

A Prospective Assessment of the Role of Diabetes Mellitus in Causing Posterior Subcapsular Cataracts

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Abstract

Aim: This study aimed to determine the role of diabetes mellitus in causing cataracts, especially posterior subcapsular cataracts.

Methods: The present study was conducted in the Department of ophthalmology, ANMMCH, Gaya, Bihar, India for the period of 10 months. The consecutive sampling method used in this study the overall data of cataract patients treated by the Department of ophthalmology, ANMMCH, Gaya, Bihar. This data is a medical record containing a history of diabetes mellitus and the types of cataracts suffered by 200 patients.

Results: In this study, 200 patients' data were used; it is known that there were 70 patients with a history of diabetes mellitus (35%) and history of non-diabetes Mellitus as many as 130 patients (65%). As for 200 patients who suffer from cataract eye disorders or diseases in this study, it was found that 40 patients or 20%, had PSC type cataracts, and 160 patients, or 80%, had non-PSC type cataracts. From the cross-section analysis results, it is known that as many as 38 patients or 19% had a history of diabetes mellitus and had PSC cataracts, while two patients or 1%, did not have a history of diabetes mellitus but had PSC cataracts. In addition, the results of the analysis also showed that there were 32 patients, or 16% had a history of diabetes mellitus and had non-PSC cataracts, while 128 patients or 64%, did not have a history of diabetes mellitus experiencing non-PSC cataracts.

Conclusion: As the number of people with DM is estimated to continue to increase, cataract surgery will remain important for diabetic patients. Patients with diabetes have multiple issues to be evaluated preoperatively, perioperatively, and in the postoperative period.

Keywords: Cataract; Diabetes Mellitus; PSC Cataract

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Introduction

The prevalence of diabetes mellitus (DM) is increasing on a daily basis, with the International Diabetes Federation estimating that there will be 439 million DM patients by 2030. [1] An aging population and longer patient life expectancy also means that the prevalence of DM will exceed 33% by 2050. [2] DM can lead to pathologies in many tissues in

the eye structure, with both a systemic chronic metabolic disease and a microangiopathic character. [3] Cataract is one of the major causes of visual impairment in diabetic patients. [4] Patients with DM are reported to be up to five times more likely to develop cataract, in particular at an early age. [5-8] Due to the increasing prevalence of DM, the

incidence of diabetic cataracts has also risen. Cataract extraction is one of the most common surgical procedures among the general population, and the number of cataract surgeries each year also continues to increase.

Eyes need lenses that are clear, transparent, and flexible or elastic. If the lens in the eye loses its translucency or clarity, the vision will become foggy and even cause a person unable to see at all [9], this is because the cloudiness that occurs in the lens makes the amount of incoming light decrease and causes a person unable to see correctly. [10] Turbidity or loss of translucency that occurs in the lens is called a cataract. Turbidity in the lens or cataracts can occur due to hydration of the lens fluid, denaturation of the lens protein, or a result of both. [11]

Cataracts consist of four types: secondary cataracts, senile cataracts, complicated cataracts, and traumatic cataracts. [12] In a population over 50 years old, most people suffered from senile cataracts consisting of nuclear cataracts, cortical cataracts, and Posterior Subcapsular Cataracts (PSC) caused by lens degeneration. [13] This research will focus on the PSC, which is located in front of the posterior lens capsule. Early in its development, PSC made patients feel dazzled by the light and then experienced decreased vision of bright light. [14]

Diabetes mellitus is a chronic metabolic disease caused by inadequate insulin secretion, impaired insulin function (insulin resistance), or both.¹¹ Diabetes mellitus is reported to cause cataracts due to long-term uncontrolled hyperglycemia and significant fluctuations in blood glucose levels. [15] This condition is because most of the glucose breakdown in the lens 78% is via the anaerobic glycolysis pathway, 14% via the pentose phosphate pathway, and about 5% via the polyol pathway. In conditions of

hyperglycemia, the anaerobic glycolysis pathway saturates quickly, and glucose selects the polyol pathway. In the polyol pathway, glucose is converted to sorbitol. Sorbitol is then broken down into fructose by the Polyol Dehydrogenase enzyme. However, in diabetes mellitus, the Polyol Dehydrogenase enzyme levels are low, so sorbitol accumulates in the eye lens. A hypertonic state will draw the Aquos fluid into the eye lens, damage the lens architecture and cause lens cloudiness or what is called cataracts. [16]

PSC cataract patients may not realize they have cataracts if the visual disturbance does not occur in the centre of the lens because visual disturbances in cataract patients occur slowly and are only realized when their eyesight is getting worse, even when patients experience blindness. [17] PSC cataracts and diabetes mellitus are a severe condition, which becomes an enormous health burden, especially for developing countries such as Indonesia, which do not yet have excellent and affordable cataract and diabetes management. [18]

This study aimed to determine the role of diabetes mellitus in causing cataracts, especially posterior subcapsular cataracts.

Materials and Methods

The present study was conducted in the Department of ophthalmology, ANMMCH, Gaya, Bihar, India for the period of 10 months. The consecutive sampling method used in this study the overall data of cataract patients treated by the Department of ophthalmology, ANMMCH, Gaya, Bihar. This data is a medical record containing a history of diabetes mellitus and the types of cataracts suffered by 200 patients.

The criteria set are:

1. Cataract patients over 45 years old at the Eye Hospital
2. Experiencing PSC cataract or Non-PSC cataract eye disease

3. Have a history of diabetes mellitus or non-diabetes mellitus

In this study, the independent variable was diabetes mellitus, while the dependent variable was PSC cataract. The analysis results were recorded in a 2x2 table. The hypotheses proposed in this study are as follows.

H0: History of diabetes mellitus does not cause PSC cataract eye disease

H1: History of diabetes mellitus causes PSC cataract eye disease

In addition to the cross-sectional analysis, a regression test was also conducted to determine the value of the determinant coefficient (R²), which shows the magnitude of the influence of Diabetes Mellitus disease history (independent

variable) in causing PSC cataract (dependent variable). If the R² value shows a value of 0.67 or more, then the independent variable significantly influences the dependent variable. Meanwhile, if the R² value shows a value of 0.33 or 0.19, then each independent variable has a moderate or weak influence on the dependent variable. [19]

Statistical analysis

The data obtained in this study were then processed and analyzed with a cross-sectional design and chi-square test using IBM SPSS 26 software to determine the proportion of data distribution and the relationship between the independent and dependent variables.

Results

Table 1: Number of diabetes and cataract patients

History of Disease	N%
Diabetes Mellitus	70 (35)
Non-Diabetes Mellitus	130 (65)
Type of cataract	
PSC	40 (20)
Non-PSC	160 (80)

In this study, 200 patients' data were used; it is known that there were 70 patients with a history of diabetes mellitus (35%) and history of non-diabetes Mellitus as many as 130 patients (65%). As for 200 patients

who suffer from cataract eye disorders or diseases in this study, it was found that 40 patients or 20%, had PSC type cataracts, and 160 patients, or 80%, had non-PSC type cataracts.

Table 2: Cross-Section Test Results

History of disease	Type of cataract		Total
	PSC N%	Non-PSC N%	
Diabetes Mellitus	38 (19)	32 (16)	70 (35)
Non-Diabetes Mellitus	2 (1)	128 (64)	130 (65)
Total	40 (20)	160 (80)	
Chi-Square Test			
Pearson Chi Square	89.56	1.0000	0.000

From the cross-section analysis results, it is known that as many as 38 patients or 19% had a history of diabetes mellitus and had PSC cataracts, while two patients or 1%, did not have a history of diabetes mellitus but had PSC cataracts. In

addition, the results of the analysis also showed that there were 32 patients, or 16% had a history of diabetes mellitus and had non-PSC cataracts, while 128 patients or 64%, did not have a history of diabetes mellitus experiencing non-PSC cataracts. Overall, there were 70 patients, or 35%

had a history of diabetes mellitus and had cataracts, and there were 130 patients or 65% who did not have a history of diabetes mellitus but had cataracts. Thus, it can be concluded that diabetes mellitus has a relationship with cataracts, especially PSC cataracts. This condition is proven by more patients with PSC cataracts who have a history of diabetes mellitus than patients who suffer from PSC cataracts but do not have a history of diabetes. In this study, a confidence interval of 95% or α 0.05 was used. Thus, to accept hypothesis H1, the Pearson Chi-Square value on the resulting Chi-Square test must be less than the cut-off value of 0.05.

Discussion

The eye is an essential visual organ for humans.¹⁶ With the eye, human beings can get a variety of visual information transmitted to the brain properly to be processed as a basis for decision making in carrying out daily activities. Every organ in the eye has a vital function for humans because if one of the eye functions is problematic, it will affect the function of other organs. According to data reported by the World Health Organization [20], it is estimated that 2.2 billion people suffer from vision problems, with 65.2 million people in the world suffering from cataracts. With a large number, cataracts are pointed out as one of the global health problems.

It was found that there were 32 patients or 16% had a history of diabetes mellitus and had non-PSC cataracts, while 160 patients or 64% did not have a history of diabetes mellitus experiencing non-PSC cataracts. From these results, it can be seen that diabetes mellitus has a relationship with the occurrence of PSC cataracts. This situation is in line with research conducted by Ehrlich RM and Taskapili M which states that anterior and subcapsular posterior are structural characteristics of cataracts in diabetic patients. [21,22]

In testing the hypothesis in this study, the chi-square test was carried out. As known in the previous analysis, the resulting Pearson chi-square value is 0.000 less than the cut-off value of 0.05. Thus, hypothesis H1 is accepted, which means that a history of diabetes mellitus can cause PSC cataract eye disease. Then, in the R2test, it was found that the PSC cataract eye disease was influenced by a history of diabetes mellitus by 39.1% (R^2 : 0.391); this means that the history of diabetes mellitus has a moderate effect in causing PSC cataracts, and as much as 60.9% is influenced by other factors that were not examined in this study. This finding supports other studies that say that the cause of PSC cataracts is multifactorial with other factors, not only by one thing, such as diabetes mellitus. [14]

The results of this study also support several studies that have shown that diabetes mellitus can cause cataracts to occur more frequently than non-diabetics. Framingham and other eye studies showing a three to fourfold increase in cataract prevalence in patients with diabetes under 65 years old and a two-fold increase in patients over 65 years old. The results of hypothesis testing in this study also in line with The Visual Impairment Project, which evaluates risk factors for cataract development in Australia. The study showed that diabetes mellitus is an independent risk factor for posterior subcapsular cataract if it occurs for more than five years. [24] In addition, eight studies in Europe, America, Africa, and Australia on 20,837 cataract patients using a meta-analysis method showed that type 2 diabetes mellitus has an increased risk of developing posterior subcapsular cataracts ($OR=1.55, 95\% CI: 1.27-1.90, P<0.001$). [23] Medicare analysis from 1997 to 2001 revealed that the diagnosis rate of postoperative pseudophakic cystoid macular edema (PCME) was higher in diabetic patients than in non-diabetic patients. [24] So that PCME prophylaxis

should be done immediately depending on the stage of diabetic retinopathy. However, if diabetic retinopathy is found, patients with PSC cataracts should delay surgery or cataract extraction. [25,26]

Conclusion

As the number of people with DM is estimated to continue to increase, cataract surgery will remain important for diabetic patients. Patients with diabetes have multiple issues to be evaluated preoperatively, perioperatively, and in the postoperative period. With the advent of modern surgical and pharmacologic therapies, these patients can, like other cataract patients without diabetes, recover excellent vision. Postoperative monitoring and management of surgical complications will also help to alleviate the risk of vision loss in these patients.

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