Pterygium-induced Corneal Astigmatism

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Abstract

Background: Previous work has suggested an association between increasing size of pterygium and increasing degrees of induced corneal astigmatism.

Objectives: To assess the quantitative relation between pterygium size and induced corneal astigmatism using a computerized corneal analysis system (TMS II) and slit-lamp beam evaluation of pterygium size, and to conclude whether corneal astigmatism is an early indication for surgical intervention.

Methods: We evaluated 94 eyes of 94 patients with unilateral primary pterygium of different sizes, using TMS II and slit-lamp beam measurements of the size of the pterygium (in millimeters) from the limbus to assess parameters of pterygium size with induced corneal astigmatism. Best corrected visual Snellen acuity was performed.

Results: Primary pterygium induced with-the-rule astigmatism. Pterygium extending >16% of the corneal radius or 1.1 mm or less from the limbus produced increasing degrees of induced astigmatism of more than 1.0 diopter. Significant astigmatism was found in 16.16% of 24 eyes with pterygium of 0.2 up to 1.0 mm in size, in 45.45% of 22 eyes with pterygium of 1.1 up to 3.0 mm in size ($P \leq 0.0004$), and in 100% of 3 eyes with pterygium of 5.1 up to 6.7 mm in size ($P = 0.0005$). We found that visual acuity was decreased when topographic astigmatism was increased.

Conclusions: When primary pterygium reaches more than 1.0 mm in size from the limbus it induces with-the-rule significant astigmatism (≥1.0 diopter). This significant astigmatism tends to increase with the increasing size of the lesion. Topographic astigmatism tends to be improved by successful removal of the pterygium. These findings suggest that early surgical intervention in the pterygium may be indicated when the lesion is more than 1.0 mm in size from the limbus.

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Before invasion of the visual axis, pterygium typically induces with-the-rule astigmatism. One report indicates that pterygium extending >45% of the corneal radius or within 3.2 mm of the visual axis produces increasing degrees of induced astigmatism [1]. Therefore, we assessed the amount of pterygium that induced astigmatism, and correlated it with the visual acuity and horizontal size of the lesion, with the aim of determining whether early surgical intervention is indicated.

Methods

We evaluated 94 eyes of 94 patients with primary unilateral pterygium of different horizontal size, from 0.2 up to 6.7 mm from the limbus. We divided the eyes into four groups according to the size of the lesion. Group A consisted of 24 eyes with pterygium of 0.2–1.0 mm; Group B, 22 eyes with lesion of 1.1–3.0 mm; Group C, 45 eyes with lesion of 3.1–5.0 mm; and Group D, 3 eyes with lesion of 5.1–5.7 mm from the limbus. Best corrected Snellen visual acuity was estimated.

Induced astigmatism was evaluated using computerized corneal analysis (TMS II). Estimations were performed on eyes without excess tearing. The size of the lesion was measured in millimeters from the limbus (horizontal length) by the beam of a hag-streit 900 slit-lamp microscope. We correlated parameters of horizontal pterygium size with induced corneal astigmatism. Quantitative data of induced astigmatism and best-corrected visual acuity were evaluated by chi-square analysis. A P value of 0.05 was considered the upper limit of statistical significance.

Results

Pterygium induced with-the-rule astigmatism. No patient presented against-the-rule astigmatism. Lesions extending horizontally for >16% of the corneal radius or within 1.1 mm from the limbus produced increasing degrees of induced astigmatism. Best corrected visual acuity decreased when topographic astigmatism was increased [Table 1]. Astigma-

Table 1. Topographic astigmatism and BCVA analysis in the four groups of patients with pterygium

	Topographic astigmatism (diopters)	No. of eyes with pterygium	BCVA	P*
Group A	1.0±1.8	24	0.832±0.321	
Group B	3.7±2.7	22	0.665±0.321	<0.001
Group C	5.1±1.2	45	0.567±0.299	<0.001
Group D	8.3±2.7	3	0.431±0.135	<0.0001

* P compared to Group A.

BCVA = best corrected Snellen visual acuity (decimal notation: 6/9=0.8)

Table 2. Pterygium-induced significant astigmatism in the four groups of patients

	No. of eyes with pterygium	Astigmatism >1 diopter	*P* value*
Group A	24	4 (16.6%)	
Group B	22	10 (45.45%)	<0.002
Group C	45	42 (93.33%)	<0.0004
Group D	3	3 (100%)	=0.0005

* Significance vs. Group A

tism of more than 1.0 diopter was present in 16.6% of eyes with a lesion extending from 0.2 to 1.0 mm (Group A), in 45.45% of eyes with lesion extending from 1.1 to 3.0 mm (Group B, $P \leq 0.002$ as compared to Group A), in 93.33% of eyes with lesion extending from 3.1 to 5.0 mm (Group C, $P \leq 0.0004$ as compared to Group A), and in 100% of 3 eyes with lesion extending more than 5.1 mm from the limbus (Group D, $P = 0.0005$ as compared to Group A) [Table 2].

Discussion

Corneal topography analysis is an important component for evaluating patients with pterygium, revealing significant abnormalities that indicate the need for surgical intervention. The process of generating a topographic corneal map begins with a keratoscope image, which is a visual image of concentric circles (or mires) created by the cornea's reflection of the keratoscope illuminated target. The mires are then digitized to create individual points (inset) that can be measured. Keratoscope images are formed by a reflection that occurs at the tear film layer. Tear film may not be problematic if it is uniform over the entire corneal surface, but it can create difficulties if the patient is tearing sufficiently to cause lacrimal lakes at the upper or lower lid margins or if focal tear film break-up leads to digitization errors [2]. The cause of astigmatism in pterygium appears to be an alteration of the tear film, rather than traction on the cornea by the pterygial lesion [3]. To minimize these errors, our corneal topographic estimations were performed on eyes without excess tearing.

Astigmatism of eyes with pterygium was found to be significantly greater than that of normal human controls [4–7]. We were unable to demonstrate any effect of pterygium surgery on keratometric measurements of the corneas because we used the Javal keratometry, which samples only a small area of the control cornea [8]. Lin and Stern [9] recently reported that pterygium extending to >45% of the corneal radius or within 3.2 mm of the visual axis produced increasing degrees of induced astigmatism. They reported that since all of the visual and topographic indices were significantly improved by successful surgery, this improvement is a valid indication for surgical excision of the pterygium. They concluded that surgery should be considered when the pterygium begins to induce significant degrees of hemiastigmatism [9].

The results of our study indicate that significant astigmatism is induced by pterygium of more than 1 mm from the limbus in size, and it tends to rise with the increasing size of the lesion. Increased astigmatism in patients with pterygium caused a decrease in visual acuity. Therefore, early surgical intervention in pterygium may be indicated when the size of the lesion is more than 1.0 mm from the limbus.

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Capsule

Genomes and activity

Complete genomes for some organisms, such as yeast, are now available, but methods are needed to screen the possible activities of the proteins that are encoded. Martzen et al. have combined biochemical assays with genomic arrays to create a rapid way to identify the functions of expressed proteins. Open reading frames representing more than 6,000 genes were fused to a tag that facilitated affinity purification of gene products that were then assayed to identify previously unknown proteins involved in the transfer of RNA splicing pathway. This technique may shorten the process of functional identification from months or years to days.

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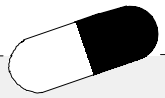

Xenografts and retroviruses

Pig organs may offer a solution to the shortage of human donor organs for transplantation. But concerns remain about possible cross-species transmission of porcine endogenous retrovirus (PERV). A study by a few groups reported by Pardalis et al. described samples collected from 160 patients who had been treated with various living pig tissues up to 12 years earlier. Reverse transcription-polymerase chain reaction (RT-PCR) and protein immunoblot analyses were performed on serum from all 160 patients. No viremia was detected in any patient. Peripheral blood mononuclear cells from 159 of the patients were analyzed by PCR using PERV-specific primers. No PERV infection was detected in any of the patients from whom sufficient DNA was extracted to allow complete PCR analysis (97% of the patients). Persistent microchimerism (presence of donor cells in the recipient) was observed in 23 patients for up to 8.5 years.

Xenotransplantation could provide a ready supply of cells, tissues and organs to treat a variety of serious human conditions. The "uncertain perils" are to what extent the animal cells or tissue will perform properly in the human host, whether immunological rejection can be overcome, and whether harmful zoonoses can be prevented. Despite the greater immunological barrier, pigs are favored over primates as a source of transplant tissue for a variety of practical, ethical and safety reasons. Among the many microbes harbored by pigs, PERV has aroused particular concern. Animal endogenous retroviruses are integrated proviral DNA genomes inherited in a Mendelian manner. At least 50 copies of PERV exist in pig chromosomes and PERV cannot be eliminated by pathogen-free, closed breeding of pigs. Some PERV genomes have given rise to human-trophic PERV strains in culture.

Fetal pig nerve cells have been transplanted into patients' brains in an attempt to slow down neurodegeneration in Parkinson's and Huntington's diseases and to treat epilepsy. A recent report on 24 such patients indicated no evidence of subsequent PERV infection in the blood. Last year, lack of PERV infection was reported in 10 diabetic patients transplanted with pig pancreatic islet cells secreting insulin and in two renal dialysis patients whose blood was extracorporeally perfused through pig kidneys. Eight of the diabetics and both of the dialysis patients were reanalyzed in the present 160-patient study, which used similar PCR and RT-PCR amplification methods to detect viral genomes, and Western blotting to detect viral antigens in serum.

The lack of evidence for PERV infection will encourage biotechnology companies, physicians and surgeons to explore pig tissue treatments further. Hyperacute rejection and acute vascular rejection present a major hurdle to whole-organ xenotransplantation. Rejection of pig organs is triggered by natural human antibodies that recognize carbohydrate "xeno-antigens" expressed on pig endothelial cells that line blood vessels. Several biotechnology companies are attempting to block complement-mediated immune attack of xenografts by breeding transgenic pigs that express human proteins. But an unfortunate corollary of such genetically modified pigs may be that the porcine viruses they carry may more readily infect humans.

A chain of events required for PERV to pose a threat to public health has been proposed. PERV is present in the pigs being bred for xenotransplantation, and human-trophic PERV is expressed in many cells and tissues, though apparently not in fetal brain cells. Thus far, PERV has not infected patients exposed to porcine tissues, but if this were to occur, we would need to investigate whether PERV caused disease and whether it could be transmitted to other individuals. To address the risks of infection, the U.S. Food and Drug Administration established an Advisory Panel on xenotransplantation. And in 1997 the British government, still reeling from the evidence that bovine spongiform encephalopathy ("mad cow disease") had spread to humans, moved quickly to set up the UK Xenotransplantation Interim Regulatory Authority (UKXIRA).

With the latest reports on the lack of evidence for PERV infection *in vivo*, the keenest advocates of xenotransplantation may mutter that the concern over the risk of PERV infection unnecessarily delayed progress in the field. The Novartis/CDC teams, however, conclude that only cautious progress in closely monitored, prospective clinical trials will help in "assessing the safety and efficacy of using porcine cells, tissues, or organs therapeutically in humans." Both the FDA and UKXIRA take this attitude and appear ready to approve, in principle, small-scale human trials of porcine cellular therapy.

Whereas the endogenous retroviruses in our house guests (cats and mice) have not naturally been transmitted to humans, we have known for more than 20 years that human tumor xenografts grown in immunosuppressed animals sometimes become infected. PERV, however, does not proliferate as readily in human cells as human-trophic feline and murine endogenous retroviruses. But the possibility remains that, say, one among 1,000 xenograft recipients may become infected by PERV or by a virus resulting from recombination between PERV and human retroviral sequences.

Although the public may demand evidence of no risk, retrospective epidemiological surveys can at best provide no evidence of risk, which is a rather different matter. We should heed the Hippocratic precautionary principle — "at least do no harm." Yet no new medical procedure can be deemed entirely safe, so we need to balance risk with benefit, for the patient and for the human population.

For the individual transplant recipient, the real promise seems to be greater than uncertain peril. Indeed, one of the potential advantages of xenotransplantation over allotransplantation (person-to-person grafts) is that pathogen-free pigs might pose a lesser threat of infection than a graft from an unknown human donor. After all, many cases of life-threatening infections have been transmitted by human transplantation and transfusion: HIV, hepatitis B and C viruses, various herpesviruses, tuberculosis, and Creutzfeldt-Jakob disease.

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