



Primary Acquired Nasolacrimal Duct Obstruction – Epidemiology, Clinical Signs, and Surgical Treatment

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Abstract

Aim: The aim of this study was to discuss the epidemiological aspects, clinical picture and the mode of surgical treatment in patients with primary acquired nasolacrimal duct obstruction (PANDO).

Patients and methods: Between 1995 and 2016, the Eye Clinic at the University Hospital in Pleven carried out a retrospective analysis on 28 PANDO patients who underwent external dacryocystorhinostomy (DCR). The effect of surgical treatment was assessed based on a history of watery eyes and the tear drainage system's patency. Only eight of those patients responded to a follow-up examination after surgery for the purposes of this study.

Results: The demographics of the evaluated patients were as follows: 17.9% were male, 82.1% were female, 78.6% lived in the city, 92.9% had one impaired eye, and 7.1% had bilateral PANDO. The mean age of the patients at operation was 43.3±5.7 years (SD=14.6). All patients experienced epiphora and discharge; 63.3% had redness of the skin around the lacrimal sac, and 33.3% had episodes of acute dacryocystitis prior to surgery. The surgical success of external DCR was evaluated in nine eyes among the eight patients who responded to the postoperative review. The results showed that the operation was successful in 55.6% of these patients, whereas in 11.1% it had a doubtful effect, and in 33.3% it was not successful.

Conclusion: PANDO primarily affects women in their middle years. Cases that are unilateral are more common. External DCR is performed in patients with prolonged epiphora and purulent discharge. 55.6% of the cases are successful. In spite of the outcome, patients expressed great satisfaction with the cosmetic outcome and the disruption of their everyday lives caused by the watering of the eyes.

Keywords

clinical picture, epidemiology, external DCR, PANDO

INTRODUCTION

The term primary acquired nasolacrimal duct obstruction (PANDO) was first used in the literature by Linberg and McCormick in 1986. [1] This is an idiopathic inflammatory disease of the nasolacrimal duct which leads to fibrosis of the wall with partial stenosis or complete obstruction of the duct. [2,3] The incidence of PANDO varies between 3% and

6.6%. [4-7] In the population-based study of Woog nasolacrimal duct obstruction was found to have an incidence of 20.24 per 100,000. [8] Duggal et al. found that patients with PANDO were more often women with onset of epiphora after 40 years of age. [9] The disease has a multifactorial etiology. The major etiopathogenetic factors are hormonal fluctuations, changes in the vascular plexuses around the nasolacrimal duct, and changes in the chemical composition of tears. [10]

The main symptom in PANDO is epiphora due to defective outflow of the tears through the lacrimal drainage system.^[11-14] The reasons for excessive tearing might be anatomical (strictures, obstructions, foreign bodies, traumas, tumors) and physiological (weakness of the *orbicularis oculi* muscle, incorrect position of the lacrimal punctum, and nasal pathology).^[15] However, the majority of acquired obstructions in adulthood are not associated with trauma, neoplasm, or systemic disease.^[16] The nasolacrimal duct stenosis causes retention of secretion in the lacrimal sac. Thus, a chronic inflammation of the sac with presence of periodic, and moderate hyperemia of the overlying skin might be seen. The condition can be complicated with acute dacryocystitis when virulent microorganisms grow in the retained secretion.^[9,17,18]

The initial treatment in newly discovered cases with PANDO is conservative – with local or general application of anti-inflammatory drugs, since the compression of the nasolacrimal duct is due to inflammatory infiltration.^[1] The chronic epiphora (with duration more than 12 months) is treated radically with surgery – dacryocystorhinostomy (DCR).^[19] There are two operation techniques: external DCR (through an external skin incision) and endonasal DCR (with intranasal access).^[20] In 1904, Addeo Toti was the first to introduce the technique of external dacryocystorhinostomy^[21] which in 1921 was modified by Louis Dupuy-Dutemps and Bourguet^[22,23]. Nowadays, their operation is still considered the gold standard for traditional surgical access.^[19,24] In PANDO patients, the efficiency of external DCR is about 90% successful.^[17,25-27]

The intranasal access for dacryocystorhinostomy was introduced by Caldwell in 1893. His technique, was not widely adopted due to the poor visibility of the nasal anatomy during surgery.^[28] Currently, the improvement of technologies in lacrimal surgery and the modern endoscopic equipment make the endonasal DCR increasingly popular.^[29] The reported success rate is comparable to that with external access (around 94%).^[30] In Bulgaria, endonasal DCR is mainly performed by otorhinolaryngologists.^[31]

The surgical technique should be determined by patient's preference, available equipment, and surgeon experience.^[32]

The purpose of this study is to discuss the epidemiological aspects and clinical characteristics of primary acquired nasolacrimal duct obstruction (PANDO) and the treatment with external DCR in such patients.

PATIENTS AND METHODS

A retrospective study was conducted at the Eye Clinic at the University Hospital in Pleven. The study protocol was approved by the Research Ethics Committee of the Medical University of Pleven.

Examining the medical records between 1995 and 2016, we identified 28 consecutive patients with PANDO who had undergone external DCR. According to the information we obtained, we analyzed:

- the epidemiological data: sex, age, place of residence, laterality of the disease;
- the preoperative data: presence of symptoms of chronic dacryocystitis (watering and discharge from the eyes, hyperemia of the skin in the area over the lacrimal sac), the duration of the symptoms, existence of episodes of acute dacryocystitis in the operated eye, result from the regurgitation test and irrigation of the NLD, and
- the operational protocols presented the external DCR technique.

In all cases, external DCR was performed under general anesthesia by a single surgeon. A 2-cm incision was done with a monopolar cautery at approximately 2 mm medially from the inner eyelid angle. This was followed by blunt removal of the underlying tissues and periosteum to the anterior edge of the frontal process of the maxilla. Excision of a bone disc was performed with a trephine with a diameter of 11 mm or Kerrison 1.5 mm after a lacrimal bone puncture. The osteotomy covered two-thirds of the frontal process and one-third of the lacrimal bone. The next step was the shaping of the upper (anterior) and lower (posterior) flap of the lacrimal sac and the nasal mucosa. If there was good anatomical visibility, a suture of the lower flaps of the nasal mucosa and lacrimal sac was made. After the inferior lacrimal punctum was dilatated, a silicone intubator was passed with a metal guide exiting through the lacrimal sac incision. With the help of forceps inserted through the nose, the distal end of the silicone intubator was pulled out of the nostril. An antibiotic oiled cotton swab was introduced in the nostril. In all of the cases, a suture of the upper flaps of the nasal mucosa and lacrimal sac was done. At the end of the operation, the adaptation of subcutaneous tissue and skin was made with single interrupted sutures (Silk 6/0) (**Fig. 1**) or two layers suture with Vycril and Silk.

All of these 28 patients were invited by letters to a follow-up examination after the surgery at the Eye Clinic in Pleven. Only eight patients responded to the invitation. All of them signed informed consent form for participation in the study.

The aim of this examination was to assess the effect of the external DCR. The result of the surgery in these patients was evaluated on the basis of a history of watery eyes and the result of irrigation of the lacrimal drainage system with 0.9% physiology solution. The epiphora was graded on the Munk scale as follows^[33]:

- 0 no epiphora
- 1 epiphora requiring dabbing less than twice a day
- 2 epiphora requiring dabbing 2-4 times a day
- 3 epiphora requiring dabbing 5-10 times a day
- 4 epiphora requiring dabbing more than 10 times a day
- 5 constant epiphora

The postoperative examiner for all patients was the same physician.

A successful DCR was documented as absence of epiphora (grade 0 on the Munk scale) and patent lacrimal drainage system without reflux during irrigation.

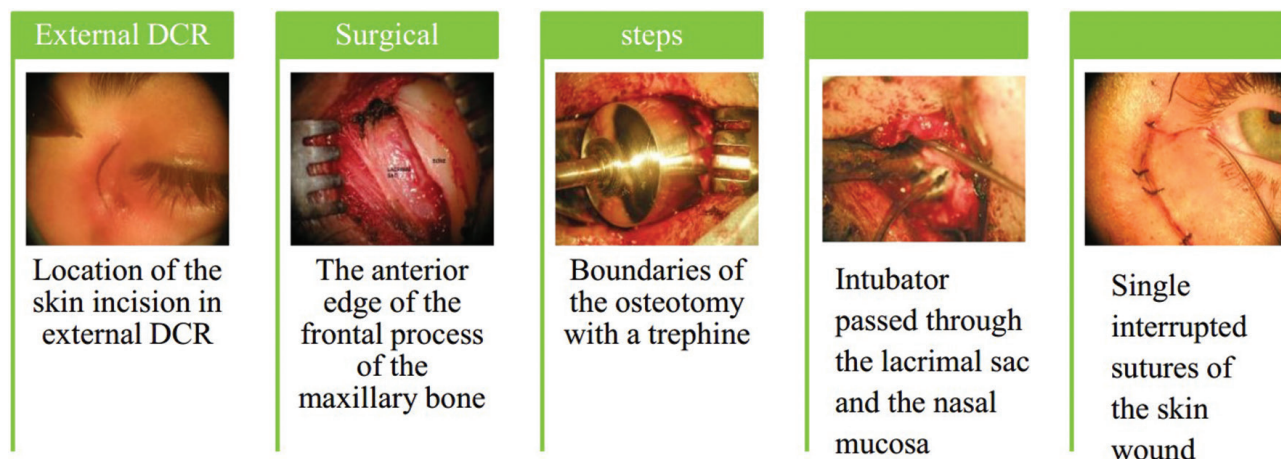


Figure 1. Surgical steps in external DCR.

DCR with doubtful effect was found in patients with intermittent epiphora (grade 1 to 4 on the Munk scale) and partially patent lacrimal drainage system with reflux from the upper punctum during irrigation. DCR was considered unsuccessful when there was permanent epiphora (grade 5 on the Munk scale) and presence of obstruction of the drainage system without passage of the physiology solution into the throat during irrigation.

The condition of the cicatrix after external DCR was assessed as: fine (at the level of the skin); with slight medial epicanthus in the area of the scar or like a keloid cicatricial scar. The cosmetic results of the operated patients was documented with photographic images.

The data from the study was statistically mapped out and analyzed using Microsoft Excel 2010, Statgraph Software 2.0.0.0 and MedCalc. The declared p-values came from the chi-square test and Fisher’s exact test (FET). If two indicators were compared, the Student’s *t*-test was used. Significant results were considered at $p < 0.05$.

RESULTS

Twenty-eight patients (30 eyes) with external DCR were retrospectively analyzed. In two of them, the operation was bilateral. No cases of reoperations were observed.

The demographic profile of the patients showed an unequal sex distribution: 23 (82.1%) women and 5 (17.9%) men, which is statistically significant ($t=3.38$, $p=0.001$). Most of the participants (22, 78.6%) lived in the city, while 6 (21.4%) of them lived in villages. Unilateral cases with PANDO were found in 26 (92.9%) patients (the right eye in 12, 46.2% patients and the left eye – 14, 53.8%), while the bilateral cases had a smaller proportion in the group distribution – only in 2 (7.1%) of the cases. The patients at surgery was divided into three age groups (Fig. 2). The mean age was 43.3 ± 5.7 years ($SD=14.6$).

Preoperative analysis was done on the number of the operated 30 eyes. All patients were diagnosed with chronic dacryocystitis when they were admitted to the clinic for surgical treatment. It was found that all of them (100.0%) had previous complaints of watering and discharge from the affected eye(s) before surgery. The epiphora had different degrees – from constant tearing (in 17, 56.7% eyes), to intermittent one (in 13, 43.3% eyes). In 19 (63.3%) eyes, there was evidence of transient moderate hyperemia and edema of the skin in the area over the lacrimal sac (without evidence of acute dacryocystitis), and in the remaining 11 (36.7%) eyes, no skin irritation was observed. The duration of tearing and discharge from the eye(s) was from several months to several years. Data on the duration of symptoms were divided into two groups: up to 1 year (in 10 eyes,

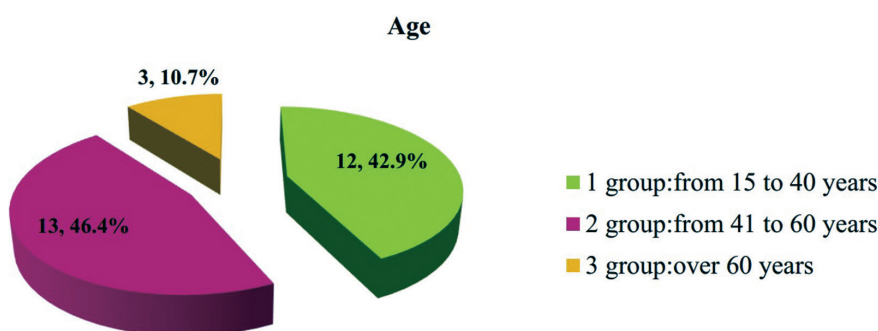


Figure 2. Distribution of cases in the age groups.

33.3%) and over 1 year (in 20 eyes, 66.7%). No evidence of the presence of similar symptoms in early childhood was found in the history. Data for conservative treatment of acute dacryocystitis in the past, before the external DCR of the same eye, were found in 10 (33.3%) eyes of the analyzed patients. In the remaining 20 (66.7%) eyes, there was no history for previous acute inflammation of the lacrimal sac.

A comparison between the presence or absence of a history of hyperemia of the skin in the area over the lacrimal sac and the duration of the symptoms was made (Fig. 3). The statistical analysis using the Fisher Exact test (FET) showed that there was no relationship between the duration of the symptoms and the history of moderate hyperemia of the skin in the area over the lacrimal sac ($p=0.250$, FET).

The data for previous acute dacryocystitis were also compared with history of recurrent hyperemia of the skin over the lacrimal sac (Fig. 4). Statistical analysis with the Fisher Exact test revealed that a history of periodic hyperemia of the skin in the area over the lacrimal sac was associated with the development of acute dacryocystitis ($p=0.003$, FET).

The regurgitation test of the affected eye showed a reflux of mucus (in 10 eyes, 33.3%) or purulent secretion (in 20 eyes, 66.7%).

A comparison between the data of the regurgitation test and history of intermittent hyperemia of the skin over the lacrimal sac was made (Fig. 5). The results of the analysis were statistically significant – purulent discharge was associated with the presence of hyperemia of the skin in the area over the lacrimal sac ($\chi^2=12.13$; Df=1; $p=0.0005$).

The data of the regurgitation test and the history of past episodes of acute dacryocystitis were also compared (Fig. 6). A statistically significant relationship was found – purulent discharge is associated with acute dacryocystitis in the past ($\chi^2=7.5$; Df=1; $p=0.006$).

It was found that during the surgery, 16 (53.3%) eyes had an anastomosis between the lower flaps of the lacrimal sac and nasal mucosa. The two mucous membranes in these cases were clearly anatomically visible. In the remaining 14 (46.7%) eyes, there was evidence of adhesion of the tissues around the lacrimal sac, as well as the inability to properly form the two flaps of the nasal mucosa for various reasons

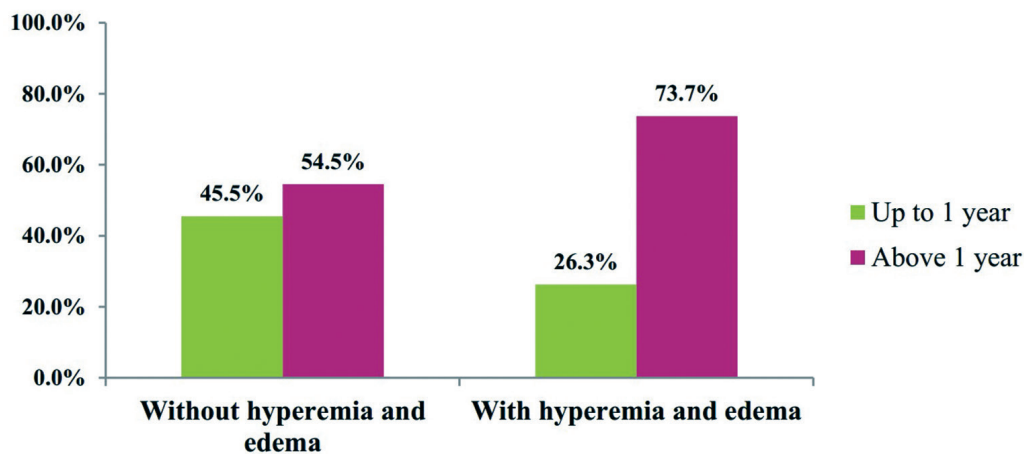


Figure 3. Distribution of eyes with and without hyperemia and edema of the skin above the lacrimal sac, according to the duration of symptoms.

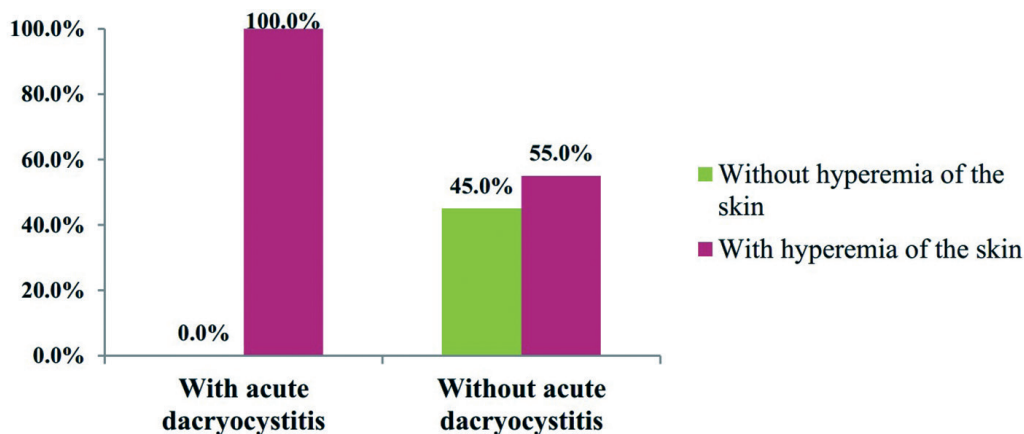


Figure 4. Distribution of the number of eyes with and without evidence of acute dacryocystitis in relation to the periodic hyperemia of the skin.

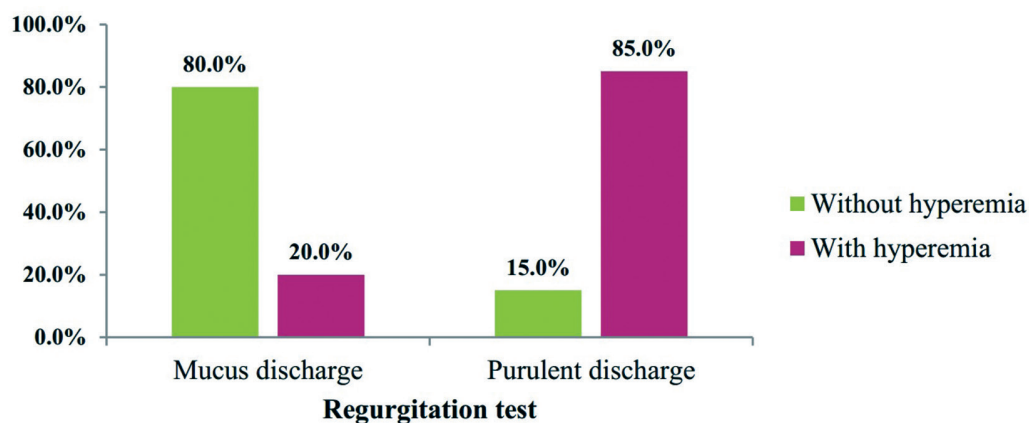


Figure 5. Distribution of eyes according to the regurgitation test and the history of periodic hyperemia of the skin.

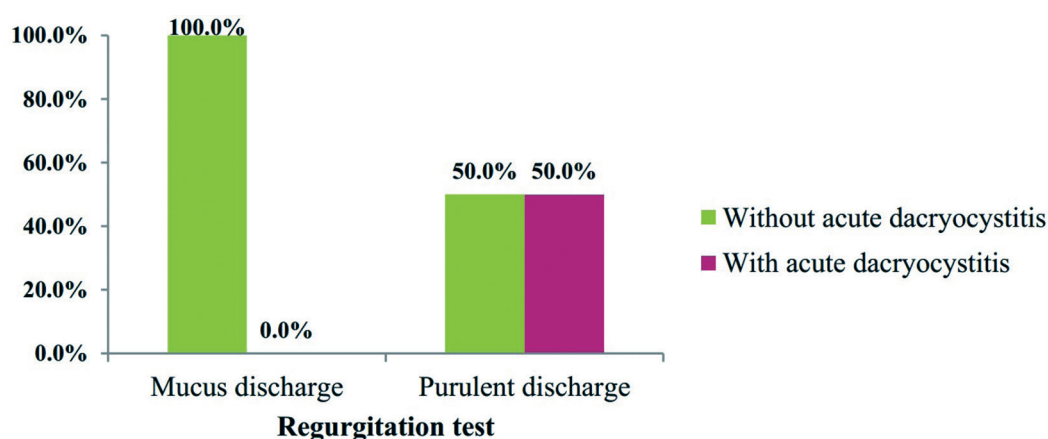


Figure 6. Distribution of eyes according to regurgitation test data and past episodes of acute dacryocystitis.

(anatomical changes from previous inflammation processes in the nose, profuse bleeding during the operation or due to the fault of the surgeon in case of inadvertent injury to the nasal mucosa). The lower flaps in these cases remained unstitched. In all of the eyes (100%), a silicone intubator was placed to maintain the patency of the surgically created fistula. After that, a connection between the upper flap of the nasal mucosa and the flap of the same name of the lacrimal sac was made.

The effect of external DCRs was evaluated in eight patients (9 eyes, 28.6%), operated on between 1995 and 2016. The follow-up period was between 2 and 23 years (average 13.7±6.7 years) (SD=8.73). Control examinations showed that in 5 (55.6%) eyes, there was no evidence of epiphora (grade 0 per Munk scale) from the operated eye, in 1 (11.1%) eye the epiphora was grade 2 on the Munk scale, and in 3 (33.3%) eyes the epiphora was grade 5 according to the used graduating scale. Watering from the eyes in these four patients did not disturb their daily life and they were satisfied after the surgery. In the nine examined eyes, the drainage system was irrigated through the lower punctum with physiological solution. Patency was found in the same 5 (55.6%) eyes which were with grade 0 per Munk scale, partial patency – in 1 (11.1%) eye with grade 2 per Munk

scale, and occlusion was found in 3 (33.3%) eyes – these were grade 5 on the Munk scale. According to the evaluated criteria the success rate of external DCR was found and displayed in Fig. 7.

The skin cicatrix was assessed as fine in 7 (77.8%) of the examined eyes, slight medial epicanthus was found in 2 (22.2%) eyes, and there was nobody with keloid cicatricial scar after the surgery. Fig. 8 shows an operated patient with a fine cicatrix and one with slight medial epicanthus in the area of the scar.

DISCUSSION

Primary acquired nasolacrimal duct obstruction is an ophthalmic problem present more often in middle-aged or elderly women probably because of hormonal fluctuations during menopause and changes in immune status.^[34-37] In our study, we found that women were 82.1% of the cases, so the women significantly predominated ($p<0.05$). A large part of the analyzed patients were aged between 41 and 60 years (46.4%) at the time of the external DCR operation. Our demographic data were similar to those reported in the literature.

Success rate of external DCR

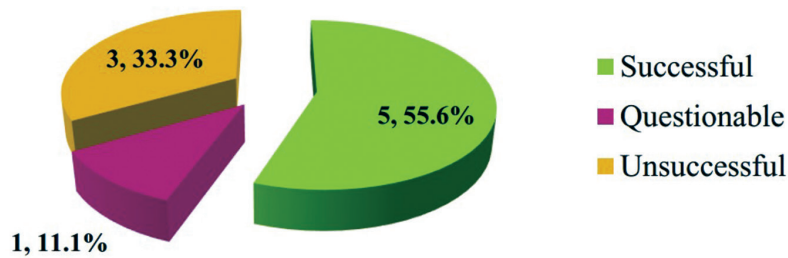


Figure 7. Success rate of external DCRs in 9 eyes.

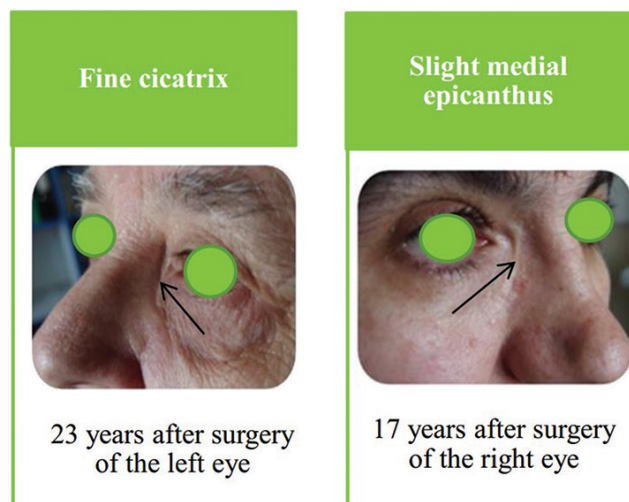


Figure 8. Condition of the cicatrix after external DCR.

An epidemiology study from Northern India found that 86.5% of the patients with DCR belonged to the rural population.^[9] Our research has shown that only 21.4% of the patients lived in a village. The low percentage here can be explained by the urbanization progress in Bulgaria. The majority of patients were urban dwellers.

According to most recent studies, unilateral cases of PANDO were more prominent, while bilateral cases occurred less frequently.^[8] Our study showed similar results, where patients with a single affected eye represented 92.9%.

Shigeta et al. found that people with anatomically narrow bony nasolacrimal duct and a sharper angle between the nasolacrimal duct and the floor of the nose were predisposed to chronic inflammation of the lacrimal drainage system, thus they are at a higher risk for development of PANDO.^[38] All patients with PANDO in our study showed symptoms of chronic dacryocystitis with different duration. In 63.3% of them there was anamnestic data of periodic hyperemia of the skin in the area over the lacrimal sac. No statistical significance was found between the duration of the complaints and the presence of hyperemia of the overlying skin ($p > 0.05$). There was a tendency, nevertheless, for the extended duration of symptoms to coexist with edema and redness in the region surrounding the lacrimal

sac. Chronic dacryocystitis presents more often with reflux of pus (66.7%) during the regurgitation test. Purulent discharge was associated with statistical significance with the occurrence of overlying skin hyperemia ($p < 0.05$) and past episodes of acute dacryocystitis ($p < 0.05$). All of these clinical characteristics in PANDO changed the anatomy of the lacrimal sac and the surrounding tissues, which made the surgical treatment difficult.

The technique of external DCR was proposed 120 years ago.^[21] All of our patients were operated with the modification of the same surgical procedure. A Kerrison or round trephine with a size of 10 or 11 mm in diameter was used to shape the osteotomy. There is a risk of injury to the nasal mucosa when the instrument is pushed in with excessive pressure. Some authors recommend a larger osteotomy of 15×15 mm in order to avoid the risk of postoperative adhesions.^[39,40] Various techniques are available to connect the flaps of the lacrimal sac to these of the nasal mucosa. The classic variant is with adaptation of the four flaps two by two.^[23] Stitching between the 2 lower and 2 upper flaps was made in most of our external DCRs (53.3%). In some cases, due to technical difficulty in shaping the mucosa, a connection was made only between the upper flaps, without anastomosis of the two lower flaps. The literature suggests that the anastomosis between the two posterior and the two anterior flaps forms a sufficiently large space of the fistula channel, which would increase the success rate of the procedure.^[41] Others believe that the adaptation between the posterior flaps did not affect the space formed between the lacrimal sac and the nasal mucosa.^[42] No statistically significant difference was found in the surgery outcome if suturing between all of the flaps was made, or it was performed only between the upper flaps of the lacrimal sac and these of the nasal mucosa.^[40] In more recent publications, the lower flaps can either be left unstitched or cut out without affecting the efficiency.^[43]

External DCR is the gold standard for the surgical treatment of nasolacrimal duct obstruction in middle-aged patients. Most of the authors found out about 90% success rate after the operation.^[19,24,27] In the present study, the long-term effect of external DCR was evaluated in 8 (28.6%) of the analyzed patients. The follow-up period was

about 14 years. Reasons for the small number of patients analyzed for long-term effects were the advanced age at the time of the control examinations or a change in their place of residence. We found a successful result of the surgery in 5 eyes (55.6%) of the patients we followed up. Only nine eyes were analyzed, therefore the success rate is not statistically comparable to the data from the literature.

Cases of failed external DCR increase with a longer follow-up period.^[27,44] The cause for this might be the growth of granulation tissue at the osteotomy which obturated the fistula.^[45] Predictive factors for the unsuccessful outcome are the incorrectly formed osteotomy, as well as its wrong location.^[8] The level of obstruction is also important: in post-sacal obstructions, surgery has better results compared to pre-sacal one.^[44] The inflammatory genesis of PANDO is a possible cause of failed external DCR, due to stenosis of the common canaliculi, despite overcome obstruction of the nasolacrimal duct after the surgery.^[46] Three eyes (33.3%) were found to have an unsatisfactory outcome in our study during the postoperative follow-up. In the literature, it is recommended to repeat DCR after a failed first operation.^[8] The patients we followed with failed surgery refused further treatment.

The skin scar after the surgery is one of the main disadvantages of external DCR.^[47] The risk of an unsatisfactory cosmetic result after the operation should not worry the patients with PANDO because of the high success rate. Furthermore, the scars are invisible or barely noticeable in most of the patients during a long-term follow-up.^[27,35] Our results showed that the cicatrix was fine in 7 (77.8%) of the analyzed eyes. Only in 2 (22.2%) eyes were found to have a mild medial postoperative epicanthus, which did not cause discomfort in the followed-up patients.

One limitation of our study is the limited amount of followed-up patients. For more reliable results, the sample size of the analyzed participants needs to be much bigger. Other limitations are that there was no collected data regarding the reasons for failed external DCR. The diagnosis of the cause of the unsuccessful operation can be done with the application of X-ray dacryocystography^[8], or the use of an endoscopic technique that enables the visualization of nasal pathologies such as septal deviation, hypertrophy of the concha, and growth of granulation tissue at the site of the fistula to the nose.^[47]

CONCLUSION

The primary acquired nasolacrimal duct obstruction is more common unilateral and affects more often middle-aged women. Our results indicate that patients with PANDO had typical presence of purulent discharge, hyperemia of the skin over the lacrimal sac, and past episodes of acute dacryocystitis. If there are such clinical characteristics plus prolonged epiphora (above 1 year) we recommend external dacryocystorhinostomy as surgical treatment of choice. Patients are satisfied with the cosmetic result and

there is an absence of complaints of daily life disturbances due to watering from the eye. The long-term success rate after the surgery is relatively high.

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Competing Interests

The authors have declared that no competing interests exist.

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Первичная приобретённая обструкция носослезного протока - эпидемиология, клинические признаки и хирургическое лечение

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Резюме

Цель: Целью данного исследования было обсуждение эпидемиологических аспектов, клинической картины и способа хирургического лечения у пациентов с первичной приобретённой обструкцией носослезного протока (ППОНП).

Пациенты и методы: В период с 1995 по 2016 год в офтальмологической клинике университетской больницы в Плевене был проведён ретроспективный анализ 28 пациентов с ППОНП, перенёсших наружную дакриоцисториностомию (DCR). Эффект хирургического лечения оценивался на основе истории слезотечения и проходимости слезной дренажной системы. Только восемь из этих пациентов ответили на последующее обследование после операции для целей данного исследования.

Результаты: Демографические данные оцениваемых пациентов были следующими: 17,9% были мужчинами, 82,1% были женщинами, 78,6% проживали в городе, 92,9% имели один поражённый глаз и 7,1% имели двустороннюю ППОНП. Средний возраст пациентов на момент операции составил $43,3 \pm 5,7$ лет ($SD=14,6$). У всех пациентов наблюдались эпифора и выделения; у 63,3% наблюдалось покраснение кожи вокруг слезного мешка, а у 33,3% были эпизоды острого дакриоцистита до операции. Хирургический успех наружной DCR оценивался на девяти глазах из восьми пациентов, которые ответили на послеоперационный осмотр. Результаты показали, что операция прошла успешно у 55,6% этих пациентов, тогда как у 11,1% она имела сомнительный эффект, а у 33,3% она не была успешной.

Заключение: ППОНП в основном поражает женщин среднего возраста. Чаще встречаются односторонние случаи. Наружная DCR выполняется у пациентов с длительной эпифорой и гнойными выделениями. 55,6% случаев успешны. Несмотря на результат, пациенты выразили большую удовлетворённость косметическим результатом и изменением своей повседневной жизни, вызванным слезотечением глаз.

Ключевые слова

клиническая картина, эпидемиология, внешний DCR, ППОНП
