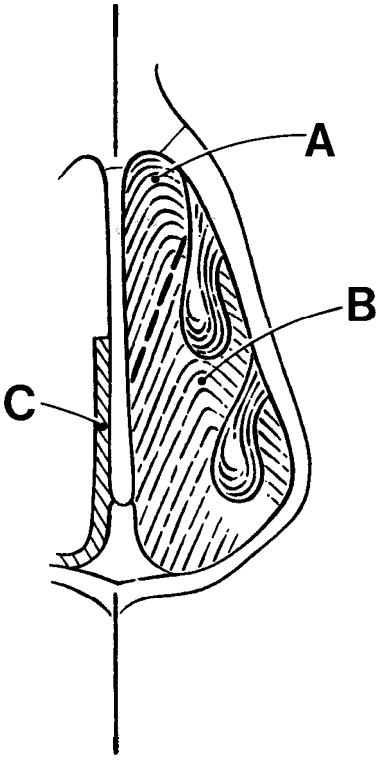


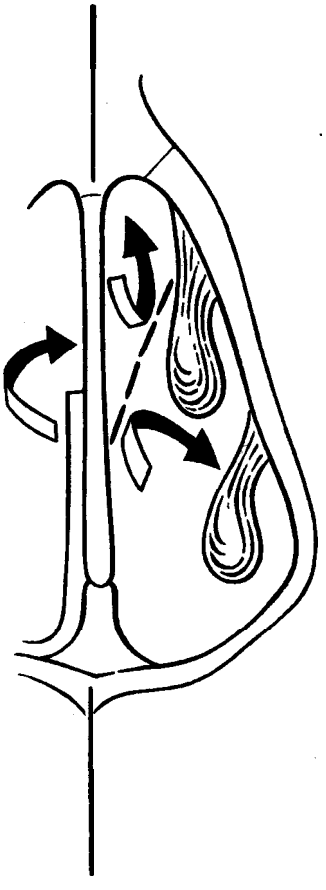
FIG. 1
Schematic view of unilateral atretic plate.

Surgical technique (see Figures 1–3)

- Elevation and mobilization of the mucoperiosteum of the posterior two-thirds of the bony septum on the atretic side and after incision of the septum on the contralateral side. Removal of the posterior two-thirds of the vomer and the lower quarter of the perpendicular plate. This is to enlarge the choanal opening medially, i.e. to the contralateral nasal cavity.
- Exposure of the crista sphenoidalis and elevation of the mucosa on the lower two-thirds of the anterior wall of the sphenoid sinus on both sides and on its floor.
- Identification of the natural ostium of the sphenoid sinus on both sides and removal of the lower two-thirds of the anterior walls, the floor and the inter-sinus septum of the sphenoid sinus using a diamond burr. The septal branches of the sphenopalatine artery have to be cut and coagulated. This is to widen the choanal opening posteriorly and superiorly creating one common big choanal opening.
- After identification of the posterior wall of the maxillary sinus by penetrating bluntly through the posterior fontanel, parts of the pterygoid plate are removed to enlarge the choana laterally keeping the overlying mucosa intact. Sometimes, branches of the sphenopalatine artery have to be cut and coagulated at the level of the sphenopalatine foramen.
- The mucosal 'blindsack' on the atretic side is incised (Figure 2a), so that every exposed bony area can be covered by pedicled mucosal flap (Figure 2b):
  A covers the pterygoid plate and the lateral sphenoid sinus wall



(a)



(b)

FIG. 2
(a) Schematic endoscopic view on the mucosal blind sack; broken lines indicate mucosal incision. (b) Three pedicled mucosal flap to cover the surgical field.

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B is laid in the opened sphenoid sinus superiorly
C (mucoperichondrium of the contralateral septum side) is swung on the palate, where the vomer has been drilled down on the level of the hard palate.

Note, almost no mucosa should be removed

- The nasal turbinates do not have to be reduced routinely.
- All flaps are covered with one piece of Gelfilm (Pharmacia & Upjohn, Diagnostics Division CH-8600 Dübendorf, Switzerland)
- No stent is inserted.
- Nasal packing is advised for two days

Post-operative management

All patients were treated with amoxycilin with clavulanic acid or a second-generation cephalosporin for 10 days. All patients used an isotonic saline nasal spray (usually sea water) for one month. Follow-up visits were performed two weeks, one, six and 12 months post-operatively at which time a rhinomanometry as well as nasal endoscopy was performed. Thereafter, patients were followed once per year. They and/or their parents were asked about fever, malaise, purulent discharge, nasal patency and overall satisfaction. No manipulation (i.e. using sucker or crust removed by forceps etc.), except for nasal endoscopy at the last visit, was performed by the surgeon.

Results

Surgery revealed a bony unilateral choanal atresia in all patients as expected by the pre-operative CT scan. In addition, the malformation consisted of a deviation of the bony septum to the atretic side posteriorly, whereas the contralateral lower turbinate was slightly hypertrophic. On surgery, the bony atretic plate could only be removed using punches and the drill in particular.

Complications such as severe bleeding and infection did not occur in the perioperative period. Infection with purulent discharge only occurred in one patient three days after having stopped the antibiotic treatment. After 10-day course of antibiotics the patient recovered without further sequelae.

All patients were prospectively followed from 0.5 to 3.3 years (mean 1.9 years). Nasal airflow measurement by rhinomanometry (Rhinotest®, Allergopharma, Joachim Ganzer KG, D-21465 Reinbek, Germany) revealed a less than 10 per cent difference in nasal resistance in five patients (Table I), whereas the difference wsa between 14 and 18 per cent in three out of eight patients. However, in one of them (patient 4), the operated side was even better (18 per cent) than the non-operated side. This was most likely due to the hypertrophic lower turbinate. Using the paired *t*-test no statistical significance in nasal resistance between the two sides could be found ($P = 0.3801$; *t*-value = 0.937; mean diff. 31.125). It has to be considered that the measurements were fairly scattered. Nasal patency was followed by endoscopy in all cases at the end of follow-up. Scarring could be detected as a small sickle-shaped cord on the nasal floor in two patients, but its size was less than two mm so that it impaired neither nasal airflow nor nasal patency. No choanal dilatation was necessary in any patient at any time post-operatively. In none of the patients was any manipulation on the nose by

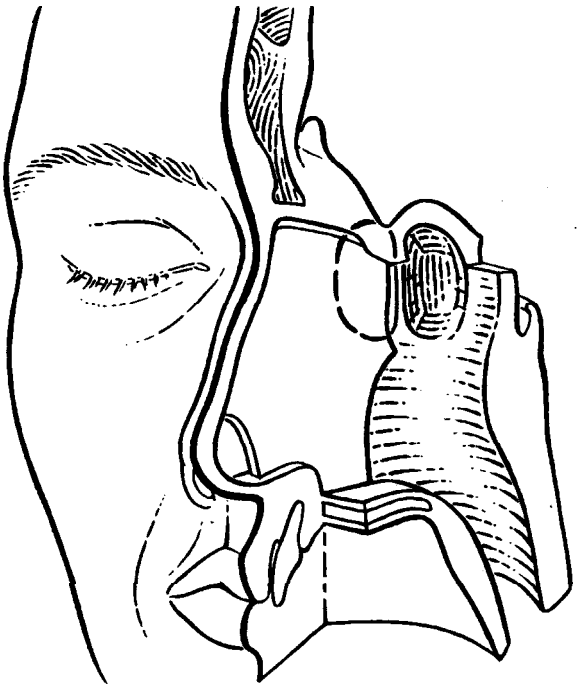

FIG. 3
Schematic view of the final result.

TABLE I
RHINOMANOMETRIC RESULTS AFTER SURGERY FOR UCA (N=8)

Patient	Age at surgery years	Atretic side	Years after surgery	Flow* Right	Flow* Left	Difference (per cent)
1	13.0	Left	2.1	598	420	16
2	8.1	Right	2.0	450	418	–4
3	18.1	Right	2.2	472	510	4
4	12.9	Left	0.5	338	476	–18
5	8.7	Right	0.75	372	374	1
6	11.3	Left	1.3	404	362	–5
7	5.3	Right	3.3	290	338	8
8	15.5	Right	2.75	362	473	14

*Volume in cm^3/s at p = 150 Pa.
Statistical data for the atretic side are Mean: 431.625; SD: 90.503; SE: 31.998; Min: 338; Max: 598; and for the non-atretic side are Mean 400.500; SD: 65.060; SE: 23.002; Min: 290; Max: 476.

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the surgeon necessary. Patients and/or parents were satisfied and they would agree to the same procedure again.

Discussion

The transnasal approach to open atretic choana became the treatment of choice even for newborns with bilateral manifestation. However, UCA causes far less symptoms in young children so that surgery usually is indicated around school age. It is rarely associated with other malformations in contrast to bilateral atresia (e.g. CHARGE syndrome). Post-operative follow-up and care in children with any kind of nasal disease can be difficult as patients frequently do not tolerate any manipulations in the nose. Removing the atretic plate and posterior parts of the frequently deviated vomer to enlarge the future choana medially became a standard in surgery for choanal atresia.[1,4] Laterally, i.e. towards the pterygoid plate, the choana can be enlarged only to a very limited extent. Hence post-operative scar formation more likely could deteriorate if the choana is only widened in these directions. By opening the pneumatized sphenoid sinus, removing the floor and the lower two-thirds of the anterior wall widens the future choana superiorly and posteriorly. Even if scarring occurs, restenosis would become less significant. Because the patients in our series became symptomatic at the age when the sphenoid sinus already was pneumatized, the option to enlarge the choana posteriorly and superiorly was ideal. Liktor and colleagues[15] also advocated the enlargement of the choana posteriorly and superiorly by opening the sphenoid sinus which creates a new, additional airway canal from the epipharynx, the sphenoid and the nasal cavity. In contrast to our technique, they also opened the posterior ethmoid cells, which is in our opinion not necessary.

Nasal endoscopy at the end of follow-up revealed a straight remaining septum with no deviation to the atretic side. In addition, slight scar formation did occur in two patients at the nasal floor but this was relevant neither to the airflow nor to the patency, as the choanal opening was enlarged enough superiorly, medially and posteriorly. An important step is to remove as little nasal mucosa as necessary and to keep pedicled nasal mucosa to cover areas where bone is to be removed. Knowledge from the frontal sinus drainage 'drill-out' procedures confirms that circumferential damage of nasal mucosa most likely leads to restenosis and, hence, stenting is required.[14] However, to cover the exposed bone by pedicled mucosal flaps as recommended by other studies[11–13] encouraged us not to use stents.

Although our prospective study was only on eight patients, we are convinced that the described transnasal technique is appropriate for children, as post-operative care can be minimized and stents do not seem to be necessary.

Conclusions

The most frequently recommended surgical technique for UCA repair mainly consists of removing posterior parts of the vomer and the atretic plate. Restenosis with consecutive nasal blockage can occur in case of scar formation in the post-operative period. With our study we demonstrate that such drawbacks can be prevented by opening the sphenoid sinus and by preserving as much nasal mucosa as possible. While the sphenoid opening provides an additional airway canal from the nasal cavity, the sphenoid sinus to the epipharynx, the covering of exposed bone by pedicled mucosal flaps seems to reduce scar tissue formation. This is supported by the fact that, on endoscopy, there was a wide choanal opening with very little scarring and that nasal airflow on the atretic side was not significantly worse than on the healthy side.

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