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Surgical Approaches for Perforated Cornea

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Corneal perforation is a sight-threatening ophthalmic emergency found worldwide that occurs when there are diseases affecting the eye, injuries to the eye or infection that can become serious if left untreated, resulting in blindness [2]. Corneal infections are considered common vision-threatening entity which is faced daily in practice. Refractory microbial keratitis deteriorates to perforated cornea which leads to devastating eye conditions and lost eyes [3]. Non-infective inflammatory causes like cicatricial pemphigoid, neurotrophic keratopathy or peripheral ulcerative keratitis associated autoimmune diseases can also lead to progressive corneal melting and perforation [4,5].

Perforated cornea needs emergent surgical and/or nonsurgical modalities of treatment to save the globe integrity and vision [4]. Nonsurgical modalities of perforated cornea treatment aims at controlling of infection, limiting of inflammation, decrease the liability of progressive corneal melting and healing delay using anti-collagenase and anti-glaucoma treatment, enhancing epithelial healing by application of bandage contact lenses and autologous serum eye drops, and pressure eye patching. Surgical treatments include cyanoacrylate tissue adhesives, amniotic membrane transplants, conjunctival flaps, tarsorrhaphy, keratoplasty and penetrating keratoplasty [6,7].

Perforation management depends on the size of the defect, the location of the perforation, the status of the underlying disease, the surgeon's experience, and the presence of amniotic membrane or donor corneal graft [8]. Small perforations < 1 mm in diameter can be treated successfully using medical treatment alone in adjacent bandage contact lenses. Large perforations require surgical procedures, including tissue adhesives, amniotic membrane transplants, and corneal transplantation [2,5]. Small sized corneal perforation can be treated emergently using amniotic membrane transplantation or tissue adhesive alongside non-surgical medical modalities of treatment to save the eye, treat infection and limit inflammation [7].

The concept behind glue application is to reestablish corneal and globe integrity in cases of infectious keratitis with significant ulceration resulting in perforations or descemetoceles. This may be a temporary measure till the time for corneal transplantation However, in some cases, especially peripheral ulcer; the glue may be left in place for prolonged periods allowing corneal tissue to heal beneath the adhesive until the glue is passively extruded. In addition to providing structural support, inhibition of inflammation is also achieved [9]. Tissue adhesives can successfully treat perforations, improve vision and reduce enucleation rate. Most of the cases with small traumatic corneal perforation had successful sealing. However, failures of sealing in corneal melting and corneal ulcers probably result from severe inflammatory reaction, therefore, it is recommended to remove all necrotic tissues as much as possible to achieve a successful seal. Cyanoacrylate side effects range from mild corneal irritation to rare serious ones like corneal decompensation, adhesion of intraocular structures and infection, however, natural avascularity of cornea and indicated small-sized perforations decrease their incidence [1].

Because cyanoacrylate and fibrin glue as tissue adhesives are degradable at the site of perforated area to be stable for a long time, amniotic membrane transplantation can enhance the outcomes of epithelial disorders treatment, preserve corneal stromal from more melting and close small-sized perforations. Transplanted scleral patches can be combined with amniotic membrane transplant if amniotic membrane alone is not enough to maintain globe integrity till elective penetrating keratoplasty to prevent the limited success and complication of urgent keratoplasty [2].

Amniotic membrane transplant can be modified to multilayered transplant to get more successful results for small-size perforations. Multilayered amniotic membrane transplant advantages are that amniotic membrane has no antigenicity that may lead to graft rejection and astigmatism compared to a peripheral corneal patch graft is much lower. Moreover, amniotic membrane can add several benefits for ocular surface disorders like mechanical barrier, enhancing epithelial healing and limiting of inflammation [4].

Using conjunctival cover to enhance healing of chronic corneal ulceration was popularized by Gundersen in 1958. Conjunctiva provides vascularized tissue to the infected area to supply humoral and cellular immunity while providing serum growth factors to enhance healing. They also act as a biological bandage relieving pain and stromal melting. Conjunctival flap is considered a modality of surgical approaches in treating refractory corneal ulcer and corneal perforation. Conjunctival flap surgery in cases of perforated cornea aims at decreasing the time of healing, relieving pain, and reduces the incidence of corneal perforation and mechanical protection to save the globe. Although, conjunctival flap may undermine the vision markedly in cases where the flap covers the visual axis, it is considered a temporary measure till performing keratoplasty later on [10].

Therapeutic penetrating keratoplasty is still considered the most saving surgical modality for perforated infective corneal ulcers treatment [5]. Penetrating keratoplasty can save the globe and stop the process of infection that lead to corneal perforation, so urgent surgical decision can be saving [12]. Successful outcomes after therapeutic penetrating keratoplasty for perforated infective corneal ulcers have been reported in the developing world [5]. Refractory infectious perforated cornea that cannot be responded to previous modalities of treatment, early surgical intervention decision with keratoplasty can prevent the risk of endophthalmitis. In contrary, traumatic perforations which have a better chance for a long term clear graft, delayed keratoplasty could be delayed in those cases [12].

Postoperative care regarding appropriate treatment will enhance the success outcome, using antimicrobial remedies to reduce graft reinfection and steroid to reduce the frequency of complications like graft rejection [12]. Despite that, failure of therapeutic keratoplasty due to recurrence of infection on graft had been reported. Several factors affect the success outcome of therapeutic keratoplasty for infective keratitis as organism virulence, predisposing factors, general health, depth and severity of pre-existing keratitis, associated ocular surface disorders, initial medical treatment and surgical techniques. Lamellar keratoplasty can be performed with non-infective or infective corneal perforation that sparing posterior stroma and endothelium [4].

Despite the fast learning curve of penetrating keratoplasty in comparison to lamellar techniques, performing penetrating keratoplasty in patients with perforated infectious cornea needs skillful surgical experience, precise surgical technique and management. Penetrating keratoplasty for perforated infectious cornea is accompanied with several intraoperative complication that leading to loss of the globe. Postoperative success of penetrating keratoplasty in cases of perforated infectious cornea is markedly influenced the surgeon s techniques as corneal graft diameter selection, adding peripheral iridectomy and/or releasing synechia techniques, moreover how to deal and manage with intraoperative complications [7].

Although patients with non-infective perforated ulcer that are associated with autoimmune diseases who have been performed therapeutic keratoplasty in addition to receiving maximal adjunctive measures, the outcome of those cases have been documented to be worse than the outcome of penetrating keratoplasty for infectious perforated cornea. This raise the red flag for the importance of earlier detection and starting non-surgical management of sterile corneal ulceration to prevent perforation from occurring and to avoid the worse outcome of surgery for those cases [5].

The outcome of therapeutic penetrating keratoplasty can be assessed in terms of anatomical, therapeutic, and functional results which impact the success and failure. Anatomical success is presented in the restoration of tectonic integrity of globe, whereas anatomic failure is presented in pthisis bulbi. Therapeutic success is defined by complete eradication of primary infection postoperatively using appropriate medical treatment alongside the highly skillful surgery. That can be detected during examination with absence of recurrent infiltrates on the cornea or sclera, recurrent hypopyon or endothelial exudates or plaques, and posterior segment infection as vitritis or endophthalmitis. Functional success is detected through maintaining of visual function with Best Corrected Visual Acuity starting from good perception of light projection upto 20/40. Functional failure is considered in cases with lost light projection or poor light projection [3].

Tectonic therapeutic penetrating keratoplasty is considered another modality of surgical approaches in cases with perforated infectious cornea. In comparison to conventional routine penetrating keratoplasty, tectonic therapeutic penetrating keratoplasty requires more surgical experience and skills for proper choosing diameter of donor graft, performing peripheral iridectomy or not and for intraoperative controlling haemostasis [7]. Recently, SMILE intrastromal lenticule after refractive surgery can be used as a tectonic graft for perforated cornea that needs tectonic keratoplasty. This lenticule is considered a safe, efficient allogenic alternative approach for perforated cornea in addition to its low cost as no complete donor corneal graft is needed for this approach [13].

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