Case Report

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Autologous Lamellar Keratoplasty for the Treatment of Feline Acute Bullous Keratopathy: A Case Report

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Abstract A 4-year-old female Munchkin cat presented with a 2-day history of a large mass in the left eye. On the first presentation, slit lamp biomicroscopy revealed a large corneal bulla occupying around 40% of the corneal surface along the visual axis. Based on the results, a diagnosis of feline acute bullous keratopathy was made. Due to the location of the extensive corneal bulla, autologous lamellar keratoplasty was performed based on prior studies, to both minimize postoperative complications that may affect axial vision and address any cosmetic concerns the owner had. The autologous lamellar keratoplasty successfully resolved the corneal bulla with no signs of corneal opacities postoperatively. Therefore, autologous lamellar keratoplasty may be a useful surgical treatment for feline acute bullous keratopathy from both the tectonic and optical points of view.

Key words cat, conjunctival graft, corneal edema, corneal transplantation, keratoplasty.

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Introduction

Feline acute bullous keratopathy (FABK) is characterized by the formation of bullae due to predominant corneal stromal edema in young adult cats (2). The condition is a rapidly progressive and devastating corneal disease that results in permanent extensive corneal scarring and/or corneal rupture, and loss of vision (1,2,4). The onset of the disease may be asymmetrical, but it typically affects both eyes. The exact cause of FABK is unknown, but several potential etiologies and risk factors have been suggested (2,12,13). These include corneal stromal and endothelial abnormalities (inherited stromal dystrophy, defect of Descemet's membrane and the endothelium and endothelial dystrophy), prolonged use of immunomodulating drugs (cyclosporine and dexamethasone), pre-existing ocular conditions (uveitis), and infectious agents (bacteria, protozoa, and viruses such as the feline herpesvirus) (2). The treatment of FABK depends on the severity of the condition. Mild lesion can be responsive to topical medical therapy alone and combined with therapeutic soft contact lenses, while more severe cases often require surgical intervention to restore the globe by preventing the rapid process of FABK (1,15).

Given the corneal perforation due to the rapid progression of FABK, the surgical procedure should provide both corneal tamponade and tectonic support, such as combinations of superficial keratectomy and conjunctival graft, corneal graft, and homologous keratoplasty (2,4,11). Among these, conjunctival grafts have been widely used for treatment of extensive corneal lesion in FABK, but the success rate of this procedure remains unknown (1,2,10). Surgical failures related to conjunctival graft dehiscence accounts for 9 and 32% in the complicated type of ulcers in dogs (8). Additional disadvantages regarding conjunctival grafts in veterinary literature include corneal scarring, neovascularization, corneal pigmentation, and visual limitations because of grafted tissue (1,2,10). The purpose of the case study is to present a case of FABK treated with autologous lamellar keratoplasty (ALK).

Case Report

A 4-year-old, female, Munchkin cat presented for an ocular evaluation with a 2-day history of a large red mass in the left eye (OS). The owner reported that there were no special events leading to the sudden development of the mass. On physical examination, the patient was healthy and alert, but displayed minor ocular discomfort of intermittent squinting in the OS. Complete ophthalmic examinations of both eyes were performed, and no abnormalities were noted in the right eye. On the first presentation, a remarkably extensive bulging red mass was observed on the ventro-temporal cornea, and mild serous discharge and blepharospasm were apparent. Neuro-ophthalmic examinations including menace response, direct and indirect pupillary light reflexes, and the dazzle reflex were positive. The intraocular pressure measurement OS with rebound tonometry (IcareTonoVet®, Tiolat, Finland) was 9 mmHg. Slit lamp biomicroscopy (HS-7000®, Huvitz Co., Ltd., Korea) OS revealed a large red corneal bulla with surrounding mild edema, which occupied around 40% of the corneal surface (Fig. 1). The bulla was approximately 7 mm in diameter and fluorescein stain was positive thinly atop the bulla. No abnormalities were identified within the anterior chamber. Binocular indirect ophthalmoscopy (Heine Omega 500®, Heine, Germany) revealed a normal appearance in the fundus. Based on the ocular examination, a diagnosis of both FABK and corneal ulcer was made in the OS.

A conjunctival flap was recommended as a preferred option for the patient in order to mitigate the possibility of corneal perforation, but this was declined by the owner due to permanent cosmetic concern and visual impairment caused by an extensive conjunctival graft. The various surgical options and possible sequelae were discussed with the owners based on previous reports describing the treatment of FABK. As a result, ALK was chosen to both address the concerns of the owner and achieve surgical success (5). The patient was premedicated with meloxicam (Metacam®, Boehringer Ingelheim, Spain, 0.1 mg/kg IV), and butorphanol (Butorphan®, Myungmoon Pharm, Korea, 0.2 mg/kg IV) and midazolam (Midazolam®, Bukwang Pharm, Korea, 0.2 mg/kg IV) were administered as pre-anesthestic medications. General anesthesia was induced by the intravenous injection of 6 mg/kg propofol (Provive®, Myungmoon Pharm, Korea). General anes-

Fig. 1. Clinical appearance of corneal surface at initial presentation viewed by direct diffuse illumination of slit lamp biomicroscopy. Note a large red corneal bulla with surrounding mild edema, which occupied around 40% of the corneal surface.

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thesia was maintained with isoflurane (Ifran®, Hana Pharm Co., Korea) and oxygen.

For the ocular surgery, the periocular area of the OS was clipped, and for preoperative antisepsis, a 0.5% diluted povidone-iodine solution and saline were used. The eye was draped routinely, and an eyelid speculum was placed to secure exposure for debridement and ALK. Firstly, the loose epithelial cells of the ulcer area at the top of the bulla were debrided with a Swann-Morton 64 microsurgical blade (SM microsurgical blades®, London, UK) together with the removal of loose epithelial cells around the bulla. A curvilinear incision 1 mm around the margin of the corneal bulla was made to secure the harvested corneal tissue. Secondly, the autologous graft was harvested from the dorsotemporal cornea of the ipsilateral eye. A sterile skin biopsy punch, 8 mm in diameter was used to delineate the donor site. The desired graft depth of 70% of the corneal thickness was achieved with the approximate cutting edge of the microsurgical blade. For superficial keratectomy, the tip of the cornea outlined was slightly undermined with the microsurgical blade to introduce a 2.6 mm crescent microsurgical knife (Kai Medical®, Tokyo, Japan) for lamellar dissection of the stromal button. The autologous graft was finally resected with corneal scissors. The donor graft was sutured on the bulla with four single cardinal sutures followed by a simple interrupted pattern using 10-0 polypropylene (Prolene®, Ethicon Inc., USA). Lastly, a nictitating membrane-to-superior-lid flap (NMF) was performed with three horizontal mattress sutures of 4-0 monofilament non-absorbable suture material (Dafilon®, B. Braun, Spain). Postoperative treatment included administration of topical ofloxacin 0.3% (Ofloc®, Bynexs Pharmaceutical Co., Ltd., Korea) three times a day in the NMF for 4 weeks. Systemic meloxicam (Meloxifen®, Kukje Pharm., Korea) at 0.1 mg/kg was administered once a day and doxycycline (Doxycycline Hyclate®, Kukje Pharm., Korea) at 5.0 mg/kg twice a day for 1 week. The NMF was removed 30 days after surgery, and corneal suture materials were stitched out after topical instillation of 0.5% proparacaine (Alcaine®, Alcon, Korea) 40 days postoperatively.

On the removal of the NMF at day 30 postoperatively, it was observed that the cornea began to become transparent around the graft surrounded by superficial blood vessels. The corneal bulla resulted in moderate keratoconus with multiple focal bullae under corneal epithelium along with extensive opacity (Fig. 2A, B). Corneal epithelial healing of the donor site was identified by means of a negative fluorescein stain and slit lamp biomicroscopy, and a positive menace response was observed. Antibiotics was continued with topical 0.3% tobramycin (Trona®, Kukje Pharm., Korea) twice daily and 0.1% hyaluronic acid (Hyalon®, Samcheondang Pharmaceutical Co., Ltd., Korea) was added three times a day. On re-examination at day 40 postoperatively, the keratoconus of the

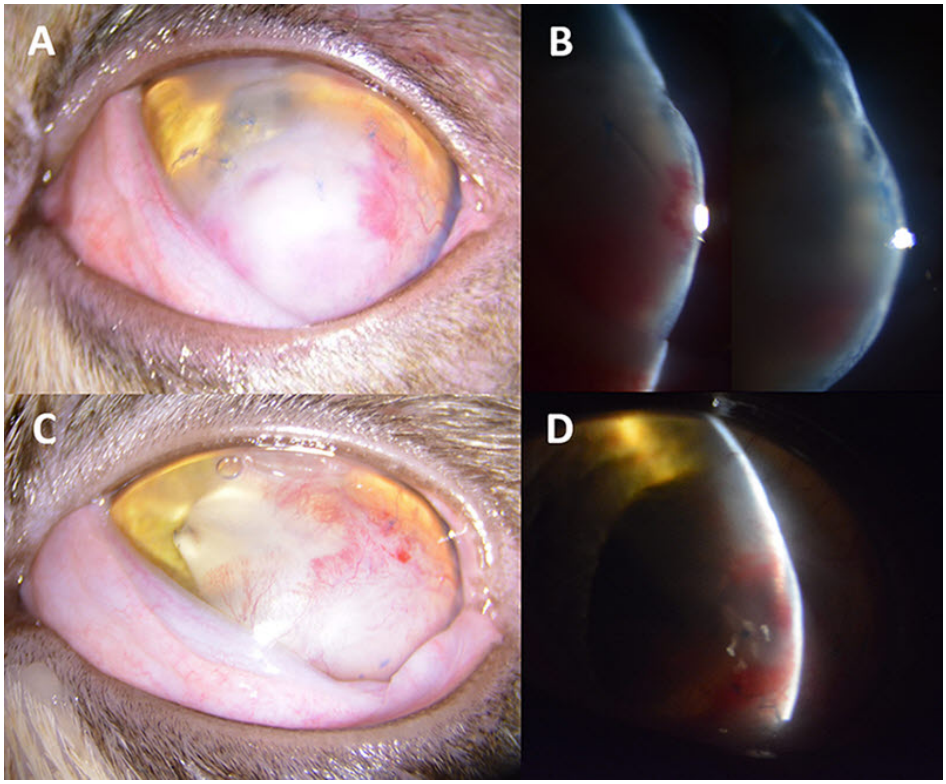

Fig. 2. Slit lamp biomicroscopic photographs 30 (A, B) and 40 days (C, D) after autologous lamellar keratoplasty. (A) Note profound graft opacity and surrounding superficial blood vessels. (B) Note moderate keratoconus with multiple focal bullae. (C) reduced graft opacity and extended superficial vessel axially. (D) Almost disappeared keratoconus in the recipient bed.

recipient button had almost disappeared, leading to possible visualization into the anterior chamber. The superficial vessel around the graft extended to the axial graft (Fig. 2C, D). On the re-examination at day 80 postoperatively, mild faint corneal opacity and vascularization on the graft tissue were observed, allowing for complete visualization of the iris surface (Fig. 3). In addition, an improvement in the corneal integrity on the graft surface was confirmed by slit lamp biomicroscopy and the donor site was restored completely as well.

Discussion

It is well known that surgical procedures are the first choice for the treatment of FABK to address ocular discomfort and prevent vision loss because of possible corneal perforation (1,2). Compared to conjunctival grafts, which have been the most commonly used approach to FABK treatment, ALK provided positive outcomes, in terms of preserving the axial vision in this case study. In addition, the cosmetic results with ALK were also good, making it a more suitable surgical option for the treatment of FABK.

Based on the reports published to date, the most important considerations in the surgical treatment of FABK are to provide tectonic support and to tamponade the bullous tissue for excellent surgical outcomes (1). The tectonic supports using conjunctival grafts, autologous/homologous lamellar keratoplasty and other corneal biomaterials are instrumental in strengthening complicated corneal lesions. A previous study reported positive outcomes both cosmetically and tectonically after using homologous lamellar corneal grafts in the treatment of FABK (4). Therefore, electing autologous corneal keratoplasty to address corneal lesions is a viable option when treating extensively wide, protruding corneal bullae, while also addressing cosmetic and axial vision concerns. In this case, an autologous lamellar graft was the best option to serve as a tectonic graft that would compensate for the defected corneal tissue and preserve the corneal thickness (2,4). From a tectonic support perspective, there was no difference in maintaining corneal integrity between these surgical procedures including ALK performed in this case (3,5). Additionally, the use of NMF applies pressure to the corneal bullae, thereby preventing fluid expansion to normal cornea tissue. This process may also aid in fluid resolution as the cornea reabsorbs and undergoes repair. In addition, it can protect the autologous lamellar graft from blinking movement (11). As a result, the NMF served as a tamponade for both the profound bulla and the autologous lamellar graft in this study.

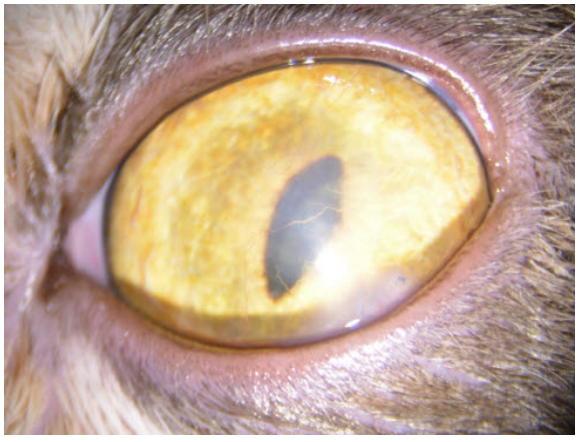

Fig. 3. Slit lamp biomicroscopic photographs 80 days after autologous lamellar keratoplasty. Note mild faint corneal opacity and vascularization on the cornea and complete visualization of the iris surface.

Compared to conjunctival grafts, the major advantage of ALK is that it can provide clear vision through the graft itself and graft rejection is limited. Depending on the size and location of the corneal defect, conjunctival grafts cause corneal opacity to a variable extent, which affects the quality of vision and may result in a significant visual compromise along the visual axis (2,10). In the case, the graft which was harvested from the ipsilateral eye and used for ALK was devoid of the corneal endothelium. Therefore, inflammatory response between the donor tissue and the recipient bed was unlikely to occur, thus reducing the chances of graft rejection of the donor and consequent corneal scarring (9). For this reason, the use of ALK in the report is most likely to create corneal transparency even in the extensive corneal bulla, unlike the corneal opacification caused by conjunctival grafts. Likewise, during the postoperative follow-up period of 80 days, there were no signs of donor rejection such as increased graft thickness, keratic precipitates, and subepithelial infiltration (9). Therefore, from an optical and cosmetic point of view, ALK is believed to be superior to the conjunctival grafts used to treat FABK (2,3,5,10).

Since the previous reports describing the treatment of FABK using NMF, conjunctival grafts and homologous lamellar keratoplasty are mainly retrospective studies and case reports, there are limitations in interpreting the duration of posttreatment amongst these surgeries. However, the duration of postoperative treatment for all surgical procedures was found to be approximately 30 days after each surgery (4,10,11). In the present study, on NMF removal at day 30, the eye was fluorescein-negative, and the autologous lamellar graft was incorporated with adjacent corneal tissue.

To achieve successful surgical outcomes when applying ALKs to the treatment of FABK, there are some considerations to take during surgery. Firstly, when the cornea is suspected to be perforated in case of extensive corneal bullae, it is more appropriate to utilize lactated Ringer's solution or

balanced salt solution that is similar to aqueous humor for irrigating the corneal surface. In particular, the balanced salt solution can minimize damage to the delicate intraocular tissues such as the corneal endothelium (7). It is also important to exercise caution to prevent the povidone–iodine from entering the anterior chamber as concentrations of 5% and above can be extremely toxic to endothelial cells (6). Secondly, it is important to separate the same lamellar plane within the donor stromal layer using blunt dissection such as a Martinez corneal dissector, thereby maintaining a constant incisional depth. The blunt dissector is better suited for gently separating the corneal lamellar tissue without going beyond the initial incision's depth. A low-cost disposable substitute for the dissector such as the crescent knife and microsurgical blade #6400 or #6900, is also available (14).

One of the limitations of the ALK procedure is the availability of enough healthy cornea to support the corneal lesion because the graft was harvested from the same eye that had the corneal defect as described above (5). The other limitation of the procedure is the potential opacity of the donor corneal area. Previous studies have reported corneal opacification associated with corneo-conjunctival transposition, a type of ALK performed in dogs and cats (3,5).

Conclusions

In this case report, ALK was performed to manage the extensive corneal bulla along the visual axis. This procedure produced good vision and cosmetic appearance with excellent comfort observed during the 80-day follow-up. Therefore, ALK may be a useful additional surgery to restore corneal transparency in the treatment of FABK.

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Conflicts of Interest

The author has no conflicting interests.

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