CASE REPORT

Deep anterior lamellar keratoplasty in case of Hurler-Scheie syndrome

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SUMMARY

A 12-year-old boy with Hurler-Scheie syndrome (H/S syndrome) reported with reduced vision in both the eyes for past few years. Deep anterior lamellar keratoplasty (DALK) was performed for visual rehabilitation in his left eye. During surgery, the predescemet's plane was reached by meticulously dissecting the lamellar fibres using a manual technique. Histopathology of the dissected cornea showed the presence of numerous alcian blue positive deposits corroborating with the diagnosis of mucopolysaccharidosis (MPS). Postoperative course was uneventful. One year following surgery, the graft was clear and had a visual acuity of 20/50 with +1.00 170° – 0.75 refractive correction. Endothelial cell count, as measured by non-contact specular microscopy, was 2473.4 cells/mm². This case report highlights the application of DALK in a case of MPS-related corneal stromal opacification.

BACKGROUND

Selective replacement of the diseased corneal layers has gained popularity among paediatric corneal surgeons in recent past.^{1–4} Deep anterior lamellar keratoplasty (DALK) involves selective stromal replacement while preserving the healthy host endothelium. Thus, this technique eliminates the risk of irreversible endothelial failure due to allograft rejection and long-term steroid use-related complications.^{5–8} Several different techniques^{4 8–10} of DALK have been described to successfully bare the descemet's membrane. We describe a child who presented with cloudy and extremely thick corneas and was successfully managed by DALK.

CASE PRESENTATION

A 12-year-old young boy was brought by his parents with gradual diminution of vision and progressive corneal discolouration in both the eyes since 5–6 years. The parents' had noticed the corneal discolouration with progressive skeletal deformities, bloated abdomen and protrusion at umbilicus since early childhood. For the past 5 years, he had recurrent episodes of upper respiratory tract infection. On examination, a normal intellectual development and systemic abnormalities were revealed as shown in figure 1A,F. The child was born of an uncomplicated full-term normal vaginal delivery. There was no history of parental consanguinity and family history was negative for known genetic disorders.

During ophthalmic assessment, his best-corrected vision acuity (BCVA) as measured by Snellen chart was 20/400 in both the eyes. Slit-lamp

biomicroscopic examination showed a diffuse, full thickness, ground-glass stromal opacity in both the eyes (figure 2A,B) with normal intraocular pressure. Corneal thickness as measured by anterior segment optic coherence tomography (Visante OCT, Carl Zeiss Meditec) was 710 µm. Subsequent enzymatic analysis showed low level of α-l-iduronidase in leucocytes. Considering the above features, a clinical diagnosis of H/S syndrome was made.

TREATMENT

As mucopolysaccharidosis (MPS) predominantly involves epithelium and stroma, DALK was performed for visual rehabilitation in the left eye. The surgery was performed under laryngeal mask airway anaesthesia, as intubation was not possible. In host cornea, the predescemet's plane was reached by meticulously dissecting the lamellar fibres using a manual technique. The combination of hydrodelamination and viscodissection was used to reach the predescemet's membrane plane. A descemet stripped donor corneal button (8.25 mm) was subsequently placed at the predescemet's level of the recipient bed (8 mm) and sutured to the host cornea by 16-interrupted 10–0 monofilament nylon sutures (Ethilon, Ethicon). Postoperatively, the patient was on topical prednisolone acetate 1% and ofloxacin 0.3%, four times a day for 2 weeks, and thereafter, prednisolone acetate eye drop was gradually tapered to once daily by 3 months. Histopathological analysis of dissected recipient specimen (figure 3A) showed a localised thinning of Bowman layer along with multiple interlamellar deposits stained positively with alcian blue, confirming the diagnosis of MPS.

OUTCOME AND FOLLOW-UP

At 2 weeks postoperatively, fundus examination of the left eye showed an elevated disc with blurred margins and obliterated cup, suggestive of infiltrative pathology (figure 3B). This finding was well correlated with the preoperative B-scan (Opro: OTI-300), which showed hyper echoic elevations of both the optic discs (figure 3C,D).

Corneal graft was clear after the surgery (figure 4). Suture removal was initiated at 3 months and was completely removed by 12 months. One month after the surgery, BCVA of the left eye was 20/50 with +1.00 170° – 0.75 refractive correction. Corneal thickness as measured by anterior segment optic coherence tomography (Visante OCT, Carl Zeiss Meditec) was 520 µm. Non-contact specular microscopy (Nidek Confoscan 4, eye and health care, Nidek

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Figure 1 (A–F) Typical patient of mucopolysaccharidosis showing marked growth retardation, joint stiffness, enlarged head, coarse facial features, short neck, low set ears, short stubby fingers, bloated abdomen, umbilical hernia and hallux valgus.

Co. Ltd, Tokyo, Japan) showed normal endothelial mosaic pattern and a cell density of 2473.4 cells/mm² (normal range for his age: 2252–3797 cells/mm²) with coefficient of variation as 34.5% and hexagonality of 57%. We chose to defer surgery in the other eye

in view of high risks associated with general anaesthesia, and good functional vision in his left eye.

DISCUSSION

H/S syndrome is a type of MPS, autosomal recessive in nature, characterised by accumulation of dermatan and heparan sulfate in various organs and ocular tissues due to deficient activity of lysosomal enzyme α -L-iduronidase.¹¹ The phenotypic spectrum appears extremely similar, but less severe than phenotype of type I MPS. Characteristically, ocular manifestations include diffuse corneal clouding, glaucoma, retinopathy, optic nerve head swelling and atrophy whereas systemic features are characterised by facial changes, cardiac, respiratory and variable skeletal abnormalities with normal cognitive development.¹¹ Effective management depends on timely recognition of affected individuals, which may be challenging given the phenotypic overlap of H/S syndrome with other types of MPS. Mainstays of management include the prevention of accumulation of end products of GAGs, watchful monitoring of ophthalmic and systemic complications. Although, enzyme replacement therapy and haematopoietic stem cell transplantation have been effective in lessening systemic consequences, their ophthalmic utility is still controversial.^{11 12}

Ocular intervention in children with MPS is often fraught with numerous technical difficulties such as narrow palpebral fissure, shallow anterior chamber, increased posterior upthrust and low corneoscleral rigidity. The thick and densely compacted opaque cornea makes it difficult to reach the predescemet plane with the pneumatic method of DALK. In addition, the compromised airway passage and systemic comorbidities pose difficulties during intubation and extubation and increase the risk of airway obstruction, pulmonary oedema and the need for emergency tracheostomy.¹³ Therefore, these patients are treated as high-risk category as per American Association of Anaesthesiologists. The former complication, that is, difficulty in intubation, results from concomitant comorbidities such as short neck, abnormal cervical vertebrae and infiltration of GAGs

Figure 2 (A and B) Slit-lamp biomicroscopy showing diffuse and full-thickness stromal opacity in the right and the left eye, respectively.

Figure 3 (A–C) Histopathological slide showing interlamellar deposits, stained positive with alcian blue (A), fundus examination showing optic nerve involvement in the left eye in postoperative period (B) which was delineated in both the eyes (C and D) in preoperative period on ultrasonography B-scan.

in soft tissues of the airway. A similar difficulty was encountered in this case, and so, the surgery had to be performed under laryngeal mask airway.

Figure 4 Clear graft after surgery.

Descemet membrane separation is an important prerequisite for successful DALK.¹⁴ Therefore, defining descemet separation intraoperatively is important, particularly in thickly compacted opaque cornea as in cases of MPS where it plays a very decisive role. It is technically difficult to achieve a consistent big bubble due to abnormal deposition of glycosaminoglycans. One attempt of big bubble formation led to diffuse stromal opacification. Hence, manual dissection technique was considered in order to reach pre-descemet membrane plane. This case study highlights the advantage of sparing the recipient's descemet membrane, thus precluding the need for high-quality donor tissue, less stringent postoperative follow-up and need for lesser steroid use.

However, functional success depends on multiple variables, that is, age at onset, type of MPS, prior enzyme replacement treatment or bone marrow transplant, time taken for intervention, untreated refractive error, manifest strabismus, density of amblyopia, pre-existing glaucoma, surgical technique and prompt postoperative care. In our case BCVA was limited to 20/50; this could be partly due to optic disc

infiltration, retinopathy and amblyopia because of uncorrected hyperopia.

Patients with MPS with visually significant stromal opacification can achieve excellent visual outcomes and realise a significant improvement in corneal transparency by undergoing DALK. Timely recognition of this clinical entity is crucial in minimising the sight threatening sequelae. A multidisciplinary approach is necessary, with provision of both corrective spectacles and proper training about these and other lifestyle measures for affected individuals, their parents, other caregivers and school staff. Definitive molecular diagnosis allows for appropriate preventive management, including advice and aids to preclude future systemic as well ophthalmic complications, with its major consequences for quality of life.

Learning points

- ▶ Hurler-Scheie (H/S) syndrome is a rare disease. In developing countries, parents often bring their child late due to ignorance and lack of medical facilities. At this stage, systemic therapies such as haematopoietic stem cell transplantation and enzyme replacement therapy become questionable.
- ▶ At a later age, ophthalmologist can play an important role in improving the quality of life by way of corneal transplantation.
- ▶ This article highlights deep anterior lamellar keratoplasty being an invaluable technique in patients with H/S syndrome as this newer technique is challenging but enhances graft survival preventing the child from repeated general anaesthesia.
- ▶ It may be advised to directly attempt manual dissection, as it is technically difficult to achieve a big bubble in a case of mucopolysaccharidosis.

Contributors MR performed the design and conduct of the study. AS, MR, SC, and SMP performed data collection, management, analysis, and interpretation. MR, AS and SC prepared, reviewed, or approved the manuscript.

Competing interests None.

Patient consent Obtained.

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