Dehydrated Amniotic Membrane in Pterygium Surgery

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ABSTRACT

Pterygium is a degenerative tissue of the conjunctiva that can extend to the cornea and can cause vision loss with astigmatism. Different surgical techniques exist to treat this condition. Amniotic membrane graft is an emerging option. We report this new technique in the case of a 44-year-old male who presented a temporal pterygium. We excised it and grafted an amniotic membrane on the site. During follow-up, we found no complications and no sign of recurrences. The amniotic membrane is the inner layer of the placenta facing the fetus. It has been described to have many benefits. It is more and more used in the medical field and ophthalmology. It has multiple indications for ocular diseases and one of the themes is for pterygium excisions. The surgical procedure is easy and can be reproduced.

Keywords: Amniotic membrane graft, ocular surface, Pterygium.

1. Introduction

Pterygia refer to fibrovascular degenerations of the conjunctiva that gradually extend onto the cornea as time goes on [1]. The main risk factors associated with pterygia include exposure to ultraviolet light, advancing age, and being male [1].

Several surgical techniques are utilized for treating pterygium. After the excision, the available options include primary closure of the conjunctiva, conjunctival flaps, conjunctival autograft, conjunctival rotational graft, limbal-conjunctival autograft (LCAG), and amniotic membrane graft [2].

The use of amniotic membranes in ophthalmology and in other medical fields is on the increase [3]. The amniotic membrane serves as a plentiful reservoir of biologically active factors, making it highly effective in promoting healing and serving as an efficient material for wound dressing [3].

Simple excision of pterygium without graft has a high recurrence rate compared to excision with conjunctival autograft or amniotic membrane transplantation [1]. We report a case of pterygium removal with a dry amniotic membrane graft.

2. Case Report

A 44-year-old male patient who presented a temporal pterygium in the right eye (Fig. 1) without any significant symptom.

The patient presented no ophthalmic or medical antecedents. The clinical examination found a 10/10 visual acuity, with a refraction of (−0.25 at 170°) on the right eye and a normal refraction on the left.

The ocular tonus was normal (13 mmHg for both eyes). The rest of the ophthalmologic exam was normal. The patient wanted a pterygium removal for aesthetic issues.

We began with a pterygium removal from the conjunctiva and the cornea, then we resected the tenon that was behind the pterygium. We placed a lyophilized amniotic membrane stroma down on the sclera. Next, we covered the membrane with the temporal conjunctiva and fixed it with 2 resorbable sutures with the limbus at 7 and 10 o’clock (Figs. 2 and 3).

Finally, we placed a soft lens to protect the cornea and the membrane (Fig. 4). Follow-up showed no recurrence and no ocular redness or complications (Fig. 5).
The prevalence of pterygium varies among different populations and is influenced by factors such as age, sex, and geographic location [6]. Researchers have predominantly focused on population-based studies to assess its prevalence, with only a limited number of studies providing a more comprehensive global perspective on the burden of this condition [7]. A recent meta-analysis by Liu et al. [6] reviewed 20 population-based studies conducted between 2000 and 2013. The pooled worldwide prevalence of pterygium was found to be 10.2% [6], with rates ranging from 2.8% to 33% in different studies [8]. Moreover, the prevalence of pterygium was observed to be higher in men (14.5%) compared to women (13.6%), and it generally increased with age up to 69 years [6].

The most common site for pterygium formation is the nasal limbus, which is believed to be linked to the concentration of light passing through the anterior chamber at this location [9]. This phenomenon may lead to damage to the limbal stem cells and induce oxidative stress [10]. Various population-based studies have also shown that pterygium formation is associated with outdoor occupations and activities, likely due to increased exposure to ultraviolet (UV) radiation, which has been implicated in its pathogenesis [11]. Additionally, pterygium prevalence tends to be higher in rural populations as compared to urban populations, possibly due to lifestyle and lifetime differences in UV radiation exposure [12], [13].

Pterygium exhibits characteristics like tumors, including its potential to invade normal tissue, high recurrence rate, and coexistence with premalignant lesions. These features challenge the assumption that pterygia are entirely benign [9]. For instance, in one study involving 100 pterygium cases, concurrent ocular surface diseases were observed, including 5 ocular surface squamous neoplasia, 6 primary acquired melanosis, and 2 compound nevi with 1 of them is suspicious of melanoma [9]. Given these findings, on 100 excisions only 87 are benign so it is recommended that all pterygia be subjected to histopathology to exclude the possibility of malignant lesions [9].

3. Pathogenesis

Different studies have linked the expression of p53 and Mouse double minute 2 (MDM2) and pterygium development [2].

The p53 serves as a protein that suppresses tumor formation by triggering apoptosis and curbing the proliferation
of cancer cells [14], [15]. On the other hand, MDM2 functions as an E3 ubiquitin ligase, acting in opposition to p53. It binds to p53, impeding its capacity to initiate transcription [16].

Cao et al. [17] compared the expression level of p53 and MDM2. They found that within the conjunctiva, detectable p53 expression was absent, with only minimal MDM2 expression observed. In contrast, both p53 and MDM2 exhibited robust expression within pterygium tissue.

3.3. Surgical Approaches

Pterygia can only be treated by surgical techniques. It is essential to evaluate the risks of recurrence with each approach. It is necessary to review each method one by one.

3.4. Primary Closure

This approach consists in removing the pterygium and then suturing the remaining conjunctiva on both sides of the wound over the bare sclera to close the defect. However, this procedure also exhibits an unacceptably high rate of recurrence compared to more modern techniques, ranging from 45% to 70% of recurrences [18].

3.5. Bare Sclera Excision

This technique involves removing a pterygium without repairing the resulting defect. However, this method is no longer recommended due to its remarkably high recurrence rate, which ranges from 38% to 88% [18]. This rate of recurrence is higher than that associated with any other treatment approach. The only advantages of this technique are its simplicity and short surgical time. Given the unsatisfactory recurrence rates of both bare sclera excision and primary closure techniques, advancements in pterygium excision have focused on utilizing grafts and adjuvant therapies.

3.6. Conjunctival Autograft

The most employed method. In this technique, the pterygium is excised, and the resulting defect is closed using the patient’s own grafted conjunctiva, secured with fibrin glue or sutures. Typically, the ipsilateral superior conjunctiva is used, although both superior and inferior conjunctival autografts have been considered viable options [19]. The recurrence rates for this procedure have been reported to be between 2% and 20% [18]. Notably, a study by Alpay et al. [20] observed that all recurrences in their case series (3 out of 18, equivalent to 16.65%) occurred in eyes that had undergone previous pterygium surgery. Syam et al. [21] discovered an interesting finding that approximately 36.66% of patients developed conjunctival scarring at the site where the donor conjunctiva was used.


Novel technique pioneered by Lawrence Hirst. This method differs from traditional conjunctival autografting as it involves extensive removal of Tenon’s layer after pterygium excision. In a prospective trial of 250 consecutive patients with primary pterygia, Hirst demonstrated a recurrence rate of 0% and achieved good cosmetic outcomes. Additionally, this technique proved effective for the excision of recurrent pterygia with a recurrence rate of 0% and few complications [22].

3.7. Limbal Conjunctival Autografting (LCAG)

It involves transplanting limbal stem cells along with autologous conjunctiva to cover the defect left after pterygium excision. This method not only decreases recurrence rates but also promotes healing, with sutured limbal conjunctival autografts showing a recurrence rate ranging from 0% to 14.29%. The use of fibrin glue has been shown to significantly reduce the rate of recurrence in one study [18].

3.8. Conjunctival Flap Procedure

This method requires undermining the conjunctiva at the donor site without detaching it from its origin, and then rotating the flap to cover the excised pterygium’s defect. While this technique has few complications, such as conjunctival cyst formation and flap retraction, Alpay et al. [20] reported a recurrence rate of 33.33% and noted that the cosmetic outcome improved with time.

3.9. Amniotic Membrane Grafts

The membrane can also be utilized to cover the bare sclera after pterygium excision and fixed with fibrin glue (Fig. 6). These grafts are believed to promote healing and reduce recurrence rates due to their anti-inflammatory properties, promotion of epithelial growth, and suppression of transforming growth factor β (TGF-β) signaling and fibroblast proliferation [18]. Recurrence rates following AMG range from 14.5% to 27.3% [18], and the use of postoperative steroid injections further reduces the rate of recurrence. However, when compared to conjunctival and limbal autografting, AMG has higher recurrence rates.

The surgical technique we used is different from the usual excision with fibrin fixation of AM. It consists first of the excision of the pterygium then the amniotic membrane is placed stroma down on the sclera (Fig. 7). The second
The amniotic membrane serves as the innermost lining of the placenta, adjacent to the developing fetus. Its structure involves being partially transparent and having a thickness ranging from 0.02 to 0.05 mm. This membrane lacks blood vessels and a direct blood source. Comprising three distinct tiers, it starts with an epithelial layer consisting of a single layer of metabolically active cuboidal cells featuring numerous microvilli. This is succeeded by a basement layer, which contains specific components like collagen IV and VII, fibronectin, laminins, and hyaluronic acid. The third layer, an avascular stroma, is further subdivided into an inner dense section, a middle layer containing fibroblasts with a loosely arranged network, and an outermost spongy layer with minimal cell presence. Within the stroma, collagens I, II, III, V, and VI are primarily prevalent [3].

The advantageous impacts of AM have been ascribed to various mechanisms, drawn from both its structural makeup and its chemical composition. It fosters the process of epithelialization and showcases properties that counteract microbial activity, fibrosis, inflammation, and angiogenesis [24]. The absence of immunogenic response stands as a crucial attribute of AM with regards to its suitability for grafting purposes. Given its transparent nature, AM finds advantageous application on the ocular surface, offering an ideal platform for the proliferation, movement, and attachment of epithelial cells. Moreover, AM has the capacity to uphold a natural and moist microenvironment, effectively minimizing moisture loss and enhancing the recuperative process of wounds.

### 3.11. Medical Uses of Amniotic Membrane

AM has been used essentially for skin defects. It has been used for vaginal reconstruction in gynecology and for the prevention of surgical synechia in maxillo-facial surgery [25], [26].

In dermatology, it finds application in crafting dermal sheets for skin substitutes, serving notably as a provisional skin cover following burn injuries. Additionally, it is being employed as an alternative therapeutic approach for conditions like venous leg ulcers and skin ulcers [27]–[30].

### 3.12. Ophthalmic Uses

AM in ophthalmology is widely used for grafting in different pathologies. The utilization of AM revolves around several primary goals: stopping inflammation on the ocular surface, stimulating epithelial growth, alleviating discomfort, and preventing the formation of surgical adhesions [25], [31].

Predominantly, AM serves as a substrate that aids in the cultivation of corneal or conjunctival epithelial cells. In these scenarios, the AM is positioned with its epithelial side facing upwards. In a smaller subset of cases, especially when AM is employed to counteract sudden inflammation, the AM is positioned with its epithelial side facing downward [25].

The indications are multiple, it is used in corneal, conjunctival diseases and even in glaucoma surgeries (Table I). There are 3 operative techniques for AM depending on...
the pathology: overlay technique, inlay technique and combined.

3.13. Overlay Technique

The amniotic membrane (AM) is stitched onto the ocular surface with a patch that extends beyond the size of the underlying defect. This ensures that the host’s epithelium remains underneath the membrane. You can use the AM with either the epithelial side facing up or the stromal side facing up, as the host’s epithelium is anticipated to regrow underneath the AM, serving as a natural bandage or contact lens [3].


The purpose of the AM is to serve as a foundation or framework for the growth of epithelial cells, which is why it is positioned with the epithelial side facing upward. In addition to a single-layer graft inlay, a multi-layer graft inlay can also be employed [3].

3.15. Combined Technique

In this technique, we employ two or more layers of AM. The inner, smaller layer or layers function as grafts, while the outer, larger AM serves as a patch. The anticipation is that the epithelium will regenerate between the uppermost inlay and the patch [3].

3.16. Future Applications of Amniotic Membrane

The potential of using AM cells, especially epithelial cells, appears highly encouraging for addressing cancer, thwarting tumor spread, and rejuvenating tissue harmed by chemotherapy. AM’s ability to combat cancer is attributed to its anti-angiogenic, immunoregulatory, and anti-apoptotic characteristics [32], [33]. The use of AM could be a good option after resection of ocular surface squamous neoplasia (OSSN) with its anti-apoptotic ability.

Cells derived from AM exhibit the capability to transform into multiple kind of cells: chondrogenic, cardiacmyogenic, hepatic, adipogenic, and neural cells that can produce insulin. Because of this capacity AM could be used for multiple clinical applications as a source of stem cells [34]–[36].

4. Conclusion

Pterygium removal with amniotic membrane graft is a good alternative for autograft. The recurrence rate is low compared to the other surgical methods but a little bit higher than the autograft. The advantage of AM is the preservation of the superior conjunctiva in case of a future trabeculectomy. The graft of the AM is simpler, faster, and less traumatic. After the excision, the AM is only fixed with 2 sutures and covered with the peripheral conjunctiva no need to fix it more. The AM has many more indications in ophthalmology especially for corneal defects where the use of it is widely spread. More studies must be done for other uses in the ophthalmic field. In other medical sectors (dermatology, gynecology, and oncology) AM is also used for many benefits as anti-angiogenic, immunoregulatory, and anti-apoptotic characteristics.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

References

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