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Effects of rhEGF combined with hydroxyglycoside on tear film function and the ERK/NF-κB pathway in patients with xerophthalmia after cataract surgery

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Abstract: **Background**: Postoperative xerophthalmia (XER) following cataract surgery significantly impacts patient prognosis and quality of life, with traditional artificial tears offering limited efficacy. **Objectives**: This study investigates the therapeutic effects and molecular mechanisms of recombinant human epidermal growth factor (rhEGF) combined with hydroxyglycoside. **Methods**: A total of 164 patients were enrolled: A control group treated with hydroxyglycoside and an observation group treated with rhEGF combined with hydroxyglycoside. Before and after treatment, the tear film break-up time, Schirmer test, corneal fluorescence staining and other indicators were detected, and the levels of serum inflammatory factors and oxidative stress markers were measured in the two groups. At the same time, the dry eye rat model was established, and the rats were divided into groups for intervention. The pathological changes of corneal tissues were observed by HE staining, and the expressions of ERK/NF-KB pathway related proteins were detected by Western blot. **Results**: After 8 weeks of treatment, there was no significant difference in the overall response rate between the two groups ($P>0.05$). However, the observation group demonstrated a significantly higher and good response rate compared to the control group ($P<0.05$). Furthermore, the observation group demonstrated superior tear film function compared to the control group post-treatment ($P<0.05$). Blood sample analysis revealed greater reductions in serum inflammatory factors and oxidative stress markers, along with significantly higher superoxide dismutase activity in the observation group ($P<0.05$). Finally, animal experiments further confirmed that rhEGF combination therapy mitigates corneal epithelial damage, inhibits inflammatory cell infiltration and reduces the expression of phosphorylated ERK1/2 (p-ERK1/2) and phosphorylated NF-κB (p-p65) in corneal tissue. **Conclusion**: This combination therapy offers a potential treatment strategy for postoperative XER following cataract surgery.

Keywords: Cataract; ERK/NF-κB; Hydroxyglycoside; Recombinant human epidermal growth factor; Xerophthalmia

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INTRODUCTION

Cataract, a visual disorder induced by lens opacity, is characterized by an insidious onset, with painless and progressive vision decline as the major symptom (Li *et al.*, 2020). At present, cataract represents the primary blinding eye disease globally, as it is responsible for over 46% of blind people worldwide (Shiels & Hejtmancik, 2021). The incidence of cataracts is highly age-dependent, ranging from 20 to 21 percent in people over 60 years of age and climbing to more than 40 percent in people over 70 (Berry *et al.*, 2020). Although the risk of cataract-induced blindness has been significantly decreased with advances in medical care, some visual impairments after the onset of this disease are irreversible (Jing *et al.*, 2023). Currently, phacoemulsification surgery remains the main treatment option for cataracts. However, due to the damage to the corneal surface during the surgical process, postoperative xerophthalmia (XER) occurs frequently (Sharma *et al.*, 2021). Statistics reveal that approximately 60-80% of cataract patients experience XER of varying degrees after surgery (Sun & Zhang, 2022). The occurrence of XER not only increases the risk of other postoperative complications and affects the patient's recovery, but also, in more serious cases, may ultimately lead to blindness due to XER (Marek *et al.*, 2023). Consequently, effectively resolving the issue of XER following cataract surgery has consistently been a hotspot in clinical research.

At present, tear replacement using artificial tears is mainly used to relieve postoperative XER in clinical practice. Hydroxyglycoside, in particular, is a commonly used type among artificial tears and is currently recognized as the artificial tear that best meets the physiological requirements of the human body. It has good lubricity and viscosity and can promote the healing and repair of the ocular surface epithelium (Khan *et al.*, 2023). However, a growing number of studies have demonstrated that the improvement effect of using artificial tears alone on XER is rather limited and the recurrence rate of XER remains relatively high (Liu *et al.*, 2021). Recently, the application of recombinant human epidermal growth factor (rhEGF) in various ophthalmic surgical procedures has started to draw significant clinical attention. Pharmacological research has

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verified that rhEGF plays an active role in promoting cell repair, division and regeneration, enhancing the stability of the tear film and accelerating the recovery process of patients (Tsai *et al.*, 2021). In a recent study, rhEGF combined with sodium hyaluronate has been shown to significantly ameliorate the symptoms of XER patients (Gong *et al.*, 2022). Nevertheless, there are few reports on the application of rhEGF combined with hydroxyglycoside in the treatment of XER following cataract surgery.

Therefore, this study aims to investigate the effect and underlying mechanism of rhEGF combined with hydroxyglycoside on the tear film function of XER patients after cataract surgery, thereby providing a more reliable guarantee for the postoperative safety of cataract surgery in the future.

MATERIALS AND METHODS

Research subjects

The sample size required for the study was calculated using G*power software (v. 3.1.9.2) and the results indicated that the minimum sample size for each group was 64 cases. Patients with XER following cataract surgery, who were admitted to Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University between April 2023 and June 2023, were selected as the research subjects for retrospective analysis. After screening according to the inclusion and exclusion criteria, 164 cases were finally included. Among them, 88 cases were treated with hydroxyglycoside eye drops and were designated as the control group. The remaining 76 cases received a combination of rhEGF and hydroxyglycoside eye drops and were considered the observation group. The research process is shown in Fig. 1.

Inclusion and exclusion criteria

Inclusion criteria: Diagnosis of cataract by examination (Miller *et al.*, 2022) and treatment with phacoemulsification in Taizhou Hospital of Zhejiang Province, Affiliated to Wenzhou Medical University, with postoperative XER; no previous history of XER; first time receiving XER medication; no history of using neurological or estrogen-related drugs in the recent 3 months; good cognitive and language functions. *Exclusion criteria*: Visual impairment due to other factors; tumor or immune system-associated diseases; other eye diseases; severe liver and kidney dysfunction.

Methods

Surgery: After admission, all patients were treated by phacoemulsification combined with intraocular lens implantation, completed by the same ophthalmologist. The conjunctival sac was irrigated with 0.5% povidone-iodine and compound sodium chloride solution. Subsequently, a 3.2-mm limbal tunnel incision was made at the 11-o'clock position and an auxiliary incision was created with a 15° keratome at the 2 to 3-o'clock position. After injection of a viscoelastic agent into the anterior chamber, continuous circular capsulorhexis of the anterior capsule with a diameter of approximately 5.5 mm was carried out. Next, hydro-dissection and hydro-delamination of the lens cortex and nucleus were performed, followed by phacoemulsification and aspiration of the lens nucleus using standard techniques. After complete aspiration of the cortex, a foldable intraocular lens was implanted into the capsular bag. Following hydration of the incision, the conjunctival sac was smeared with tobramycin-dexamethasone ophthalmic ointment. Dressing changes and examinations were conducted on the first and second postoperative days.

Treatment: Patients in the control group were treated with hydroxyglycoside eye drops (H20066132, Chengdu Qingshan Likang Pharmaceutical Co., LTD.), 1 drop/time, 3 times/day. In addition to the treatment in the control group, the observation group was given rhEGF eye drops (S20020016, Guilin Huanuowei Gene Pharmaceutical Co., LTD.), 1 drop/time, 3 times/day. Both groups of patients received continuous treatment for 8 weeks.

Clinical efficacy and tear film function assessment

After treatment, the tear film function of patients was tested, including: (1) tear film breakup time (BUT) (Chatterjee & Agrawal, 2021): 2% fluorescein sodium was slowly added into the conjunctival sac and the BUT was observed and recorded via slit-lamp (SL130, Zeiss, Germany) examination. (2) Schirmer I test (SIT) (Brott *et al.*, 2024): One end of the test filter paper was folded back and then positioned at the one-third demarcation point of the outer part of the patient's conjunctival sac. The patient was asked to keep the eyes closed for 5 minutes and then open the eyes, after which the test paper was retrieved to measure the soaked length of the filter paper. (3) corneal fluorescent (FL) (Soifer *et al.*, 2023): The fluorescein staining of the cornea was observed under a cobalt blue light. A score of 0 was assigned for no staining, 1 for scattered punctate staining, 2 for diffuse punctate staining and 3 for epithelial patchy staining. According to the XER treatment guidelines (Feroze and Kaufman, 2025), the following criteria were used for efficacy assessment: When clinical symptoms disappeared, with FL = 0 and SIt > 10 mm, the patient was considered cured; when symptoms were significantly alleviated, with FL = 1 and SIt ranging from 5-10 mm, the treatment was regarded as markedly effective; when symptoms were alleviated, with FL = 2 and SIt < 5 mm, the treatment was considered effective; those not meeting the above-mentioned criteria were classified as ineffective; total effective rate = (cured +markedly effective +effective) cases / total number of patients × 100%; excellent and good rate = (cured +markedly effective) cases / total number of patients ×100%.

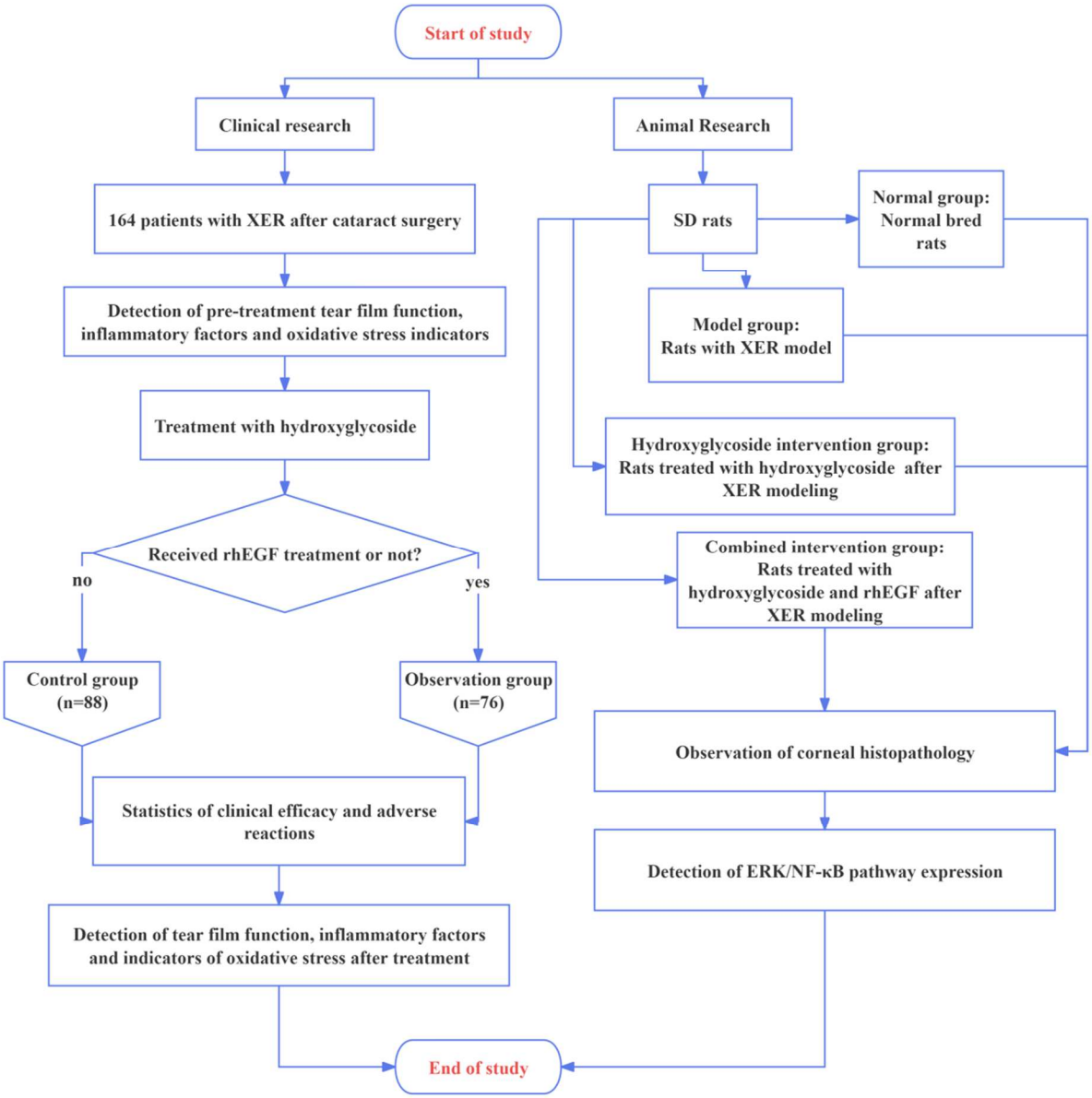

Fig. 1: Flow chart of this study.

Inflammation and oxidative stress response detection

Before and after treatment, 3 mL of fasting venous blood from the elbow was drawn from patients. After separating the serum, enzyme-linked immunosorbent assay (ELISA) was used to detect lipid hydroperoxide (LPO), superoxide dismutase (SOD), tumor necrosis factor-α (TNF-α), interleukin-1β (IL-1β) and interleukin-6 (IL-6) (the kits were purchased from Wuhan Huamei Biological Engineering Co., LTD.).

Animal data

Twenty specific-pathogen-free (SPF)-grade Sprague-Dawley (SD) rats (10 weeks old, 280-300g) were procured from Beijing Vital River Laboratory Animal Technology Co., Ltd. (Animal Production License Number: SCXK (Beijing) 2021-0006). All the rats were reared in an animal facility with a temperature range of 20-23°C, a humidity level of 50-60% and a 12-hour light-dark cycle, with free access to food and water.

XER model

After one week of adaptive feeding, the rats were categorized into four groups, namely the normal, model, hydroxyglycoside intervention and combined intervention groups. The rats in the normal group were left untreated and fed normally, while the other three groups were subjected to the establishment of XER rat models through subconjunctival injection of scopolamine (with a dosage of 5 μL per injection, 4 times per day and an interval of 3 hours between each injection for 7 consecutive days) (Lee *et al.*, 2021). During the modeling process, air circulation in the animal room was maintained and the relative

humidity was kept at 50-60%. The successful establishment of the XER model was indicated by reduced tear secretion, decreased density of goblet cells in the conjunctival tissue and increased corneal fluorescence staining in the rats.

Intervention treatment of rats

After the completion of the model, rats in the hydroxyglycoside intervention group were treated with hydroxyglycoside eye drops (one drop each time, three times a day). On the basis of the hydroxyglycoside intervention group, the combined intervention group was additionally treated with rhEGF eye drops (one drop each time, three times a day). The control and model groups were instilled with an equal amount of normal saline. Four weeks after the intervention, all rats were euthanized and the conjunctival tissue was isolated. One part was fixed in 4% paraformaldehyde and routinely embedded in paraffin for sectioning and the other part was frozen and stored in a-80 °C refrigerator.

Hematoxylin-eosin (HE) staining

HE staining was performed after the corneal tissue slices were dewaxed in water. The pathological damage of the rat corneal tissue was observed under a microscope (Sigma360, Zeiss, Germany) and photographed.

Detection of ERK/NF-κB pathway

The total protein of the frozen corneal tissue was extracted using RIPA protein lysis buffer. The proteins were denatured after determining the protein concentration by the BCA method. The denatured proteins were then separated by gel electrophoresis, transferred to a polyvinylidene fluoride (PVDF) membrane by wet blotting method and sealed with skim milk powder. Subsequently, primary antibodies against p-ERK1/2, ERK1/2, p-p65 and p65 (at a dilution ratio of 1:1000) were added and the samples were incubated overnight at 4°C. The next day, the corresponding secondary antibody (1:5000) was added and the incubation was continued for 2 hours at room temperature. After ECL development, images are captured using the Image J system and the relative expression levels are calculated with GAPDH serving as an internal reference.

Statistical analysis

Statistical analysis was performed using SPSS 24.0 software. Qualitative data were recorded as [n(%)] and the chi-square test or Fisher's exact test were used for comparison. For quantitative data, the Shapiro-Wilk test was first performed; normally distributed data were recorded as ($\bar{\chi}\pm s$) and compared using Independent-sample t-tests (between groups) and paired t-tests (within groups); non-normally distributed data were recorded as median (interquartile range), with the inter-group and intra-group comparisons made by the Mann-Whitney U test and the Willcoxon rank-sum test, respectively. A P-value less than 0.05 is considered to indicate a statistically significant difference.

RESULTS

Comparison of clinical data

First of all, to ensure the reliability of the research results, a comparison of the clinical data of the two patient groups was conducted. The results showed no statistical difference in the age, sex and course of cataracts between the control and observation groups (P>0.05, Table 1), which confirmed the comparability between them.

Comparison of treatment effects

Then, the clinical efficacy of the two groups was counted. No notable difference was found in the overall treatment effective rate between groups (P>0.05). However, the excellent and good rate of treatment in the observation group was 68.42%, higher compared to the control group (51.14%; P<0.05, Table 2), suggesting that rhEGF combined with hydroxyglycoside is more effective in treating XER.

Comparison of tear film function

In the tear film function test, the two groups were not markedly different in BUT, SIt and FL before treatment (P>0.05). However, the BUT and SIt of both groups increased after treatment, with those of the observation group being (6.50±0.93) s and (8.41±0.93) mm/5min, respectively, higher compared to the control group (P<0.05); the FL of the two groups decreased after treatment, with that of the observation group was being (0.49±0.50), which was lower than that of the control group (P<0.05, Table 3). The above results suggest that rhEGF combined with hydroxyglycoside can improve the tear film function of patients more significantly.

Comparison of inflammation and oxidative stress injury

The inflammation and the oxidative stress damage of the two groups was evaluated by detecting inflammatory factors and oxidative stress markers. IL-1β, TNF-α, IL-6, LPO and SOD showed no evident differences between groups before treatment (P>0.05). Both groups exhibited a decrease in IL-1β, TNF-α and IL-6 after treatment, particularly in the observation group (P<0.05); SOD increased after treatment and was even higher in the observation group than in the control group (P<0.05, Table 4). It can be seen that rhEGF combined with hydroxyglycoside is more helpful in alleviating inflammation and oxidative stress damage in patients.

Comparison of adverse effects

Regarding safety, adverse reactions like ocular surface damage, redness and swelling were observed in both groups. The total incidence of adverse reactions was 9.09% in the control group and 10.53% in the observation group respectively, with no significant difference between them (P>0.05, Table 5), suggesting the two treatment regimens are equally safe.

Table 1: Comparison of clinical data

Groups	Control (n=88)	Observation (n=76)	t or x^2 values	P-values
Age (years)	66.14±4.95	67.54±5.63	1.697	0.092
Sex			0.529	0.467
Male	39 (44.32)	38 (50.00)		
Female	49 (55.68)	38 (50.00)		
Course of cataract (months)	14.65±4.71	13.92±4.84	0.973	0.332
Diseased eye			0.631	0.427
Left eye	46 (52.27)	35 (45.05)		
Right eye	42 (47.73)	41 (53.95)		
Long-term smoking			0.498	0.48
Yes	30 (34.09)	22 (28.95)		
No	58 (65.91)	54 (71.05)		
Long-term drinking			0.502	0.479
Yes	19 (21.59)	20 (26.32)		
No	69 (78.41)	56 (73.68)		
Family history of Disease			0.247	0.619
Yes	14 (15.91)	10 (13.16)		
No	74 (84.09)	66 (86.84)		

Table 2: Comparison of clinical efficacy

Groups	Cured	Markedly effective	Effective	Ineffective	Excellent and good rate	Total effective rate
Control (n=88)	20 (22.73)	25 (28.41)	37 (42.05)	6 (6.82)	51.14	93.18
Observation (n=76)	22 (28.95)	30 (39.47)	20 (26.32)	4 (5.26)	68.42	94.74
χ^2 or Fisher's exact	0.828	2.240	4.450	-	5.042	0.172
P	0.363	0.135	0.035	0.753	0.025	0.678

Table 3: Comparison of tear film function

Groups	BUT (s)		SIt (mm/5min)		FL	
	Before	After	Before	After	Before	After
Control (n=88)	3.13±0.72	5.72±0.92*	6.87±0.82	7.62±0.66*	2.49±0.59	0.69±0.49*
Observation (n=76)	3.24±0.80	6.50±0.93*	6.93±1.03	8.41±0.93*	2.54±0.64	0.49±0.50*
t	0.941	5.408	0.404	6.378	0.530	2.662
P	0.348	<0.001	0.687	<0.001	0.597	0.009

Note: * indicates P<0.05 compared to the same treatment group.

Effect of rhEGF on ERK/NF-KB pathway

To confirm the therapeutic mechanism of rhEGF combined with hydroxyglycoside in XER, an XER animal model was established and subjected to an intervention treatment using the combination of rhEGF and hydroxyglycoside. HE staining showed that corneal epithelial cells in normal group rats developed well and the stromal layer cells were closely arranged with a normal morphological appearance. However, in the model group, the corneal epithelial layer of rats was thickened and the stromal layer cells were disorganized and loosely arranged with partial loss, accompanied by enlarged nuclear spacing and extensive infiltration of inflammatory cells. In both the hydroxyglycoside intervention group and the combined

Table 4: Comparison of inflammation and oxidative stress responses

Groups		Control (n=88)	Observation (n=76)	t	P
IL-1β (ng/mL)	Before	123.89±19.03	129.14±18.36	1.792	0.075
	After	70.62±11.03*	65.23±14.66*	2.682	0.008
TNF-α (pg/mL)	Before	259.16±48.46	261.93±57.12	0.337	0.737
	After	193.31±30.31*	182.96±25.04*	2.360	0.020
IL-6 (pg/mL)	Before	1450.04±124.69	1478.07±110.20	1.514	0.132
	After	1212.67±118.91*	1138.42±106.41*	4.185	<0.001
LPO (μmol/L)	Before	2.43±0.28	2.40±0.27	0.735	0.464
	After	1.41±0.36*	1.10±0.19*	6.835	<0.001
SOD (U/L)	Before	281.53±35.83	291.48±46.67	1.542	0.125
	After	311.93±32.97*	330.28±44.59*	3.021	0.003

Note: * indicates P<0.05 compared to the same treatment group.

Table 5: Comparison of adverse reactions

Groups	Ocular surface damage	Ocular redness and swelling	Allergic reaction	Reduced vision	Keratitis (conjunctivitis)	Total incidence
Control (n=88)	3 (3.41)	2 (2.27)	1 (1.14)	1 (1.14)	1 (1.14)	9.09
Observation (n=76)	2 (2.63)	3 (3.95)	2 (2.63)	0 (0.0)	1 (1.32)	10.53
x^2						0.095
P						0.757

intervention group, the stromal layer cells of the corneal tissue in rats were more closely aligned, the nuclear spacing was reduced and the infiltration of inflammatory cells was alleviated, indicating a partial recovery of pathological damage, with a more pronounced effect in the combined intervention group. Analysis of the expression of the ERK/NF-κB pathway demonstrated that compared to the normal group, both p-ERK1/2/ERK1/2 and p-p65/p65 were significantly elevated in the model group (P<0.05). No significant difference was observed between the hydroxyglycoside intervention group and the model group (P>0.05). However, in the combined intervention group, p-ERK1/2/ERK1/2 and p-p65/p65 were lower than those in both the model group and the hydroxyglycoside intervention group (P<0.05), suggesting that the repair of corneal tissue damage by rhEGF is associated with the ERK/NF-KB pathway (Fig. 2).

DISCUSSION

How to alleviate postoperative XER symptoms, maintain tear film stability in patients and ensure the integrity of meibomian glands are risk factors affecting the postoperative visual recovery of patients and the improvement of their quality of life, which require extensive clinical attention. This study analyzed the therapeutic effect of rhEGF combined with hydroxyglycoside on XER after cataract surgery. Compared with the use of hydroxyglycoside eye drops alone, the combination with rhEGF obviously enhanced clinical effectiveness in patients, validating the application value of this treatment protocol, which is also consistent with the research results of (Sun & Zhang, 2022). It is widely recognized that during cataract surgery, patients may experience a weakening of the corneal reflex and a reduction in tear secretion due to preoperative anesthesia-related losses, intraoperative mechanical or physical injuries and drug-induced injuries from corticosteroids (Baldini *et al.*, 2024). At this time, the use of artificial tears can cover the ocular surface, prolong the BUT and moisten the eyeball, thereby alleviating symptoms such as ocular dryness, foreign-body sensation and ocular fatigue (Aygun *et al.*, 2020), which is also the mechanism underlying the use of artificial tears in the treatment of XER.

However, relying solely on artificial tears has limited intervention effects, where, on the one hand, it is challenging to promote the repair of the damaged tear film. On the other hand, with the increase in human drug resistance, the moisturizing effect on the eyeball will gradually decline. (Chato-Astrain *et al*., 2021) proposed that rhEGF can activate the intracellular signal transduction pathway after binding with its receptors, which can promote the synthesis of DNA, RNA and proteins and accelerate the metabolism of conjunctival and corneal epithelial cells. This can not only shorten the repair and healing time, ensure the even distribution of the tear film across the ocular surface, but also stimulate the proliferation of corneal stroma and fibroblasts, thus improving the arrangement of collagen fibers (lamellae) (Chato-Astrain *et al.*, 2021). Therefore, the use of rhEGF combined with hydroxyglycoside can not only alleviate the dryness of patients' eyes, but also effectively promote the

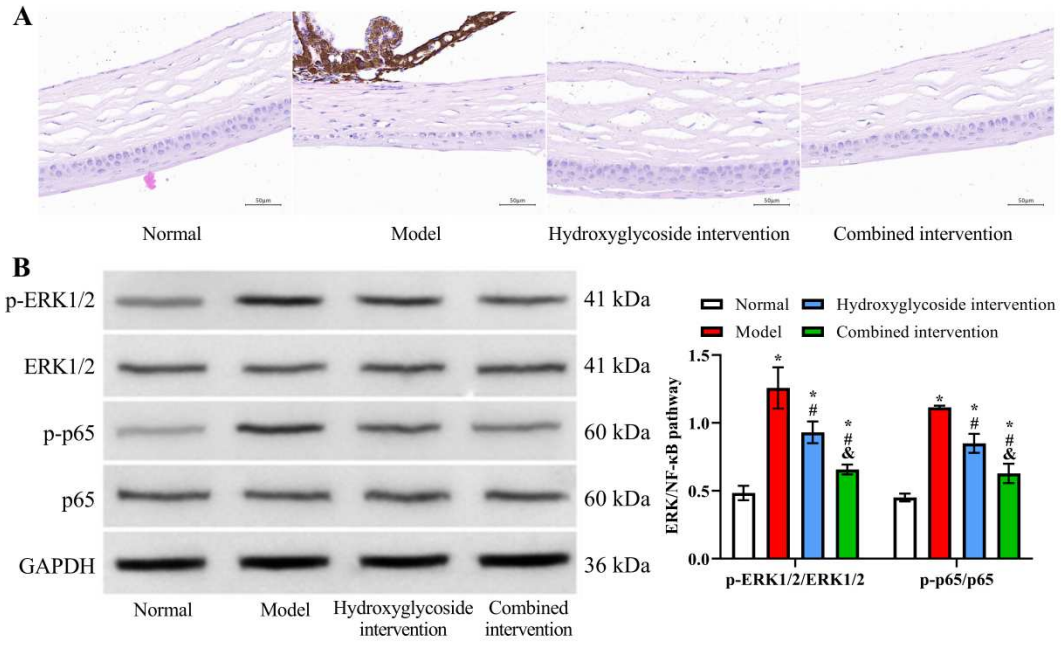

Fig. 2: Effects of rhEGF on corneal tissue in XER rats.
(A) The effect of rhEGF on corneal tissues was observed by HE staining. (B) Effects of rhEGF on ERK/NF-κB pathway were observed by Western blot. *, #, & indicate P<0.05 compared with normal group, model group and hydroxyglycoside intervention groups, respectively.

repair of the damaged tear film, thus enhancing therapeutic efficacy. This is further corroborated by the observation that, when comparing the tear film functions of the two patient groups, the BUT and SIt values were higher and the FL value was lower in the observation group after treatment. Furthermore, research has confirmed that the proliferative status and inflammatory response within the conjunctival epithelium are associated with the tear film stability and the inflammatory response may play a significant role in the pathogenesis of XER (Caroleo *et al.*, 2022). XER can induce ocular surface inflammation and conversely, the presence of inflammation on the ocular surface can exacerbate the severity of XER. After cataract surgery, patients experience an elevated release of ocular factors, which results in an increased permeability of the ocular vascular wall. This, in turn, leads to an abnormally high synthesis and release of mitogen-activated protein kinases and triggers a substantial and abnormal increase in reactive oxygen species. Subsequently, lipid peroxidation reactions are initiated, giving rise to oxygen-free radicals that cause certain damage to the ocular surface tissue (Khalil *et al.*, 2020).

The results of this study revealed that both the inflammatory and oxidative stress damages in the observation group exhibited more pronounced improvements compared to the control group after treatment, which is hypothesized to be associated with rhEGF's ability to facilitate corneal regeneration and repair, as well as to suppress the release of inflammatory factors in conjunctival epithelial cells. Moreover, it is also found that hydroxyglycoside can promote the discharge of toxic substances and help alleviate inflammatory responses (Swain *et al.*, 2023). Therefore, the combination of the two drugs has a more obvious inhibitory effect on both inflammation and oxidative stress. In terms of safety, there was no difference in the incidence of adverse reactions between groups. It suggests that rhEGF combined with hydroxyglycoside is safe and will not increase the risk of other adverse reactions, with high clinical application value. (Poudel *et al*., 2023) compared the effects of rhEGF derivatives and other hormonal drugs on promoting bone healing and found that rhEGF can more effectively maintain the stability of the bone microenvironment with higher safety, which further supports the findings of this study.

Although the above-mentioned studies have preliminarily confirmed the therapeutic effect of the combination of rhEGF and hydroxyglycoside on XER after cataract surgery, the specific mechanism remains unclear. The ERK/NF-κB signaling pathway was repeatedly mentioned in the previous research on the mechanism of rhEGF (Zhang *et al.*, 2021). Therefore, it is speculated that the effect of rhEGF on XER may also be related to the ERK/NF-κB pathway. In an animal model, the good improvement effect of rhEGF combined with hydroxyglycoside on the pathological injury of corneal tissue in rats. Meanwhile, the ratios of p-ERK1/2/ERK1/2 and p-p65/p65 in the model group of rats were higher than

those in the normal group, suggesting that the ERK/NF-κB pathway is activated in XER, consistent with previous research results (Peng *et al.*, 2025). The decreased expression of p-ERK1/2/ERK1/2 and p-p65/p65 in the combined intervention group also provided us with an initial understanding that the effect of rhEGF on XER may be through the regulation of the ERK/NF-κB pathway.

Limitations

The limitations of this study are as follows: (1) As a single-center retrospective analysis, more cases are required and the follow-up period should be extended to further observe the comprehensive impact of the combination of rhEGF and hydroxyglycoside on XER after cataract surgery. Meanwhile, the mechanism of rhEGF needs further experimental verification. (2) The number of rats per group was only 5, which is extremely low for animal model studies, especially for Western blot and histopathological analysis. This seriously weakens the reliability and universality of the ERK/NF-κB pathway research and more complete studies are needed to verify it.

CONCLUSION

rhEGF combined with hydroxyglycoside can improve the excellent and good rate of XER after cataract surgery, which can effectively improve the tear film function of patients and suppress the damage induced by inflammatory and oxidative stress responses. The mechanism may be related to the regulation of the ERK/NF-KB pathway. In the future, this combination therapy could provide more reliable safety guarantees for the surgical treatment of cataracts.

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Not applicable

Authors' contributions

Ledan Wang, Guang Li, Huijun Li, Gangfeng Cui conceived and designed the project, and wrote the paper. Ledan Wang, Guang Li, Huijun Li, Zhenyang Xiang, Feifei Feng, Luyan Zhang generated the data. Ledan Wang, Li Guang, Huijun Li, Gangfeng Cui, analyzed the data. Ledan Wang, Guang Li, Gangfeng Cui modified the manuscript. All authors gave final approval of the version to be published and agree to be accountable for all aspects of the work.

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Data availability statement

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethical approval

The study involving human subjects complied with the Declaration of Helsinki and animals. The study was approved by the ethical committee of the Taizhou Hospital of Zhejiang Province, affiliated to Wenzhou Medical University (No.202200124 and No.202200835) and all participants provided written informed consent.

Conflict of interest

The authors report no conflict of interest.

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