Balloon Dacryocystoplasty with Pushed Monocanalicular Intubation as a Primary Management for Primary Acquired Nasolacrimal Duct Obstruction

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Research Article

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Abstract

Though dacryocystorhinostomy (DCR) has long served as the gold treatment for primary nasolacrimal duct obstruction (PANDO), balloon dacryocystoplasty (DCP) and silicone stent intubation were applied especially in partial PANDO in the attempts to avoid osteotomy and reduce invasiveness. Herein, we present the results of the combined procedures with balloon DCP and pushed monocanalicular intubation in complete PANDO, and comparison of the combination to balloon DCP alone. We retrospectively reviewed 72 eyes of 56 patients, including 37 eyes of 29 patients in the combination group and 35 eyes of 28 patients in the balloon DCP alone group. There was no significant difference in the success rate between antegrade balloon DCP with and without pushed MCI in general. Nevertheless, interestingly the former procedure was associated with significantly higher surgical success rate than the latter in younger patients.

Introduction

Dacryocystorhinostomy (DCR) has been considered to be the gold treatment for primary nasolacrimal duct obstruction (PANDO) due to its high success rate, especially among patients with complete PANDO [1–5]. In an attempt to avoid osteotomy, several surgical procedures have been developed for PANDO, including balloon dacryocystoplasty (DCP) and silicone stent intubation. Nevertheless, current studies on either balloon DCP, silicone stent intubation or a combination of the two procedures have mostly been focused on partial PANDO, where the reported success rates varied, ranging from 25–76% [6–12]. Some studies have discussed balloon DCP for complete PANDO [10, 11, 13], while limited studies have discussed about silicone stent intubation [13–15].

In this study, we aimed to determine whether a combination of antegrade balloon DCP with pushed-type monocanalicular silicone stent intubation (MCI) would result in better clinical outcomes than antegrade balloon DCP alone.

Materials And Methods

We conducted a retrospective, non-randomized, comparative consecutive study in the Ophthalmology Department of National Cheng Kung University Hospital in Taiwan. Approval from the Institutional Review Board at National Cheng Kung University Hospital has been obtained. All procedures in this study with human participants were in accordance with the ethical standards of National Cheng Kung University Hospital, the 1964 Helsinki declaration, its later amendments, and all laws in Taiwan. An informed consent was waived by the Institutional Review Board at National Cheng Kung University Hospital due to retrospective nature of study.

From December 2014 to May 2019, patients with complete nasolacrimal duct obstruction based on obstructed intra-sac irrigation were enrolled in the present study. Post-operative follow-up time was required to be more than 6 months. Thereafter, we excluded patients aged younger than 18 years old and

those with previous ocular intervention, punctal stenosis or ocular infection. All patients underwent antegrade balloon DCP (QUEST MEDICAL INC., Texas, USA) followed by a pushed monocanalicular silicone stent (Masterka; FCI SAS, PARIS, France) intubation for 1 month or balloon DCP alone as the primary treatment for complete PANDO.

All procedures were performed by the same ophthalmologist, Dr. Chun-Chieh Lai, under local anesthesia at National Cheng-Kung University Hospital, Taiwan. In Group 1, we initially dilated the upper punctum. Then, probing was preformed with a Bowman probe. In the next step, we inserted a balloon catheter via the superior punctum until the superior mark of the catheter reached the lacrimal punctum (15 mm proximal to the beginning of the balloon). Next, we inflated the balloon using a manometer at 8 atmospheres for 90 seconds followed by another one at the same pressure for 60 seconds. After the balloon was deflated, we withdrew the balloon catheter until the second mark of the catheter reached the lacrimal punctum (10 mm proximal to the beginning of the balloon). A 90-second inflation, deflation, and a 60-second inflation were performed again at 8 atmospheres.

After the balloon catheter was deflated and removed, we performed a lower punctum dilation followed by insertion of a sizer through the inferior punctum until its tail reached the nasal floor, also testing whether the pushed-type antegrade MCI was appropriate for the patient. Next, we measured the proper length of the introducer (30, 35, 40 mm) according to the point on the sizer where the punctum was fitted. After measuring the proper length, we removed the sizer and performed a pushed-type antegrade MCI through the inferior punctum. Then, we withdrew the guide along the axis of the lacrimal sac. Finally, an anchoring plug was inserted into the vertical canaliculus. In Group 2, we performed balloon DCP alone after probing.

All operated eyes were treated with topical 0.3% gentamicin and 0.1% betamethasone sodium phosphate 4 times per day for 2 weeks followed by topical 4% sulfamethoxazole and 0.1% fluorometholone 4 times per day for 2 weeks. Postoperative follow-up was arranged at approximately 1 week postoperatively. After that, we arranged an appointment at 1 month postoperatively to remove the stents at the outpatient department without anesthesia. Then, we performed intra-sac irrigation to check whether the lacrimal system was patent. Afterwards, we arranged a further outpatient department follow-up at 3 months and 6 months postoperatively. Intra-sac irrigation was performed at the two follow-up appointments.

Surgical success was defined as a patent lacrimal draining system based on the intra-sac irrigation results and patient’s subjective improvement of symptoms. The surgical outcomes were recorded at 1 month, 3 months, and 6 months postoperatively. Patients who missed their postoperative appointments for intra-sac irrigation and arranged another outpatient department follow-up themselves were included in this study. If the intra-sac irrigation result demonstrated patency over 6 months postoperatively, we defined it as surgical success at 3 months and 6 months postoperatively. If the patient was unable to tolerate epiphora and underwent another surgical intervention less than 6 months postoperatively, the outcome was considered a surgical failure at 6 months postoperatively.

A statistical analysis was completed using Mann-Whitney U tests and the Fisher's exact test. Differences were considered statically significant if the p value was less than 0.05.

Results

72 eyes of 56 patients were included in our study. They were divided into two groups: balloon DCP combined with pushed-type MCI (Group 1, 37 eyes of 29 patients) and balloon DCP alone (Group 2, 35 eyes of 28 patients). There were no intraoperative complications found in either group. The baseline characteristics of the two groups are provided in Table 1. No significant differences between age, gender or laterality were found. There were also no between-group differences found in the proportion of patients younger than 65 years old and those at least 65 years old.

Table 1
Demographic data and differences in patients in Group 1 (balloon DCP combined with pushed-type MCI) and Group 2 (balloon DCP)

Variable	Group 1 (37 eyes of 29 patients)	Group 2 (35 eyes of 27 patients)	P value
Gender (male/female)	2/27	6/21	0.14 [a]
Number of eyes			> 0.99 [a]
18–64 years old	11	11	
At least 65 years old	26	24	
Mean age (years old; per eye)	69.3 ± 12.2	66.1 ± 13.2	0.23 [b]
Laterality			0.24 [a]
Right	19	23	
Left	18	12	
[a] Two-tailed Fisher's exact test			
[b] Two-tailed Mann-Whitney U test			

At 1 month postoperatively, Group 1 had a significantly higher success rate than Group 2 (89.2% vs. 62.9%, $p = 0.009$). However, no significant differences were found at 3 months (73.0% vs. 62.9%, $p = 0.25$) or 6 months (70.2% vs. 60.0%, $p = 0.25$) postoperatively despite the success rates of Group 1 were higher than that of Group 2 (Table 2). No post-operative complications were found in Group 1; nevertheless, 1 eye in Group 2 developed chronic dacryocystitis.

Table 2
Postoperative surgical success rate and differences in patients in Group 1 (balloon DCP combined with pushed-type MCI) and Group 2 (balloon DCP)

	Group 1	Group 2	P value
1 month	33/37 (89.2%)	22/35 (62.9%)	< 0.01[a*]
3 months	27/37 (73.0%)	22/35 (62.9%)	0.25 [a]
6 months	26/37 (70.2%)	21/35 (60.0%)	0.25 [a]
[a] One-tailed Fisher's exact test			

We conducted a subgroup analysis by dividing the patients into those under 65 years old (groups 1–1 and 2 – 1) and those aged at least 65 years old (groups 1–2 and 2–2). The demographics and the results of the subgroup analysis are demonstrated in Table 3. No significant differences were found in age, gender and laterality.

Table 3
Demographic data and differences in patients in Group 1–1 (balloon DCP combined with pushed-type MCI) and Group 2 – 1 (balloon DCP) for patients younger than 65 years old, and in patients in Group 1–2 (balloon DCP combined with pushed-type MCI) and Group 2–2 (balloon DCP) for patients aged at least 65 years old

	Age less than 65 years old			Age at least 65 years old		
	Group 1–1	Group 2 – 1	P value	Group 1–2	Group 2–2	P value
Gender (male/female)	0/10	2/7	0.21 [a]	2/17	4/14	0.40 [a]
Mean age (years; per eye)	53.5 ± 8.8	49.8 ± 8.8	0.25 [b]	76.0 ± 5.3	73.6 ± 6.3	0.12 [b]
Laterality			> 0.99 [a]			0.27 [a]
Right	6	7		13	16	
Left	5	4		13	8	
[a] Two-tailed Fisher's exact test						
[b] Two-tailed Mann-Whitney U test						

The success rates were significantly higher in Group 1–1 than in Group 2 – 1 at 1 month, 3 months, and 6 months postoperatively (81.8% vs. 9.1%, $p = 0.001$; 72.7% vs. 9.1%, $p = 0.004$; 72.7% vs. 9.1%, $p = 0.004$; Table 4). On the other hand, there were no significant between-group differences in success rate in Group

1–2 and Group 2–2 at 1 month, 3 months, and 6 months postoperatively (92.3% vs. 87.5%, $p = 0.46$; 73.1% vs. 87.5%, $p = 0.18$; 69.2% vs. 83.3%, $p = 0.20$; Table 4).

Table 4
Postoperative surgical success rate and differences in patients in Group 1–1 and 2 – 1 (balloon DCP combined with pushed-type MCI and balloon DCP alone, respectively) and Group 1–2 and 2–2 (balloon DCP combined with pushed-type MCI and balloon DCP alone, respectively)

	Age less than 65 years old			**Age at least 65 years old**		
	Group 1–1	Group 2 – 1	P value	Group 1–2	Group 2–2	P value
1 month	9/11 (81.8)	1/11 (9.1)	< 0.01[a*]	24/26 (92.3)	21/24 (87.5)	0.46[a]
3 months	8/11 (72.7)	1/11 (9.1)	< 0.01[a*]	19/26 (73.1)	21/24 (87.5)	0.18[a]
6 months	8/11 (72.7)	1/11 (9.1)	< 0.01[a*]	18/26 (69.2)	20/24 (83.3)	0.20[a]
[a] One-tailed Fisher's exact test						

Discussion

Kuchar and Steinkogler used antegrade balloon DCP combined with silicone stent intubation for 3 to 6 months for complete NLDO, and the success rate was 90% at 3 months and 70% at 6 months postoperatively [13]. In the present study, antegrade balloon DCP was combined with pushed-type MCI intubation for only 1 month, which is the shortest reported intubation duration to date [5–9, 12–14, 16]. Our success rate at 3 months postoperatively seemed lower when compared to a previous study in which antegrade balloon DCP with silicone stent intubation was combined (73.0% vs. 90%, respectively), but the result was similar at 6 months postoperatively (70.2% vs. 70%) [13]. Since a longer postoperative follow-up period has been suggested, the differences between previous studies and the current study at 3 months and 6 months postoperatively were not significant [13, 17]. Also, the current study revealed that the additional pushed-type MCI for antegrade balloon DCP did not significantly improve the surgical outcomes in general since the success rates were not significantly higher at 3 months and 6 months postoperatively despite the significantly higher success rate at 1 month postoperatively.

A randomized trial conducted by Andalib *et al*. compared bicanalicular intubation (BCI) and MCI for partial PANDO, revealing no significant differences in the surgical outcome between the two [12]. However, to date, there have been no comparative studies for complete PANDO. Mimura *et al*. reported a clinical success rate of 91.7% at 6 months postoperatively using BCI for complete PANDO without canaliculi involvement, while Inatani *et al*. reported a success rate of 68% [14, 15]. However, surgical outcomes for MCI for complete PANDO have not yet been studied.

We favored MCI stents because repeated manipulations at the inferior meatus were not required during intubation. In addition, despite the use of prophylactic antibiotics, the postoperative infection rate with BCI for complete PANDO has been reported in previous studies to be as high as 9.5% [12, 14].

Furthermore, a high punctal laceration rate (13.6%) was also reported by Kashkouli *et al* [16]. Among MCI stents, the pulled-type MCI was still required some intervention at the inferior turbinate while the pushed-type one did not [18]. We chose the pushed-type MCI in this study since it was easier to perform than the pulled-type.

To our knowledge, our study is the first to compare the differences in success rates between patients younger than 65 years old and those older than 65 for balloon DCP and silicone stent intubation. Interestingly, we found the success rates when combining balloon DCP with pushed-type MCI were always significantly higher than when using balloon DCP alone in patients younger than 65 years old regardless of the postoperative timing. On the other hand, there were no significant differences found in the success rates between patients receiving balloon DCP combined with pushed-type MCI and those receiving balloon DCP alone if the patients were aged over 65 years old. We assumed that it was resulted from the silicone stent, which was intubated for 1 month, played an important role especially in patients younger than 65 years old with complete PANDO by maintaining the patency of the nasolacrimal duct just as the surrounding tissue began to scar [19], while balloon DCP only creates a perioperatively patent nasolacrimal duct (NLD). The stent intubation might weigh more in younger patients due to the increased inflammation and possibility of adhesion from their better healing ability and significant inflammatory reaction. By combining balloon DCP with pushed-type MCI, the patency of the NLD was maintained by avoiding excessive scarring, and consequently resulted in a better surgical outcome.

DCR is currently considered the standard treatment for PANDO due to its high success rate, which was reported with approximately 90% [1, 2, 4]. When it comes to complete PANDO, DCR has also been suggested as the gold standard. Nevertheless, DCR resolves the PANDO at the cost of invasiveness, such as osteotomy regardless of whether the approach is endonasal or external. In order to decrease the level of invasiveness and bleeding while operating, transcanalicular laser-assisted DCR was developed as an alternative to the conventional DCR by Michalos *et al* [20]. However, a recent study conducted on transcanalicular laser-assisted DCR by Ayintap *et al*. revealed a significantly lower success rate in younger patients with complete PANDO that the overall success rate in patients younger than 65 years old was approximately 62% at 2-year follow-up, which was lower than the success rate in the present study with 72.7% at 6-month follow-up [21].

Although our overall long-term success rates with balloon DCP combined with pushed-type MCI (70.2%) did not achieve that using conventional DCR (around 90%), the procedure still yielded several advantages. First, no general anesthesia was required for our surgical methods. Second, we minimized the degree of invasiveness by preserving the original nasolacrimal system instead of performing an osteotomy. Third, our method did not require further manipulation of the inferior nasal meatus; thus, we decreased the possibility of significant bleeding. Last but not least, no postoperative complications were found after antegrade balloon DCP with the pushed-type MCI in current study.

The current study was limited by its retrospective and non-randomized design. Also, we did not use any radiographic assistance to confirm the diagnosis of complete PANDO; for example, transcanalicular

endoscopy or dacryocystography [10, 13]. In addition, we did not perform subjective parameters such as the Munk score as the outcome parameter since some of the patients suffered from dry eye, which may also present with epiphora due to reflex tearing. In addition, our case number was relatively small, which may limit the statistical power. Current results implied efficiency and few complications with antegrade balloon DCP followed by pushed-type MCI for patients with complete PANDO at 6 months postoperatively, and further large-scaled investigations with longer follow-up duration were needed for a more definite long-term result.

In general, the combination of balloon DCP and pushed-type MCI did not lead to a significantly higher success rate as compared to balloon DCP alone for complete PANDO. However, in patients under 65 years old with complete PANDO, the combination of balloon DCP and pushed-type MCI was associated with significantly higher surgical success rates as compared to balloon DCP alone. In addition, the former procedure had several advantages over DCR, including its non-invasiveness and the avoidance of general anesthesia as well as hospitalization for postoperative care. Balloon DCP followed by pushed-type MCI could be of value when it comes to treating complete PANDO in younger patients and it could also serve as an alternative for the elderly who are poor candidates for general anesthesia.

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