Eye (2008) 22, 1483–1487

www.nature.com/eye

CLINICAL STUDY

Long-term results of balloon dacryocystoplasty: success rates according to the site and severity of the obstruction

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Abstract

Purpose **To evaluate the long-term patency of lacrimal drainage system (LDS) after balloon dacryocystoplasty (BD) and to give the long-term success rates according to the severity and localization of the obstruction.**

Methods **Between May 1993 and December 2003, BD was attempted in 117 eyes of 108 patients with idiopathic-acquired LDS obstruction. Patients with active dacryocystitis, dacryolithiasis, traumatic obstruction or lacrimal mass, obstructions at the superior or inferior canaliculi lateral to the common canaliculus, and follow-up period less than 36 months were excluded from the study.**

Results **The results of BD were evaluated in 99 eyes of 94 cases. The obstruction was seen at the common canaliculus in seven eyes, proximal nasolacrimal duct in 70 eyes, and distal nasolacrimal duct in 22 eyes. The mean follow-up period was 100.0 ± 38.4 months (range: 36–142 months). The long-term overall success rate was 40.8% (20/49 eyes) in complete obstruction and 68% (34/50 eyes) in partial obstruction. The clinical success rate was 57.1% in common canalicular (complete: 33.3%, partial: 75%), 50% in proximal nasolacrimal duct (complete: 38.5%, partial: 64.5%), and 68.2% in distal nasolacrimal duct (complete: 57.1%, partial: 73.3%) obstructions. The overall success was 54.5% (54/99 eyes) for the entire series at the last clinical follow-up visit.**

Conclusion **The long-tem success rate of BD for the treatment of epiphora is low and is not comparable to conventional dacryocystorhinostomy. More predictable results can only be achieved in carefully selected patients and this procedure can be recommended in cases demonstrating partial obstruction of the distal nasolacrimal duct.**

Eye (2008) **22,** 1483–1487; doi:10.1038/sj.eye.6702912; published online 24 August 2007

Keywords: balloon dilatation; epiphora; lacrimal obstruction; long-term results

Introduction

Epiphora is a common ophthalmological problem in adults, which generally results from complete or partial obstruction of the lacrimal drainage system (LDS) at various levels.[1] This condition is generally treated surgically by means of external or endoscopic dacryocystorhinostomy. Despite the high rates of successful results, reformation of the LDS via new pathways through lacrimal and nasal bones, and incisions on mucosal surfaces are the major shortcomings of these well-known surgical techniques. In search of minimally invasive techniques, non-surgical alternatives of dacryocystorhinostomy such as balloon dacryocystoplasty (BD) and nasolacrimal stent placement have also been evaluated for management of LDS obstructions. The success rates of nasolacrimal stent placement showed initial favourable results; however, the long-term results were not encouraging due to fibrotic overgrowth through the stent lumen causing re-blockage of the LDS during the follow-up period.[2–5]

The BD was first described by Becker and Berry,[6] and Munk *et al*,[7] and its results have been reported since 1990; however, the late

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Received: 16 February 2007
Accepted in revised form: 25 May 2007
Published online: 24 August 2007

None of the authors has a financial or proprietary interest in any method or material mentioned.

This study was presented at the 24th European Society of Ophthalmic Plastic and Reconstructive Surgery Meeting, 13–16 September 2006, London, UK

results of larger series are given in few studies.[8–12] In 1995, the authors had given the early results of retrograde BD in LDS obstruction.[13] The aim of this study was to give the long-term patency of LDS after BD, and evaluate long-term success rates according to the severity and localization of the obstruction.

Materials and methods

Between May 1993 and December 2003, BD was attempted in 117 eyes of 108 patients with idiopathic-acquired LDS obstruction. Patients with active dacryocystitis, dacryolithiasis, traumatic obstruction or lacrimal mass, and obstructions at the superior or inferior canaliculi lateral to the common canaliculus were excluded from the study. Additionally, 14 patients who lost to follow-up before 36 months were excluded from the study. Therefore, the results of BD were evaluated in the remaining 99 eyes of 94 patients.

All the patients had clear epiphora. It was evaluated subjectively in six scales to assess clinical improvement according to a scale proposed by Munk *et al*,[7] which is graduated as follows: grade 0 = no epiphora, grade 1 = epiphora requiring wiping the eye less than twice a day, grade 2 = epiphora requiring wiping two to four times a day, grade 3 = epiphora requiring wiping 5–10 times a day, grade 4 = epiphora requiring wiping more than 10 times a day, and grade 5 = constant tearing. Before the procedure, symptoms of epiphora were grade 3 in two eyes, grade 4 in seven eyes and grade 5 in the remaining 90 eyes.

Complete or partial LDS obstruction was confirmed by using Jones I and II dye tests and dacryocystography. Digital subtraction dacryocystography was performed in all patients before the procedure to determine the site and severity of obstruction. Complete obstruction was defined when there was no radiological evidence of contrast material passage to the nasal cavity on digital subtraction dacryocystography. BD was performed as described in our previous report.[13] After topical anesthesia of conjunctival sac and nasal mucosa, a 20-gauge soft plastic arterial sheath that supported intraluminally with a guiding metal probe was introduced through the superior canaliculus into the LDS. The probe was advanced to the level of obstruction, where the metal probe was retracted few millimetres and the soft tip of the arterial sheath was gently manipulated to pass the obstruction site. After the metal probe was completely removed, contrast medium was injected through the sheath to confirm the intraluminal position. A 0.0016-inch steerable guidewire (Stubbie; Target Therapeutics, Fremont, CA, USA) with a flexible tip was introduced through this plastic sheath, gently manipulated and advanced into the inferior meatus of the nasal cavity and brought forward through the external nose. The distal 25 cm of this guidewire was pulled out of the nasal aperture, and the sheath was removed superiorly from the canaliculus. The guidewire was 175 cm long, with the distal 3 cm platinum tip tapering to 0.013 inch. An angioplasty balloon dilatation catheter was passed retrograde over the guidewire through the nasal aperture to the site of obstruction in the LDS. Digital subtraction fluoroscopic (road-mapping) or high-resolution digital fluoroscopic monitoring in lateral projection was used during the passage of the guidewire through the LDS to achieve a correct positioning of the balloon at the obstruction site. Dilatation was achieved by inflating the 50% water-soluble contrast medium for 5 min at 5 atm pressure. At the end of dilatation, the deflated balloon catheter was pulled out inferiorly through the nasal aperture and the guidewire was pulled superiorly. The procedure was followed by irrigation of the LDS through the superior canaliculus. After dilatation, digital subtraction dacryocystography was repeated to verify the patency of the LDS. The procedure was performed on an outpatient basis in all patients. After the risks and benefits of the procedure were explained, informed consent was obtained from each patient.

The patients received topical antibiotic and steroid treatment for 1 week and LDS patency was evaluated by lacrimal irrigation 1 week after the procedure. Follow-up digital subtraction dacryocystography and clinical examination was carried out 2 months after dilatation, and patients were examined every 3 months for first 12 months and at 6–12 month intervals thereafter to obtain follow-up information. At each visit, epiphora was evaluated with Munk's scale and lacrimal irrigation was performed.

Technical success was defined as intraluminal negotiation of a guidewire through the obstruction, balloon dilatation at the site of obstruction, and patency of the LDS on digital subtraction dacryocystography performed immediately after the procedure. The procedure was considered successful if the patient had grade 0 or grade 1 epiphora with patency of LDS confirmed by lacrimal irrigation.

Results

There were 75 women and 19 men with the mean age of 46.5 ± 13.9 years (range: 18–81 years). The obstruction was seen at the common canaliculus in seven eyes, proximal nasolacrimal duct (or the junction between the lacrimal sac and the nasolacrimal duct) in 70 eyes, and distal nasolacrimal duct in 22 eyes. In cases demonstrating multiple obstruction sites, the localization of the most severe obstruction was regarded as the

obstruction site for categorization purposes. Obstruction of the LDS was complete in 49 eyes and partial in 50 eyes (Table 1). There were 49 right-sided, 40 left-sided, and 5 bilateral obstructions. The mean follow-up period was 100.0±38.4 months (range: 36–142 months). The mean interval between the onset of epiphora and BD was 28 months (range: 4–240 months). The mean duration of epiphora was 27.7 months and 31.6 months in successful and unsuccessful cases, respectively ($P>0.05$).

BD was technically successful in 36 complete (36/49 eyes, 73.4%) and 43 partial (43/50 eyes, 86%) obstructions, with technical success rate of 79.8% (79/99 eyes) for the entire series. Among these 20 eyes with technical failure, obstruction was at the common canaliculus in two eyes (both complete obstructions), the proximal nasolacrimal duct in 15 eyes (10 complete and 5 partial obstructions), and the distal nasolacrimal duct in three eyes (one complete and two partial obstructions) (Tables 2 and 3). The causes of technical failure were inability to negotiate the guidewire beyond the obstruction in 17 eyes, and lack of free flow of contrast medium into the nasopharynx on digital subtraction dacryocystography performed immediately after dilatation procedure in three eyes. The procedure-related complication occurred in these three eyes with the evidence of false passage on digital subtraction dacryocystography.

Of the 79 eyes with technical success, 47 eyes demonstrated improvement of epiphora to grade 0 (39 eyes) or grade 1 (eight eyes), after the first procedure and did not necessitate further treatment during the follow-up period. Eleven cases with initial unsuccessful BD underwent a secondary procedure with the same technique, and seven of them, totally 54 eyes over 79 eyes (68.3%) with technical success showed improvement of epiphora.

Improvement of epiphora was achieved in four of seven eyes (57.1%, one complete, three partial) with common canalicular obstruction, in 35 of 70 eyes (50%, 15 complete, 20 partial) with proximal nasolacrimal duct obstruction and in 15 of 22 eyes (68.2%, 4 complete, 11 partial) with distal nasolacrimal duct obstruction (Table 2). The long-term overall success rate was 40.8% (20/49 eyes) in complete obstruction and 68% (34/50 eyes) in partial obstruction. The overall success was 54.5% (54/99 eyes) for the entire series at the last clinical follow-up (Table 3).

Of the 45 eyes with unfavourable results (20 eyes with technical failure, 25 eyes with no improvement with BD), 37 eyes underwent dacryocystorhinostomy, and all cases showed improvement after surgery within a mean follow-up period of 25.7 months. The remaining eight eyes cannot be treated due to unwillingness of the patients for further procedures.

Table 1 The localization and severity of lacrimal drainage system obstruction in the study group

Site	*No. of eyes (%) (n=99)*	*Complete obstruction (%) (n=49)*	*Partial obstruction (%) (n=50)*
Common canalliculus	7 (7.1)	3 (6.1)	4 (8.0)
Junction	70 (70.7)	39 (79.6)	31 (62.0)
Nasolacrimal duct	22 (22.2)	7 (14.3)	15 (30.0)

Table 3 Technical and clinical success rates according to the severity of obstruction

Result	*Partial obstruction (%) (n=50)*	*Complete obstruction (%) (n=49)*	*Total (%) (n=99)*
Technical and clinical success	34 (68.0)	20 (40.8)	54 (54.5)
Technical success, clinical failure	9 (18.0)	16 (32.7)	25 (25.2)
Technical failure	7 (14.0)	13 (26.5)	20 (20.2)

Table 2 Technical and success rates according to the localization and severity of obstructions

Site of obstruction	*No. of eyes*	*Success (%)*	*Technical success clinical failure (%)*	*Technical failure*
Common canaliculus	7	4 (57.1)	1 (14.2)	2 (28.5%)
Complete	3	1 (33.3)		2
Partial	4	3 (75)		
Junction	70	35 (50.0)	20 (28.6)	15 (21.4%)
Complete	39	15 (38.5)		10
Partial	31	20 (64.5)		5
Nasolacrimal duct	22	15 (68.2)	4 (18.1)	3 (13.6%)
Complete	7	4 (57.1)		1
Partial	15	11 (73.3)		2

Discussion

The success rates of BD were reported between 25 and 94%,[10,14] but long-term results were given in few studies. The most encouraging long-term result was reported by Janssen *et al*[11] for the management of subcanalicular obstructions of LDS with 70 and 81% of primary and secondary patency rates, respectively. However, there are less favourable long-term patency rates for the management of idiopathic canalicular and subcanalicular LDS obstructions, reported between 20 and 35.5%.[8,10] In our previous study, the overall patency rate of BD was calculated as 66.2% for canalicular and subcanalicular lesions in the mean follow-up period of 13 months. In this study, the overall patency rate was 54.5% after a mean follow-up period of 100 months. The differences in the overall outcomes in BD necessitate evaluation of the long-term results according to the level and severity of obstructions to predict the results of this technique.

There are few studies reporting the long-term results of BD for management of canalicular obstructions.[8,12] The most comprehensive study was performed by Ko *et al*,[12] reporting 40% patency rate in 195 eyes after 2 years follow-up period, where BD was defined as a safe method for common canalicular obstruction despite its high recurrence rates. In our previous study, the initial success rate for common canalicular obstruction was 61.5% (8 of 13 cases), and initial success was achieved in all cases with partial obstructions. Of the 13 cases, we followed up seven cases and calculated their long-term patency as 57.1%. Although, the clinical success rate was relatively higher in partial common canalicular obstructions than complete obstructions (75 *vs* 33.3%), larger series are necessary to assess the long-term efficacy of BD for the treatment in this group.

The success rates of BD for obstructions at the junction between lacrimal sac and the nasolacrimal duct were reported to be less than 50%.[8,10,15] In this study, the long-term success rate of BD for junctional obstructions was similar and calculated as 50%. The reason for this low success rate may be the irregular morphology of the lacrimal sac lumen, where the soft-tipped guidewire could not be negotiated through adhesions between lacrimal sac walls. The success rate was higher in partial obstructions when compared to complete obstructions (64.5 *vs* 38.5%) supporting that the adhesions in the lumen of the sac might deteriorate the success rate. Additionally, dilatation of the lacrimal sac and formation of a mucocele due to postsaccal obstructions may increase the risk of false tract formation or damaging lacrimal sac mucosa during negotiation of the guidewire from a dilated and fragile sac lumen through a rigid bony nasolacrimal canal. In this study, all the three cases that showed false-track formation demonstrated obstruction at the junction between lacrimal sac and the nasolacrimal duct.

The most encouraging results of BD were given for the management of nasolacrimal duct obstructions. Lee *et al*[8] reported the highest initial and long-term success rates in nasolacrimal duct obstructions. In our previous study, we achieved clinical success in all nasolacrimal duct obstructions during a short follow-up period. In this study, we calculated the overall long-term result as 68.2% where it was 57.1 and 73.3% for complete and partial obstructions, respectively. The reason for relatively better results may be explained by higher technical success rates. The rate of technical failure was lowest in this group since the bony nasolacrimal canal might provide a direct route for the negotiation of the guidewire through the inferior meatus. However, the success rate of complete nasolacrimal duct obstructions is still not encouraging. The nasolacrimal duct occlusions are treated by inflating the balloon catheter in the duct. In most of the studies, the subcanalicular lesions were treated with 4–5 mm balloon catheters. Since the diameter of bony nasolacrimal canal is similar to the diameter of the balloon catheter, the lumen may not be adequately expanded to open the mucosal adhesions in the rigid bony canal.

The results of BD in complete and partial LDS obstructions were evaluated in different series; however, it is still not clear whether the severity of obstruction may interfere with the long-term results of BD. There were studies demonstrating better initial results in partial obstructions, but their long-term results did not maintain that difference.[8,10] Jansen *et al*[11] showed that partial obstructions have better outcome in both initial and long-term followup period when compared to the complete obstructions. In our previous study, we achieved initial success in all cases with partial obstruction, and it was 56.8% in complete obstructions. In this study, we achieved higher technical success in partial obstructions, and long-term BD results were better in partial obstructions in all levels of obstructions.

After Munk *et al*[7] defined the technique of BD in LDS obstructions, several technical modifications were reported to achieve better outcomes. The main differences in the technique of BD were related to the diameter and inflation time of the balloon, and the type of the guidewire. Generally, the investigators use 2–3 mm balloons for canalicular and 3–5 mm balloons for subcanalicular lesions with inflation time between 2 and 5 min. Although the studies comparing the variations in BD techniques were limited, Lee *et al*[8] used 2–3 mm balloons for canalicular and 3–5 mm balloons for subcanalicular lesions, and concluded that the diameter of the balloon did not affect the long-term results in BD. There were different types of guidewires used in the

literature. Lee *et al*[10] reported that hard-tipped guidewires increased the incidence of false passage and they obtained better results via ball-tipped guidewire. Most of the investigators used soft-tipped guidewires not to violate the fragile mucosa of the LDS, but difficulties that were encountered during negotiation of the obstruction with a soft-tipped guidewire was its main disadvantage. In our study, we also used a soft-tipped guidewire, but initially an arterial cannula with a guiding metal probe was used to pass the obstruction. This study showed that 68.3% of patients who underwent technically successful BD showed improvement of epiphora. This may support the idea that improvements in the technical results may also improve the outcomes of BD for the treatment of LDS obstructions.

In conclusion, the long-term results of BD for LDS obstructions are not encouraging. Therefore, this procedure cannot be recommended as a first-line management. More predictable results can only be achieved in carefully selected patients and this procedure can be recommended in cases demonstrating partial obstruction of the distal nasolacrimal duct who cannot undergo more invasive procedures.

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