

CLINICAL PROFILE OF PATIENTS SUBJECT TO PENETRATING KERATOPLASTY IN A BRAZILIAN REFERENCE SERVICE

PERFIL CLÍNICO DE PACIENTES SUBMETIDOS A CERATOPLASTIAS PENETRANTES EM UM SERVIÇO BRASILEIRO DE REFERÊNCIA

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ABSTRACT: With the development of new surgical techniques, instrumentation and pharmacological advances, corneal transplant procedures can undergo changes directly in the clinical profile of patients with the indication for penetrating keratoplasty technique. The aim of this study was to identify the clinical profile of patients undergoing penetrating keratoplasty and the main indicating conditions at a university hospital in Northeast Brazil. This is an epidemiological, cross-sectional, descriptive study performed using data from medical records of 241 patients who underwent keratoplasty between January/2010 and December/2014. From the total keratoplasties performed in the hospital during the study period, 88.37% were carried out by penetrating technique. Of these, 50.44% were performed in male patients with an average age of 55.2 years. The main indications were keratoconus, followed by bullous keratopathy and keratitis. Preexisting clinical conditions for penetrating keratoplasty were found, such as changes in vascularization, glaucoma, previous surgery, aphakic and pseudophakic eyes and keratoplasties combined with other types of surgeries. Knowledge of the clinical profile of patients who underwent penetrating keratoplasty enabled identification of the main ocular diagnoses that result in this type of transplant as a therapeutic indication. From this, it is possible to point out the main pre-existing medical conditions of penetrating keratoplasty that may represent potential risk factors for complications in the postoperative period and even lead to graft failure. We suggest that further studies be carried out on a thematic.

KEYWORDS: Corneal transplantation. Keratoplasty. Penetrating. Glaucoma. Cataract Extraction.

INTRODUCTION

Penetrating keratoplasty (PK) was the first surgical technique developed since the start of the twentieth century for the realization of corneal transplantation (CT). CT is the most common type of tissue transplantation made around the world, when there is substitution of all corneal layers (the epithelium, Bowman's layer, stroma, Descemet's membrane and endothelium) with the aim of restoring corneal integrity and to improve vision affected by infectious or chronic diseases or trauma (OLIVA; SCHOTTMAN; GULATI, 2012; WANG, 2013).

Indications for PK may include corneal ectasia, especially keratoconus, corneal scarring secondary to trauma or infection, various forms of keratopathies (pseudophakic bullous keratopathy, herpes simplex and keratitis) and congenital corneal opacities (Peter anomaly, aniridia) (SEVERINSKY, 2014).

In the PK method, the entire thickness of the cornea is replaced, while in the Lamellar Keratoplasty (LK) technique only a few layers are

replaced. The health of the corneal endothelium is the main criterion for deciding whether a previous or subsequent procedure will be indicated. Diseases involving the corneal endothelium can be controlled with endothelial or penetrating keratoplasties, and those diseases that involve both the endothelium and the corneal stroma generally require PK (REINHART, 2011).

With the development of new surgical techniques, instrumentation and pharmacological advances, corneal transplant procedures can undergo changes directly in clinical profiles of patients with an indication for the PK technique (WANG, 2013).

Thus, by considering PK as an ophthalmic surgical technique that contributes to restoring eye health and considering the development of other lamellar techniques for performing CT, the aim of this study is to identify the clinical profile of patients undergoing penetrating keratoplasty and the main indicating conditions at a university hospital in the northeastern region of Brazil.

This study is justified by the need to determine how cornea transplants vary according to certain clinical characteristics that allow identifying

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groups at risk for prevention, in addition to generating hypotheses for later investigations (CRUZ et al, 2016; 2017).

In this context, we hope that our results may contribute toward improving organization and planning care for users who undergo cornea tissue transplant, in addition to promoting health professionals' training and to support discussion of the subject in seeking to offer specialized care in the operative periods based on attention to detecting and preventing complications (CRUZ et al, 2016; 2017; 2018). So, this study aimed to identify the clinical profile of patients undergoing penetrating keratoplasty and the main indicating conditions at a university hospital in Northeast Brazil.

MATERIAL AND METHODS

This an epidemiological cross-sectional descriptive study, with collection of secondary data obtained from medical records of patients who underwent penetrating keratoplasty at a reference hospital for CT located in northeastern Brazil.

To compose the sample were selected 241 medical records of patients who underwent CT at the investigated hospital were evaluated, of which 228 were carried out through the surgical technique of penetrating keratoplasty within the period from January 2010 to December 2014. This period (January 2010 – December 2014) corresponds to the beginning of conducting the procedure in the institution and completion of data collection, respectively.

Secondary sources were used for data collection from cases, as contained in the medical records of the patients treated at this service and supplemented by data obtained from the Ocular Tissue Bank of the State of Rio Grande do Norte, Brazil.

Data available from patients of both genders at all ages accompanied in the studied period with confirmed medical indication for penetrating keratoplasty were included in the sample. Those who presented an indication for lamellar keratoplasty and those which did not contain all the information needed to reach the proposed goal were excluded. The final sample consisted of 228 medical records of completed/performed penetrating keratoplasty. Data collection took place between January and April 2015.

The following clinical and epidemiological characteristics of patients undergoing PK were analyzed: gender, age, origin, operated eye, surgical purposes, pre-existing medical conditions (i.e. vascularization of the corneal tissue, glaucoma,

previous surgery, classification of the eye regarding the lens and ocular diagnosis) and combined surgery.

Data entry was performed using Microsoft Excel®. For descriptive analysis, absolute, relative and medium frequencies were used by analysis in SPSS software, version 20.0.

The research protocol of this study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Norte in its ethical and methodological aspects, according to the resolution of the National Health Council No. 466/2012, under decree No. 876.177 and CAAE N. 37533014.8.0000.5537.

RESULTS

Of the total 258 corneal transplants performed in this hospital during the studied period, 88.37% (228) corresponded to penetrating keratoplasty procedures. Of these, 50.44% (115) were performed in male patients, with an average age of 55.2 years. Regarding their origin, 87.72% patients were from urban areas and 12.28% from rural areas.

Table 1 shows the pre-existing clinical characteristics of patients undergoing penetrating keratoplasty in the location and at the time of the study.

Of the penetrating keratoplasty procedures conducted in the period from 2010 to 2014, 50.66% occurred in the left eye, 75.44% (n = 172) were for optical purpose, and with the presence of the lens in 75.55% (n = 170). The main ocular diagnosis which consisted of an indicative condition for performing the transplant was keratoconus (23.68%), followed by bullous keratopathy (22.37%), keratitis (22.37%), leukoma (10.09%) and late failure (9.65%).

Although vascularization of the corneal tissue was absent in the majority of cases (56.39%), it was found in 43.61%, while 88.55% did not have preexisting glaucoma prior to PK.

Having previous surgery to CT occurred in 41.41% of PK (procedures), of these 58.51% of the surgeries were facetectomy, 92.73% with the use of intraocular lenses (pseudophakics), and 2.27% without the use of the lenses (aphakics). Of all keratoplasties performed, 7.89% were combined with cataract surgery.

Table 1. Preexisting clinical characteristics of patients submitted to penetrating keratoplasty. Natal/RN, 2015 (n = 228).

Clinical characteristics		Frequency	%
Ocular Diagnosis	Keratoconus	54	23.68
	Bullous keratopathy	51	22.37
	Keratitis	51	22.37
	Leukoma	23	10.09
	Late failure	22	9.65
	Fuchs dystrophy	12	5.26
	Other corneal dystrophies	5	2.19
	Perforation	4	1.75
	Primary failure	2	0.88
	Corneal degeneration	2	0.88
	Post-traumatic endothelial failure	1	0.44
	Burn	1	0.44
Operated eye*	Left	115	50.66
	Right	112	49.34
Classification of the eye *	Phakic	170	75.55
	Pseudophakic	51	22.67
	Aphakic	4	1.78
Vascularization of the cornea*	No	128	56.39
	Yes	99	43.61
Glaucoma*	No	201	88.55
	Yes	26	11.45
Previous surgery*	No	133	58.59
	Yes	94	41.41
Purpose	Optical	172	75.44
	Tectonic	38	16.67
	Therapeutic	18	7.89
In combination with facetectomy	No	210	92.11
	Yes	18	7.89
Total		228	100.00

* Some medical records had missing data.

DISCUSSION

In the global context, keratoplasty has achieved great progress in terms of quality and quantity over the last few years. Currently, about 50,000 keratoplasties are performed in the US each year. Due to changes in the profile of corneal diseases and advances in surgical techniques and instrumentation, there have been several changes in indications and types of corneal transplants. In developed countries, the main indications for endothelial keratoplasty have been Fuchs dystrophy

and pseudophakic corneal edema, which explains the increasing number of endothelial keratoplasties performed in the country (EBAA, 2014). At the same time, the main indications for keratoplasty surgery in developing countries are infectious keratitis and scarring of the cornea, thus PK continues to be the most widely used technique for corneal transplantation (WANG, 2011; BAJRACHARYA, 2013).

The epidemiological profile of the main indications for performing PK in the studied hospital is consistent with the national reality, considering that keratoconus is one of the main

diagnoses with an indication for keratoplasty in Brazil. However, in observing the epidemiological profile by regions of the country, this profile can vary. In the state of Santa Catarina, located in Brazil's southern region, keratoconus is the main indication for keratoplasty, accounting for 36.09% of cases, with an average age of 45.51 years. Another study conducted in a university hospital in southeastern Brazil found that 23% of PK had leukoma as an indicating condition, 57.4% were performed in male patients and the mean age found was 52.3 years (SD = 21.42) (ZESCHAU, 2014; BARBOSA, 2012).

A study conducted in Germany showed that of the 1,200 PK conducted between 2001 and 2010, keratoconus was the main indication (25.5%), followed by corneal dystrophy (23.3%) and scarring of the cornea (14.4%). Moreover, the authors reported a statistically significant increase in the number of keratoplasties performed for keratoconus and Fuchs dystrophy, and a statistically significant decrease in the number of PK performed by corneal scarring (WANG, 2013).

In developing countries such as Vietnam, the main indicative condition for keratoplasty was infectious keratitis (DONG, 2016). In Shandong, China, during the period of 2005-2010, the main indications were infectious keratitis (37.1%), herpes simplex (19.1%) and keratoconus (11.2%) (WANG, 2011). Similarly, infectious keratitis was the main indication for corneal transplantation in Nepal (BAJRACHARYA, 2013), and it is the second indicative condition for PK in the present study along with bullous keratopathy.

As a result, efforts to prevent cases of preventable blindness and increases due to demands of indications for corneal transplantation should focus on controlling chronic and infectious diseases that affect the corneal tissue, as these are evident in epidemiological profiles in studies worldwide.

While there is a variance in relation to main indicative condition for PK procedures, the variables gender and age in the present study corroborate findings in the literature, with a predominance of male gender aged between the fourth and sixth decade of life (WANG, 2013; ZESCHAU, 2014; BARBOSA, 2012; DONG, 2016).

PK was found as the predominant technique for surgical practice in the service, accounting for 88.37% of cases of keratoplasties; however, according to the presented epidemiological profile, other surgical techniques could be adopted due to the prevalent ocular diagnostics affecting the anterior layer of the cornea, such as keratoconus and

keratitis. Lamellar surgeries of the anterior corneal layer (deep anterior lamellar keratoplasty - DALK), are mainly recommended for keratoconus, although the indications have declined due to the improvement of surgical techniques and materials used (ZESCHAU, 2013).

The main advantages of PK over DALK is that the penetrating can be used for treating diseases which affect the corneal endothelium, such as Fuchs dystrophy, pseudophakic and aphakic corneal edema, posterior polymorphous corneal dystrophy and hereditary and congenital endothelial corneal dystrophies, although endothelial keratoplasties may be preferred. It is also worth considering that PK is the most familiar surgical procedure for most surgeons who treat the cornea (REINHART, 2011).

Among the advantages of DALK over PK procedure worth noting are the fact that it is an extraocular procedure instead of Intraocular in which immune rejection of corneal endothelium does not occur, the use of topical corticosteroids can usually be discontinued earlier, there is less loss of Endothelial cell density (ECD), the sutures may be removed in a shorter period and the tensile strength of the eyeball is greater in cases of trauma without cutting (REINHART, 2011).

The predominant choice for PK technique in the studied hospital may not only be associated with the experience of the surgical team in performing this procedure, but also because it is the most appropriate procedure in cases of corneal diseases that affect deeper layers of the stroma and the endothelium.

Regarding the preexisting clinical condition of patients who underwent PK, vascularization was present in 43.61%, glaucoma in 11.45%, and prior surgery in 41.41% of cases. Facetectomy was the most frequently performed procedure prior to PK procedures, 58.51% of the surgeries were performed with the purpose of cataract extraction, 92.73% made use of intraocular lenses (pseudophakics) and 2.27% without the use of the lenses (aphakics), while 7.89% of performed keratoplasties were combined with removal of cataracts simultaneously to the transplant.

The cornea is a transparent avascular tissue, however neovascularization of corneal tissue may occur as a result of several factors, corresponding to an ocular clinical condition which can result in post-transplant complications and lead to a higher risk of rejection and graft failure. Factors such as the presence of vascularization and their levels should be considered and monitored from the pre-transplant until the postoperative period so that control measures can be taken to minimize recurring

damages to this condition (MAIMAITIMING, 2015).

A study conducted in Israel, in the Middle East, evaluated the incidence and risk factors for the occurrence of post-keratoplasty ocular hypertension. The univariate analysis identified significant risk factors for this condition, which included pre-existing glaucoma, previous eye surgery, graft size of the donor greater than 0.5 mm, additional surgical procedures combined with PK, as well as aphakia and pseudophakia. Variables such as age, gender, the operated eye, indication for PK, graft size and type of suture were not significantly related to elevated intraocular pressure (IOP) in the postoperative period of a univariate analysis. Multivariate analysis showed that the pre-existence of glaucoma and surgery in combination with the PK were the only significant risk factors found for the occurrence of ocular hypertension after PK (ORUÇOGLU, 2014).

Glaucoma is a high incidence serious complication after the completion of PK. Any patient with pre-existing history of glaucoma should be carefully evaluated prior to undergoing PK and monitored after this procedure. Surgeries being performed in combination with PK increase the risk of postoperative ocular hypertension, and as such the multidisciplinary team should consider these risks in such circumstances. The introduction of lamellar techniques in performing corneal transplants can reduce the incidence of postoperative ocular hypertension, considering that if IOP is not controlled after PK, it can be a major cause of graft failure and result in visual loss (ORUÇOGLU, 2014; GUPTA; SHARMA; ICHHPUJANI, 2014).

Thus, it is observed that the preexisting clinical profile prior to penetrating transplants in the present study is exposed to risk factors that may result in postoperative complications and consequent irreversible eye damage. The preexistence of glaucoma, vascularization, previous surgeries, ocular pseudophakia and aphakia, and PK in combination to other surgeries represents potential risk factors that require control and monitoring to prevent damage.

This study aimed to emphasize the magnitude of the problem by identifying the risk factors which predispose patients undergoing PK to

compromise their eye health. However, as this is a cross-sectional study, it is necessary that longitudinal studies are conducted to identify the long-term results of preexisting clinical factors of PK. Study with data collection originating from secondary data, it should be assumed that some biases may constitute limiting factors (as any study opting for this technique), such as the loss of important information, some degree of inaccurate data and weaknesses in the records and information systems used by the services.

CONCLUSIONS

The identification of the clinical profile of patients undergoing penetrating keratoplasties allows for identifying the main ocular diagnostics that indicate the performance of corneal transplantation as a therapeutic option. In addition to pointing out what are the pre-existing medical conditions to keratoplasty, it may also represent potential risk factors for complications in the postoperative period and even for graft failure.

Factors such as preexisting glaucoma, vascularization, previous eye surgery, additional surgical procedures combined with PK, pseudophakia and aphakia are presented in the present study as variables that compromised/affected the ocular health of patients undergoing transplantation. Health professionals must ensure the realization of a thorough ocular evaluation in the periods before, during and after surgery, with the implementation of appropriate measures to minimize the risks of complications associated with preexisting factors to the transplantation.

Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this article. The submitting authors are responsible for co-authors declaring their interests.

ACKNOWLEDGEMENTS

To National Council of Technological and Scientific Development – CNPq and to Federal University of Rio Grande do Norte.

RESUMO: Com o desenvolvimento de novas técnicas cirúrgicas, de instrumentação e avanços farmacológicos, os procedimentos de transplantes de córneas podem sofrer mudanças diretamente no perfil clínico dos pacientes com indicação para realização da técnica de ceratoplastia penetrante. O objetivo deste estudo foi identificar o perfil clínico dos pacientes submetidos à ceratoplastia penetrante e principais condições indicadoras em um Hospital Universitário da região

nordeste brasileira. Trata de um estudo epidemiológico, transversal, descritivo, realizado com dados de prontuários de 241 pacientes submetidos às Ceratoplastias no período de janeiro/2010 a dezembro/2015. Do total de ceratoplastias realizadas no serviço no período estudado, 88,37% foram realizadas pela técnica penetrante. Destas, 50,44% foram realizadas em pacientes do sexo masculino, com uma média de idade de 55,2 anos. As principais indicações foram o ceratocone, seguido pelas ceratopatia bolhosa e ceratite. Foram encontradas condições clínicas preexistentes às ceratoplastias penetrantes, como alterações de vascularização, glaucoma, cirurgia prévia, olhos afácicos e pseudofácicos e ceratoplastias combinadas com outros tipos de cirurgias. O conhecimento do perfil clínico dos pacientes submetidos às ceratoplastias penetrantes possibilita identificar os principais diagnósticos oculares que resultam nesse tipo de transplante como indicação terapêutica. A partir dele é possível apontar as principais condições clínicas preexistentes à ceratoplastia penetrante que podem representar potenciais fatores de risco para complicações no período pós-operatório e até mesmo levar a falência do enxerto realizado. Novos estudos sobre a temática devem ser considerados.

PALAVRAS-CHAVE: Transplante de córnea. Ceratoplastia Penetrante. Glaucoma. Extração de catarata.

REFERENCES

BAJRACHARYA, L.; GURUNG, R.; DEMARCHIS, E. H.; OLIVA, M.; RUIT, S.; TABIN, G. Indications for keratoplasty in Nepal: 2005-2010. **Nepal J Ophthalmol**, v. 5, n. 2, p. 207–214, 2013. <https://doi.org/10.3126/nepjoph.v5i2.8730>

BARBOSA, A. P.; ALMEIDA JÚNIOR, G. C.; TEIXEIRA, M. F.; BARBOSA, J. C. Evaluation of penetrating keratoplasty indications in inner part of the São Paulo state. **Rev Bras Oftalmol**, v. 71, n. 6, p. 353-357, 2012. <https://doi.org/10.1590/S0034-72802012000600002>

DONG, P. N.; HAN, T. N.; ALDAVE, A. J.; CHAU, H. T. M. Indications for and techniques of keratoplasty at Vietnam National Institute of Ophthalmology. **Inter J Ophthal**, v. 9, n. 3, p. 379-383, 2016.

EYE BANK ASSOCIATION OF AMERICA. 2013 Eye banking statistical Report. Washington, DC: 2014.

CRUZ, G. K. P.; SILVA, S. B.; AZEVEDO, I. C.; CARVALHO, D. P. S. R. P.; MEIRELES, P. F.; VITOR, A. F.; FERREIRA JÚNIOR, M. A. Epidemiological Profile of Patients Undergoing Urgent Corneal Transplant in a Referral Center in Northeastern Brazil. **Transpl Proceedings**, v. 48, p. 2366-70, 2016. <https://doi.org/10.1016/j.transproceed.2016.06.012>

CRUZ, G. K. P.; AZEVEDO, I. C.; CARVALHO, D. P. S. R. P.; VITOR, A. F.; SANTOS, V. E. P.; FERREIRA JÚNIOR, M. A. Clinical and epidemiological aspects of cornea transplant patients of a reference hospital. **Rev. Latino-Am. Enfermagem**, v. 25, n. 2897, p.1-9, 2017.

CRUZ, G. K. P.; FERREIRA JÚNIOR, M. A.; SILVA, S. B.; AZEVEDO, I. C.; SANTOS, V. E. P.; IVO, M. L. Chronological Factors of the Process of Donation and Classification of Corneal Tissue. **Transpl Proceedings**, v. 50, n. 3, p. 827-30, 2018. <https://doi.org/10.1016/j.transproceed.2018.02.022>

GUPTA, P.; SHARMA, A.; ICHHPUJANI, P. Post penetrating keratoplasty glaucoma - A review. **Nepal J Ophthalmol**, v. 6, n. 11, p. 80-90, 2014. <https://doi.org/10.3126/nepjoph.v6i1.10776>

MAIMAITIMING, R.; YANG, X.; WUPUER, K.; YE, N.; KONG, N.; GU, B.; FAN, Y.; SHAO, L. A retrospective clinical study of Xinjiang Uygur patients with corneal allograft rejection. **Inter J Clin Exp Med**, v. 8, n. 3, p. 4356-4362, 2015.

OLIVA, M. S.; SCHOTTMAN, T.; GULATI, M. Turning the tide of corneal blindness. **Indian J Ophthalmol**, v. 60, n. 5, p. 423-427, 2012. <https://doi.org/10.4103/0301-4738.100540>

ORUÇOGLU, F.; BLUMENTHAL, E. Z.; FRUCHT-PERY, J.; SOLOMON, A. Risk factors and incidence of ocular hypertension after penetrating keratoplasty. **J Glaucoma**, v. 23, n. 9, p. 599–605, 2014. <https://doi.org/10.1097/IJG.0b013e31828700f5>

REINHART, W. J.; MUSCH, D. C.; JACOBS, D. S.; LEE, W. B.; KAUFMAN, S. C.; SHTEIN, R. M. Deep Anterior Lamellar Keratoplasty as an Alternative to Penetrating Keratoplasty : A Report by the American Academy of Ophthalmology. **Ophthalmology**, v. 118, n. 1, p. 209-218, 2011. <https://doi.org/10.1016/j.ophtha.2010.11.002>

SEVERINSKY, B.; BEHRMAN, S.; FRUCHT-PERY, J.; SOLOMON, A. Scleral contact lenses for visual rehabilitation after penetrating keratoplasty: Long term outcomes. **Cont Lens Ant Eye**, v. 37, n. 3, p. 196-202, 2014. <https://doi.org/10.1016/j.clae.2013.11.001>

WANG, J.Y.; XIE, L.X.; SONG, X.S.; ZHAO, J. Trends in the indications for penetrating keratoplasty in Shandong, 2005-2010. **Int J Ophthalmol**, v. 4, n. 5, p. 492-497, 2011.

WANG, J.; HASENFUS, A.; SCHIRRA, F.; BOHLE, R. M.; SZENTMARY, N. Changing indications for penetrating keratoplasty in Homburg/Saar from 2001 to 2010--histopathology of 1,200 corneal buttons. **Graefes Arch Clin Exp Ophthalmol**, v. 251, n. 3, p. 797-802, 2013. <https://doi.org/10.1007/s00417-012-2117-2>

ZESCHAU, A.; BALESTRIN, I. G.; STOCK, R. A.; BONAMIGO, E. L. Indications of keratoplasty: a retrospective study in a University Hospital. **Rev Bras Oftalmol**, v. 72, n. 5, p. 316-320, 2013. <https://doi.org/10.1590/S0034-72802013000500007>

ZESCHAU, A.; BALESTRIN, I. G.; STOCK, R. A.; BONAMIGO, E. L. Indications and epidemiological profile of patients submitted. **Rev Bras Oftalmol**, v. 73, n. 3, p. 162-166, 2014.