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Role of proton pump inhibitor in healing after choanal atresia repair: a randomized control trial

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Abstract

Background: Choanal atresia (CA), defined as the anatomical closure of the choanae in the nasal cavity, is relatively uncommon disease entity with an estimated incidence of 1:5000–7000 births. Post-operative restenosis remains a common complication of the endoscopic CA repair. Risk factors for restenosis include nasopharyngeal reflux and gastroesophageal reflux.

Results: Forty patients who underwent choanal atresia repair were divided randomly into 2 groups. Group A patients received postoperative PPI medication compared to group B patients who acted as control who underwent the same operation without receiving postoperative proton pump inhibitor medication.

Only 2 patients (10%) in group A experienced restenosis compared to 8 patients (40%) in the control group B.

Conclusion: The use of esomeprazole which is a proton pump inhibitor acting as an antireflux should be considered, in postoperative treatment, to decrease the rate of choanal restenosis by preventing inflammation on choanal mucosa which can enhance good healing mechanism.

Keywords: Choanal atresia, Proton pump inhibitor, Restenosis, Healing

Background

Congenital choanal atresia (CA) is a rare cause of upper airway obstruction. It varies from between 1 in 5000 and 1 in 8000 live births. In the anatomic point of view, it consists of an enlarged vomer and medialized lateral pterygoid plate causing a complete nasal obstruction. It is more frequently unilateral (usually the right side) and seems to affect girls more than boys. As newborns are solely nasal breathers, bilateral CA may be life-threatening. Unilateral cases may be left undiagnosed for a long time [1].

Some CA may be associated with other congenital anomalies; however, in 50% of cases, no genetic relationship maybe found. The embryologic mechanism seems to be a combination of the persistence of either the nasobuccal membrane of Hochstetter or the buccopharyngeal membrane of the foregut, incomplete resorption of nasopharyngeal mesoderm, and locally misdirected mesodermal flow. This occurs between the 4th and 11th fetal week [2].

Several surgical approaches may be used to treat congenital CA. Historically, the transpalatal technique was the first one described [2]. Then, laser and endoscopic stenting were used to treat congenital CA. Recently, transnasal endoscopic surgery has been developed as a treatment approach for this indication. Powered instruments such as shavers have been introduced and rendered bony and membranous resection easier. Image-guided surgery allows a better appreciation of the resection needed and increases safety and precision in difficult anatomic cases. Postoperative stenting is another operative technique, although the type and the duration of the

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stenting vary greatly depending on the surgeon. The main complication of the transnasal endoscopic approach is restenosis of the choanae. Reported rates of restenosis have ranged from 9 to 36% [3].

This study aims to study the efficacy of proton pump inhibitors in healing after choanal atresia repair and to compare these results with the results of other group of patients who underwent the same operation without receiving postoperative proton pump inhibitor medication.

Methods

The protocol of this study was approved by the institutional Research Ethics Committee. Informed written consent to participate in the study was provided by all participants' parent or legal guardian as all cases were infants.

Forty patients presented to the ENT outpatient clinic or ER diagnosed with choanal atresia. The inclusion criteria include patients with bilateral bony choanal atresia, both genders. The exclusion criteria include any patient with membranous choanal atresia, patients with previous atresia repair, and patients with associated congenital anomalies.

Diagnosis and preoperative evaluation

The preliminary diagnosis was done by the neonatologist at the time of birth based on the clinical finding of cyclic respiratory obstruction that was relieved by crying or by placement of an oropharyngeal airway. The diagnosis was suspected by failure of introducing a small 6-French catheter through the nose into the nasopharynx.

Preoperative multi-slice CT scans were done for all cases to confirm the diagnosis as well as to evaluate the extent and nature of the atresia. Complete preoperative routine laboratory investigations and cardiac evaluation including chest X-ray and echocardiography were also performed prior to surgery.

Surgical technique

The bony plate was perforated in its infero-medial part using an olive tip suction and then widened with an otologic drill to allow exposure of the posterior edge of the bony septum thus entering the nasopharynx (the bone is usually incomplete at this point forming a tiny dimple between the junction of the nasal septum and the nasal floor). The perforation formed was carefully enlarged under vision. The same procedure was performed on the contra-lateral side.

Once the atretic plate has been punctured, power instrumentation and sinus instruments can be used to further open the choanae. This was done with a drill and a 0° or 30° endoscope (3 mm in diameter). The posterior part of the nasal septum was gently excised starting from the osteo-chondral junction in a posterior direction. With copious irrigation, the pterygoid plate was removed using the drill. A backbiter was used to remove the posterior portion of the vomer. Adequate resection of the vomer and the atretic plate over the pterygoid processes is essential to create a large neo-choana, thus preventing restenosis and forming a wide neo-uni-choana "choanoplasty."

Careful puncture of the infero-medial point of the obliterating plate (a membrane in mixed types and a thin point in pure bony types) under direct, full, and clear vision followed by bone boundaries drilling, and protection of the skull base by nasopharyngeal packing were all possible reasons for safety during surgery.

Eroding of the vomer, after creating the neochoana, had moved the medial border of this neochoana anteriorly in a sagittal plane creating what is called a "septochoana" in either side. This septochoana had two planes, one coronal (neochoana) and one sagittal (posterior septectomy). This posterior septectomy had removed the sagittal barrier between the created two neochoanae, converting them into what is called a "common choana."

At the end of the surgical procedure, repeated saline nasal irrigation was used to wash-out any bony fragments that could cause postoperative nasal debris and crust formation. We use stents in all cases with CA. oral feeding was started immediately after complete recovery from surgery in all cases.

Postoperative care

Forty patients who underwent the choanal repair were divided randomly into 2 groups: the first group received postoperative proton pump inhibitor, starting from day 1 in dose of 10 mg once daily in the form of sachets for those who are 1 year and above, and 0.5 mg/kg for pediatrics less than 1 year given for 6 weeks; the second group did not receive a proton pump inhibitor. Stents will be inserted intrachoanal and left for 6 weeks.

Follow-up

Endoscopic assessment by rigid 3-mm nasal endoscopy and radiological assessment using CT were done after stents are removed 6 weeks later. Surgery was considered successful if the patient showed bilateral normal nasal breathing with no evidence of airway obstruction during feeding or at rest and no evidence of stenosis in CT. During the postoperative follow-up period, any granulations or crusts found were removed, and debridement was performed until complete healing was achieved. Results were analyzed regarding (1) age at time of surgery, (2) sex, (3) postoperative complications, and (4) restenosis.

Results

This current study included 40 cases of choanal atresia, with age ranged between 3 days and 1 month, 26 females (65%) and 14 males (35%).

The cases were divided in two equal groups: the first group received PPI (esomeprazole) postoperatively, while the second group did not. During the follow-up, there was subjective nasal obstruction given by two cases in the group of PPI; only two of them were proved to have choanal restenosis by CT representing only 10% of the cases; so, 18 cases who received PPI postoperatively had good prognosis without choanal restenosis (Fig. 1); examples of them are shown in Fig. 2. This was compared to 8 cases who developed choanal restenosis in the control group representing 40% of the cases (Fig. 3), and this resulted in a statistical difference between the two groups (P value = 0.02) (Table 1).

The age groups at the time of surgery were similar in both groups before endoscopic repair, and the choanal restenosis did not show any correlation with age at the time of surgery (Table 2).

Sex distribution was not different in both groups before management. And it did not show a correlation with choanal restenosis following surgery (Tables 2 and 3).

Discussion

Blockage of the nasal passages in newborns is a potentially fatal condition. Choanal atresia is the most congenital nasal anomaly contributing to such condition, accounting for one in each 5000–8000 births. The concern of such condition is primary contributed to the fact that the neonates are obligate nasal breathers for the first 4–6 weeks of the life. This is owing to the special anatomy of the newborn of relatively large tongue contacting more of the palate, superiorly placed larynx, and large floppy epiglottis. That is why bilateral choanal atresia leads to respiratory distress and cyclic cyanosis relieved by crying; and so, it is considered an emergency [4].

So, early management is crucial, and it is definitely surgical. Many approaches have been developed including transpalatal, transseptal, and transnasal approaches.

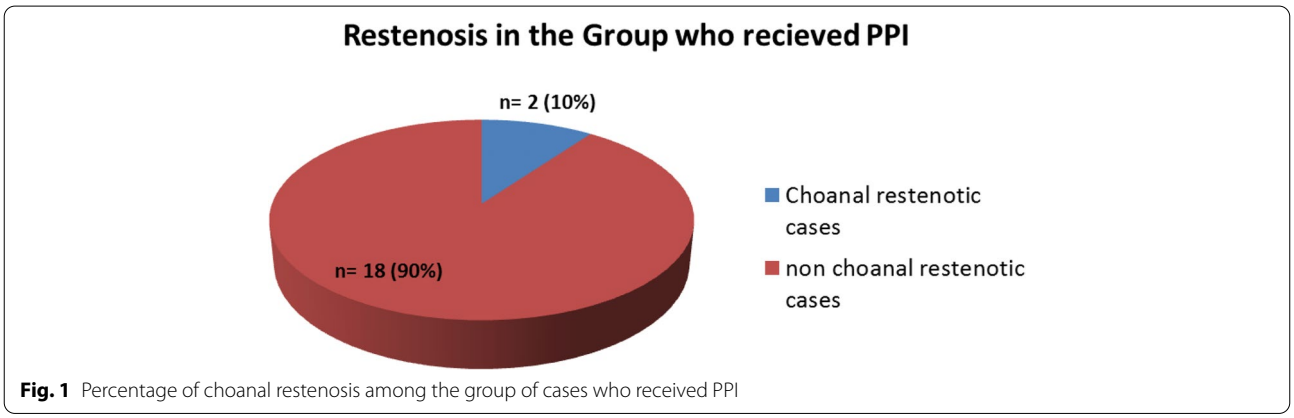

Fig. 1 Percentage of choanal restenosis among the group of cases who received PPI

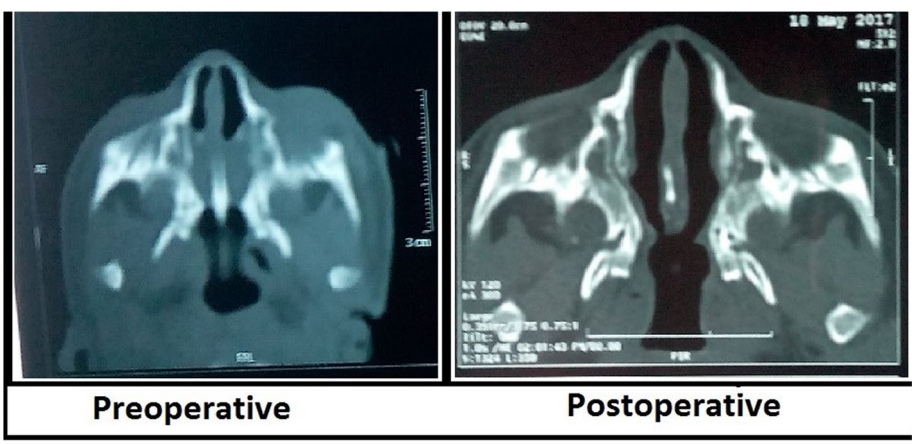

Fig. 2 Case number 1 in PPI group showing no choanal restenosis postoperatively

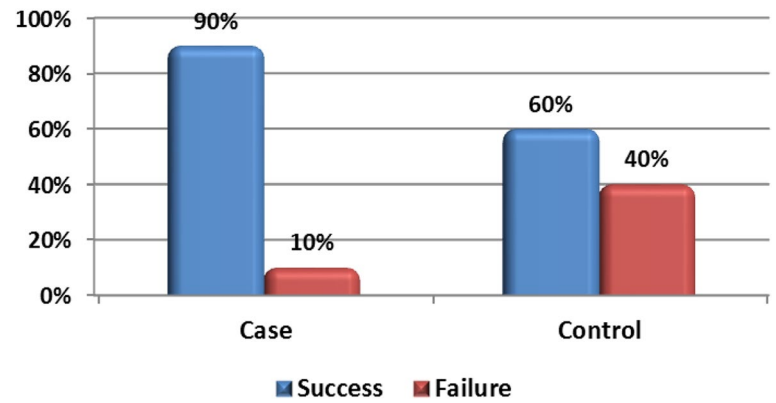

Fig. 3 Comparison between the success rates in both groups

Table 1 Percentage of choanal restenosis among the two groups

	PPI group		Control group		*P* value
	Count	%	Count	%	
Atresia	2	10.0	8	40.0	0.02
No atresia	18	90.0	12	60.0	

But endoscopic transnasal approach using powered instrumentation has become the primary technique nowadays. Universally, it is considered safe and effective as it enables direct approach to the surgical field and allows adequate resection of the atretic plate and its bony boundaries with minimum trauma to the surrounding vital structures [5].

There is still universal debate about use of stents in choanal atresia repair. Also, type of stents, duration, and technique of securing in the nostrils are matters of controversy. Much evidence supported that stents carry the advantages of maintaining airway and preventing restenosis during the re-epithelization of the neochoana [6]. At the opposite side, it may carry the risk of bacterial overgrowth, granulation formation, and pressure damage to the nasal mucosa. Shortening of the duration of stenting and use of soft material can minimize such complications [7]. In this present study, the stents were used empirically in all cases for 6 weeks.

The main complication of transnasal endoscopic approach is restenosis. There is still no agreed definition for surgical failure, but many authors attributed it mainly to postoperative restenosis [8]. The literature had proposed many factors for this complication. The bulk of the

Table 2 Distribution of sex in both groups before surgery

		PPI group		Control group		*P* value
		Count		Count		
Sex	**F**	***14***	***70.0%***	***12***	***60.0%***	***1***
	M	***6***	***30.0%***	***8***	***40.0%***	

Table 3 Sex distribution in relation to choanal atresia after surgery

		Choanal restenosis		No choanal restenosis		*P* value
		Count		Count		
Sex	**F**	**7**	**77.8%**	**6**	**54.5%**	**0.374**
	M	**2**	**22.2%**	**5**	**45.5%**	

literature had accused the surgical technique, surgeon's experience, stenting, postoperative follow-up, nature and side of choanal atresia, age at the time of surgical repair, and presence of associated congenital anomalies [8].

At the end of the last century, the idea of correlating the GERD with restenosis after choanal atresia repair has been proposed, and it was extrapolated from the well-documented effect of GER on the laryngeal airway [9]. In 1994, David et al. [10] had documented GERD in 4 neonates with bilateral choanal atresia. They did so by GER scan in one patient and pH monitoring in the other 3 patients using dual probes; one was placed in the esophagus, and the other one was placed in the posterior choana, and they found reflux in the nasopharyngeal region concurrent with esophageal reflux with pH values less than 4. Three patients underwent transnasal endoscopic repair for bony atresia, and one patient underwent transpalatal repair for membranous atresia, and all the 4 patients had postoperative stenting for different periods. It was noticed that all the 4 patients developed postoperative stenosis which required repeated dilatations. GERD was treated in these patients; two of them had mild GERD that responded well to medical treatment in the form of prokinetics (metoclopramide) and H2 blockers (cimetidine), while the remaining two patients had severe form that necessitated surgical intervention in form of Nissen fundoplication. Subsequent pH dual probes for the 4 patients were within normal values which coincided with period of patent nasal airway without need for further dilatations for periods ranged between 7 and 23 months. Based on these findings, David et al. in 1994 [10] supposed that GERD is an important risk factor for restenosis after choanal atresia repair; in addition, it may be a complication of choanal atresia repair.

In addition, more than one study studied the relation between GERD and chronic sinusitis, especially in pediatric age group. One of these was conducted in 1999 by Bothwell et al. [11], in which they diagnosed GERD in 28 children with recalcitrant chronic sinusitis after FESS failure. A dramatic response was noticed after proper antireflux treatment in form of PPI. Similar findings were noticed in another study used the same method of assessment and treatment but it included adult patients with recalcitrant chronic sinusitis. It stated that reflux can reach sinus ostia initiating inflammation and edema occluding them [12].

These previously mentioned studies reached a conclusion that the acid reflux can go high up reaching the region of the nasopharynx. The relation between GERD and restenosis after choanal atresia repair was explained by the direct injury of pepsin and acid on the nasal mucosa, leading to inflammation and subsequent granulation tissues formation that leads eventually to stenosis. In addition, stents—if present—may wick the acid reflux, prolonging its effect on the nasal mucosa [13].

The previous conclusions were the base of this current study which was the first one to study the effect of routine administration of antireflux treatment in preventing restenosis after choanal atresia repair. It was found that only two patients developed stenosis despite antireflux therapy compared to eight patients in the control group. And this finding was statistically significant (10% vs. 40%, p value = 0.02).

Although this current study is not the only study that used antireflux treatment in preventing restenosis, it was the first one that used antireflux treatment in the form of PPI instead of antacids, prokinetics, and fundoplication in another studies. PPI was proved to be effective in treatment of severe refractory GERD in children [14]. Esomeprazole was chosen as it has been reported to have a somewhat higher potency in acid inhibition than other PPIs. Using esomeprazole in dose of 10 mg per day for 6 weeks is safe [15].

Combining all these data together—high prevalence of GERD, difficult diagnosis of GERD in infants, implication of GERD in restenosis following surgery, and the efficacy and the safety of PPI—can give the justification of the routine use of PPI following choanal atresia repair for prevention of restenosis.

Conclusion

The use of esomeprazole which is a proton pump inhibitor acting as an antireflux in postoperative treatment and is an effective drug in preventing choanal restenosis and in preventing inflammation on choanal mucosa enhances good healing mechanism.

Abbreviations

CA: Choanal atresia; CT: Computed tomography; PPI: Proton pump inhibitor; GERD: Gastroesophageal reflux disease.

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Not applicable.

Authors' contributions

AE was responsible for the design of the work, GA was the main operator of the cases in the pediatrics ENT department, TF was responsible for data acquisition, and AF was responsible for the data analysis and writing of the manuscript. All authors have approved the submitted version of the manuscript.

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Availability of data and materials

The data of this study are available at the corresponding author upon request.

Declarations

Ethics approval and consent to participate

All procedures performed in this study were in accordance with the ethical standards of the research committee of the ENT Department Faculty of Medicine, Cairo University.

Informed written consent to participate in the study was provided by all participants' parent or legal guardian as all cases were infants.

Consent for publication
Written informed consent to publish the patients' clinical details information was obtained from the patients' parent or legal guardian.

Competing interests
The authors declare that they have no competing interests.

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