Original Article

Histomorphological Changes in Human Senile Cataractous Lenses with Diabetic and Non-Diabetic Patients: A Comparative Study

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ABSTRACT

Objective: To determine the histomorphological changes in the human senile cataract. between diabetic and non-diabetic eyes and the correlation between anterior ocular segment biometry and HbA1c level.

Study Design: Cross-sectional study.

Place and Duration of Study: This study was conducted at the Department of Anatomy with collaboration of Sindh Institute of Ophthalmology and Visual Sciences (S.I.O.V.S) @ Eye Hospital Hyderabad, Sindh for the period of six months from April 2020 to October 2020.

Materials and Methods: This study was conducted on 385 patients aged more than 40 years who underwent intra-capsular cataract extraction who were included in study while those patients whose age less than 40 years. Data were analyzed using SPSS version 22.0

Results: A total of 385 patients of senile cataract extraction were selected. The frequency of cataracts was found 107(27.79%) among diabetics' patients. There was a statistically significant difference concerning the increased incidence of senile cataract with HbA1C (mg/dL) in diabetic patients as compared to non-diabetic patients (p-value = <0.0001). The calcareous change was noted in 5 cases of 40 to 100 years' age**.** Calcarious change and Collagen bundles were noted out of 278 cases of non-diabetic of 40 to 100 years' age.

Conclusion: Duration of diabetes, age, and gender were found to be significant risk factors for predicting the grade of cataract in male or female diabetic patients.

Key Words: Histomorphological changes, senile cataractous lenses, diabetic Mellitus

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INTRODUCTION

A cataract is considered to be primary reason for curable blindness that is caused by progressive loss of lens transparency and affects millions of people around world.[1] The prevalence of blindness in developing countries is 10-40 times higher than in developed countries[2]. Across Western sub-Saharan Africa, age-standard blindness incidence is still most widespread across people over age of 50 with a level of 6.0%.

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In Eastern Asia, tropical Latin America, and Western Europe,[3] highest reductions in age-standardized blindness are attributed to cataracts in people aged 50 years. It is likely to become an increasing problem as world population ages.[2]

The risk of cataract is now increasingly increasing[4]. Many clinicians are diagnosed between ages of 40 and 80 and cataracts are diagnosed fairly widespread, regardless of race or sex. Among developing countries, cataract is leading cause of blindness because of lack of medical care.[5] A regional survey in Rawalpindi reveals that about 75% of population 75 years of age and over is prone to cataracts, which are biggest cause of vision impairment and blindness worldwide. Regular or flexible lenses are transparent.[6]

The zonular fibers are fixed in position and attach lens between equatorial lines and lens to a muscle tissue circle called ciliary body.[7]

Several culprits, from occupational, behavioral, UV radiation, medical and age factors have all been implicated.[8] Obesity was at risk of mixed lens opacities at baseline and older age.[9] Other risk factors include diabetes prolong exposure to sunlight and alcohol intake.[10] In Memon AF et al.'s research, cataracts are

stated to be 4 times more frequent in diabetics and 2 times more frequently in people. In diabetic patients, nuclear sclerosis was most common type of cataract.[11]
The prevalence of type 2 diabetes mellitus is on rise, more so in Pakistan. The risk factors for cataract formation include long-term diabetic disorder, advanced age when clinically diagnosed; advanced retinopathy; diuretic therapy; low blood sugar control and even reduced fast glucose (IPG); [12] Since incidence of type 2 diabetes mellitus (DM) is growing, occurrence of cataracts among diabetics should be examined. This research helps to understand how role of medical and biochemical factors affect development of cataracts. It highlights risk factors (age, sex, duration of diabetes, family history, RBS, glycosylated hemoglobin, serum cholesterol) both, biochemical and lifestyle variables and modulation of these variables may delay occurrence of cataract in population of type 2 diabetes mellitus. The present study aims to determine histomorphological changes in human senile cataract. between diabetic and non-diabetic eyes and the correlation between anterior ocular segment biometry and HbA1c level.

MATERIALS AND METHODS

This cross-sectional study was conducted in Department of Anatomy with collaboration of Sindh Institute of Ophthalmology and Visual Sciences at Eye Hospital Hyderabad, Sindh for six months from April 2020 to October 2020. A total of 385 patients were included. Age more than 40 years, patients who undergone intra-capsular cataract extraction (both male and female) were included. Those with a record of eye injury, regional and systemic hormones, acute and ocular illness and those who have not given their permission were excluded. A detailed history was taken and an examination of patient admitted for cataract operation was done. After taking history morphometry of lens was done with help of ultrasonography, Catatractous lenses were obtained at time of operation. Cataracts are graded as cortical, vascular, subcapsular, or combined for morphological purposes. With written consent of participants, spontaneous levels of blood glucose and fasting blood plasma, and glycemia (HbA1c) were measured. The study was undertaken after ethical approval was granted by PUMHSW University Hospital Ethical Committees. Informed consent was taken from all participants.

Histological examination of senile cataractous lenses: The lens was washed with normal saline and lens was divided into 2 parts. Half was preserved in bovine fluid and a half was preserved in Mcmannous fluid. The lens was processed for paraffin wax section and stained with Haematoxylin & Eosin for general Histological changes, Masson's Trichome- for collagen, PAS Staining- for glycogen, Sudan black B-for lipids. Microscope and after that photography of slides was taken on Kodak Gold color film,100ASA,21DIN.

Tissue processing: Tissues were placed in graded Alcohol 30%, 50%, 70%, and 90% for 2 minutes each. Tissues were embedded in molten paraffin wax using tissue blocks and allowed to cool and solidify. The sections were cleared in two changes of xylene for 3 minutes each. The sections were placed in graded alcohol 90%, 70%, and 50% for 2 minutes each.

Statistical Analysis: In SPSS version 22.0, frequencies and percentages have been determined to compare ratios of categorical variables such as age (in groups), race, and Chi-square (if needed). The mean $\pm$ standard deviation, "t" test was used to compare means among different ages such as ages, diameters, and thickness of lenses. All data was calculated on a 95% confidence interval. P-value $\leq$ 0.05 were considered as significant level.

RESULTS

A total of 385 patients of senile cataract extraction (both male and female) were selected based on inclusion criteria. The frequency of cataracts was found in 107(27.79%) among diabetics and 278(72.21%) among non-diabetics.

Age incidence: In this study, minimum age of patients with cataract was 40 years and maximum age was 100 years. The Mean age ± SD of diabetic patients was 52.2804 ± 6.84 years while mean ± SD of non-diabetic patients was 66.2590 ± 10.27 years.

Out of 107 diabetic patients, frequency of cataracts in DM patients increased with age to 64(59.8%), 38(35.5%), 5(4.6%) in 41 to 50 years, 51-60, and >60 age groups respectively.

Gender: Among 385 patients, 236(61.5%) were females and 148(38.5%) were male patients. Senile cataract was seen as more common in female patients as compared to male patients. In diabetic females, there was an increased incidence of 66(62.3%) of senile cataracts as compared to decreased prevalence among diabetic males 40(37.7%). Cataract was significantly associated with gender concerning increased incidence of senile cataract in female diabetic patients (p-value = 0.040).

HbA1C: The mean HbA1C ± SD was 7.3914±1.018 mg/dL in diabetic patients. However, there was a statistically significant difference concerning increased incidence of senile cataract with HbA1C (mg/dL) in diabetic patients as compared to non-diabetic patients (p-value = <0.0001).

Duration of Diabetic Mellitus: In the present study, minimum duration of DM was 2 years and maximum duration of DM was 12 years. out of 107 diabetic patients, mean duration of DM ± SD was 4.56 ± 2.17 years. Cataract prevalence was also higher 105(98.1%) in subjects with shorter duration of diabetes (<10 years)

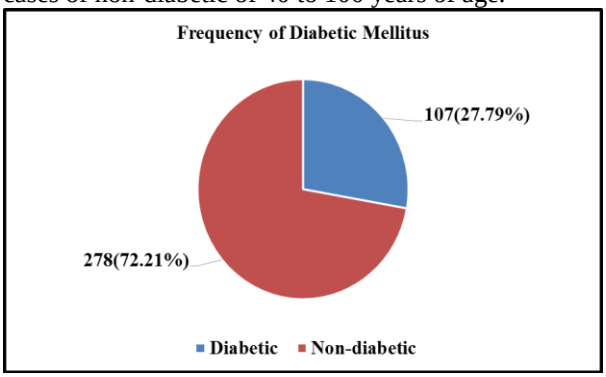
than in those 2(1.9%) with longer duration of diabetes (> 10 years).

Type of lens: In respect to regions of lens, Posterior sub-capsular cataract was commonest type in 79(73.8%) of cataract cases in diabetics followed by cortical cataracts 26(24.3%), mixed type 107(100%).

Histological findings: The nucleus showed an anteroposterior arrangement of primary lens fibers, surrounded periodically by secondary fibers. A decrease in thickness of capsule in cataracts at all planes was recorded when compared with normal lenses. The retention of broken lens cells debris and water in form of tiny globules was noted in 12 cases of 40 to 100 years of age.

The epithelial cells showed migration beyond the post-equatorial plane beneath posterior capsule out of 107 cases of diabetic Mellitus of 40 to 100 years of age and were accompanied by equatorial and posterior cortical degeneration with dystrophic calcification. Calcareous change was noted in 8 cases of 40 to 100 years ago.

The retention of broken lens cells debris and water in form of tiny globules, Calcareous change was noted in 8 cases of 40 to 100 years' age was noted in 12 cases of 40 to 100 years of age. Calcareous change (calcium deposition) and Collagen bundles were noted out of 278 cases of non-diabetic of 40 to 100 years of age.



Graph 1: Frequency of diabetes mellitus

Table No.1: Distribution of patients according to age in years in Diabetic and Non-Diabetic groups (n = 385)

	Diabetic n = 107	Non-diabetic n= 278	total	P value
Age in years	52.2804 ± 6.84	66.2590 ± 10.27		<0.00001
Age in groups				
41 to 50 years	64(59.8%)	15(5.4%)	79(20.5%)	
51 to 60 years	38(35.5%)	93(33.5%)	131(34.0%)	0.0001
61 to 70 years	3(2.8%)	115(41.4%)	118(30.6%)	
71 to 80 years	1(.9%)	33(11.9%)	34(8.8%)	
81 to 90 years	1(.9%)	17(6.1%)	18(4.7%)	
91 to 100 years	0(.0%)	5(1.8%)	5(1.3%)	
Gender: Male	40(37.7%)	108(38.8%)	148(38.5%)	0.90
Female	66(62.3%)	170(61.2%)	236(61.5%)	
RBS (mg/dL)	166.86 ± 35.35	116.88 ± 40.60		<0.00001
Regions of lens				
Nuclear Sclerotic Cataracts	2(1.9%)	190(68.3%)	192(49.9%)	
Cortical Cataracts	26(24.3%)	48(17.3%)	74(19.2%)	<0.00001
Posterior Subscapular Cataracts	79(73.8%)	38(13.7%)	117(30.4%)	
Mixed type	107(100.0%)	278(100.0%)	385(100.0%)	
HbA1C Level	7.3914 ± 1.018	5.6990 ± 1.312	-	0.001
Thickness (mm)	3.8857 ± 0.57	4.0943 ± 0.54	-	0.001
Anterior Chamber (AC)	6.2955± 33.34772	3.0863 ± 1.87549	-	0.011
Vitrous	16.0283 ± .68	15.7332 ± .83	-	0.001
Total Length (TL)	22.7508 ± 0.613	30.1737 ± 126.095	-	0.54
Morgagnian Globules	31(29.0%)	17(6.1%)	48(12.5%)	<0.0001
Morganian Globules + Dystrophic Calcification	14(13.1%)	29(10.4%)	43(11.2%)	0.473
Morganian Globules + Collagen bundles	12(11.2%)	12(4.3%)	24(6.2%)	0.018
Epithelial Migration	93(86.9%)	76(27.3%)	169(43.9%)	<0.0001
Collagen Bundles	13(12.1%)	12(4.3%)	25(6.5%)	0.009
Morganian Globules + Collagen Bundles + Migration of Epithelium	13(12.1%)	13(4.7%)	26(6.8%)	0.013
Migration of epithelium + Dystrophic Calcification	16(15.0%)	17(6.1%)	33(8.6%)	0.008
Mortganian Globules + Dystrophic Calcification + Collagen Bundles	24(22.4%)	30(10.8%)	54(14.0%)	0.005

Histological findings

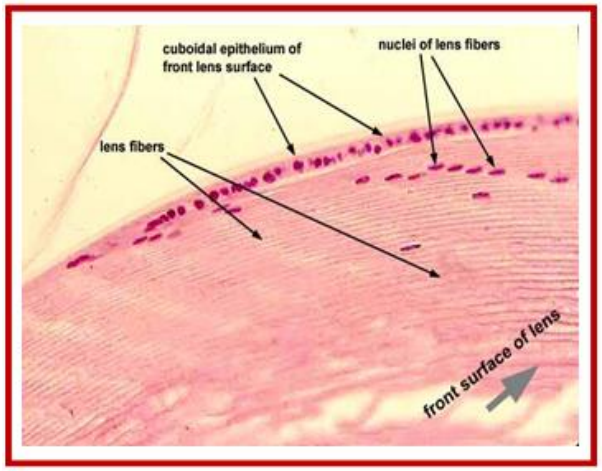


Figure No.1: Anterior part of normal human lens stained with H & E x 410

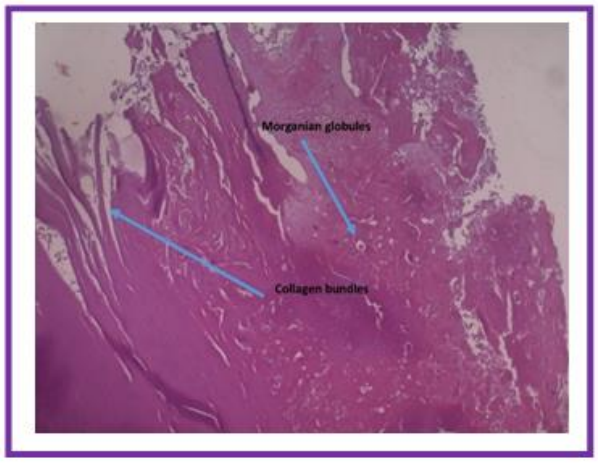


Figure No.2: Morganian globules and Collagen bundles stained with H and Ex250.

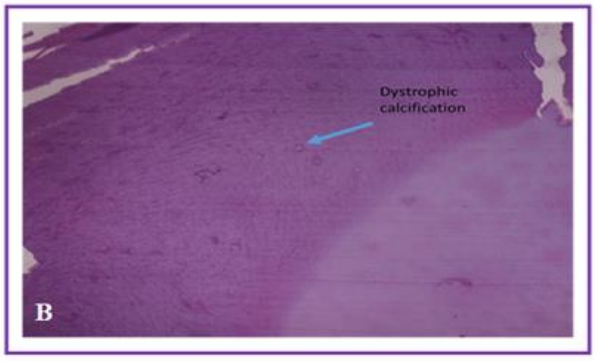


Figure No.3: Dystrophic calcification stained with H & E x 250.

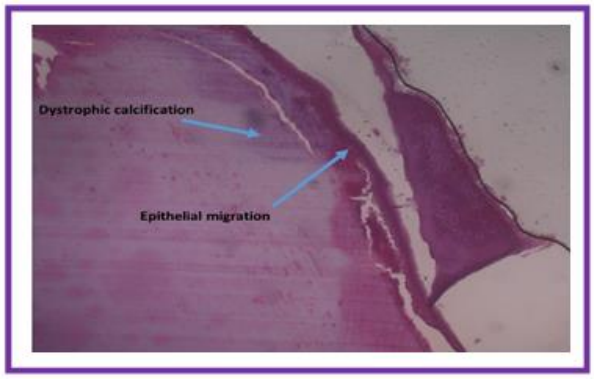


Figure No.4: Dystrophic calcification and Epithelial migration within anterior cortex of lens substance stained with H and E x 250.

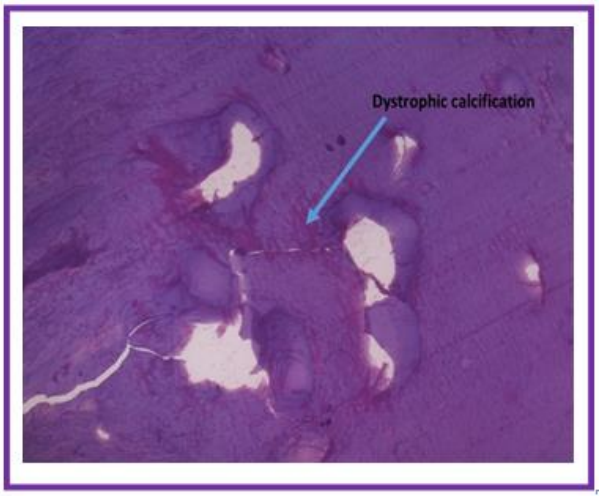


Figure No.5: Dystrophic calcification stained with H & E x 250.

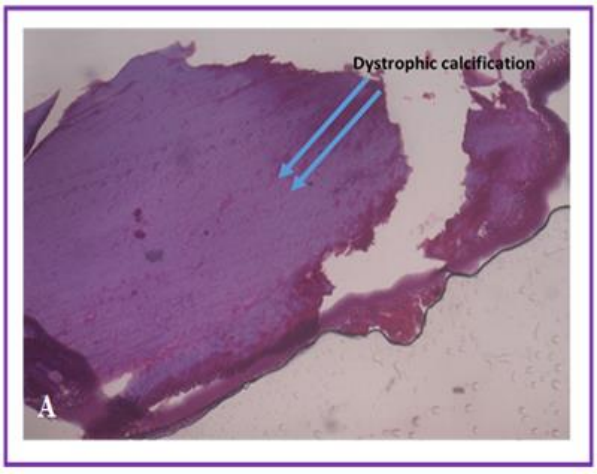


Figure No.6: Dystrophic calcification stained with H & E x 250.

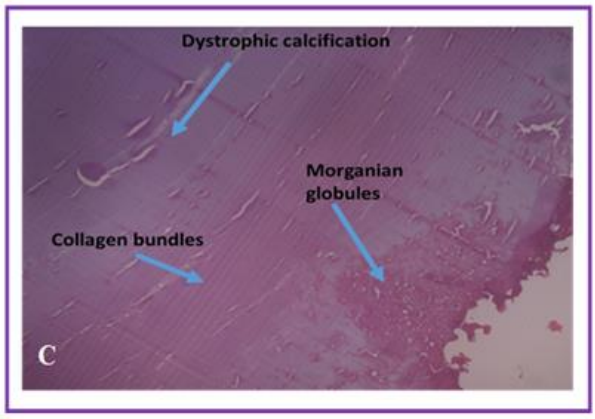


Figure No.7: Dystrophic calcification, Collagen bundles, and organian globules within anterior cortex of lens substance stained with H and E x 250

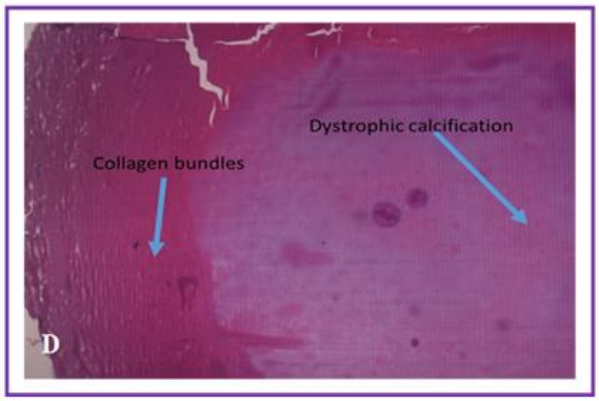


Figure No.8: Dystrophic calcification and Collagen bundles stained with H & E x 250.

Table No.2: Distribution of patients according to Descriptive statistics of Duration of DM (n = 107)

Descriptive statistics	
Mean	4.56
Standard Deviation	2.17
Mode	3.00
Median	4.00
Range	2 to 11 years
Minimum	02
Maximum	12
Duration of DM: < 10 years > 10 years	 105(98.1%) 02(1.9%)

DISCUSSION

This study showed that the average age of patients with diabetes in cataracts was 61±10, which is identical to Raman and his colleague's Indian studying, and higher than that of Janghorbani[13] average age at 49.2 years.[14] In both diabetic and non-diabetic cataracts, both forms of cataracts (atomic, cortical, post capsular, and mixed cataracts) are discovered with a higher prevalence for diabetics, and radioactive cataracts in non-diabetics. This was consistent with Beaver Dam Eye Study and Blue Mountains Eye Study which demonstrated a statistically significant correlation of Post-capsular cataract with diabetes.[15, 16],

We found glucose in all of the diabetic nuclei with a mean concentration of 21,24 mg/dl and a mean concentration of non-diabetes of 12,30 mg/dl in this biochemical research portion. This finding is compatible with Pirie who has observed that diabetic cataract lenses have igneous sorbitol and glucose and fructose levels compared to non-diabetic lens[17], most likely at same frequency as high glucose levels in diabetic comedy.[18]

The Park Young M et al.[19] notes that nuclaratal assailable cuboidal sloshed capsular has been observed to have an equivalent cuboidal epithelial cell monolayer firmly attached to anterior capsule. According to previous studies using extraction lens abnormal permeability of lens around sac to induce cataract, which is due to histologic analysis of cell membrane damage and consequent expansion of space between lens fiber, and Some were also abnormal shape changes in lens capsule confirmation.[2, 19]

Further, duration of diabetes was found to be a significant independent predictor of cataract for patient with insulin-dependent diabetes mellitus.[20]

CONCLUSION

In many cases lens capsules were ruptured spaces between lens fibers increases in some area. The duration of diabetes, age, or gender was found to be a significant risk factor for predicting the grade of cataract in male or female diabetic patients. The present study revealed that the decreased energy available for normal functioning of the lens in old age resulted in degenerative and sclerotic changes.

Author's Contribution:

Concept & Design of Study:	Asad Ali Zardari
Drafting:	Shazia Begum Shahani, Muhammad Yaqoob Shahani
Data Analysis:	Umbreen Bano, Mujeeb-ur-Rehman Sahito, Pashmina Shaikh
Revisiting Critically:	Asad Ali Zardari, Shazia Begum Shahani
Final Approval of version:	Asad Ali Zardari

Conflict of Interest: The study has no conflict of interest to declare by any author.

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