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Original Article

Endoscopic surgical management of congenital Choanal Atresia – Experience in a tertiary-level children's hospital

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ABSTRACT

Background: Congenital choanal atresia (CCA) is a rare congenital anomaly causing nasal obstruction, respiratory distress, and feeding difficulties in neonates and infants. Endoscopic transnasal repair has emerged as the preferred surgical approach due to its minimally invasive nature and favorable outcomes. **Aim of the study:** To evaluate the demographic profile, clinical presentation, surgical outcomes, and postoperative complications of infants undergoing endoscopic repair of congenital choanal atresia at a tertiary-level pediatric hospital in Bangladesh. **Methods & Materials:** This prospective observational study was conducted at Bangladesh Shishu Hospital & Institute from January 2024 to January 2025. Thirty infants aged ≤12 months with unilateral or bilateral CCA confirmed by nasal endoscopy and CT imaging were enrolled. Patients with prior nasal surgery or significant comorbidities were excluded. All patients underwent endoscopic transnasal repair under general anesthesia, with selective stenting based on intraoperative assessment. Intraoperative details, postoperative complications, hospital stay, follow-up outcomes, and surgical success were documented. Comparative analysis between unilateral and bilateral cases was performed. **Result:** The study included 18 males (60%) and 12 females (40%), with a mean age of 3.6 ± 2.1 months. Bilateral atresia predominated (70%), and mixed-type atresia was most frequent (66.7%). Preoperatively, 80% had feeding difficulty, 66.7% presented with neonatal respiratory distress, and 50% experienced apneic/cyanotic spells? Endoscopic repair had a mean operative time of 42.5 ± 12.4 minutes. Stents were used in 66.7% of cases, and powered instruments in 93.3%. Intraoperative complications were minor, including mild bleeding (20%) and septal injury (3.3%). Postoperative complications included granulation tissue (16.7%), synechiae (10%), and minor bleeding (13.3%), with no cases requiring revision for stenosis. Mean hospital stay was 3.2 ± 1.1 days, and mean follow-up was 9.4 ± 2.7 months. Surgical success, defined as complete nasal patency without recurrence, was achieved in 100% of cases. Comparative analysis showed no statistically significant differences in operative outcomes between unilateral and bilateral cases, except for age at surgery (p = 0.01). **Conclusion:** Endoscopic transnasal repair of congenital choanal atresia in infants is a safe and effective procedure, associated with minimal complications and excellent short-term outcomes. Bilateral and unilateral cases demonstrate comparable surgical success, highlighting the reliability of the endoscopic approach in a tertiary pediatric setting.

Keywords: *Congenital choanal atresia, endoscopic surgery, nasal obstruction, pediatric otolaryngology, surgical outcomes, stenting*

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Introduction

Congenital choanal atresia (CCA) is a birth defect characterized by the complete blockage of the posterior nasal apertures (choanae), which connect the nasal cavity to the nasopharynx, preventing normal airflow through the nose [1]. Congenital choanal atresia has an incidence of approximately 0.82 per 10,000 live births, varying slightly by region but showing no significant racial differences [2]. Choanal atresia results from the failure of the buccopharyngeal membrane to rupture during the fourth to sixth weeks of gestation, preventing normal formation of the posterior nasal apertures (choanae) [3]. Bilateral choanal atresia usually presents in neonates with severe respiratory distress, cyanosis, and feeding difficulties, constituting a life-threatening emergency that requires urgent surgical intervention within the first weeks of life [4]. In contrast, unilateral choanal atresia tends to have milder symptoms, such as nasal obstruction or rhinorrhea. It may be diagnosed later in childhood or even adulthood, as it is usually well-tolerated [5]. The urgency of treatment is much greater in bilateral cases due to airway compromise, whereas unilateral cases allow for more elective surgical planning [6]. CCA, especially bilateral, severely impacts neonatal respiratory function by causing nasal airway obstruction, leading to respiratory distress, cyanosis, and feeding difficulties due to neonates' obligate nasal breathing; this can also affect growth and overall quality of life if untreated [7]. Unilateral CA tends to have milder respiratory symptoms and may present later, but can still cause recurrent cyanotic episodes and feeding problems in some cases [8]. Surgical management primarily involves endoscopic transnasal repair, which has become the preferred approach due to its minimally invasive nature, better visualization, and lower morbidity compared to traditional transpalatal methods [9]. Endoscopic repair allows precise removal of the atretic plate and creation of a patent neo-choana, often with mucosal flap techniques to reduce raw surfaces and improve healing [10]. Outcomes of endoscopic surgery are generally favorable with high long-term success rates, but restenosis is common, especially in bilateral cases, with most patients requiring at least one revision surgery within six months postoperatively [11]. Postoperative challenges include granulation tissue formation and restenosis,

and the use of nasal stents remains controversial, as stenting has been associated with higher rates of restenosis and granulation without clear benefits in surgical success [7]. Age at surgery, type of atresia, and comorbidities significantly influence surgical outcomes in CCA. Younger age, especially under 6 months or weight below 3-5 kg, is associated with higher rates of restenosis and need for revision surgery, likely due to smaller anatomical size limiting surgical access and healing. Bilateral CA, often operated on earlier, shows higher restenosis rates compared to unilateral cases, but the type of atresia (bony, membranous, or mixed) does not significantly affect surgical success [12]. Documenting experience in tertiary-level children's hospitals is essential to evaluate the effectiveness, safety, and long-term outcomes of procedures, helping optimize treatment and identify key prognostic factors in pediatric patients [13]. This study aimed to evaluate the outcomes, effectiveness, and safety of endoscopic surgical management of congenital choanal atresia in a tertiary-level children's hospital.

Methods & Materials

This was a prospective observational study conducted at the Bangladesh Shishu Hospital & Institute, a tertiary-level pediatric referral center, between January 2024 and January 2025. A total of 30 infants diagnosed with congenital choanal atresia who presented to the hospital during the study period were enrolled in the study. Ethical approval was obtained from the institutional review board, and written informed consent was obtained from the parents or legal guardians of all participants.

Inclusion & Exclusion criteria

Inclusion criteria comprised patients aged up to 12 months with unilateral or bilateral choanal atresia confirmed by nasal endoscopy and computed tomography (CT) imaging. Patients with previous nasal surgeries or significant comorbidities that could influence surgical outcomes were excluded

Preoperative Evaluation

All patients underwent a comprehensive preoperative assessment, including a detailed clinical history, physical examination, and evaluation of presenting symptoms such as respiratory distress, feeding difficulty, and cyanotic spells. Imaging studies, including CT scans of the paranasal sinuses, were performed to determine the type (bony, membranous, or mixed) and extent of atresia. Associated craniofacial anomalies and syndromic associations, including CHARGE association, were documented.

Surgical Technique

Endoscopic transnasal repair was performed under general anesthesia using a 0° or 30° rigid nasal endoscope. The atretic plate was carefully punctured and excised using micro drill or powered instruments as indicated. Stenting was selectively applied based on intraoperative assessment, using either an endotracheal tube or silastic stent. Hemostasis was achieved using topical vasoconstrictors and gentle suctioning. Intraoperative complications such as bleeding, septal injury, or other adverse events were recorded.

Postoperative Care and Follow-up

Patients were closely monitored postoperatively for airway patency, bleeding, and other complications. Debridement was performed when necessary, and stents were removed according to standard institutional protocols. Hospital stay duration and need for additional interventions were documented. Follow-up assessments were conducted at 1, 3, and 6 months post-surgery, with evaluation of nasal patency and detection of recurrence or complications, including synechiae, granulation tissue formation, and stenosis.

Outcome Measures

The primary outcome measure was surgical success, defined as complete nasal patency without recurrence at follow-up. Secondary outcomes included intraoperative and postoperative complications, operative time, hospital stay, and the need for revision surgery. Comparative analysis between unilateral and bilateral cases was performed to assess differences in operative and postoperative outcomes.

Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Comparisons between groups (unilateral vs. bilateral) were performed using Student's t-test or Chi-square/Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant. All analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Result

The study population was predominantly aged 0–3 months (60.00%), followed by 4–6 months (26.67%) and 7–12 months (13.33%), with a mean age of 3.60 ± 2.10 months. Males accounted for 60.00% and females 40.00%. Bilateral choanal atresia was more common (70.00%) than unilateral cases (30.00%). Regarding atresia type, mixed was most frequent (66.67%), bony (23.33%), and membranous (10.00%) shows in (*Table I*).

Table I
Baseline demographic and clinical characteristics of the study population (n = 30).

Variable	Frequency (n)	Percentage (%)
Age (months)		
0–3	18	60.00
4–6	8	26.67
7–12	4	13.33
Mean ± SD	3.6 ± 2.1	
Gender		
Male	18	60.00
Female	12	40.00
Laterality of Choanal Atresia		
Unilateral	9	30.00
Bilateral	21	70.00
Type of Atresia		
Bony	7	23.33
Membranous	3	10.00
Mixed	20	66.67

Difficulty in feeding was observed in 80.00% of cases, neonatal respiratory distress in 66.67%, and apneic/cyanotic spells in 50.00%. Chronic nasal discharge was noted in 40.00% of patients. Associated craniofacial anomalies were present in 20.00%, and CHARGE association in 10.00% of cases presents in (*Table II*).

Table II
Preoperative clinical presentation of patients with congenital choanal atresia.

Feature	Frequency (n)	Percentage (%)
Neonatal respiratory distress	20	66.67
Apneic/cyanotic spells	15	50.00
Difficulty in feeding	24	80.00
Failure to pass nasal catheter	30	100.00
Chronic nasal discharge	12	40.00
Associated craniofacial anomalies	6	20.00
CHARGE association	3	10.00

The mean operative time of 42.50 ± 12.40 minutes. Stenting was used in 66.67% of cases and not used in 33.33%. Among stented patients, endotracheal tubes were used in 50.00% and silastic stents in 16.67%. Powered instruments were utilized in 93.33% of surgeries. Intraoperative complications included mild bleeding in 20.00%, septal injury in 3.33%, while no major complications (0.00%) were reported in (*Table III*).

Table III
Operative details and intraoperative findings in endoscopic choanal atresia repair.

Variable	Frequency (n)	Percentage (%)
Operative time (minutes)		
Mean ± SD	42.5 ± 12.4	
Stenting used		
Yes	20	66.67
No	10	33.33
Type of stent		
Endotracheal tube	15	50.00
Silastic stent	5	16.67
Use of powered instruments	28	93.33
Intraoperative complications		
Mild bleeding	6	20.00
Septal injury	1	3.33
Major complications	0	0.00

Postoperative outcomes showed minor bleeding in 13.33%, synechiae in 10.00%, and granulation tissue in 16.67%. Postoperative debridement was needed in 40.00% of cases, while no patients required revision for stenosis (0.00%). The mean hospital stay was 3.20 ± 1.10 days, and the mean follow-up duration was 9.40 ± 2.70 months. Surgical success was 100.00% at discharge, 3 months, and 6 months, with no recurrence (0.00%) or revision surgery required, resulting in an overall surgical success rate of 100.00% explains in (*Table IV*).

Table IV
Postoperative outcomes and surgical success following endoscopic repair of choanal atresia.

Outcome Measure	Frequency (n)	Percentage (%)
Postoperative complications		
Minor bleeding	4	13.33
Synechiae formation	3	10.00
Granulation tissue	5	16.67
Stenosis requiring revision	0	0.00
Need for postoperative debridement	12	40.00
Hospital stay (days)		
Mean ± SD	3.2 ± 1.1	
Follow-up duration (months)		
Mean ± SD	9.4 ± 2.7	
Surgical success		
Complete nasal patency at discharge	30	100.00
Complete nasal patency at 3 months	30	100.00
Complete nasal patency at 6 months	30	100.00
Recurrence	0	0.00
Revision surgery required	0	0.00
Overall surgical success rate	30	100.00

Finally, demonstrates that comparison of outcomes between unilateral and bilateral choanal atresia showed that the mean age at surgery was 5.10 ± 2.30 months for unilateral and 2.40 ± 1.20 months for bilateral cases (p = 0.01). The mean operative time was 38.20 ± 10.50 minutes for unilateral and 44.30 ± 13.10 minutes for bilateral cases (p = 0.18). Stenting was used in 44.44% of unilateral and 76.19% of bilateral cases (p = 0.10). Postoperative granulation occurred in 11.11% of unilateral and 19.05% of bilateral cases (p = 0.62), while synechiae formation was 0.00% in unilateral and 14.29% in bilateral cases (p = 0.28). No recurrences were observed in either group (0.00%) (*Table V*).

Table V
Comparison of operative and postoperative outcomes between unilateral and bilateral choanal atresia.

Variable	Unilateral (n=9)	Bilateral (n=21)	p-value
Age at surgery (months)	5.1 ± 2.3	2.4 ± 1.2	0.01*
Mean operative time (minutes)	38.2 ± 10.5	44.3 ± 13.1	0.18
Stent used	4 (44.44)	16 (76.19)	0.1
Postoperative granulation	1 (11.11)	4 (19.05)	0.62
Synechiae	0 (0.00)	3 (14.29)	0.28
Recurrence	0 (0.00)	0 (0.00)	—

Discussion

Choanal atresia, first recognized in the 18th century, represents a congenital obstruction of the posterior nasal airway, with Emmert describing the first surgical intervention in 1851 via a transnasal approach, though restenosis rates were high [14]. Clinically, bilateral choanal atresia constitutes a medical emergency due to neonatal obligate nasal breathing, often presenting with paradoxical cyanosis, whereas unilateral forms are frequently diagnosed later, typically due to persistent unilateral rhinorrhea [15]. Multiple surgical approaches—including transnasal, transseptal, and transpalatal techniques—have historically been utilized, each with specific advantages and age-related considerations. The transpalatal approach offers superior anatomical exposure and lower risk of intracranial complications but may adversely affect maxillofacial growth and carries a higher risk of intraoperative bleeding and soft-palate injury [15]. The introduction of endoscopic techniques has revolutionized the management of choanal atresia. Endoscopic surgery provides a minimally invasive, highly precise operative field with reduced trauma and improved postoperative visualization. Despite variability in practice related to stent use and duration, largely due to the rarity of the condition, endoscopic repair is now widely regarded as the preferred approach because of its safety, efficacy, and reduced morbidity [16]. In the present study, most patients were young infants, with 60% presenting between 0–3 months of age. This age distribution is consistent with large multicentre evidence from Paradis et al., who reported that the majority of symptomatic choanal atresia (CA) cases—particularly bilateral forms—are detected within the first weeks of life due to hallmark features such as cyclical cyanosis and respiratory distress [17]. Similar early-age predominance has been noted in both single-centre and multicentre endoscopic series, including the work of Ferlito et al., who reported a predominance of neonates and young infants undergoing endoscopic repair [18], and Eladl et al., who likewise described early presentation with mean ages within the first few months of life [19]. In the present study, male predominance (60%) was observed, contrasting with most classical and contemporary reports, which typically describe a female predominance with a female-to-male ratio of approximately 2:1 [20]. Similar trends were reported in a retrospective analysis of 58 endoscopically managed cases, where only 29% were male [21]. Bilateral choanal atresia accounted for 70% of cases in our cohort, consistent with findings by Khafagy et al. and Baldovin et al., who noted that bilateral atresia is often identified earlier and necessitates urgent surgical intervention compared with unilateral forms [22–23]. The distribution of atresia type in our study showed mixed bony-membranous atresia in 66.7% of patients, with pure bony and membranous forms being less frequent. This predominance of mixed atresia aligns with several previous reports, including a large bilateral series where 76% of cases were mixed, and smaller retrospective analyses reporting mixed types in 50–56% of patients [24]. Some studies also have noted higher proportions of membranous or bony atresia, reflecting differences in diagnostic methods, patient selection, and characteristics [25]. In our study, neonatal respiratory distress, feeding difficulties, and inability to pass a nasal catheter were the predominant clinical presentations, consistent with established hallmarks of congenital choanal atresia (CCA). Similar observations were reported by Saleem et al. and other South Asian studies, where newborns with bilateral CCA exhibited respiratory compromise and catheter obstruction, with diagnosis confirmed via endoscopy and CT imaging [26]. International literature further supports this pattern; a large neonatal study evaluated by Van Den Abbeele *et al.* highlighted failure to pass a nasal catheter as a reliable bedside diagnostic marker, particularly in bilateral atresia [27]. Associated craniofacial anomalies were observed in 20% of our study, with CHARGE association in 10%. These findings align with Ferretti et al., who reported locoregional airway anomalies in 86.8% of children undergoing endoscopic repair, CHARGE syndrome accounting for 12% of bilateral cases [18]. Endoscopic repair has become the preferred technique for congenital choanal atresia owing to its minimally invasive nature, enhanced visualization, and lower morbidity compared to transnasal or transpalatal approaches. In the present study, the mean operative time was 42.5 ± 12.4 minutes, aligning with previously reported study [19]. Powered instruments were utilized in 93.3% of cases, reflecting contemporary endoscopic surgical practices aimed at enhancing precision and minimizing tissue trauma. Stenting was applied selectively in 66.7% of patients, primarily using endotracheal tubes, based on intraoperative findings and surgeon discretion. This approach aligns with current evidence suggesting that microdebriders or drills facilitate improved visualization and precise removal of the atretic plate, contributing to high patency rates [27–28]. Recent meta-analyses indicate that non-stented endoscopic repairs are associated with lower rates of restenosis and granulation formation without compromising surgical outcomes [29]. Furthermore, stentless or minimally stented transnasal choanoplasty has demonstrated satisfactory patency, acceptable restenosis rates, and reduced stent-related complications such as synechiae, ulceration, and migration [30–31]. In the present study, postoperative outcomes were excellent, with all patients (100%) achieving complete nasal patency at six months and no instances of restenosis or requirement for revision surgery. Minor complications were observed, including granulation tissue in 16.7% and synechiae

formation in 10% of cases. Endoscopic transnasal repair has consistently demonstrated high rates of long-term choanal patency. Josephson et al. reported 12 of 14 choanae remained patent postoperatively, with only one case of minor granulation requiring early debridement [28]. Systematic reviews further suggest that stentless techniques may reduce granulation and restenosis without compromising surgical success [7]. Our findings also indicated a higher trend of stent use in bilateral atresia (76.2%) compared to unilateral cases (44.4%), though this difference was not statistically significant (p=0.1). This observation aligns with previous reports, as stents are often employed in bilateral cases due to perceived higher restenosis risk. However, studies such as Elmorsy et al. (2012) have noted increased granulation and postoperative complications with stent use, without clear long-term patency benefits [32]. Comparison between unilateral and bilateral atresia revealed that bilateral cases underwent surgery at an earlier age (2.4 ± 1.2 months) than unilateral cases (5.1 ± 2.3 months, p=0.01), reflecting their more acute presentation. Operative time and complication rates were comparable, supporting the safety and efficacy of endoscopic repair for both unilateral and bilateral lesions [33].

Limitations

This study has several limitations. First, the sample size was relatively small which may limit the generalizability of the findings. Second, the follow-up duration was short to intermediate (mean 9.4 months), precluding assessment of long-term recurrence or late complications. Third, the study was conducted at a single tertiary center, potentially introducing institutional bias. Finally, stenting decisions were made intraoperatively without randomization, which may influence the comparative outcomes between stented and non-stented cases.

Conclusion & Recommendations

Endoscopic transnasal repair of congenital choanal atresia in infants is a safe, effective, and minimally invasive surgical approach, demonstrating excellent short-term outcomes with complete nasal patency in all patients. The procedure is associated with low rates of intraoperative and postoperative complications, and selective stenting does not adversely impact surgical success. Both unilateral and bilateral cases achieved comparable results, highlighting the reliability of this technique. Early intervention, meticulous surgical technique, and structured postoperative follow-up are key to optimizing outcomes in this pediatric population.

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