Prevalence of Keratoconus in Egyptian Subjects With High Corneal Astigmatism

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Research Article

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Abstract

Purpose: to determine the prevalence of keratoconus in subjects with astigmatism of two dioptres (2D) or greater using data from the Pentacam Scheimpflug images.

Materials and Methods: This prospective cross-sectional study included 600 eyes of 600 patients with refractive errors aged ≥ 18 years who had no Present or past ocular pathology other than refractive error. Patients were equally divided into Group I (Patients with 2 diopters or greater of corneal astigmatism) and Group II **(**Patients with less than 2 corneal astigmatism).

Results: the cylindrical refractive error among normal individuals in group I (high astigmatism) was -2.93 ± 0.89 ranging from -5.00 to -7.0, while that among keratoconus patients was -3.22 **±** 1.17 ranging from to -2.00 to -8.00. No significant difference was found (P= 0.107). In group II (low astigmatism) the cylindrical refractive error among normal individuals was -0.7 ± 0.49 ranging from 0.0 to -2.0, while that among keratoconus patients was -0.75 ± 0.43 ranging from to 0.0 to 1.0. No significant difference was found (P= 0.65). It was found that among group I population (high astigmatism) 12.3% diagnosed as keratoconus patients, while 1.7% of group II (low astigmatism) were keratoconus patients. There was a highly significant difference between the two groups (P < 0.00001).

Conclusions: The current study showed that subjects with 2D or more of astigmatism who present to outpatient clinics had higher prevalence of keratoconus than subjects with less than 2 D astigmatism. Therefore, it can be concluded that magnitude of astigmatism can be a risk factor for development of keratoconus.

Introduction

Astigmatism is defined as an error of refraction in which incident parallel rays cannot be focused to a single point.(1) Total corneal astigmatism is the sum of both the anterior corneal surface and the posterior corneal surface astigmatism.(2) Astigmatism has several classifications ,most common classification is classification into two main groups; regular and irregular. In the regular astigmatism, the steepest and the flattest meridian are perpendicular on each other.(1) In the irregular astigmatism, the difference between the steepest and flattest meridian is lower than 90 degrees in which, we cannot get a clear image on the retina just by simple cylinder correction in one specific meridian.(3)

Keratoconus (KC) is a corneal ectatic disease resulting from axial protrusion of the cornea and stromal thinning which eventually makes the cornea conical in shape leading to myopia and irregular astigmatism,(4).(5) It is typically a disease of adolescence with a significant economic and social effects on the patients.(6) (7)..(8)

Pentacam is the imaging modality of choice for keratoconus detection.(9) Classification of ectetic corneal disorders and pattern of Keratoconus determined with pentacam relay on the sagittal map, Thickness

map, Elevation maps, Keratoconus indices and Belin ambrosio parameters.[10]. In this study, we explored the prevalence of keratoconus in subjects with astigmatism of two dioptres (2D) or greater using data from the Pentacam Scheimpflug images.

Materials And Methods

The study protocol was approved by the Local Ethics Committee of the Faculty of Medicine, Alexandria University, Egypt.

The study was designed as prospective conducted between April 2019 and July 2020. It included 600 eyes of 600 patients. presented to El Safwa outpatient clinic scheduled for routine refractive surgery. They were equally divided into two groups; group I (patients with 2 diopters or greater of corneal astigmatism and group II (patients with less than 2 corneal astigmatism). Patients with Present or past ocular pathology other than refractive error, dry eye disorders, corneal edema, opacity or dystrophy, previous ocular surgery, previous ocular trauma, age less than 18 years were excluded from the study.

All patients included in the study as documented by their records were subjected to complete assessment including: full History taking (age, medical history, surgical history, previous trauma, last time they used contact lens if they are contact lens wearer), a thorough ophthalmic examination was done before pentacam (UCVA, cycloplegic refraction and slit lamp biomicroscopy to examine the cornea, and detect any abnormalities in the iris, lens and anterior vitreous).

Pentacam imaging was done using Oculus Pentacam HR. The rotating Scheimpflug camera captured 50 images automatically around the optical axis of the eye. Following parameters were recorded from the Pentacam maps: Topographic astigmatism, Kmax, central corneal thickness and thinnest lacation thickness. Diagnosis of keratoconus depended on presence of 2 or more pentacam derived criteria of keratoconus:

1. Kmax value greater than 48 diopters.
2. Thinnest location thickness less than 470 μ.
3. Increased posterior surface elevation more than 18 μ at the central 6 mm zone.

Statistical analysis

Quantitative data were presented in mean ± SD. Statistical analysis was carried out by SPSS, version 2.3.2. (SPSS Inc., New York, New York, USA). Chi-square test was used in the comparison between two groups with qualitative data. Independent t-test was used in the comparison between two groups with quantitative data and parametric distribution and Wilcoxon Mann-Whitney test was used in the comparison between two groups with quantitative data and non-parametric distribution. The comparison between two quantitative data and parametric distribution were done by using Pearson Correlation Test. Spearman correlation coefficients were used to assess the significant relation between two quantitative

parameters in the same group and non-parametric distribution. The difference was considered statistically significant if the P value was less than 0.05.

Results

A total of 600 eyes of 600 patients were equally divided into two groups; group I (patients with 2 diopters or greater of corneal astigmatism) (n = 300) and group II (patients with less than 2 corneal astigmatism) (n = 300), with mean age 28.55 ± 8.96 years and 26.69 ± 8.83 years in group I and II, respectively. there was no statistically significant difference between the two groups as regards gender with female predominance. The mean cylindrical refractive error of our studied population was − 2.97 ± 0.96 and − 0.703 ± 0.495 in group I (high astigmatism) and II (low astigmatism) respectively. The mean K-max in group I patients was 45.4 ± 2.4, while in group II it was 44.6 ± 1.6.

Table (1): Correlation between Cylinder and Pentacam findings in the both studied groups

	Pentacam findings	Group I (n = 300)		Group II (n = 300)	
		Spearman correlation		**Spearman correlation**	
Cylinder		**P**	**r**	**P**	**r**
	Topographic	< 0.0001*	0.36	< 0.0001*	0.48
	K-max	0.0037*	0.2	0.0049	0.16
	Thinnest location	0.773	0.02	0.05	-0.11

Table (1) shows that a strong positive correlation was found between topographic astigmatism and cylindrical refractive error was found in both group I and II (r = 0.36, p < 0.0001 and r = 0.48, p < 0.0001, respectively). A statistically highly significant positive correlation was found between K-max and cylindrical refractive error was found in group I (r = 0.2, p = 0.0037) and group II (r = 0.16, p = 0.049). There was a statistically insignificant correlation between cylindrical refractive error and thinnest location in both group I (r = 0.02, p = 0.773). This correlation in group II was statistically significant (r = -0.11, p = 0.05).

Table (2): Comparison between the studied groups according to Diagnosis

	Group I (n = 300)		Group II (n = 300)		Chi square test	
Diagnosis						
	No.	**(%)**	**No.**	**(%)**	$X^2 = 24.6$	**P < 0.00001***
Normal	263	87.7%	295	98.3%		
KC	37	12.3%	5	1.7%		

According to table (2) and Fig. 1 it was found that among group I population (high astigmatism) 12.3% diagnosed as keratoconus patients, while 1.7% of group II (low astigmatism) were keratoconus patients. There was a highly significant difference between the two groups (P < 0.00001).

Table (3): Distribution between Cylinder and diagnosis in Group I and Group II

Cylinder				
Group I (n = 300)				
Diagnosis	**Range**	**Mean ± SD**	**Median (IQR)**	**P**
Normal	-0.5 – -7.0	-2.93 ± 0.89	-2.75 (-2.25- -3.375)	0.107
KC	-2.0 – -8.0	-3.22 ± 1.17	-3.00 (-2.5 - -3.75)	
Group II (n = 300)				
Normal	0.0 – -2.0	-0.7 ± 0.49	-0.5 (-0.25- -1.0)	0.65
K C	0.0 – -1.0	-0.75 ± 0.43	-1.0 (-0.75 - -1.0)	

Table (3) shows that in group I (high astigmatism) the cylindrical refractive error among normal individuals was − 2.93 ± 0.89 ranging from − 5.00 to -7.0, while that among keratoconus patients was − 3.22 ± 1.17 ranging from to -2.00 to -8.00. No significant difference was found (P = 0.107).

In group II (low astigmatism) the cylindrical refractive error among normal individuals was − 0.7 ± 0.49 ranging from 0.0 to -2.0, while that among keratoconus patients was − 0.75 ± 0.43 ranging from to 0.0 to 1.0. No significant difference was found (P = 0.65).(Figs. 2 and 3)

Discussion

Since keratoconus is typically characterized by the progression of irregular astigmatism, thinner cornea, and increased steepening of corneal curvature. Keratoconus is often first detected in the course of an eye examination and patients may be unaware of it, even though they complain of poor vision and have sought ocular care. Knowing the query prevalence of subclinical and clinical KC introduces much earlier

interventions to hold the progression of the disease and guard against one of the most common causes of blindness.[11]

The aim of this study was to determine the prevalence of keratoconus in subjects with astigmatism of two diopters (2D) or greater using data from the Pentacam Scheimpflug images. This prospective cross-sectional study included 600 eyes of 600 patients. They were equally divided into two groups; group I (patients with 2 diopters or greater of corneal astigmatism) (n = 300) and group II (patients with less than 2 corneal astigmatism) (n = 300).

The current study reported that in group I a strong positive correlation was found between topographic astigmatism and cylindrical refractive error in both group I and II ($r = 0.36$, $p < 0.0001$ and $r = 0.48$, $p < 0.0001$, respectively). Galindo et al. study result comes in agree with our results.[12]

A statistically highly significant positive correlation was found between K-max and cylindrical refractive error was found in group I ($r = 0.2$, $p = 0.0037$) and group II ($r = 0.16$, $p = 0.049$). There was a statistically insignificant correlation between cylindrical refractive error and thinnest location in both group I ($r = 0.02$, $p = 0.773$). This correlation in group II was statistically significant ($r = -0.11$, $p = 0.05$).

Hashmani et al in a study conducted to determine the median CCT among normal Pakistani population and to correlate CCT with age, sex, and refractive errors, found astigmatism to have a significant positive correlation with CCT ($P < 0.001$, $r = 0.154$).[68] Also, Linke et al in previously conducted study detected that refractive state showed a positive correlation with the thinnest point in corneal thickness ($r = 0.07$, $P < .001$).[13]

In our study among group I population (high astigmatism) 12.3% diagnosed as keratoconus patients, while 1.7% of group II (low astigmatism) had keratoconus. There was a highly significant difference between the two groups ($P < 0.00001$).

The study published by Serdarogullan et al. found that, 14.1% of patients suffering astigmatism ≥ 2 D had some degree of KCN (6.3% of eyes had KCN and 7.8% had subclinical KCN).[14] The current result is a different finding from the prevalence of KC reported by Shakir and Alwan where 21% of the patients with astigmatism ≥ 2D.[15]

It is obvious that higher prevalence of keratoconus is more common when cylindrical power increases. Our study has several limitations the most important of them is small sample size making results possibly do not reflect the actual prevalence of KCN in the population with high astigmatism.

Conclusion

The current study showed that subjects with 2D or more of astigmatism who present to outpatient clinics had higher prevalence of keratoconus than subjects with less than 2 D astigmatism. Therefore, it can be concluded that magnitude of astigmatism can be a risk factor for development of keratoconus.

Declarations

Ethics approval and consent to participate

Ethics committee at Alexandria university, Faculty of Medicine approved this study. Methods were performed in accordance with the relevant guidelines and regulations.Written informed consents with all details were obtained from all participants to be enrolled in the study and allow the results for publications. All data mentioned in the study are available

Financial support and funding

This study has not received any funds nor financial support from any company or organization.

Conflicts of interest

there are no conflicts of interest for any of the author

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request

Authors contribution

Amr said and Menatallah Ibrahim wrote the manuscript. Hany helaly and amr aboelheir reviewed the manuscript . Menatallah Ibrahim performed the statistical analysis ,

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Figures

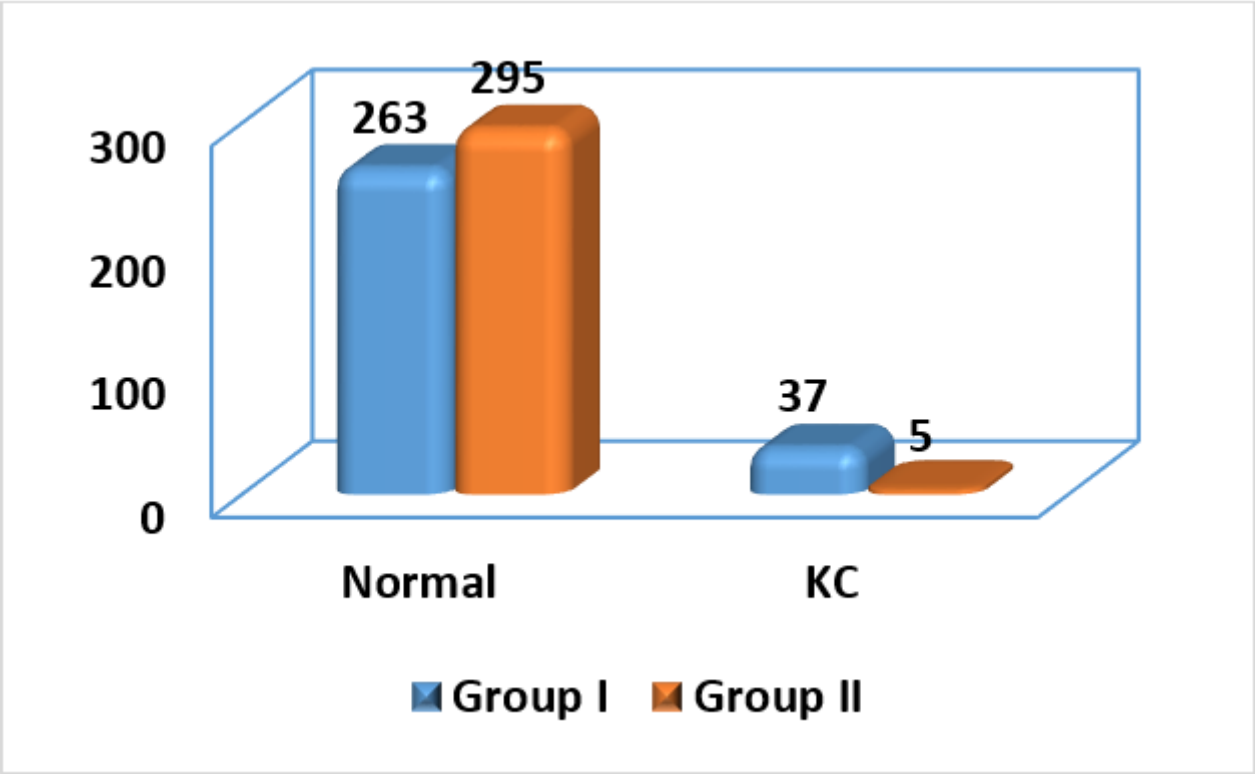

Figure 1

Distribution of Diagnosis between the two studied groups.

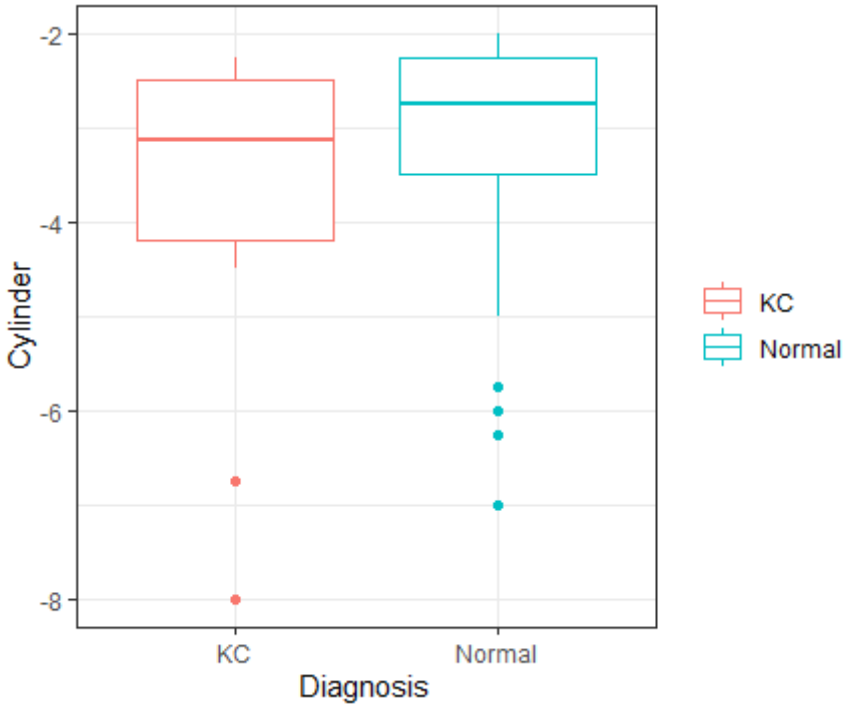

Figure 2

Boxplot between Diagnosis and Cylinder in Group I.

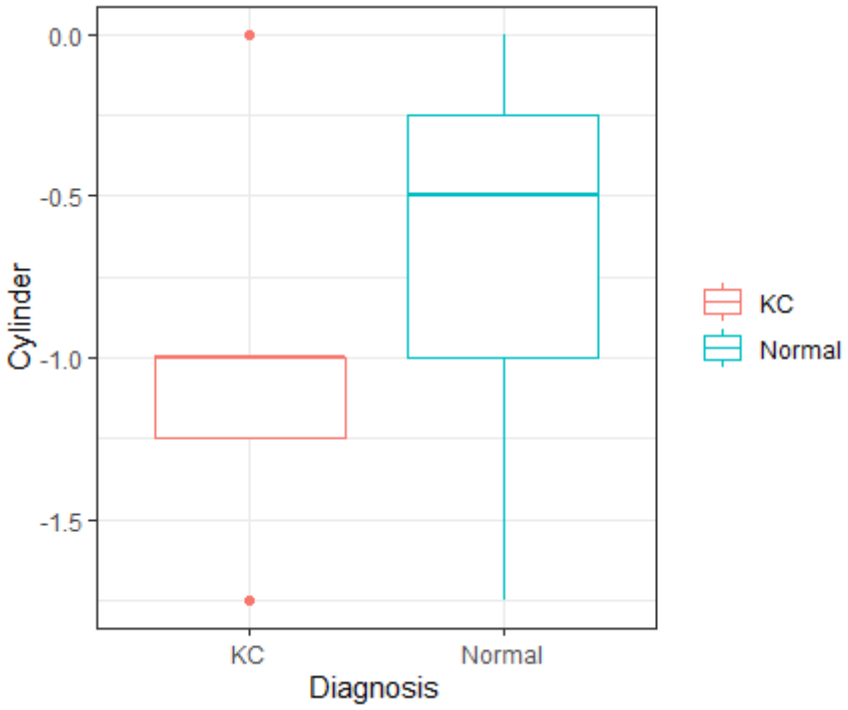

Figure 3

Boxplot between Diagnosis and Cylinder in Group II