Risk Factors and Risk Prediction Model of Poor Prognosis in Patients with Chronic Dacryocystitis Treated by Endoscopic Nasal Dacryocystostomy

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AIM: Chronic dacryocystitis often leads to a poor prognosis due to factors like chronic inflammation resulting in lacrimal duct obstruction and recurrent infections. Therefore, this study aims to investigate the risk factors of poor prognosis in patients with chronic dacryocystitis treated by endoscopic nasal dacryocystostomy and to establish a risk prediction model.

METHODS: We retrospectively analyzed the clinical data of chronic dacryocystitis patients (n = 101) treated between January 2022 and February 2024. They were divided into a training set (n = 71) and a validation set (n = 30). Patients were followed up for three months post-operation, and recurrence rates were assessed. Logistic regression analysis was used to identify risk factors for poor prognosis, and a nomogram model was developed utilizing these risk factors. Model validation involved the bootstrap method, calibration curves, receiver operator characteristic (ROC) curves, and the Hosmer-Lemeshow test.

RESULTS: Out of the 101 patients, 27 (26.73%) experienced recurrence. The older age, longer operation time, and greater intraoperative bleeding were all associated with poor prognosis (all $p < 0.05$). Multivariate regression indicated that age (odds ratio (OR) = 2.18, 95% CI: 1.30–3.68), operation time (OR = 1.89, 95% confidence interval (CI): 1.13–3.17), and intraoperative bleeding (OR = 1.69, 95% CI: 1.06–2.69) were significant risk factors. The nomogram model incorporating these factors showed an area under the curve (AUC) of 0.666 for the training set and 0.585 for the validation set. Furthermore, for the training set, sensitivity and specificity were 0.654 and 0.621, and for the validation set, they were 0.598 and 0.548, respectively, with calibration curves indicating good agreement.

CONCLUSIONS: Age, operation time, and intraoperative bleeding are significant factors affecting the prognosis of patients with chronic dacryocystitis.

Keywords: chronic dacryocystitis; nasal endoscopy; rhinodacryocystostomy; poor prognosis; nomogram model

Introduction

Chronic dacryocystitis is a common chronic ophthalmic disease particularly among middle-aged and older women [1]. The primary symptoms include excessive tearing and purulent secretions. Chronic dacryocystitis is generally attributed to various factors leading to the stenosis or obstruction of the nasolacrimal duct [2]. When tears are retained in the lacrimal sac, bacteria can proliferate, leading to inflammation and, in severe cases, developing into orbital cellulitis [3]. Dacryocystitis disrupts the normal tear discharge process, resulting in excessive or insufficient tear production, which can cause pain, itching, and redness. If left unmanaged, chronic dacryocystitis can lead to long-term infections within the lacrimal duct system, resulting in severe eye infections such as conjunctivitis and keratitis, and in extreme cases, blindness [4].

Therefore, identifying effective treatment methods is crucial to improve the cure rate and quality of life for patients with chronic dacryocystitis. While traditional dacryocystonasal anastomosis can be beneficial, it has shortcomings, such as complex procedures and limited visibility, resulting in low patient acceptance [5]. With the rapid development of nasal endoscopy technology, medical professionals have gradually improved dacryocystonasal anastomosis by incorporating nasal endoscopy. This approach offers a clearer field of vision, avoids facial incision, and aligns better with the aesthetic pursuits of female patients [6]. Endoscopic dacryocystostomy is simple, convenient, and allows for quick hemostasis, helping to reduce pain and improve surgical outcomes [7]. Although this offers a success rate of over 90% in treating chronic dacryocystitis, some patients still experience postoperative recurrence, resulting in surgical failure and poor prognosis [8].

Therefore, understanding the prognostic factors and implementing timely, effective measures are crucial to predict surgical outcomes and enhance postoperative recovery. Hence, this study aims to improve prognosis by analyzing the clinical data of chronic dacryocystitis patients, identify-

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Table 1. Comparison of baseline data between the poor and good prognoses groups [$\bar{x} \pm s$, n (%)].

Variables	Poor prognosis group (n = 27)	Good prognosis group (n = 74)	χ^2/t-value	p-value
Age (years)	54.25 ± 5.48	51.22 ± 5.19	2.558	0.012
Gender			2.526	0.112
Male	8 (29.63)	35 (47.30)		
Female	19 (70.37)	39 (52.70)		
Duration of disease (years)	4.31 ± 0.45	4.28 ± 0.43	0.306	0.760
Time of operation (min)	37.58 ± 5.41	33.84 ± 5.22	3.156	0.002
Intraoperative bleeding (mL)	33.22 ± 5.80	30.45 ± 5.20	2.297	0.024
Degree of septum deviation			0.092	0.761
Not serious	17 (62.96)	49 (66.22)		
Serious	10 (37.04)	25 (33.78)		
Dacryocyst (eye)			0.591	0.442
Yes	14 (51.85)	32 (43.24)		
No	13 (48.15)	42 (56.76)		
Regular follow-up after surgery			2.811	0.094
Yes	20 (74.07)	65 (87.84)		
No	7 (25.93)	9 (12.16)		
Recurrent dacryocystitis			0.092	0.761
Yes	10 (37.04)	25 (33.78)		
No	17 (62.96)	49 (66.22)		
Bilateral operation			0.471	0.493
Yes	8 (29.63)	17 (22.97)		
No	19 (70.37)	57 (77.03)		

ing risk factors for poor outcomes, and establishing a nomogram model for predicting prognosis.

Materials and Methods

Study Participants

We retrospectively analyzed the clinical data of chronic dacryocystitis patients (n = 101) treated at our hospital from January 2022 to February 2024. The study participants included 43 males and 58 females, aged between 36 to 70 years, with an average age of 50.85 ± 6.31 years.

Inclusion criteria for patients were as follows: (1) Patients with a confirmed diagnosis of chronic dacryocystitis [9]; (2) Patients whose diagnosis was supported by lacrimal duct angiography CT; (3) Those with no intranasal tumor or severe nasal septum deviation; (4) Patients with no mental abnormalities or communication difficulties; and (5) those with complete clinical data. However, exclusion criteria were as follows: (1) Patients with nasal polyps or severe suppurative paranasal sinusitis; (2) Patients with acute mass or inflammation in the lacrimal sac; (3) Those with atrophic rhinitis or lacrimal duct tumor; (4) Patients who cannot tolerate surgical treatment; (5) Those with contraindications to anesthesia; and (6) patients with blood coagulation disorders or platelet deficiency.

The patients were randomly divided into a training set (n = 71) and a validation set (n = 30) at a 7:3 ratio. This study was conducted in accordance with the principles of the Declaration of Helsinki, and informed consent was obtained from all patients and their families. This study received approval from the Ethics Committee of the hospital (The Third People's Hospital of Chengdu [2021] S-10).

Surgical Procedure

The surgical procedure was performed as follows:

(1) The patients were positioned on the operating table in the standard surgical position. The surgical site was disinfected and covered with a towel. (2) General anesthesia was administered using narcotic drugs. (3) Using an endoscope, the surgical site was observed, and its boundaries were defined: the upper boundary was the anterior axilla of the middle turbinate, and the posterior boundary was the uncinate process. An incision was made on the mucoperiosteal surface, and mucoperiosteal tissue was separated and folded back to expose the frontal process of the maxilla and the lacrimal bone. (4) Using an electric drill, a part of the frontal process of the maxilla was removed, creating a bone window. Most of the lacrimal bone was removed or the bone surface was smoothed using a grinding drill and the lateral wall of the lacrimal cyst was exposed. (5) The lacrimal sac was explored using a probe, and a curved incision was made to form a mucosal flap on the lacrimal sac's wall. The mucosal flap was turned over and attached to the anterior mucosa of the uncinate process. The mucoperiosteal flap from the outer wall of the nasal cavity was divided into two sections: the anterior flap covering the maxillary bone surface, and the posterior flap covering the lacrimal sac mucosal flap of the anterior uncinate process. The lacrimal sac was incised, and the internal tissue was

Table 2. Comparison of general data between patients in the training and verification sets [$\bar{x} \pm$ s, n (%)].

Variables	Training set (n = 71)	Verification set (n = 30)	χ^2/*t*-value	*p*-value
Age (years)	50.31 ± 5.44	50.41 ± 5.30	0.085	0.932
Gender			0.116	0.734
Male	31 (43.66)	12 (40.00)		
Female	40 (56.34)	18 (60.00)		
Duration of disease (years)	4.19 ± 0.51	4.25 ± 0.58	0.518	0.605
Time of operation (min)	35.06 ± 5.84	35.59 ± 5.29	0.428	0.669
Intraoperative bleeding (mL)	30.15 ± 6.86	30.33 ± 6.43	0.123	0.903
Degree of septum deviation			0.006	0.937
Not serious	42 (59.15)	18 (60.00)		
Serious	29 (40.85)	12 (40.00)		
Dacryocyst (eye)			0.058	0.809
Yes	35 (49.30)	14 (46.67)		
No	36 (50.70)	16 (53.33)		
Regular follow-up after surgery			0.010	0.922
Yes	49 (69.01)	21 (70.00)		
No	22 (30.99)	9 (30.00)		
Recurrent dacryocystitis			0.044	0.834
Yes	30 (42.25)	12 (40.00)		
No	41 (57.75)	18 (60.00)		
Bilateral operation			0.004	0.948
Yes	35 (49.30)	15 (50.00)		
No	36 (50.70)	15 (50.00)		

trimmed. Once debridement of the internal wall was completed, bone debris was removed, and the lacrimal sac was rinsed. (6) A tobramycin-dexamethasone gelatin sponge was placed into the stoma to maintain dilation, and the nasal mucosal flap was fixed by filling the stoma with the gelatin sponge particles. (7) Tobramycin-dexamethasone eye drops were used to reduce infection risk, alleviate surgical irritation, and prevent infection. Additional treatments included hemostatic drugs, systemic hormones, anti-inflammatory agents, and systemic antibiotics, according to the patient's condition.

Data Collection and Follow-up

Demographic data, clinicopathological indicators, surgical indicators, prognosis, and other relevant information for all patients were collected. Follow-up was conducted by telephone or by consulting electronic medical records, and the recurrence of patients was counted after 3 months. If a patient develops either blindness or relapse after surgery, the prognosis is considered poor.

Construction and Verification of the Nomogram Prediction Model

Single-factor analysis was used to identify factors affecting poor prognosis in patients. Factors exhibiting statistically significant differences were analyzed using multivariate logistic regression to assess independent risk factors for poor prognosis in chronic dacryocystitis patients. These factors were incorporated into a nomogram model, which was used to predict the incidence of poor prognosis based on the corresponding scores for each variable. The nomogram model was validated using an individual validation set.

Statistical Analysis

Statistical charts were generated using SPSS 24.0 (IBM, Armonk, NY, USA) and R 4.1.3 (R Foundation for Statistical Computing, Vienna, Austria). The Shapiro-Wilk test was utilized to assess the normality of the data distribution. Non-parametric tests were used for variables that did not meet the normality assumptions. Measurement data meeting the normality assumptions were represented as mean ± standard deviation ($\bar{x} \pm$ s) and analyzed using a *t*-test. Categorical data were expressed as frequencies (n, %) and analyzed using the χ^2 test. Logistic regression was used to identify independent risk factors for poor prognosis in chronic dacryocystitis patients. The model was validated employing the Bootstrap method, and a calibration curve was created. Receiver operator characteristic (ROC) curve and Hosmer-Lemeshow goodness-of-fit test assessed prediction efficiency and goodness-of-fit. The p-value < 0.05 was considered statistically significant.

Results

Follow-up Results

All patients were followed up for three months to examine the recurrence. Out of the 101 patients, 27 showed a relapse, resulting in a recurrence rate of 26.73%.

Table 3. Univariate and multivariate regression analysis of adverse outcomes in patients with chronic dacryocystitis.

	Univariate regression analysis					Multivariate regression analysis				
Variables	*B*	*S.E.*	*Wald* χ^2	OR (95% CI)	*p*-value	*B*	*S.E.*	*Wald* χ^2	OR (95% CI)	*p*-value
Male	–0.757	0.482	2.470	0.47 (0.18–1.21)	0.216					
Operation time										
<35 mins	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
≥35 mins	1.692	0.521	10.566	1.24 (1.01–1.89)	<0.01	1.692	0.521	10.566	1.89 (1.13–3.17)	0.016
Age										
<45	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
≥45	0.999	1.094	0.835	1.64 (1.41–1.99)	0.047	0.999	1.094	0.835	2.18 (1.30–3.68)	0.003
Intraoperative bleeding										
<30 mL	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
≥30 mL	0.693	0.462	2.253	1.28 (1.08–2.04)	0.002	0.693	0.462	2.253	1.69 (1.06–2.69)	0.028
Duration of disease	0.702	0.520	2.249	1.02 (0.05–1.09)	0.239					
Degree of septum deviation										
Not serious	Ref	Ref	Ref	Ref	Ref					
Serious	0.142	0.468	0.092	1.15 (0.46–2.89)	0.761					
Dacryocyst (eye)										
Yes	0.346	0.451	0.589	1.41 (0.58–3.42)	0.443					
No	Ref	Ref	Ref	Ref	Ref					
Regular follow-up after surgery										
Yes	–0.927	0.565	2.693	0.40 (0.13–1.20)	0.201					
No	Ref	Ref	Ref	Ref	Ref					
Recurrent dacryocystitis										
Yes	0.142	0.468	0.092	1.15 (0.46–2.89)	0.761					
No	Ref	Ref	Ref	Ref	Ref					
Bilateral operation										
Yes	0.345	0.504	0.468	1.41 (0.53–3.79)	0.494					
No	Ref	Ref	Ref	Ref	Ref					

CI, confidence interval; OR, odds ratio; *S.E.*, standard error.

Comparison of General Data of Patients with Different Prognoses

We observed that the poor prognosis group was older than the good prognosis group ($p < 0.05$). Furthermore, the procedure time and intraoperative bleeding volume were significantly greater in the poor prognosis group than in the good prognosis group ($p < 0.05$, Table 1).

Comparison of the General Data between Patients in the Training and Verification Sets

There was no significant difference between the baseline data of the training set and the verification set ($p > 0.05$, Table 2).

Univariate and Multivariate Regression Analysis Affecting Poor Prognosis of Patients with Chronic Dacryocystitis

We classified age, procedure time, and intraoperative bleeding as categorical variables for regression analysis. The threshold for age was set at 45 years, based on clinical observations that patients older than this age are generally at higher risk for poor prognosis. However, based on their average values, the thresholds for operation time and intraoperative bleeding were set at 35 minutes and 30 milliliters, respectively. Multivariate regression analysis identified old age (odds ratio (OR) = 2.18, 95% confidence interval (CI): 1.30–3.68, $p = 0.003$), long operation time (OR = 1.89, 95% CI: 1.13–3.17, $p = 0.016$), and greater intraoperative bleeding (OR = 1.69, 95% CI: 1.06–2.69, $p = 0.028$) as independent risk factors for poor prognosis in chronic dacryocystitis patients ($p < 0.05$, Table 3).

Construction and Evaluation of the Nomogram

As depicted in Fig. 1, age, operation time, and intraoperative blood loss, identified as independent factors through multivariate regression analysis, were incorporated into a nomogram model to predict the prognosis of patients with chronic dacryocystitis. Each predictor had a specific score, and the total score was calculated by accumulating these values to infer the probability of disease progression in chronic dacryocystitis patients. Furthermore, the area under the curve (AUC) for the ROC curve was 0.666 (0.581–0.751) in the training set and 0.585 (0.507–0.663) in the validation set, as shown in Fig. 2. The *p* values were 0.003 and 0.006, with sensitivities of 0.654 and 0.598 and specificities of 0.621 and 0.548, respectively, indicating good prediction performance. Additionally, the calibration curve showed

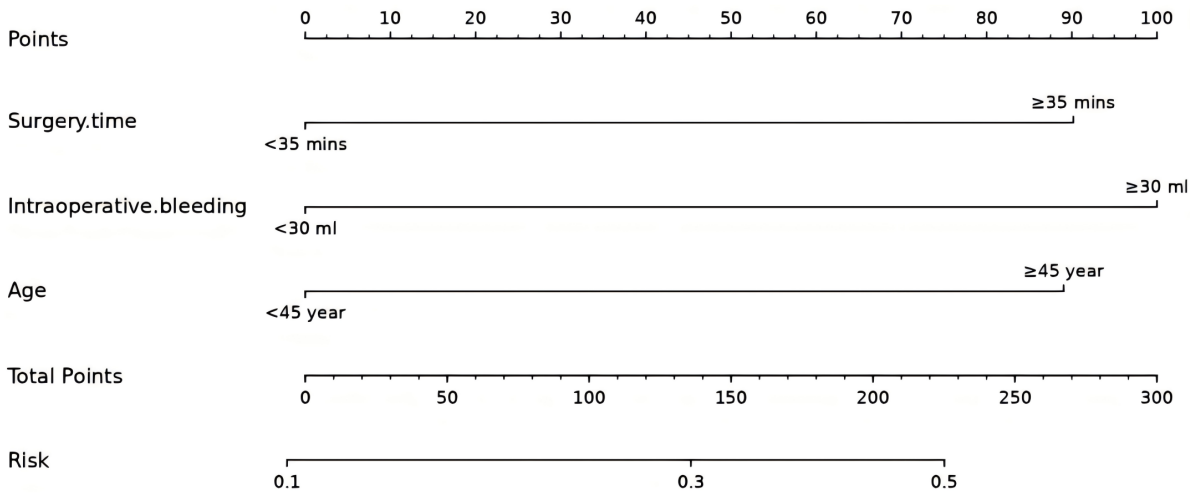

Fig. 1. Nomogram to predict the prognosis of chronic dacryocystitis patients.

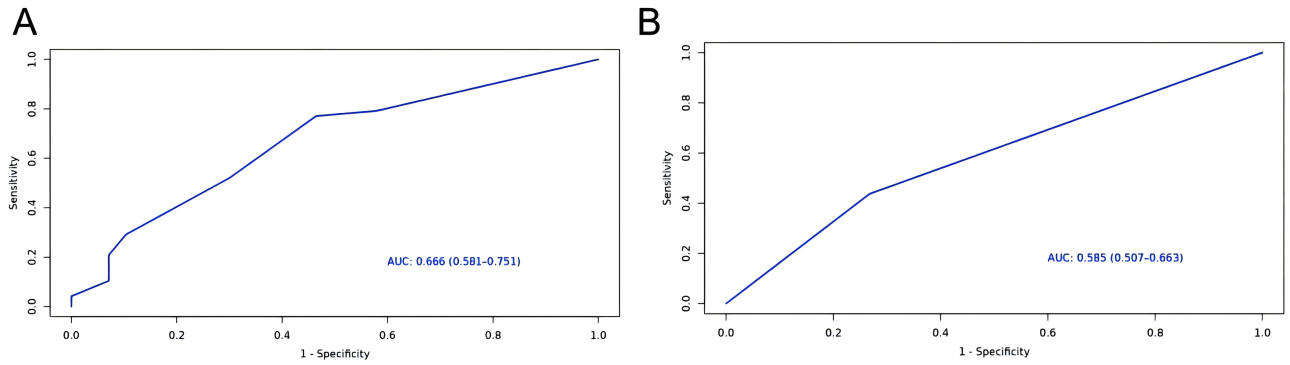

Fig. 2. Receiver operating characteristic curves for the training (A) and verification sets (B). AUC, under the curve.

good agreement between the predicted outcomes and the observed outcomes, as shown in Fig. 3.

Discussion

Chronic dacryocystitis is an inflammatory condition of the lacrimal sac resulting from obstruction or infection of the lacrimal passage. This disease is primarily caused by an obstruction in the lacrimal passage. Tears are produced by the lacrimal gland located at the upper part of the eyelid and flow through the lacrimal passage, which includes the lacrimal point, lacrimal sac, and nasolacrimal duct in the nasal cavity. When any part of this lacrimal passage becomes narrowed, blocked or obstructed, tears cannot drain properly, making the fluid in the lacrimal sac susceptible to infection [10]. Dacryocystitis tends to recur, and the accumulated fluid within the sac provides an optimum environment for bacterial growth. When the lacrimal sac is blocked, tears are not discharged in a timely manner, leading to bacterial multiplication and infection, commonly including streptococcus, staphylococcus, and Klebsiella pneumoniae [11]. Inflammation of the dacryocyst occurs as an immune response to infection [12]. The body responds to infection by releasing inflammatory mediators, such as white blood cells and cytokines [12]. These inflammatory mediators can lead to swelling, redness, pain and increased secretion in the lacrimal sac. Chronic dacryocystitis may result from repeated episodes of persistent irritation and inflammation [13]. If chronic dacryocystitis is not interfered with, long-term stimulation may lead to the transformation from chronic to acute, or the further spread of inflammation may lead to orbital cellulitis, which makes it difficult to carry out other eye operations (cataract, glaucoma) in the later stage, and brings troubles to clinicians [14]. Therefore, it is critical for chronic dacryocystitis patients to receive prompt treatment after diagnosis to reduce the impact on the eyes and alleviate clinical symptoms.

The current treatments for chronic dacryocystitis include antibiotics, lacrimal duct mucosal tissue repair, and other drugs. However, drug therapy is only effective for patients with a short disease duration. In more severe cases, surgery is needed to suppress the source of infection and improve prognosis [15]. Traditional dacryocystonasal anastomosis, a routine procedure, primarily involves incision in the inner canthus to connect the lacrimal sac and the nasal mucosa,

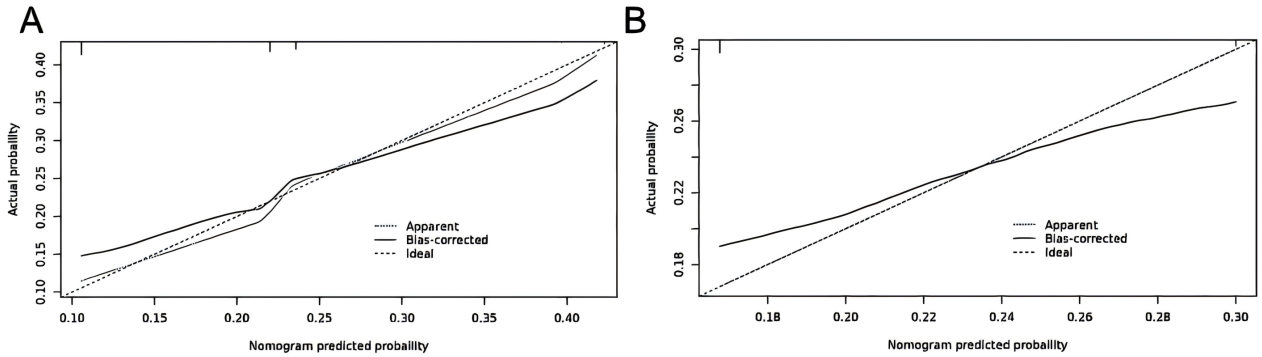

Fig. 3. Calibration curves for training set (A) and verification set (B).

thereby alleviating symptoms. However, clinical practice has shown that patients' compliance with this traditional procedure is low, mainly due to the substantial trauma and the high rate of postoperative recurrence.

Moreover, the intraoperative vision is limited, which is very likely to damage the tissues around the lacrimal sac of patients (inner canthus ligament and orbicularis oculi muscle, etc.) and prolong the recovery time [16]. In recent years, the emergence and application of nasal endoscopy have offered significant improvement in dacryocystonasal anastomosis. These advancements have significantly improved the scientific basis and feasibility of surgical treatment, promoting patient recovery. Nasal endoscopic dacryocystorhinostomy uses the illumination and video amplification capabilities of the endoscope, offering a precise surgical procedure while avoiding damage to the inner canthus ligaments and arteries. This strategy helps effectively preserve the normal physiological function of the lacrimal sac, addresses the shortcomings of traditional surgery that the anatomical structure cannot be observed clearly within the naked eye, reduces trauma, and significantly improves patient acceptance and compliance [17, 18]. Before surgery, the lacrimal passage was rinsed, and the internal structure of the nose was clearly observed under nasal endoscopy. This approach allowed for targeted treatment of the pathological tissue, reducing unnecessary damage and improving the overall curative effect [19, 20]. Karim *et al.* [21] reported that early endoscopic nasal dacryocystostomy can avoid facial scarring, preserve the ligament structure of the inner canthus, and protect the function of the tear pump system, making it the preferred option for treating both chronic dacryocystitis and acute dacryocystitis. While endoscopic dacryocystostomy has been widely used in recent years, it is crucial to note that some patients still experience poor outcomes, relapse, or even surgical failure, which warrants further clinical attention [22].

The findings of this study demonstrated that age, operation time, and intraoperative blood loss are independent risk factors for poor prognosis in patients with chronic dacryocystitis. The reasons are as follows: (1) With the increase of age, many surgical risks of patients become more unpredictable, especially for patients over 70 years old, whose physical fitness and immune resistance are significantly decreased. This reduction substantially impacts surgical prognosis and complications, resulting in higher surgical risk and poorer prognosis [23]. (2) Longer operation time increases the exposure of eye tissue to air, increasing the possibility of normal tissue injury and raising the risk of infection. Furthermore, longer operation time increases the risk of cardiovascular and cerebrovascular complications in elderly patients, negatively affecting their prognosis and even posing life-threatening challenges. To minimize these issues, thorough preoperative preparation, enhanced analysis of risk factor, establishment of safe and effective surgical conditions, and close cooperation between doctors and assistants are crucial to prevent prolonged procedure time and improve prognosis. (3) Hemoglobin supplies oxygen throughout the body, and anemia reduces this oxygen supply, activating the coagulation system and increasing the risk of postoperative complications. Intraoperative bleeding is often related to intraoperative vascular injury during surgical procedures. Excessive intraoperative bleeding can lead to decreased hemoglobin levels, increased oxygen consumption, and alleviated immunity, all of which can adversely affect the surgical outcome and result in poor prognosis [24]. Therefore, careful operation should be performed during the operation to reduce intraoperative bleeding and postoperative complications.

Other study has pointed out that patients with chronic diseases combined with other systems have poor prognosis, and disease superposition strengthens the links between various systems, resulting in worse tolerance of patients [25]. An endoscopic score of >16.5 for discharge, inflammation, and polyps/edema (DIP) is effective in assessing the postoperative efficacy of patients undergoing chronic dacryocystitis surgery [26]. Additionally, the history of rhinitis, prior lacrimal passage laser surgery, intraoperative use of tamponade absorbable materials, and lacrimal passage catheterization also affect prognosis [27]. The above conclusions could not be drawn in this study, which may be

related to the small sample size and regional differences. Further research is needed to explore these factors more comprehensively.

This study has several limitations. Firstly, the relatively small sample size may limit the generalizability of the findings. Secondly, being a single-center study, the results may not apply to other populations or settings due to potential institutional and regional variations. Thirdly, the three-month follow-up period may not be sufficient to capture all instances of recurrence or long-term outcomes, which could provide a more comprehensive understanding of prognosis. Additionally, the lack of external validation for the nomogram model limits confidence in its predictive accuracy across different patient groups. Lastly, unmeasured confounding variables may have influenced the outcomes, and the study may not have considered all potential risk factors for poor prognosis.

Conclusions

In conclusion, age, operation time, and intraoperative bleeding are significant factors affecting the poor prognosis of chronic dacryocystitis patients undergoing nasal dacryocystostomy with nasal endoscopy. The prediction model constructed by each factor provides valuable strategic guidance for assessing the patient's prognosis. Thus, clinicians can use the appropriate treatment to reduce the risk of postoperative recurrence of chronic dacryocystitis and improve the prognosis of patients.

Availability of Data and Materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

WTW and CZ designed the research study; WTW and CZ performed the research; WTW and CZ collected and analyzed the data. WTW and CZ were involved in drafting the manuscript, and both authors were involved in revising it critically for important intellectual content. Both authors gave final approval for the version to be published. Both authors participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to accuracy or integrity were appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the principles of the Declaration of Helsinki, and this study was conducted with the informed consent of the patients and their families, and approved by the Ethics Committee of the hospital (The Third People's Hospital of Chengdu [2021] S-10).

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Conflict of Interest

The authors declare no conflicts of interest.

References

[1] Engelsberg K, Sadlon M. First-Onset Dacryocystitis: Characterization, Treatment, and Prognosis. Ophthalmology and Therapy. 2022; 11: 1735–1741.

[2] Huo Y, Li L, Mo Y, Guo S. A case report of chronic dacryocystitis caused by nasal stones. BMC Ophthalmology. 2023; 23: 445.

[3] Meireles MN, Viveiros MM, Meneghin RL, Galindo-Ferreiro A, Marques ME, Schellini SA. Dacryocystectomy as a treatment of chronic dacryocystitis in the elderly. Orbit (Amsterdam, Netherlands). 2017; 36: 419–421.

[4] Zabek O, Eggenschwiler L, Goldblum D, Meyer P. Filamentous Fungus Dacryolith as a Cause of Chronic Dacryocystitis. Klinische Monatsblatter Fur Augenheilkunde. 2021; 238: 356–357.

[5] Zloto O, Koval T, Yakirevich A, Ben Simon GJ, Weissman A, Ben Artsi E, *et al*. Endoscopic dacryocystorhinostomy with and without mucosal flap-is there any difference? Eye (London, England). 2020; 34: 1449–1453.

[6] Khorrami Kashi A, Keilani C, Nguyen TH, Keller P, Elahi S, Piaton JM. Dacryolithiasis diagnosis and treatment: a 25-year experience using nasal endoscopy. The British Journal of Ophthalmology. 2023; 107: 289–294.

[7] Kumar R, Batni G, Bharke S. Comparison of Endonasal DCR Surgery Using Cautery and Surgical Blade Technique in Cases of Chronic Dacryocystitis. Indian Journal of Otolaryngology and Head and Neck Surgery: Official Publication of the Association of Otolaryngologists of India. 2018; 70: 295–298.

[8] Lüchtenberg M, Tratz F, Schalnus R, Helbig M, May A. Endonasal dacryocystorhinostomies with transillumination and intubation in patients with combined pathologies of the nose and after revision. Klinische Monatsblatter Fur Augenheilkunde. 2013; 230: 46–50.

[9] Li Y, Liu X, Zhang W, Song X, Zhang L, Xiao C. Differently Expressed Circular RNAs in Lacrimal Sacs from Patients with Chronic Dacryocystitis. Frontiers in Genetics. 2022; 13: 834111.

[10] Baybora H, Uysal HH, Baykal O, Karabela Y. Investigating Estrogen and Progesterone Receptors in the Lacrimal Sacs of Individuals with and Without Chronic Dacryocystitis. Beyoglu Eye Journal. 2019; 4: 38–41.

[11] Luo B, Li M, Xiang N, Hu W, Liu R, Yan X. The microbiologic spectrum of dacryocystitis. BMC Ophthalmology. 2021; 21: 29.

[12] Singh S, Selva D. Non-infectious Dacryoadenitis. Survey of Ophthalmology. 2022; 67: 353–368.
[13] Heichel J, Sandner A, Siebolts U, Bethmann D, Struck HG. Concretions and iatrogenic foreign bodies in the lacrimal system: Treatment recommendations. HNO. 2016; 64: 403–416.
[14] Pauk SV, Petriček I, Tomić M, Bulum T, Jandroković S, Kalauz M, *et al*. Manual interferometric device for routine non-invasive tear film break-up time assessment. Seminars in Ophthalmology. 2021; 36: 94–102.
[15] Bernal-Sprekelsen M, Alobid I, Guilemany JM, Tomás-Barberán M. Diagnosis and treatment of chronic epiphora and recurrent dacryocystitis. Laryngo- Rhino-Otologie. 2007; 86: 597–597–606; quiz 607–8. (In German)
[16] Xie C, Zhang L, Liu Y, Ma H, Li S. Author Correction: Comparing the Success Rate of Dacryocystorhinostomy With and Without Silicone Intubation: A Trial Sequential Analysis of Randomized Control Trials. Scientific Reports. 2018; 8: 17901.
[17] Doğan M, Alizada A, Yavaş GF, Kahveci OK, Bakan O. Laser-assisted dacryocystorhinostomy in nasolacrimal duct obstruction: 5-year follow-up. International Journal of Ophthalmology. 2018; 11: 1616–1620.
[18] Wong WK, Dean S, Nair S. Comparison between endoscopic and external dacryocystorhinostomy by using the Lacrimal Symptom Questionnaire: A pilot study. American Journal of Rhinology & Allergy. 2018; 32: 46–51.
[19] Hainarosie R, Rusescu A, Pietrosanu C, Ionita I, Hainarosie M, Stefanescu DC, *et al*. T-Tube Conformational Stent with Aspiration Used in Dacryocystorhinostomy. Materiale Plastice. 2018; 55: 46–47.
[20] Gokcek A, Argin A, Altintas AK. Comparison of failed and successful dacryocystorhinostomy by using computed tomographic dacryocystography findings. European Journal of Ophthalmology. 2005; 15: 523–529.
[21] Karim R, Ghabrial R, Lynch T, Tang B. A comparison of external and endoscopic endonasal dacryocystorhinostomy for acquired nasolacrimal duct obstruction. Clinical Ophthalmology (Auckland, N.Z.). 2011; 5: 979–989.
[22] Atkova EL, Astrakhantsev AF, Fedorov AA, Rein DA, Krakhovetsky NN, Yartsev VD. The nasal mucosa and outcomes of dacryocystorhinostomy. Arkhiv Patologii. 2019; 81: 24–28.
[23] Tessler I, Warman M, Amos I, Halperin D, Bavnik Y, Milstein A, *et al*. Endoscopic dacryocystorhinostomy among the old and oldest-old populations - A case control study. Auris, Nasus, Larynx. 2021; 48: 898–904.
[24] Zhang WB, Ding ZX, Liao MY, Wen ZH, Qiu MY. Analysis of influencing factors of curative effect of dacryocystorhinostomy with nasal endoscope in patients with dacryocystitis. International Eye Science. 2020; 20: 1637–1640. (In Chinese)
[25] Dalgic A, Ceylan ME, Çelik Ç, Aliyeva A, Aksoy GY, Edizer DT. Outcomes of Endoscopic Powered Revision Dacryocystorhinostomy. The Journal of Craniofacial Surgery. 2018; 29: 1960–1962.
[26] Durr ML, Pletcher SD, Goldberg AN, Murr AH. A novel sinonasal endoscopy scoring system: the discharge, inflammation, and polyps/edema (DIP) score. International Forum of Allergy & Rhinology. 2013; 3: 66–72.
[27] Li S, Chen L, Zhang Y, Zheng YJ. Analysis of the influencing factors of endoscopic dacryocystorhinostomy. International Eye Science. 2020; 20: 547–550. (In Chinese)