MORPHOLOGICAL ANALYSIS OF THE LENS NUCLEUS

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ABSTRACT

438 eyes of 365 patients undergoing Extra-Capsular Cataract Extraction were included in this study. Preoperatively the age of the patients, colour of the nucleus and grading on the Wilmer System were recorded. Postoperatively the diameter, width and hardness of the nucleus were recorded. Statistical analysis revealed a strong correlation between the age, depth of colour and grading on the Wilmer system and the size and hardness of the nucleus. The size and hardness of the nucleus can be predicted preoperatively by proper assessment of the age, colour, and grading on the Wilmer System. This would help the Surgeon in evolving a proper surgical plan for each patient and thus bringing down the complication rate and difficulties faced during the surgery especially during Phacoemulsification surgeries.

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KEY WORDS Cataract; Lens colour; Nuclear hardness; Lens nucleus.

Introduction

The studies on the human lens and cataract have so far concentrated on the whole lens. With the advent of micro surgery and the increasing popularity of Extra-Capsular Cataract Extraction (ECCE) and newer techniques of small incision cataract surgery and phacoemulsification the nucleus has assumed great importance. The nucleus is the single most important determinant of the success of small incision cataract surgery and phacoemulsification. Nucleus management has become the most important step in these techniques. The diameter and thickness of the lens nucleus is directly related to the size of the incision and the hardness of the nucleus preoperatively which could help the operating surgeon in planning small incision surgery including Phacoemulsification.

Material and Methods

The study population consisted of all patients undergoing Extra-Capsular Cataract Extraction during the period of study. A proforma was made and completed for each patient. The proforma was pretested on 30 patients. The data obtained was compiled and analysed to see if it helped in achieving the objective set out for the study. This proforma was then modified in light of the knowledge obtained. A complete history along with ocular status was recorded. Pre-operatively nucleus opacities and the type of cataract was graded based on the Wilmer system. The age of the patient and the colour of the nucleus was recorded. Post operatively the diameter and the width of the extracted lens nucleus was measured immediately after extraction, using the Vernier callipers and screw gauge. The epinucleus was then removed by repeated hydrodissection in vitro and the central nucleus was isolated and the diameter and width again measured. The hardness of the nucleus was measured in terms of ease of breakability with a modified Mophersons forceps. The information so collected was computed in the form of a master table for subsequently deriving other tables with relevant information.

Results

It was observed that the size, colour and hardness of the nucleus had a direct correlation with age i.e. with increasing age the diameter and width of the nucleus also increased, the colour increased in depth and the nucleus was found to be harder. The size, colour and hardness of the nucleus also had a direct correlation with the grading of the nuclear cataract on the Wilmer System i.e. the increased grading from 0 to IV showed a corresponding increase in size, depth of colour and the hardness of the nucleus. The largest and smallest diameter of the central hard nucleus were 8.06 mm and 4.21 mm with a mean of 6.43 mm. The largest and smallest thickness of the central hard nucleus were 3.65 mm and 2.03 mm with a mean of 2.87 mm. The maximum diameter of the central nucleus was 8.06 mm. 85% of the patients had a central nucleus size less than 7 mm. A careful preoperative assessment of age, colour and grading on Wilmer System can help predicting the size of the nucleus in individual cases and the length of the incision can be reduced.

The diameter of intact nucleus in 438 patients of Indian origin ranged from 5.89 to 9.21 with an average of 7.36 mm and the thickness ranged from 2.56 mm to 5.05 mm with an average of 3.5 mm.

Discussion

Cataract Surgery is increasingly being judged by its refractive results. Earlier the aim of cataract surgery was just to cure blindness. Today the aim is to give a perfect vision to a cataract patient. In this quest for perfection the lone barrier has been the post operative astigmatism, the spherical element being corrected by implantation of a proper IOL with the required power. The main cause of the postoperative astigmatism has been the large incision used in the conventional extra capsular extraction. Newer techniques of small incision cataract surgeries [3,4] and phacoemulsification have been evolved mainly to contain the astigmatism by reducing the size of the incision. All the techniques

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TABLE 1
Average size of nucleus

Parameter	Mean	Sample size	S.D.	Range
Diameter of intact nucleus	7.36 mm	429	0.65	5.89 mm to 9.21 mm
Diameter of central nucleus	6.43 mm	429	0.56	4.31 mm to 8.06 mm
Thickness of intact nucleus	3.5 mm	429	0.33	2.56 mm to 5.05 mm
Thickness of central nucleus	2.87 mm	429	0.39	2.03 mm to 3.65 mm

TABLE 2
Correlation of age vs central nucleus diameter

Age group	No of patients	Mean diameter	S.D.
< 40 yrs.	18	5.50 mm	0.45
41-50 yrs.	77	5.93 mm	0.39
51-60 yrs.	143	6.30 mm	0.35
61-70 yrs.	130	6.71 mm	0.35
> 71 yrs.	61	7.08 mm	0.43

Analysis of variation

Variation	s.s.	DF.	MS	F Statistic	P value
Between	74.05	4	18.51	133.13	< 0.001
Within	58.96	424	0.13		
Total	133.01	428			

TABLE 3
Correlation of age vs colour of nucleus

Age group	White	Yellow	Brown	Black	Total
< 40 yrs.	19	0	0	0	19
41-50 yrs.	58	17	2	0	77
51-60 yrs.	41	79	23	0	143
61-70 yrs.	23	57	47	3	130
> 71 yrs.	5	6	45	5	61
Total	146	159	117	8	430

Chi Square 223.8; Since the number was very low including 0 at places it was not amenable for statistical analysis.

revolved around the nucleus management. The nucleus is the single most important determinant of success of these surgeries. Despite being so important very few studies have been performed to define the morphology of the lens nucleus.

We carried out a morphological analysis of the lens nucleus with the aim of assessing the significance of the age of the patient, colour of the nucleus and the Wilmer system of nucleus grading in predicting the size and hardness of the nucleus. The size of the nucleus influences the size of the incision in the conventional ECCE and the Non Phaco small incision surger-

TABLE 4
Correlation of age and central nucleus width

Age group	No of patients	Mean width	S.D.
< 40 yrs.	18	2.39 mm	0.21
41-50 yrs.	77	2.63 mm	0.28
51-60 yrs.	143	2.80 mm	0.23
61-70 yrs.	130	2.98 mm	0.25
> 71 yrs.	61	3.29 mm	0.60

Analysis of variation

Variation	ss	DF	MS	F Statistic	P value
Between	21.48	4	5.37	51.71	< 0.001
Within	44.04	424	0.10		
Total	65.53	428			

TABLE 5
Correlation of age vs hardness of the nucleus

Age group	1 Soft	2 Medium	3 Hard	Total
< 40 yrs.	18	0	0	18
41-50 yrs.	59	18	0	77
51-60 yrs.	43	97	3	143
61-70 yrs.	25	59	46	130
> 71 yrs.	4	6	51	61

Chi Square 289.9; Since the number was very low including 0 at places it was not amenable for statistical analysis

TABLE 6
Colour vs hardness of the nucleus

Colour	1 Soft	2 Medium	3 Hard	Total
White	143	2	0	145
Yellow	6	151	2	159
Brown	0	27	90	117
Black	0	0	8	8
	149	180	100	429

Chi Square 665.82; DF 6; Statistical analysis not possible

TABLE 7
Colour vs central nucleus diameter

Colour	No of Pts	Mean diameter	S.D.
White	145	6.01	0.47
Yellow	159	6.45	0.49
Brown	117	6.89	0.38
Black	8	7.24	0.44

Analysis of variation

Variation	s.s.	DF	MS	F Statistic	P Value
Between	56.20	3	18.73	103.66	< 0.001
Within	76.80	425	0.181		
Total	133.01	428			

TABLE 8
Colour vs central nucleus width

Colour	No of pts.	Mean width	SD
White	145	2.65	0.27
Yellow	159	2.87	0.24
Brown	117	3.13	0.49
Black	8	3.5	0.19

Analysis of variation

Variation	s.s.	DF	MS	F Statistic	P Value
Between	18.06	3	6.02	53.89	< 0.001
Within	47.47	425	0.11		Highly significant
Total	65.53	428			

ies. The central thickness of the nucleus is useful in trenching of the nucleus during Phacoemulsification. The hardness of the central nucleus directly influences the technique of phacoemulsification.

The average diameter of the intact nucleus in the present study was 7.36 mm. The average diameter of the central nucleus was 6.43 mm (Table 1). Gullapalli, Murthy and Murthy [7] in their study in 1995 done on 130 patients all aged above 40 years found out the diameter of the central nucleus to be 7.14 mm $\pm$ 0.76 mm, Ayaki, Ohde and Yokoyama [3] in their study on 88 eyes found the average diameter of the central nucleus to be 6.5 $\pm$ 0.75 mm. In another study by the same authors on 100 eyes the average diameter of the central nucleus was 6.43 $\pm$ 0.86 mm [2].

The findings of present study are similar to the findings of the Japanese study [1,2]. the slightly higher value found by Gullapalli, Murthy and Murthy [7] could be due to a smaller sample or a different method of measuring the diameter. They used a transparent scale, whereas the present study used a micrometer screw gauge and the Japanese study [1,2] an electronic callipers both measuring the diameter to an accuracy of 1/100th of a mm.

The average thickness of the intact nucleus was 3.5 mm and of the central nucleus was 2.87 mm respectively (Table-1). Gullapalli, Murthy and Murthy [2] found the thickness of the central nucleus to be 3.05 $\pm$ 0.48 mm. Ayaki, Ohde and Yokoyama [1,2], in their two studies found it to be 2.96 $\pm$ 0.33 mm and 2.93 $\pm$ 0.36 mm respectively.

The largest and the smallest diameters of the intact nucleus revealed by this study were 9.21 mm and 5.89 mm and that of the central nucleus were 8.06 mm and 4.31 mm respectively (Table 1). Ayaki, Ohde and

Yokoyama [1,2] in their study found it to be 8.01 mm and 4.09 mm for the central nucleus. The largest and the smallest central thickness of the intact nucleus were 5.05 mm and 2.56 mm and that of the central nucleus were 3.65 mm and 2.03 mm respectively (Table 1). Ayaki, Ohde and Yokoyama [1,2] found the central thickness to be 3.67 mm and 2.03 mm respectively.

Our study revealed that the diameter, width and hardness of the Central nucleus were directly related to the age of the patient, the colour of the nucleus and the grading on the Wilmer System i.e. with increase in age, increased depth of colour and higher grade on the Wilmer system, the size and hardness of the nucleus increased in a linear manner as is depicted in the Table 2 to 8. The Wilmer System of grading of Nuclear Cataract was applicable only in immature cataracts and had no role in mature or hyper mature cataracts. But the age and colour of the nucleus could be applied to all the cases. A proper assessment of the colour, age and assessment by Wilmer System of grading, preoperatively can help the operating surgeon in predicting the size and hardness of the nucleus prior to surgery and enable him to modify his technique to a one suitable to deal with the kind of nucleus he is dealing with. An individualised preoperative surgical plan could thus be evolved for each patient which would bring down the complications and difficulties faced by the surgeon during the surgery and would help the surgeon in providing the patient with the best possible visual outcome.

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