

Air reflux following endoscopic dacryocystorhinostomy

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Abstract

Purpose: To evaluate the incidence of air reflux following endoscopic dacryocystorhinostomy and determine its association with symptomatic control following surgery.

Methods: Questionnaire assessment was performed for adult patients 1 year following primary endoscopic dacryocystorhinostomy for nasolacrimal duct obstruction at the Hong Kong Eye Hospital.

Results: 43 patients were included. Overall, 97.7% of patients reported improved symptoms after endoscopic dacryocystorhinostomy. Air reflux was present in 14 patients (32.6%), with 78.6% noting moderate-to-severe symptoms, although the majority (71.4%) did not consider it a nuisance. All patients with air reflux noted symptomatic improvement. There was no significant difference in symptom improvement between patients with and without air reflux ($p = 1.000$). Air reflux was found to have a high specificity (100%) but poor sensitivity (33%) in reflecting symptom control, and had a positive predictive value of 100% and negative predictive value of 3.4%.

Conclusion: The presence of air reflux did not reflect the success of endoscopic dacryocystorhinostomy in managing symptomatic nasolacrimal duct obstruction. Nonetheless its presence was well tolerated and can be reassuring to patients as it indicates lacrimal drainage patency.

Introduction

Epiphora is a common ophthalmic condition seen in primary, secondary and tertiary care, with acquired nasolacrimal duct obstruction (NLDO) being one of the most common causes.^{1,2} Traditionally, NLDO is treated by dacryocystorhinostomy (DCR), where a communication is created between the mucosal surfaces of the nasolacrimal sac and the nasal cavity, using an external approach (ExDCR). The reported success rates vary from 90% to 97%.³⁻⁵ With the advent of endoscopic techniques for performing functional intranasal and sinus surgery, an endoscopic approach, termed endoscopic dacryocystorhinostomy (EnDCR), has become the preferred initial surgery of choice for NLDO. During EnDCR, a nasal mucosal flap is first created, followed by endonasal bone osteotomy to expose the lacrimal sac, and then marsupialization to the nasal cavity. Historically, the reported success rates ranged from 84% to 91%.⁶⁻⁸ This lower success rate is one of the most common reasons cited for choosing ExDCR over EnDCR.⁹ Nonetheless, a recent meta-analysis confirmed comparable success rates for the 2 approaches (87%).¹⁰ Long-term anatomical and functional EnDCR success was also reported to be 97.7% and 95.5%, respectively after a mean follow-up of 21.8 months.¹¹

We conducted a retrospective study where patients who underwent EnDCR completed a telephone questionnaire interview 1 year postoperatively about the presence of air reflux (AR), a term that describes the retrograde passage of air from the nose to the eye, causing a sensation of cold air or bubbling at the inner canthus. AR has been described as proof of nasolacrimal patency after ExDCR by means of Valsalva bubble test (VBT).^{12,13} The current study aimed to evaluate the incidence of AR following EnDCR and determine its association with symptomatic control following surgery.

Key words: Air movements; Dacryocystorhinostomy; Endoscopy

Methods

A structured telephone questionnaire interview was performed among adult patients who had undergone primary EnDCR for NLDO at the Hong Kong Eye Hospital between 2009 and 2010. The surgery was performed by oculoplastic surgeons following routine EnDCR procedures. The study adhered to the tenet of the Declaration of Helsinki, and verbal consent prior to the interview was obtained from all patients. The study was approved by the Institutional Review Board, Kowloon Central Cluster, Hospital Authority.

Surgical technique

Topical nasal decongestant (xylometazoline nasal drops) was instilled 4 times at 15-minute intervals 1 hour prior to surgery performed under general or regional anesthesia (transcaruncular block with plain 2% lignocaine). The nasal cavity of the side intended for EnDCR was packed for 5 minutes with ribbon gauze soaked in 3 ml of 5% cocaine. The inferior punctum was dilated and a 20-gauge disposable vitrectomy light pipe (Fiber Optic Illuminator; Storz Ophthalmics, St. Louis [MO], USA) was passed through the lower canaliculus into the lacrimal sac. After removal of nasal packing, a 4-mm, zero-degree rigid nasal endoscope (7200A Hopkins, Karl Storz, Tuttlingen, Germany) was introduced into the nasal cavity. The intended osteotomy site was determined by viewing the transillumination of the light pipe by an endonasal approach. The area was infiltrated with 1–2 ml of 2% lignocaine with 1:200,000 adrenaline. The nasal cavity was repacked with the ribbon gauze soaked in 5% cocaine used previously for another 5 minutes. Limited nasal septoplasty or middle turbinate reduction or uncinctomy was performed when necessary. An incision anterior to the maxillary line over the lacrimal fossa, covering the full length of the lacrimal sac, was made using a radiofrequency unit (Surgitron IEC; Ellman International Inc., New York, USA). A nasal mucosal flap hinged on its posterior base was fashioned with intranasal scissors (Bellucci Scissors; Karl Storz, Tuttlingen, Germany) and reflected backward. The lacrimal bone was perforated with a freer periosteal elevator. The osteotomy was enlarged with bone punches (Kerrison up-biting rongeur [2 mm]; Medicon, Tuttlingen, Germany) and powered microdrill (Core Powered Instrument Driver [3 mm]; Stryker, Kalamazoo [MI], USA) if needed. The frontal process of the maxilla was removed superiorly and anteriorly to expose the fundus and the body of the lacrimal sac. Some bone covering the upper part of the nasolacrimal duct was also removed. The lacrimal sac was then tented up with the light pipe and a vertical incision was made with a crescent blade (2.3 mm Angled Crescent Knife; Unique Tech Inc., Mohnnton [PA], USA). The anterior flap was removed with a bone punch. For the posterior flap, a superior and inferior relaxing cut was made with intranasal scissors. The nasal mucosal flap was repositioned from its reflected position and put next to this lacrimal mucosal flap over the osteotomy. Intraoperative mitomycin C at a concentration of 0.4 mg/ml was applied over the mucosal flaps for 5 minutes. Bicanalicular intubation was performed using silicone tubing (Lacrimal Intubation Set; Beaver-Visitec International Ltd.,

Warwickshire, United Kingdom). A small piece of gelfoam (20 mm x 20 mm x 5 mm) soaked with triamcinolone acetonide 40 mg in 1 ml was threaded along the silicone tube by an endonasal approach and passed all the way to the site of the ostium using a freer under endoscopic guidance. At the end of surgery, a merocel coated with xylocaine gel was packed in the nostril. The silicone intubation was removed under endoscopic guidance at 4 to 6 weeks when the ostium was seen to be epithelialized. Patients underwent nasal endoscopy 3 months postoperatively to assess DCR patency.

Questionnaire assessment was performed for primary EnDCR patients 12 months postoperatively. The same surgeon performed all the telephone interviews. Presence of AR before and after surgery was recorded. Changes in presenting symptoms, specific improvement in epiphora (flow symptom), and mucoid or viscous discharge (volume symptom) following EnDCR were also recorded. Changes in presenting symptoms were categorized as ‘better’ or ‘same/worse’. The questionnaire further surveyed the frequency (daily, weekly, monthly, or rarely), duration, severity, method of alleviation (‘none’, ‘nose pinching’, or ‘eye squeezing’), and degree of nuisance of AR where present.

Statistical analyses

Statistical analyses were performed using PASW software version 18.0 (SPSS/IBM Inc., Chicago [IL], USA). Categorical variables between groups were compared using Fisher’s exact tests. A *p* value of < 0.05 was considered statistically significant.

Results

43 patients who underwent primary EnDCR were reviewed after 1 year. The response rate was 75.4%. The mean ($\pm$ standard deviation) age was 60.2 ± 9.7 years and median follow-up duration was 6 months (range, 3 to 60 months). Anatomical success, which was defined by positive endoscopic dye test with the presence of fluorescent stain on nasal endoscopic examination, was 100%. There were no major surgical complications in this cohort. Overall, 97.7% of patients reported improvement in symptoms following surgery, with only 1 patient (2.3%) reporting worsening of symptoms postoperatively. No patients had AR before surgery, and 14 (32.6%) had AR after EnDCR. No patient developed acute dacryocystitis, and none had obstructive sleep apnea requiring continuous positive airway pressure (CPAP).

Among those 14 patients with AR, the majority (42.9%) noted the presence of AR weekly, followed by monthly (35.7%), rarely (14.3%), and daily (7.1%). AR persisted for the whole year in all these patients. Moderate-to-severe AR (78.6%) was reported more frequently than mild, but the majority (71.4%, *n* = 10) did not perceive it to be a nuisance. All patients reported improvement in symptoms. AR was managed by nose pinching (14.3%) or eye squeezing (7.1%). Most patients (78.6%) simply ignored it (Table).

Table. Characteristics of air reflux (n = 14).

Data	
Frequency	
Daily	1 (7.1%)
Weekly	6 (42.9%)
Monthly	5 (35.7%)
Rarely	2 (14.3%)
Severity	
Mild	3 (21.4%)
Moderate to severe	11 (78.6%)
Degree of nuisance	
None	10 (71.4%)
Mild	3 (21.4%)
Moderate to severe	1 (7.1%)
Modes of alleviation	
None	11 (78.6%)
Nose pinching	2 (14.3%)
Eye squeezing	1 (7.1%)

No significant difference in symptom improvement was found between patients with and without AR ($p = 1.000$). AR was found to have a high specificity (100%) but poor sensitivity (33%) in reflecting symptom control. Positive predictive value was 100% and negative predictive value was 3.4%.

Discussion

According to the Ducasse classification, functional success is based on resolution of symptoms, while anatomical success depends on duct permeability on nasal endoscopy and a positive Jones fluorescein test.¹⁴ Studies have variable outcome measures, with some defining success as patency to irrigation and others concentrating on symptom resolution. In Tsirbas and Wormald's landmark paper that introduced EnDCR, 95% anatomical and 89% functional success rates were reported.¹⁵ This discrepancy is explained by Rose's proposal of a lacrimal paradox, where volume-related backwash from the lacrimal sac is expected to respond to improved anatomical patency, but flow-related restraints will remain limited by inherent tear conductance and canaliculi hydraulic resistance postoperatively.¹⁶ It was noted that 95% of anatomic obstructions and 81% of functional obstructions in Tsirbas and Wormald's review became asymptomatic.¹⁵

Clear advantages of endoscopic surgery include lack of a potentially disfiguring scar, minimal postoperative discomfort, minimal blood loss, and minimal disturbance to the medial canthal ligament attachment and lacrimal pump.¹⁷ Reported complications of EnDCR include nasal synechiae, nasal granulomas, abscess, mild postoperative epistaxis, intraoperative bleeding, and cerebrospinal fluid leakage through an ethmoid defect.^{18,19}

In 2007, Herbert and Rose²⁰ first described AR as a complication following ExDCR in 47% of patients immediately after surgery, of whom 78% had persistent symptoms at longer follow-up. The majority of patients (85%) were not concerned by the symptom, and claimed easy control by pinching the medial canthus during sneezing or nose blowing. Nonetheless AR has been reported as irritating to patients; it was the most common complaint (41.6%) in patients who were dissatisfied with the outcome of endoscopic-guided transcaruncular Lester-Jones tube (LJT) intubation without DCR.²¹ Patients with moderate-to-severe obstructive sleep apnea on CPAP have also documented discomfort following DCR, including severe air regurgitation, dry eyes, vascularized limbal keratitis, conjunctivitis and recurrent microbial keratitis.²²⁻²⁴ It was postulated that the positive pressure created by CPAP therapy forces air up through the enlarged nasolacrimal ostium with its absence of normal anatomical valves or through the LJT. The majority of literature published on CPAP complications following a DCR are, however, related to LJT placement.²⁴⁻²⁶ Only 2 publications assessed patients post-EnDCR. In one such study that assessed post-EnDCR AR in patients undergoing CPAP therapy, 70% complained of air regurgitation, while 60% had additional eye symptoms of dryness, irritation and redness. CPAP was discontinued in 20% of patients because of intolerable ophthalmic symptoms.²⁷

Despite this, AR can be viewed from another perspective. Patients report reassurance by this simple, self-assessable confirmation of the patency status of the new lacrimal drainage.²⁰ Mulligan et al¹² also described the use of air regurgitation during the Valsalva maneuver as a quick, clean and easy means of assessing lacrimal patency following ExDCR.¹² They defined the presence of bubbles rising through a drop of saline placed in the medial canthus as the VBT, and a high correlation between this test with Jones fluorescein testing was observed, confirming AR's role as a fast, safe and accurate method of confirming DCR patency.¹²

Here we evaluated the bearing of AR as an indicator of surgery success. The overall success rate of EnDCR, defined as improvement in tearing symptoms, was 97.7%. This was comparable with the results of Ali et al²⁷ after 21 months of follow-up, where 97.7% and 95.5% of patients reported anatomical and functional success respectively at last follow-up. In our study, only 32.6% ($n = 14$) had AR, a figure lower than the reported incidence of 45.5% and 47.0%.^{20,28}

No significant difference was found between AR and overall symptom improvement in our patients. This contradicts observations by Biro et al²⁸ where success of EnDCR correlated significantly with presence of AR ($p = 0.0044$), and Herbert and Rose²⁰ who also found an association of AR with a higher success rate (relative risk, 1.22; $p = 0.02$). Our results suggest that although the presence of AR indicates a good clinical response, as evidenced by 100% specificity, it is not useful for predicting success. Absence of AR does not translate directly into poor outcome, and 96.6% (28

out of 29 patients) without AR still reported improvement of symptoms. This is further supported by AR's low sensitivity and negative predictive value. This discrepancy may be explained by an intact valve of Rosenmüller that could prevent backflow of air from the lacrimal sac to the canalicular system in these patients despite a patent lacrimal drainage. Endoscopic examination will then confirm patency.

Although AR was a poor predictor of success, all patients with AR had symptomatic improvement. The presence of AR postoperatively should therefore be reassuring for clinicians and patients. In addition, while weekly AR was the most common frequency of symptom, only 1 patient found it moderately to severely troublesome, and the majority (78.6%) could tolerate it without active management of the pneumatic sensation.

Limitations of this study include its retrospective nature. Anatomical patency was only evaluated up to 3 months postoperatively. Late failure is not common following

DCR.^{29,30} Zenk et al²⁹ reported overall success of 81.8% at 5-year follow-up, and the majority of late complications occurred between 1 and 3 months after surgery. Moreover, symptomatic improvement is more clinically relevant compared with demonstration of a patent lacrimal drainage. Unfortunately we did not assess the ocular surface in our patients who completed only a telephone interview.

In conclusion, the presence of AR did not reflect the success of EnDCR in managing symptomatic NLDO. Its presence is well tolerated and can be reassuring to patients as it indicates lacrimal drainage patency. Because AR occurs in approximately a third of patients who undergo EnDCR, preoperative counseling about the likelihood and significance of AR is important and can enable better management of patient expectations.

Declarations

The authors declared no conflict of interest in this study.

References

- Williams B, Johnson D, Hurst J, Kratky V. Patterns and causes of epiphora referrals to a tertiary oculoplastic practice. *Can J Ophthalmol*. 2014;49:180-2.
- Sibley D, Norris JH, Malhotra R. Management and outcomes of patients with epiphora referred to a specialist ophthalmic plastic unit. *Clin Experiment Ophthalmol*. 2013;41:231-8.
- Yuksel D, Kosker M, Akoç I, Simsek S. Long-term results of simultaneous bilateral external dacryocystorhinostomy in cases with bilateral dacryostenosis. *Semin Ophthalmol*. 2015;30:20-4.
- Uludag G, Yeniad B, Ceylan E, Yildiz-Tas A, Kozar-Bilgin L. Outcome comparison between transcanalicular and external dacryocystorhinostomy. *Int J Ophthalmol*. 2015;8:353-7.
- Takahashi Y, Mito H, Kakizaki H. External dacryocystorhinostomy with or without double mucosal flap anastomosis: comparison of surgical outcomes. *J Craniofac Surg*. 2015;26:1290-3.
- Tsirbas A, Wormald PJ. Endonasal dacryocystorhinostomy with mucosal flaps. *Am J Ophthalmol*. 2003;135:76-83.
- Dolman PJ. Comparison of external dacryocystorhinostomy with nonlaser endonasal dacryocystorhinostomy. *Ophthalmology*. 2003;110:78-84.
- Ben Simon GJ, Joseph J, Lee S, Schwarcz RM, McCann JD, Goldberg RA. External versus endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction in a tertiary referral center. *Ophthalmology*. 2005;112:1463-8.
- Barmettler A, Ehrlich JR, Lelli G Jr. Current preferences and reported success rates in dacryocystorhinostomy amongst ASOPRS members. *Orbit*. 2013;32:20-6.
- Huang J, Malek J, Chin D, et al. Systematic review and meta-analysis on outcomes for endoscopic versus external dacryocystorhinostomy. *Orbit*. 2014;33:81-90.
- Ali MJ, Psaltis AJ, Bassiouni A, Wormald PJ. Long-term outcomes in primary powered endoscopic dacryocystorhinostomy. *Br J Ophthalmol*. 2014;98:1678-80.
- Mulligan NB, Ross CA, Francis IC, Moshegov CN. The Valsalva DCR bubble test: a new method of assessing lacrimal patency after DCR surgery. *Ophthalm Plast Reconstr Surg*. 1994;10:121-3.
- Knisely A, Harvey R, Sacks R. Long-term outcomes in endoscopic dacryocystorhinostomy. *Curr Opin Otolaryngol Head Neck Surg*. 2015;23:53-8.
- Rosique López L, Lajara Blesa J, Rosique Arias M. Usefulness of local postoperative care after laser dacryocystorhinostomy [in English and Spanish]. *Acta Otorrinolaringol Esp*. 2013;64:279-82.
- Tsirbas A, Wormald PJ. Mechanical endonasal dacryocystorhinostomy with mucosal flaps. *Br J Ophthalmol*. 2003;87:43-7.
- Rose GE. The lacrimal paradox: toward a greater understanding of success in lacrimal surgery. *Ophthalm Plast Reconstr Surg*. 2004;20:262-5.
- Whittet HB, Shun-Shin GA, Awdry P. Functional endoscopic transnasal dacryocystorhinostomy. *Eye (Lond)*. 1993;7(Pt 4):545-9.
- Gioacchini FM, Alicandri-Ciuffelli M, Kaleci S, Re M. The outcomes of endoscopic dacryocystorhinostomy in children: A systematic review. *Int J Pediatr Otorhinolaryngol*. 2015;79:947-52.
- Fayet B, Racy E, Assouline M. Cerebrospinal fluid leakage after endonasal dacryocystorhinostomy. *J Fr Ophthalmol*. 2007;30:129-34.
- Herbert HM, Rose GE. Air reflux after external dacryocystorhinostomy. *Arch Ophthalmol*. 2007;125:1674-6.
- Choi WC, Yang SW. Endoscopy-guided transcanalicular Jones tube intubation without dacryocystorhinostomy. *Jpn J Ophthalmol*. 2006;50:141-6.
- Cannon PS, Madge SN, Selva D. Air regurgitation in patients on continuous positive airway pressure (CPAP) therapy following dacryocystorhinostomy with or without Lester-Jones tube insertion. *Br J Ophthalmol*. 2010;94:891-3.
- Harrison W, Pence N, Kovacich S. Anterior segment complications secondary to continuous positive airway pressure machine treatment in patients with obstructive sleep apnea. *Optometry*. 2007;78:352-5.
- Longmire MR, Carter KD, Allen RC. Intolerance of Jones tube placement in a patient using continuous positive airway

- pressure. *Ophthal Plast Reconstr Surg*. 2010;26:68-9.
25. Goldberg DS. Management of air regurgitation through a jones tube in a patient using continuous positive airway pressure. *Ophthal Plast Reconstr Surg*. 2011;27:e76-7.
 26. Servat JJ, Black EH, Gladstone GJ. A solution to the Jones tube continuous positive airway pressure (CPAP) dilemma? *Ophthal Plast Reconstr Surg*. 2012;28:e151-2.
 27. Ali MJ, Psaltis AJ, Murphy J, Wormald PJ. Endoscopic dacryocystorhinostomy and obstructive sleep apnoea: the effects and outcomes of continuous positive airway pressure therapy. *Clin Experiment Ophthalmol*. 2015;43:405-8.
 28. Biro N, Murchison AP, Pribitkin EA, Rosen MR, Bilyk JR. Air reflux and other sequelae following endoscopic dacryocystorhinostomy. *Ophthal Plast Reconstr Surg*. 2013;29:386-8.
 29. Zenk J, Karatzanis AD, Psychogios G, et al. Long-term results of endonasal dacryocystorhinostomy. *Eur Arch Otorhinolaryngol*. 2009;266:1733-8.
 30. Moore WM, Bentley CR, Olver JM. Functional and anatomic results after two types of endoscopic endonasal dacryocystorhinostomy: surgical and holmium laser. *Ophthalmology*. 2002;109:1575-82.