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REVIEW ARTICLE

Primary Endonasal Dacryocystorhinostomy - Impact of Multiple Factors on the Outcome

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Abstract

Purpose: Endoscopic dacryocystorhinostomy (en-DCR) is the mainstay of treatment of patients with nasolacrimal duct obstruction, with current success rates above 90%. Our aim was to evaluate multiple demographic and technical factors and estimate its influence on the outcome of en-DCR.

Methods: We performed a retrospective review of the clinical records of patients submitted to a DCR at the Lacrimal Surgery Unit of the Centro Hospitalar Tondela-Viseu between June 2010 and December 2018, and collected data on demographic characteristics, preoperative consultation notes, surgical reports, complications and follow-up results.

Results: Our study included 107 en-DCR procedures (92 consecutive patients), with an overall success rate of 89.7%. The post-operative finding of granulation tissue by post-operative week 6 was associated with a negative outcome ($p = 0.001$). None of the other variables studied achieved a statistically significant association with the outcome, including the presence of multiple comorbidities, performance of ancillary procedures or history of dacryocystitis; however, previous ocular surgery showed a tendency toward poorer results.

Conclusion: Determining factors associated with surgical failure can help advice patients accordingly in the preoperative setting. Our study analyzed multiple variables and concluded that previous ocular surgery approached a statistically significant association with the outcome. The addition of ancillary procedures (nasal or ophthalmological) does not negatively influence the outcome of en-DCR and the presence of comorbidities should not preclude surgery.

Keywords

Dacryocystorhinostomy, Nasolacrimal duct, Outcome

Introduction

Dacryocystorhinostomy (DCR) has been widely used for the treatment of nasolacrimal duct obstruction (NLDO) in patients with epiphora. The surgery aims to create a lacrimal drainage pathway between the obstructed excreting system and the nasal cavity. DCR was first described in 1904 by Toti [1], using an external approach, and has since been considered the standard treatment of NLDO [2]. In 1989 McDonogh and Meiring firstly described the relevant anatomy and the endoscopic DCR (en-DCR) surgical procedure [3], and Wormald PJ described the powered en-DCR with total sac exposure and primary intention healing [4]. Since the development of endoscopes and the experience collected through advances in functional endoscopic sinus surgery, the paradigm has shifted and the endonasal approach is nowadays regarded as an equally effective approach [2,4].

The influence of several technical variations on surgical success (concomitant application of adjunctive mitomycin C [5], creation of mucosal flaps [6], silicone

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intubation [7,8], among others), were estimated by multiple study groups. However, despite the extensive debate on methods to improve surgical success, there is limited information regarding the reasons behind a surgical failure. Small ostium size and granulation tissue formation leading to scarring of the rhinostomy site [9] have been implicated on surgical failure, as well as the experience of the surgical team [10]. By performing a thorough evaluation of the medical records of patients submitted to an en-DCR, performed by an experienced single surgical team, our aim was to identify demographic and technical factors that could influence the surgical outcome of the procedure.

Material and Methods

Study design

We retrospectively reviewed the clinical records of every patient submitted to a DCR at the Lacrimal Surgery Unit of the Centro Hospitalar Tondela-Viseu between June 2010 and December 2018. All patients integrating our sample were operated by a single surgical team at the same institution, composed of one senior oculoplastic surgeon (RT) and one senior otolaryngologist (VS). Only patients who were submitted to primary en-DCR alone or combined with concomitant endonasal or ocular procedures were included in the study. Patients with a follow-up period under 6 months were excluded. Demographic data, preoperative consultation notes, surgical reports, complications and follow-up results were collected.

In our study, success of the procedure was defined as a postoperative Munk scale rated 0 or 1, patient stating subjective benefit, a positive fluorescein test done under endoscopic control and a visible patent neo-ostium with a diameter greater than 2 mm. The surgery was only considered *successful* if all four parameters were fulfilled.

Statistical analysis

Statistical analyses were conducted with SPSS 26.0®. The normality of the variables was evaluated through histogram observation and normality tests (Kolmogorov-Smirnov) when necessary. For continuous variables, where normality was verified, the student t-test was used to compare independent samples. For comparative analysis of categoric variables the chi-square test was used - when the assumptions were not fulfilled, Fisher's exact test was performed. A level of significance of 0.05% was considered for statistical purposes.

Preoperative evaluation

Every patient underwent a full ophthalmological evaluation, consisting of probing of canaliculi and lacrimal irrigation, to confirm distal obstruction, lacrimal canaliculi patency, and exclude other causes of epiphora, which would otherwise contraindicate endoscopic surgery. Lacrimal scintigraphy was not routinely used. The decision to perform a septoplasty was based on the endoscopic evaluation of the nasal cavity, performed systematically with a 0° lens rigid scope after mucosal decongestion with cotton gauze soaked with phenylephrine at the preoperative visit. Whenever the ENT consultant identified a high nasal septum deviation that obliterates the full view of the middle turbinate axilla or that narrows the work channel, anticipating technical limitations on the operating theatre or postoperative follow-up, a limited endoscopic septoplasty was offered to the patient.

Surgical technique

The surgery is performed under general anesthesia. To decongest the nasal mucosa cotton gauze soaked with phenylephrine (5 mg/ml) is applied for a few minutes, followed by submucosal injection of 1% lidocaine with 1:100,000 epinephrine on multiple sites (attachment of middle turbinate to the lateral nasal wall, area overlying the lacrimal sac and septum mucosa if an endoscopic septoplasty were to be performed). Usually, in our hands, a 0° lens is preferred. Incisions are placed to create a posteriorly-based flap and expose the junction between the lacrimal bone and the frontal process of the maxilla. A 2 mm up-bitting Kerrison punch is used to remove the bone overlying the lacrimal sac until the fundus is exposed. A Bowman lacrimal probe is inserted through the superior canaliculus until it reaches the lacrimal sac, and a tenting maneuver is made. A vertical incision on the medial wall of the sac is made with an angled 2.75 cataract knife, marsupializing the sac, and the flaps are trimmed and repositioned. Bicanalicular stent insertion is routinely performed, passed through the neo-ostium and securely tied with knots. A mitomycin C soaked sponge is applied to the osteotomy site (at 0.02% for 5 minutes) at the end of the procedure in every revision case.

Whenever a concurrent septoplasty was needed, we performed a limited endoscopic approach prior to the E-DCR. A mucosal incision is made on the same side as the E-DCR (using a Colorado microdissection needle to avoid bleeding) just caudally to the deviation in the nasal septum and a subperichondrial flap is raised. By performing the septoplasty on the same side as the E-DCR, the surgeon can clearly assess the deviation that obscures the DCR surgical field and remove the minimal amount of septal cartilage needed for optimal visualization. The flap is repositioned without suturing and a limited biodegradable synthetic polyurethane foam (Nasopore®) pack is used to maintain the flap in place at the end of the procedure.

Perioperative care and follow-up

All cases were outpatient surgeries. Post-operative topical application of steroid and antibiotic eye drops was prescribed for 7 days and topical nasal corticosteroid and saline irrigations were maintained for 2

Table 1: Demographic characteristics of the sample (n = 92 patients, who underwent 107 E-DCR procedures), comorbidities, preoperative diagnosis, preoperative imaging studies and concomitant procedures.

Characteristics	en-DCR procedures
N	107
Median Age	61.71 ± 15.9
Gender (female)	88.8%
Eye	
Left	46
Right	41
Both	15
Comorbidities	
Hypertension	50 (46.7%)
Diabetes Mellitus Type 2	14 (13.1%)
Rhinitis	11 (10.3%)
Asthma	12 (11.2%)
Eye pathology	36 (33.6%)
Chronic use of eye drops	13 (12.1%)
Chronic use of systemic medication	85 (79.4%)
Anticoagulant/Antiplatelets Agents	18 (1.8%)
Smoking History	5 (4.7%)
Preoperative Diagnosis	
Epiphora	101 (94.4%)
Dacryocistitis	19 (17.8%)
Iatrogenic lacrimal system injury	2 (1.9%)
Concomitant Procedures	
Endonasal procedures (septoplasty only)	45 (42.1%)
Ophthalmological procedures	11 (10.3%)
Silicone intubation	107 (100%)
Type of Obstruction	
Anatomical	103 (93.6%)
Functional	4 (6.4%)
Imaging Study	
Sinus/orbital CT scan	8 (7.5%)

months. The first follow-up appointment is scheduled 10 days post-operatively for surgical debridement and the second appointment is at 6 weeks for silicone stent removal. The patient is then followed-up at 3, 6 and 12 months and nasal endoscopy and functional evaluation are performed, as well as peri-ostium debridement when needed.

Results

Our study included 107 primary lacrimal surgeries from 92 consecutive patients who underwent en-DCR. Our sample characterization is exposed in Table 1. Bilateral procedures were performed in 15 patients (n = 30). The median age was 61.71 ± 15.9 years with a female preponderance of 88.8%. The median follow-up period was 10.98 months (range 6-48).

Epiphora was a complaint in 94.4% of the patients and 17.8% had previous history of chronic or recurrent dacryocistitis. These repeated infectious episodes showed no association with the outcome of the procedure (p = 1). No dacryoscintigraphy was performed, and sinus/orbital CT scans were obtained in 7.5% of the patients. Hypertension was the most prevalent comorbidity (46.7% of the sample), followed by type 2 diabetes mellitus (13.1%), asthma (11.2%) and rhinitis (10.3%). Concurrent ocular pathology was present in 33.6% of the sample, mostly cataract (n = 23), glaucoma (n = 7) and ectropion (n = 6). Previous ocular surgery had been performed in 21.5% of the eyes, mainly cataract surgery. Systemic medication for comorbidities was in use by 79.4%, with 16.8% of our sample on antiplatelet or anticoagulant medications. No chronic systemic corticosteroids were in use. Topical eye medication (mostly anti-glaucoma agents such as latanoprost and timolol) was being chronically used in 12.1% of the operated eyes. Smoking history was present in 4.7% of the sample.

Sinus pathology was found in only two patients. One of them developed NLDO following functional endoscopic sinus surgery for chronic rhinosinusitis. In our cohort 42.1% of en-DCR were accompanied by an endoscopic septoplasty, and no other concomitant endonasal procedure was performed. The success rate in the en-DCR alone group (n = 62 eyes) was 87.1% and 93.3% in the en-DCR + septoplasty group (n = 45 eyes), a difference that did not achieve statistical significance (p = 0.351). Adjunctive ophthalmological procedures were performed in 10.3% of the operated eyes, but no positive or negative association with outcome was found (p = 0.625). Bicanalicular intubation was performed in every en-DCR. The early extrusion of the stent was observed in 5.6% of the procedures, which did not show any association with the outcome (p = 0.513).

Post-operative complications include the mentioned premature extrusion of the silicone stent and mild bleeding that resolved with a vasoconstrictor agent in one patient. There were no intraoperative surgical complications reported. No complications attributable to the septoplasty or ophthalmologic adjuvant procedures occurred in our review in the follow-up period.

The overall success rate on our cohort was 89.7%. The endoscopic finding of granulation tissue by post-operative week 6 was associated with a negative outcome (p = 0.001). None of the other variables studied achieved a statistically significant association. Only previous ocular surgery (p = 0.056) approached a statistically significant association with the outcome.

Discussion

Epiphora is a common complaint and endoscopic dacryocystorhinostomy is an established technique for the treatment of nasolacrimal duct obstruction. Several advantages over the external approach have been at-

tributed to the endonasal one, such as lack of visible skin incision, decreased postoperative discomfort, preservation of the tear-pump mechanism and the ability to perform concomitant endonasal procedures [11-13]. In our study, the overall success rate of the performed en-DCR was 89.7%, which is in line with the literature.

Other reports have tried to analyze factors that influence en-DCR surgical outcome. Jung, et al. studied his cohort of 79 failures among 1083 patients to identify factors that could be related to surgical failure. He found that radioactive iodine ablation was associated with surgical failure, but age, sex, indication for surgery or early silicone tube removal were not [14]. In our cohort, neither gender (p = 0.609) or early silicone tube removal (P = 0.513) were associated with the outcome. Although an active topic of discussion, two recent meta-analysis showed no statistically significant influence on outcome, rhinostomy closure rates or synechia and granulation tissue formation, with the placement of silicone stents in primary en-DCR [7,8]. We routinely place a silicone stent as we consider it facilitates post-operative debridement.

Previous studies have identified a positive correlation between sinonasal abnormalities and NLDO [15] and some authors have suggested that ostial closure may be related to concomitant nasal pathology [16,17]. Therefore, concomitant nasal procedures, namely septoplasty when required, theoretically improve DCR surgical success by enhancing surgical exposure and decreasing adhesions. A significant proportion of en-DCR procedures in our cohort were accompanied by an endoscopic septoplasty (42.1%). Nussbaumer, et al. reported a rate of concomitant endonasal procedures of 21.5% (septoplasty in 16.4%) [18] and Figueira, et al. performed endonasal procedures in 14.1% (11.9% septoplasty) [19]. Both series reported slightly lower success rates in the en-DCR plus concomitant procedures group. Tsirbas and Wormald reported a rate of approximately 46% of patients requiring a septoplasty, stating that in order to create a larger ostium, better access is needed, but an analysis on its influence on the outcome was not performed [9]. Koval, et al. stated that septoplasty had no statistically significant impact on the outcome of en-DCR, despite raw data analysis showing a decrease in en-DCR functional success when septoplasty was concurrently performed [20]. In contrast, even though differences between both groups also did not achieve statistical significance in our study, the en-DCR + septoplasty group achieved better results regarding a successful outcome when compared to the en-DCR alone group (93.3% vs. 87.1% respectively). By performing a limited upper septoplasty, the goal is to create an anatomy no different than that of a patient without any septal deviation. Hence, statistically significant differences comparing success rates between en-DCR with or without concurrent septoplasty (not performed in patients with a straight nasal septum) are not to be expected and have not been reported in the literature. However, we believe the threshold for performing septoplasty during an E-DCR should be low, for a mild septum deviation may cause limitations either on the surgical field and on post-operative debridement. Furthermore, no increased morbidity directly attributed to the limited endoscopic septoplasty approach were found in our review, or others [19,20].

Performing concomitant oculoplastic surgeries in one stage did not negatively affect the outcome of en-DCR (p = 1). Theoretically, to perform ophthalmological procedures when required helps to reduce failure rates. Most of these surgeries were performed in patients with lower lid horizontal laxitude or ectropion who would fail to improve their epiphora symptoms if the ophthalmological procedure was not performed. To perform these adjunctive procedures concomitantly and not in a staged fashion has no negative impact on the outcome, but instead proves beneficial for the patient as further hospital admissions and anesthesias are avoided.

A statistically significant association between the identification of granuloma formation at week 6 follow-up appointment and outcome has been found in our study (p = 0.001). Previous reports have also suggested that granuloma development around the neo-ostium might be associated with failure [21,22]. These data support the role of a regular and careful follow-up and post-operative osteotomy site debridement in the management of these patients. MMC has been used to prevent granuloma formation in ophthalmic surgery, and the role of its application to the osteotomy site on primary and revisional DCR has been widely studied. A recent meta-analysis found no benefit of MMC on primary cases, but showed a significant reduction of failure rates in revision en-DCR [5]. In line with previous reports, in our cohort, the application of MMC at the end of the surgery showed no impact on the outcome of primary en-DCR (p = 0.504).

Keren, et al. identified diabetes mellitus (DM), allergies and previous ocular surgery as risk factors for surgical failure [22]. Patients with DM are more prone to chronic wounds and its presence was related to granulation and scar tissue formation at the osteotomy site [22]. In our cohort, neither of the variables achieved statistical significance concerning influence on en-DCR outcome. The presence of comorbidities should not prevent surgery from being performed as it does not hinder its success. However, patients with previous ocular surgery showed a tendency towards poorer results (p = 0.056), which may reflect the presence of non identified underlying conditions or anatomic factors in the lacrimal system. We may use this information to caution patients with previous ocular surgeries about the possibility of poorer results.

Functional nasolacrimal duct obstruction, diagnosed when epiphora was present in a patient with a positive

irrigation test, was found in only 6.4% of the sample, and a statistically relevant association between the type of obstruction and outcome was not observed (p = 1). Wormald and Tsirbas demonstrated in a prospective trial that functional obstructions had lower success rates (84%) compared to anatomical obstructions (97%) [23]. Similarly to our work, other studies have compared the outcomes of functional and anatomical obstructions, but the limited number of functional diagnosis hinders drawing assertive conclusions [22]. Patients whose surgical indications were chronic or recurrent dacryocistitis showed outcomes comparable to those with epiphora only. Other papers showed similar findings regarding surgery under the indication of repeated dacryocistitis events [22,24].

As a limitation, besides a low percentage of negative outcomes for en-DCR, some of the assessed variables were present in limited numbers; hence, further studies with a larger cohort could identify other potential risk factors among the variables examined.

Conclusion

We calculated the impact of multiple factors on the outcome of our cohort of en-DCR. In line with previous reports, we present an excellent overall success rate (89.7%) despite strict success defining criteria. Our study identified previous ocular surgery as a factor that led to a tendency towards poorer results and patients under these conditions should be advised accordingly. This study also concludes that patients with recurrent dacryocistitis have a prognosis similar to patients without recurrent infectious events and that granulation tissue formation at the osteotomy site is in a statistically significant manner associated with failure. Performing a septoplasty concurrently with the en-DCR, to improve surgical field and ease in post-operative local care, does not increase the complication rate and does not worsen the functional outcome of the procedure, minimizing the number of potential causes for failure. Furthermore, the presence of comorbidities such as type 2 diabetes mellitus, asthma or rhinitis does not have a negative impact on the outcome of the en-DCR and should not preclude its performance. Focus on the importance of a multidisciplinary surgical team, composed of one oculoplastic surgery and an otolaryngologist cannot be overstated.

Conflicts of Interest

The authors have no conflict of interests to declare.

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