·Clinical Research·

Indications for and techniques of keratoplasty at Vietnam National Institute of Ophthalmology

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Abstract

• AIM: To report the indications for and techniques of corneal transplantation at Vietnam National Institute of Ophthalmology (VNIO) over a period of 12y (2002-2013).

• METHODS: Records of patients who had undergone corneal transplantation at VNIO from January 1, 2002 to January 1, 2014 were reviewed to determine the indication for and type of corneal transplant performed. Patient age, gender, indication for corneal transplantation and surgical technique were recorded and analyzed.

• RESULTS: Corneal transplantation were underwent in 1390 eyes of 1278 patients with a mean age of 44.9±18.1y during the period under review. The most common indication was infectious corneal ulcer (*n*=670; 48.2%), followed by corneal scar (*n*=333, 24.0%), corneal dystrophy (*n*=138, 9.9%) and failed graft (*n*=112, 8.1%). Nearly all procedures performed were penetrating keratoplasty (*n*=1300, 93.5%), with a few lamellar keratoplasty procedures performed: lamellar keratoplasty (*n*=52, 3.7%), Descemet´s stripping automated endothelial keratoplasty (*n*=27, 1.9%) and deep anterior lamellar keratoplasty (*n*=11, 0.8%).

• CONCLUSION: While the most common indication for keratoplasty was infectious keratitis, nearly all indications for corneal transplantation were managed with penetrating keratoplasty. However, lamellar keratoplasty techniques, including deep anterior lamellar keratoplasty and Descemet´s stripping automated endothelial keratoplasty, are being performed with increasing frequency for isolated stromal and endothelial disorders, respectively.

• KEYWORDS: penetrating keratoplasty; lamellar keratoplasty; endothelial keratoplasty; indication for keratoplasty; technique of keratoplasty

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INTRODUCTION

Keratoplasty is one of the most successful forms of tissue transplantation performed worldwide. Since the first keratoplasty was performed in 1905 [1], keratoplasty has gained great progress both in terms of quality and quantity. Currently, there are about 50 000 keratoplasty performed in the United States each year [2]. Due to changes in disease profiles and advances in surgical techniques and instrumentation, there have been many changes in the indications for and types of corneal transplantation. In developed countries, the leading indications for keratoplasty have been Fuchs endothelial dystrophy and pseudophakic corneal edema. Therefore, endothelial keratoplasty (EK) has become the most commonly performed type of corneal transplantation in the United States [2]. At the same time, the leading indications for keratoplasty in developing countries have remained infectious keratitis and corneal scarring, and thus penetrating keratoplasty (PK) remains the most commonly performed technique of corneal transplantation[3-4]. In Vietnam, the first keratoplasty was performed in 1950[5]. However, it was rarely performed during the war. Since the year 2000, using both domestically and internationally recovered corneal tissue, keratoplasty has been performed more regularly and has now became a routinely performed ophthalmic surgery. While the number of cases is increasing and the indications are expanding, keratoplasty is still only performed at major ophthalmology institutions, such as the Vietnam National Institute of Ophthalmology (VNIO) in Hanoi, where the majority of keratoplasty procedures in Vietnam are performed. To date, there have been no published studies in the peer-reviewed literature regarding keratoplasty in Vietnam. Therefore, to determine the indications for and types of keratoplasty performed in Vietnam, we reviewed all keratoplasty procedures performed at VNIO during the previous 12y.

SUBJECTS AND METHODS

The medical records of all patients who underwent

keratoplasty at VNIO during the period from January 1, 2002 to January 1, 2014 were retrospectively reviewed. Data collection was performed in a manner compliant with the Health Insurance Portability and Accountability Act, and the described research adhered to the tenets of the Declaration of Helsinki. The following data was collected for each keratoplaty procedure: age, sex, indication for surgery, and type of keratoplasty procedure performed. Keratoplasty procedures were classified as penetrating and lamellar, which was subcategorized into anterior lamellar keratoplasty (ALK), deep anterior lamellar keratoplasty (DALK) and Descemet's stripping automated endothelial keratoplasty (DSAEK). Indication for keratoplasty was defined as the corneal pathology at time of keratoplasty as diagnosed clinically by the surgeon. These indications were divided into 9 diagnostic categories: infectious keratitis, corneal scar, corneal dystrophy, regraft, aphakic/pseudophakic bullous keratopathy (ABK/PBK), keratoconus, acute chemical or thermal injury, corneal degeneration and other (trauma, Stevens Johnson syndrome and uncertain diagnosis). Infectious keratitis was further classified according to the pathogenic species (bacteria, fungus, Acanthamoeba, herpes simplex and unknown). Corneal scars included scars secondary to infectious keratitis, prior chemical or thermal injury, trauma and congenital opacity. Regraft was defined as a case in which a failed prior corneal transplant was the indication.

The study period was divided into two six year periods (January 1, 2002 to December 31, 2007 and January 1, 2008 to January 1, 2014) for descriptive and analytical purposes. A Chi-square (χ^2) contingency table testing of the frequency of types of keratoplasty in the two time periods was performed. A P value of <0.05 was considered statistically significant.

RESULTS

Indications for Corneal Transplantation During the period from January 1, 2002 to January 1, 2014, 1390 corneal transplants were performed for 1278 patients at VNIO. The mean age (±standard deviation) of the recipients was 44.9± 18.1y (range from 1 to 89y), with males accounting for 59.5% of the patients. A significant increase in the number of corneal transplants performed was noted over the twelve-year period, with the number of transplants almost doubling from 2002-2007 (n=486) to 2008-2013 (n=904). During the twelve-year period, the most common indication for corneal transplantation was infectious keratitis (48.2%) (Table 1). Corneal perforation and failure to respond to medical therapy were the most common reasons why corneal transplantation was required in the management of infectious keratitis. The most common etiology of infectious keratitis was fungal keratitis, which accounted for 56.9% (381/670) of cases (Table 2).

Table 1 Indications for corneal transplantation at Vietnam National Instititute of Ophthalmology between 2002 and 2013 *n* (%)

Indications	2002-2007	2008-2013	Total
Infectious keratitis	273 (56.2)	397 (43.9)	670 (48.2)
Corneal scar	78 (16.0)	255 (28.2)	333 (24.0)
Corneal dystrophy	42 (8.6)	96 (10.6)	138 (9.9)
Regraft	44 (9.1)	68 (7.5)	112 (8.1)
ABK/PBK	20 (4.1)	52 (5.8)	72 (5.2)
Keratoconus	12 (2.5)	15 (1.7)	27 (1.9)
Acute eye burn	3 (0.6)	4 (0.4)	7 (0.5)
Corneal degeneration	3 (0.6)	5 (0.6)	8 (0.6)
Others	11 (2.3)	12 (1.3)	23 (1.7)
Total	486 (100.0)	904 (100.0)	1390 (100.0)

ABK/PBK: Aphakic/pseudophakic bullous keratopathy.

Table 2 Etiology of keratitis and corneal scar in recipients of corneal transplants at Vietnam National Instititute of Ophthalmology between 2002 and 2013 *n* (%)

Etiology	2002-2007	2008-2013	Total
Infectious keratitis	273 (100.0)	397 (100.0)	670 (100.0)
Fungal keratitis	145 (53.1)	236 (59.4)	381 (56.9)
Bacterial keratitis	91 (33.3)	128 (32.2)	214 (31.9)
Viral keratitis	23 (8.4)	26 (6.5)	48 (7.2)
Acanthalmoebic keratitis	6 (2.2)	5 (1.3)	11 (1.7)
Others	8 (2.9)	2 (0.5)	15 (2.3)
Corneal scar	115 (100.0)	218 (100.0)	333 (100.0)
Infectious keratitis	94 (81.7)	179 (82.1)	273 (82.0)
Eye burn	18 (15.7)	29 (13.3)	47 (14.1)
Congenital pathology	3 (2.6)	10 (4.6)	13 (3.9)

During the period 2002-2007, 56.2% of corneal transplants were performed for infectious keratitis, signifcantly greater than the 43.9% performed in the years 2008-2013 (χ^2=22.58; P <0.0001). While the percentage of corneal transplants performed each year for infetious keratitis increased between 2002 and 2009, the percentage has decreased since, with 2013 being the first year in which infectious keratitis was not the most common indication for corneal transplantation (Figure 1).

While the percentage of keratoplasty procedures peformed for other indications also differed between the first and second time periods, corneal scarring, corneal dystrophy and failed keratoplasty were the three most common indications, after infectious keratitis, in both time periods (Table 1). The most common cause of corneal scarring necessitating keratoplasty was resolved infectious keratitis. Therefore, infectious keratitis necessitating either early (n=670) or delayed (n=273) keratoplasty accounted for 67.8% of all keratoplasty procedures performed at VNIO during the twelve-year period under review (Table 2).

Technique of Corneal Transplantation Between 2002 and 2013, PK was the primary form of keratoplasty performed at VNIO, accounting for 1300 of the 1390 (93.5%) keratoplasties performed (Table 3). While ALK represents only a small percentage of the keratoplasty procedures performed in both

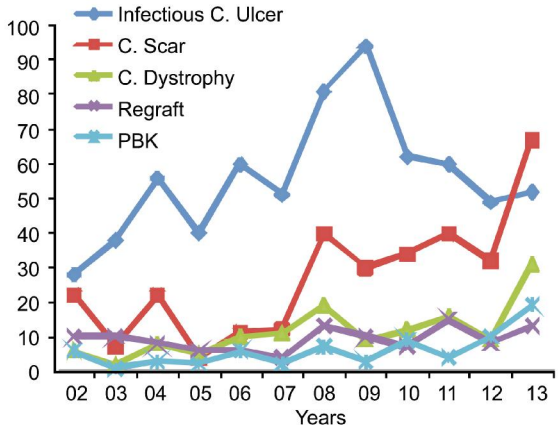

Figure 1 The 5 most common indications for corneal transplant.

Table 3 Types of keratoplaty procedures performed at Vietnam National Institute of Ophthalmology between 2002 and 2013 *n* (%)

Surgical technique	2002-2007	2008-2013	Total
PK	479 (98.6)	821 (90.8)	1300 (93.5)
LK			
ALK	7 (1.4)	45 (5.0)	52 (3.7)
DALK	0	11 (1.2)	11 (0.8)
DSAEK	0	27 (3.0)	27 (2.0)
Total	486 (100.0)	904 (100.0)	1390 (100.0)

PK: Penetrating keratoplasty; LK: Lamellar keratoplasty; ALK: Anterior lamellar keratoplasty; DALK: Deep anterior lamellar keratoplasty; DSAEK: Descemet's stripping automated endothelial keratoplasty.

Table 4 Indications for keratoplasty in published series across Asia %

Indications	Wang *et al*[3] China 2005-2010	Bajracharya *et al*[4] Nepal 2005-2010	Dasar *et al*[6] India 2002-2012	Chaidaroon *et al*[11] Thailand 1996-1999	Present study Vietnam 2002-2013
Infectious keratitis	56.2	40.9	2.94	17.8	48.2
Corneal scar	4.8	26.8	60.7	22.2	24.0
Corneal dystrophy	3.4	1.7	4.9	20.0	9.9
Regraft	6.7	11.2	12.7	8.9	8.1
ABK/PBK	8.5	9.0	8.8	28.9	5.2
Keratoconus	11.2	7.0	-	-	1.9

ABK/PBK: Aphakic/pseudophakic bullous keratopathy.

the first and second periods, the percentage of ALK procedures more than tripled from 1.4% in the first period to 5.0% in the second period. Similarly, endothelial keratoplasty represents an infrequent but increasingly commonly performed procedure at VNIO since the first DSAEK procedure was performed in October 2010 (Table 3).

DISCUSSION

To the best of our knowledge, this study is the first to report the indications for and types of keratoplasty performed in Vietnam. Similar to reports of indications for keratoplasty from other developing countries, infectious keratitis is the most common indication for keratoplasty in Vietnam. In Shandong, China during the period of 2005-2010, the leading indications for corneal transplantation were infectious keratitis (37.1%), herpes simplex keratitis (19.1%) and keratoconus (11.2%)[3]. Similarly, corneal scarring following infectious keratitis is the most common indication for keratoplasty in Southern India [6], while keratitis, either active or healed, is the major indication for keratoplasty in Nepal and Malaysia (Table 4)[4,7]. Corneal scarring is the second most common indication for keratoplasty in Vietnam, accounting for approximately one-quarter of the keratoplasty procedures performed. Similarly, other Asian countries have reported a significant percentage of corneal transplants being performed for corneal scarring, including China (55.9%)[8], India (38.03%)[9] and Taiwan, China (27.9%)[10]. As has been reported in other Southeast Asian countries such as Malaysia, the main causes of corneal scarring in Vietnam are infectious keratitis and trauma [7]. We report that approximately two-thirds of all keratoplasties performed in Vietnam are for active or resolved infectious keratitis, indicative of the fact that infection remains the leading cause of corneal pathology in Vietnam. As a consequence, efforts to reduce the incidence of avoidable blindness and need for corneal transplantation should focus on the prevention of corneal trauma and secondary infectious keratitis.

While infectious keratitis remains the most common indication for corneal transplantation in Vietnam and other developing countries in Asia, it is no longer a common indication in many developed countries. Approximately fifty years ago in Israel, infectious keratitis was the most common indication for keratoplasty, accounting for 37.0% of procedures. As time passed, infectious keratitis become a less common indication, accounting for only 6.3% of procedures, while keratoconus and graft failure became more common indications for keratoplasty in Israel [12]. In the majority of developed countries, the main indications for keratoplasty are non-infectious disorders such as keratoconus and bullous keratopathy [13-16]. In Canada, from 1986-1995, the most frequent indication for keratoplasty was bullous keratopathy (28.5%) and regraft (22.4%) while keratitis (3.7%) and corneal scar (2.8%) are relatively uncommon indications[17]. In Germany, among 1200 corneal transplants performed between 2001 and 2010, keratoconus was the main indication (25.5%), followed by corneal dystrophy (23.3%) and corneal scarring (14.4%). In addition, the authors reported a

statistically significant increase in the number of corneal transplants performed for keratoconus and Fuchs endothelial dystrophy and a statistically significant decrease in the number performed for corneal scarring[18].

The percentage of corneal transplants performed for prior failed graft at VNIO, 8.1%, is similar to that reported in other Southeast Asian countries such as Thailand (8.9%)[11] and Nepal (11.2%)[4]. As the number of corneal transplants performed annually in Vietnam continues to increase, the number of procedures performed for graft failure will continue to increase as well, as has been observed in developed countries. In fact, graft failure was the most common indication for penetrating keratoplasty in the UK from 1990-1999, accounting for 40.9% of all cases in one published series [19]. While pseudophakic and aphakic bullous keratopathy have been reported to be relatively common indications for keratoplasty in other Southeast Asian countries, such as Thailand (28.9% of all penetrating keratoplasties)[11] and Singapore (26.3% of all penetrating keratoplasties) [20], they remain a relatively uncommon indication in Vietnam, accounting for 5.2% of all cases. However, as the number of cataract surgeries performed each year in Vietnam continues to increase significantly, the incidence of post-cataract surgery corneal edema is likely to increase as well.

Penetrating keratoplasty accounts for over 90% of the keratoplasties performed at VNIO from 2002-2013, although an increasing number of selective lamellar keratoplasty procedures have been performed over the last several years. From 2008-2013, approximately 10% of all keratoplasties performed were anterior or posterior lamellar procedures, as compared to just over 1% during the preceding six years. Corneal surgeons around the world have recognized the myriad advantages of lamellar keratoplasty, including more rapid visual recovery and lower risk of rejection, leading to increased popularity of anterior and posterior lamellar keratoplasty worldwide [21-24]. In Iran, among 1859 corneal transplantations performed from 2004 to 2009, the proportion of PKP, DALK, LKP, and DSAEK was 70.9%, 20.1%, 4.4%, 2.3% respectively [25]. In the West of Scotland, the percentage of lamellar keratoplasty procedures performed increased from 14.1% between 2001 and 2005 to 40.4% between 2006 and 2010 [14]. Similarly, in the United States, 24 987 endothelial keratoplasty procedures were performed in 2013, accounting for a majority of the 48 229 keratoplasty procedures that were performed [2]. Reasons for significantly different percentage of penetrating versus lamellar keratoplasty procedures performed in Vietnam as compared to developed countries include differing indications for keratoplasty, lack of microkeratome availability and lack of domestically recovered, eye bank prepared, pre-cut tissue for DSAEK in Vietnam[24,26].

In summary, infectious keratitis is the most common indication for keratoplasty, and penetrating keratoplasty is the most common form of corneal transplantation in Vietnam. However, non-infectious indications are becoming more common as the number of corneal transplants and cataract surgeries performed annually in Vietnam continue to increase. In recent years, a small but increasing number of anterior and posterior lamellar keratoplasty procedures is being performed, which we anticipate will improve the outcomes of corneal transplantation in Vietnam.

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