The Eye Center of the Third Hospital of Peking University successfully performed the first artificial corneal endothelial transplantation in China

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On November 30, 2021, Professor Hong Jing's team from the Ophthalmology Center of Peking University Third Hospital completed China's first artificial corneal endothelial transplantation, which was a complete success. Severe corneal edema (corneal thickness > 1800 μm) in patients undergoing surgery, seriously exceeding the range of indications for human donor corneal endothelial transplantation (corneal thickness ≤ 1200 μm). It is reported that this is the first case of artificial corneal endothelial transplantation in China, and it is also the first time in the world that artificial corneal endothelial transplantation has been applied to corneal endothelial decompensation patients with severe corneal edema.

Corneal endothelial transplantation is a major breakthrough in the history of corneal transplantation. It can selectively remove the diseased corneal descemet membrane and endothelial cells, retain the healthy autologous stroma layer, and restore vision faster and better after surgery. In the United States, from 2005 to 2014, the proportion of penetrating keratoplasty in all corneal transplants decreased from 94.9% to 41.5%, while the proportion of endothelial transplantation increased from 3.2% to 55.9%. The dominant procedure in corneal transplantation. Endothelial transplantation has also become dominant in European countries such as Germany and Asian countries such as Singapore.

However, in my country, the amount of corneal endothelial transplantation only accounts for 6-8% of the total corneal transplantation. The reason, in addition to the new technology and difficulty of the operation, is the main problem is the severe shortage of corneal donors. my country's corneal transplantation technology has matured, but due to the limitation of the number of donors, the annual operation volume is still less than 8,000 cases. It is precisely in such a situation that "an inch of implantation is an inch of gold", each piece of corneal donor is a priceless treasure, and it seems that only when it is used for penetrating corneal transplantation can it be considered as perfect use; and only a thin layer is taken. The elastic membrane and endothelium are used in endothelial grafting, which is a bit extravagant in comparison.

However, the development of good technologies should not be limited due to donor material issues. Israeli ophthalmology company Eyeyon Medical's "artificial corneal endothelial implant" Endoart has been developed for ten years, and now it is finally successful. The artificial corneal endothelial patch is a purely synthetic material, which has many advantages that the human corneal endothelium does not have. For example, there is no concern about postoperative rejection, and there is no possibility of being attacked by viruses and other microorganisms. And its various properties are different from those of human corneal endothelium. Therefore, using artificial corneal endothelial grafts for surgery is undoubtedly a test for the technology of endothelial corneal transplanters.

Figure 1: Group photo of the medical team involved in the operation

The patient, Ms. Zhang, was over sixty years old and suffered from eye diseases recently. She frequently went to various eye hospitals for medical treatment. Since being diagnosed with bilateral angle-closure glaucoma, she has undergone left eye trabeculectomy and cataract extraction successively. However, corneal endothelial decompensation occurred again after the operation, so left eye endothelial corneal transplantation had to be performed again. The operation went well, and the postoperative best corrected visual acuity once reached 0.4. I thought I could take care of myself for the rest of my life, but unexpectedly, six months later, the corneal edema reappeared without any reason, and it continued to worsen.

Figure 2: Preoperative condition of the patient's left eye

When she came to the hospital for treatment, the visual acuity of the left eye was manual/10cm, the intraocular pressure was 7mmHg, the corneal stroma was severely edema, the central corneal thickness reached 1658 microns, and the thickness of the original corneal endothelial graft was 234 microns, totaling 1892 microns. This data is 3-4 times of normal central corneal thickness. Severe corneal edema leads to narrow space in the anterior segment, and the operating space is greatly compressed during the operation. According to previous international research, it is a relative contraindication for corneal endothelial transplantation.

Figure 3: Group photo of doctors and patients before operation

Under such severe edema, it is impossible to see into the eye at all, and it is impossible to formulate a detailed operation plan before the operation. At the beginning of the operation, the team had the courage and determination to explore the road in the fog and wait and see. After 20 minutes of dehydration with hypertonic fluid and anterior chamber gas, they finally barely saw the edge of the implant. After a series of careful and safe operations, the artificial endothelial graft was finally inserted into the eye. Surprisingly, the corneal edema miraculously subsided after the operation, along with the attachment of the artificial corneal endothelial graft.

Figure 4: Professor Hong Jing's surgery silhouette

Figure 5. Intraoperative and 2 weeks after operation: a The cornea is completely white before the operation; b Air support after artificial endothelial graft implantation; c OCT after air support of artificial corneal endothelial graft; d Corneal diffusion at 2 weeks after operation The photo shows the condition of the iris; e photo of the corneal fissure 2 weeks after the operation, showing that the edema was significantly reduced; f the OCT of the anterior segment 2 weeks after the operation.

After the operation, Professor Hong Jing talked about the extreme shortage of corneal donors in my country compared with Western countries, and said that the root cause lies in the cultural differences between the East and the West. Since ancient times, Chinese people have believed in the belief that "the body is the skin of the body, and the parents do not dare to damage it." Many people instinctively resist organ donation. At present, under the vigorous publicity of the state, people's attitudes toward organ donation have improved to a certain extent, especially among young people——Among the volunteers registered for donation at the Eye Bank of the Third Hospital of Peking University, young people accounted for the vast majority. However, distant water cannot quench near thirst. When the traditional concept is slowly reversed little by little, there are still 2 million patients in my country who urgently need corneal transplantation waiting in the dark. With this in mind, the research and development of new materials and artificial corneal transplantation The development of technology is the fundamental way to solve the current shortage of corneal donors in my country.

This is the first case of artificial corneal endothelial transplantation in my country, and the successful implementation of artificial corneal endothelial transplantation in patients with severe corneal edema is also the first of its kind in the world. It is believed that the further development and popularization of artificial corneal endothelial transplantation technology in China will surely benefit more blind patients due to corneal disease, so that they can get rid of the endless suffering of waiting for donors as soon as possible and regain their sight as soon as possible.

北医三院眼科中心成功实施中国首例人工角膜内皮移植手术

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2021年11月30日，北京大学第三医院眼科中心洪晶教授团队完成中国首例人工角膜内皮移植手术，获得圆满成功。手术患者角膜重度水肿（角膜厚度＞1800μm），严重超出人供体角膜内皮移植适应症（角膜厚度≤1200μm）的范围。据悉，这是中国首例人工角膜内皮移植的病例，也是国际上首次将人工角膜内皮移植应用于重度角膜水肿的角膜内皮失代偿患者。

角膜内皮移植是角膜移植手术发展史上的一次重大突破。它能选择性地去除病变的角膜后弹力膜和内皮细胞，保留健康的自体基质层，术后视力恢复更快更好。在美国，从2005到2014年，穿透性角膜移植占全部角膜移植手术的比例由94.9%降至41.5%，而内皮移植的比例则由3.2%增加到55.9%，可见内皮移植已逐渐成为美国角膜移植手术中的主导术式。在德国等欧洲国家以及新加坡等亚洲国家，内皮移植也已经居于主导地位。

但在我国，角膜内皮移植手术量仅占全部角膜移植手术总量的6-8%。究其原因，除了该术式技术新、难度大以外，最主要问题还在于角膜供体的严重缺乏。我国的角膜移植技术已趋成熟，但受到供体数量的限制，年手术量尚不足8000例。正是在这样“寸植片寸金”的情形下，每一块角膜供体都是无价之宝，似乎只有被用于穿透性角膜移植，才算得到了尽善尽美的利用；而仅取薄薄一层后弹力膜和内皮用于内皮移植手术，相较之下则不免显得有些奢侈。

然而，好技术的发展不应由于供体材料问题而受到限制。以色列眼科公司Eyeyon Medical“人工角膜内皮植片”Endoart历经十年研发，如今终于获得成功。人工角膜内皮膜片是纯人工合成的材料，有多项人角膜内皮不具备的优点，例如没有术后排斥反应的顾虑，也无被病毒等微生物侵袭的可能。而其各项性能又与人类角膜内皮有所不同，因此，使用人工角膜内皮植片进行手术，无疑是对角膜内皮移植术者技术上更上一层的考验。

图1：参与手术医护团队合影

患者张女士年逾花甲，近来饱受眼疾折磨，频繁辗转于各大眼科医院求医。自从被诊断为双眼闭角型青光眼后，她先后接受了左眼小梁切除及白内障摘除术。然而，术后又发生角膜内皮失代偿，只得再行左眼角膜内皮移植术。手术过程一切顺利，术后最佳矫正视力一度可达0.4。本以为可以安心颐养天年了，谁料天公不作美，半年后，角膜无任何诱因再次出现水肿，并且持续加重，一发不可收拾，眼看要再度陷入失明的困境。

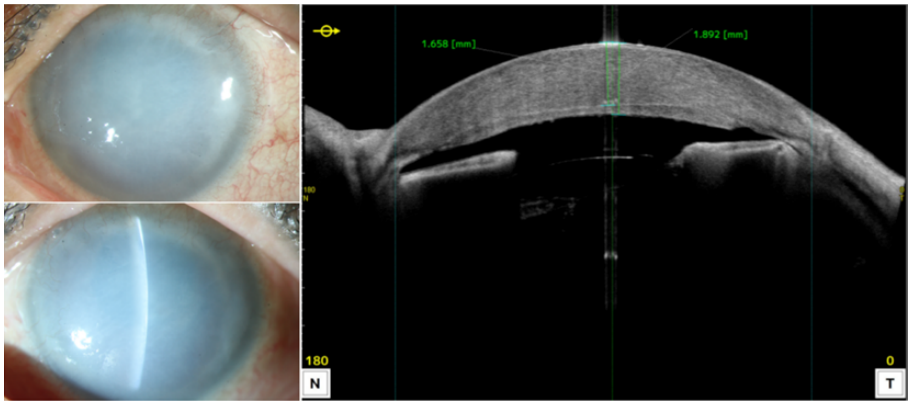

图2：患者左眼术前情况

她来到医院就诊时，入院查体左眼视力手动/10cm，眼压7mmHg，角膜基质严重水肿，角膜中央厚度达到1658微米，原角膜内皮植片厚度234微米，合计1892微米。这一数据是正常中央角膜厚度的3-4倍。角膜重度水肿导致眼前节空间狭小，术中操作空间被极大压缩，根据国际上以往的研究，已属角膜内皮移植的相对禁忌症。

图3：术前医患合影

在如此严重的水肿下，眼内完全无法窥入，术前根本无法制定详细的手术方案。手术伊始，团队抱着雾中探路，且行且看的勇气与决心，采用高渗液脱水、前房气体脱水20分钟后，才终于勉强看见植入植片的边缘。经过一系列谨慎安全的操作，人工内皮植片最终被送入眼内。令人喜出望外的是，术后，伴随着人工角膜内皮植片的贴附，角膜水肿也出现了奇迹般的消退。

图4：洪晶教授手术剪影

图5. 术中、术后2周情况：a 开始术前，角膜全白；b 人工内皮植片植入后气体支撑；c 人工角膜内皮植片气体支撑后OCT；d 术后2周角膜弥散照片，可以看清虹膜情况；e 术后2周角膜裂隙照片，可见水肿明显减轻；f 术后2周前节OCT情况。

术后，洪晶教授谈及我国角膜供体相较于西方国家极度匮乏的现状，表示根本原因还是在于东西方的文化差异。中国人自古便信仰“身体发肤，受之父母，不敢毁伤”，很多人对器官捐赠本能地抱有抵触态度。目前，在国家的大力宣传下，人们对器官捐赠的态度已有一定程度的改善，这点在青年群体中尤其明显——在北医三院眼库登记进行捐赠的志愿者中，年轻人占绝大部分。然而，远水解不了近渴，在传统观念被一点点缓慢扭转的时候，我国还有200万亟需角膜移植的患者在黑暗中苦苦等待——念及此，新材料的研发及人工角膜移植技术的发展，堪为当下解决我国角膜供体匮乏困局的根本之道。

这是我国首例人工角膜内皮移植手术，且对重度角膜水肿的患者成功实施人工角膜内皮移植，在世界范围内也是首开先河。相信人工角膜内皮移植技术在国内的进一步发展普及，必将造福更多角膜病致盲患者，使他们尽快摆脱等待供体的无尽苦海，早日重见光明。

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