



AGE-RELATED CATARACT: A CROSS-SECTIONAL POPULATION-BASED CASE-CONTROL STUDY OF BLOOD GLUCOSE AND BLOOD PRESSURE

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ABSTRACT

Cataract is opacity of the crystalline lens. The greatest risk factor for cataract formation is age. Diabetes mellitus is associated with incidence of cortical and posterior sub-capsular cataract. The association between age- related cataracts and systemic cardiovascular or atherosclerotic disease is reported in the recent epidemiologic reports. The search for these factors remains are primarily because theories of pathogenesis and prevention remain controversial. An observational population-based case-control study with 30 cluster-samples in order to analyze the relationship of blood glucose and blood pressure between cataract and no cataract patients who were 50 years or older was carried. The results of this study showed: The level of blood glucose is lower 6.1mmol/l associated with blood pressure is lower 140/90mmHg in cataract patients who were 50 years or older was unrelated. The relationship of blood glucose \geq 6.1mmol/l associated with blood pressure \geq 140/90mmHg in cataract patients who were 50 years or older has a significant difference in statistics (OR=2.1 [1-4.3], $p < 0.05$).

Purposes: To study on the relationship of blood glucose and blood pressure on cataract patients who were 50 years or older

Design- Method: An observational population-based case-control study with cross-sectional 30 cluster-samples in order to analyze the relationship of blood glucose and blood pressure between cataract and no cataract patients who were 50 years or older was carried out in population.

Results: The level of blood glucose is lower 6.1mmol/l associated with blood pressure is lower 140/90mmHg in cataract patients who were 50 years or older was unrelated. The relationship of blood glucose \geq 6.1mmol/l associated with blood pressure \geq 140/90mmHg in cataract patients who were 50 years or older has a significant difference in statistics (OR=2.1 [1-4.3], $p=0.04$).

Conclusion: Level of blood glucose \geq 6.1mmol/l associated with blood pressure \geq 140/90mmHg was related in cataract subjects who were 50 years or older.

This may also have a preventive utility, can be primarily manipulated these risk factors by general practitioners in detecting early onset retinopathy. For eye doctors, this finding may be a marker of parameters for follow-up the progression of cataract in ophthalmic practice.

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INTRODUCTION

Cataract is opacity of the crystalline lens. Cataractogenesis is often implied by various exogenous and endogenous factors. The greatest risk factor for cataract formation is age. Diabetes mellitus is associated with incidence of cortical and posterior subcapsular cataract¹. The association between age- related cataracts and systemic cardiovascular or atherosclerotic disease is reported in the recent epidemiologic reports of the Beaver Dam Eye Study and the Cataract Patient Outcomes Research Team². The search for these factors remains are primarily because theories of pathogenesis and prevention remain controversial¹.

Angiang province lies in Mekong Delta of Viet Nam with 3,500 ^{km}² square and 2 million people and over 80% of whom living in the countryside for agriculture. Cataract prevalence in our province is 3% and required cataract surgery is 0.5%, cataract surgical rate is 550 (1993). Cataract surgery has almost been done at Ophthalmic Provincial Hospital. In 1993 Provincial Ophthalmology Department has started to perform Mobile Cataract Surgery Camps (MCS) in community³. In order to assess cataract operation in our province after 5 years of intervention trial of blindness due to elderly cataract, 2 cross-sectional studies (1993-1998) were carried out in the population. On this occasion a case-control study of the relationship of blood glucose (BG) and blood pressure (BP)

between cataract group and no cataract group was also done and primarily examined in this paper.

Participants, Material and Method

Design: Observational population-based case-control study. A cross-sectional population-based case-control study: 30 clusters sampling (each cluster 5 persons) ; $N = Z \times p \times q / e^2$. Where: $p = q = 0.5$, $F = 10(90\%IC)$; $e = 0.22$
 $\Rightarrow N = (1.96 \times 0.5 \times 0.5) \times 10 / (0.22)^2 \# 100$.

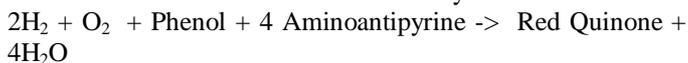
Participants: We investigated on subjects 50 years or older (range 50 to 88 years of age), in order to analyze BG, BP. Cases included cataract patients who were prepared for operation in MCS and controls (relatives' patients) were examined without any cataract presence in screening in MCS. Each group N=100 persons after adjusted age, not for sex. Trauma, uveitis were excluded in this study.

1. Ophthalmic examination: Hein ophthalmoscope, tonometer Schiozt Maclakov.
2. Blood pressure (BP): One measured generally BP by indirect method with sphygmomanometer and stethoscope, 2 times at the morning and the afternoon.
3. Blood glucose (BG) is measured by enzymatic method at early morning with empty stomach (venous blood). Normal level: 70 -110 mg% or 3.85 - 6.1 mmol/l

Glucose oxydase



Peroxydase



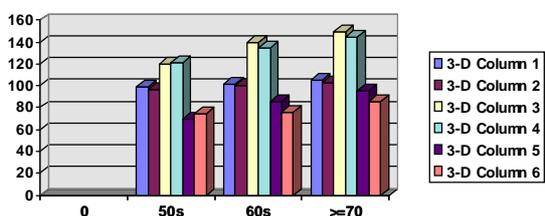
We used the upper limit BG 6.1mmol/l associated with limited high BP 140/90mmHg in order to analyze the relationship by assessing odds ratio.

RESULTS

Table I Distribution of blood glucose (BG), systolic blood pressure (SBP), diastolic blood pressure (DBP) between two groups: cataract and no cataract

	Cataract	No cataract	Statistics
Mean Age	63.9 years ±8.4	62,8 years ±9.1	t=0.91, p=0.3
BG	101.9mg% ±21	100.8mg% ±19	t=1.16, p=0.2
SBP	136.1mmHg ±25	133.08mmHg±21	t=1.53, p=0.1
DBP	83.2mmHg ±16	81.2mmHg ±16	t=1.53, p=0.1

In this study, the relationship between the level of blood glucose and blood pressure in age-related cataract were examined. BG, systolic blood pressure (SBP), diastolic blood pressure (DBP) between two groups: cataract and non cataract are not different in statistics (Table I, figure 1) but there was an increasing with age group. In Angiang province the other study on people ≥ 20 years old showed 13% of arterial hypertension (1995). There is an increasing of BG, BP with age group 50s, 60s, 70s between cataract and non-cataract but no significance in our study as the same to Japanese study [31].



Note figure 1 BG, SBP, DBP according to age groups: 50s, 60s, ≥70s:

There is an increasing of blood glucose and blood pressure with age groups. To convert values for blood glucose to millimoles per litter multiply by 0.055.

Column	Contents	Ages 50-59 54±3vs53±2	Ages60-69 64±2vs61±2	Ages ≥70 74±4vs75±4
1	Blood glucose: Cataract	99mg%	103	104
2	Blood glucose: No Cataract	98mg%	101	103
3	Systolic blood pressure: Cataract	130mmHg	138	140
4	Systolic blood pressure: No Cataract	127mmHg	134	138
5	Diastolic blood pressure: Cataract	80mmHg	82	87
6:	Diastolic blood pressure: No Cataract	78mmHg	79	84

Table II B G ≥ 6.1mmol/l and BG < 6.1mmol/l; DBP ≥ 90mmHg and < 90mmHg; SBP ≥ 140 mmHg and < 140mmHg between two groups: cataract and no cataract.

	Cataract	No cataract	OR	CI 95%	p
BG ≥ 6.1mmol/l	34	30	1.2	[0.6 - 2.2]	0.54
BG < 6.1mmol/l	66	70			
DBP ≥ 90mmHg	30	28	1.1	[0.6 - 2.1]	0.7
DBP < 90mmHg	70	72			
SBP ≥ 140mmHg	35	26	1.5	[0.9 - 3.]	0.16
SBP < 140mmHg	65	74			

In the table II: we used the upper normal BG 6.1mmol/l to analyze in pairs: The relationship of: BG ≥ 6.1mmol/l and < 6.1mmol/l showed no difference in statistics, we chose the limited high BP 140/90mmHg to analyze in pairs: The relationship of SBP ≥ 140mmHg and < 140 mmHg; DBP ≥ 90mmHg and < 90mmHg showed no difference in statistics.

Table III Blood glucose associated with blood pressure

	Cataract	No cataract	OR	CI 95%	p
BG + DBP			1.3	[0.7 - 2.7]	0.4
≥6.1mmol/l+≥90mmHg	30	22			
<6.1mmol/l+<90mmHg	66	64			
BG + SBP			1.4	[0.7 - 2.8]	0.25
≥6.1mmol/l+≥140mmHg	32	24			
<6.1mmol/l+<140mmHg	63	68			
BG + BP			2.1	[1 - 4.4]	0.04
≥6.1mmol/l+≥140/90mmHg	30	16			
<6.1mmol/l+<140/90mmHg	65	72			

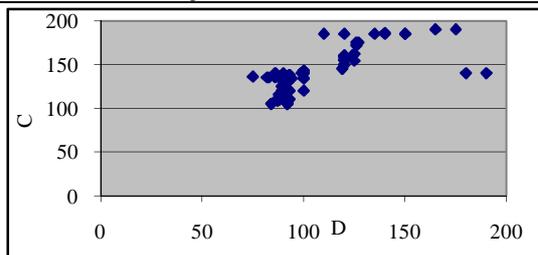


Fig. 2 (up) The correlation of blood glucose level (BG), mean arterial pressure (MAP), in no cataract group r = 0, 72

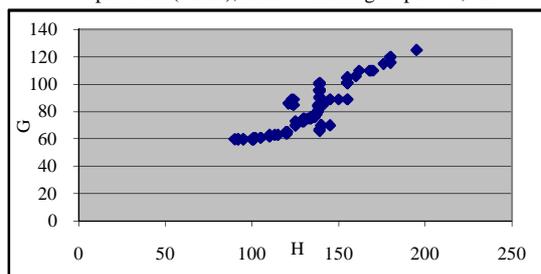


Fig 3 (bottom) The correlation of blood glucose level (BG), mean arterial pressure (MAP), in cataract group r = 0, 81

DISCUSSION

Controversial issues addressed in the management of cataract coexistent with diabetes mellitus, juvenile rheumatoid arthritis and ectopia lentis. Prolonged hyperglycemia is postulated to induce increased aldose reductase. Some authors conclude by recommending that cataract and retina be examined at the time of type I diabetes mellitus diagnosis, as the metabolic cataracts can develop quickly and impair assessment of the retina¹. Cataractogenesis is characterized by a progressive increase in light scattering from the lens. Condensation of protein into aggregates is an important molecular mechanism that produces scattering light¹.

Blood glucose and cataract

Up to now we do not have any information on this relationship. In the table II we used the upper normal BG 6.1mmol/l to analyze in pairs: The relationship of: BG \geq 6.1mmol/l and $<$ 6.1mmol/l showed no difference in statistics.

Diabetes and Cataract: *Pathology: Several studies have reported an association between glucose and the increased risk of cataract on animal and human⁴. In cataract formation of diabetes alternative mechanisms may be superimposed on the normal aging process⁵. Oxidative stress and glucose metabolism are principal mechanism of cataract. The oxidative stress is: the modification of proteins, peroxidation of lipid, decreasing of reductase glutathion. Some events of glucose and cataract are: 1928 glucose was transformed to lactate in crystalline lens, 1933 cataract in spleenectomy dog, 1935 cataract in mouse nourished with lactose, 1953 reductase glutathion in lens, 1961 the transformation of glucose to sorbitol in the case of opacification was confirmed, 1962 osmotic theory of diabetes cataract, 1975-1977 enzymes of glycolyse and hypoglycemia cataract were demonstrated, 1980 glutathion accumulated in lens in the case out of its capacity⁶.

Clinical findings: The Beaver Dam Eye Study: Diabetes mellitus is associated with incidence over 5 years of cortical and posterior subcapsular cataract and with progression of more minor cortical and posterior subcapsular lens opacities. These changes may be related to level of glycemia². In 1997 The American Diabetes Association recommended the normal glycemia should be 110mg/dl (6.1mmol/l).

Incidence: The incidence of ocular complications in diabetes is of 24%-70% retinopathy, 18-22% cataract⁷, neuro-ophthamological complication rarely⁸. Diabetes has been reported to increase the risk of cataract up to 12 fold in different population⁷. The prevalence of cataract in diabetes is about 50% according to long-term follow-up in some studies in Vietnam.

Management: Mature dense cataracts rarely occur and appear not to resolve with control of hyperglycemia, as in this case and require surgical treatment⁸. Cataract surgery in diabetes is precautious particularly aggravated retinopathy. In 1997 Santiago *et al* reported a 9 year old girl who presented with rapidly developing bilateral mature cataracts, reinforced the role of metabolic factors in cataractogenesis. The glycosylation of the lens proteins has been suggested to lead to a permanent lens opacities .In the management of these cataracts a larger than normal anterior capsulotomy has been recommended at the time of cataract surgery to permit better visualization of the fundus for future management of diabetic retinopathy⁹. According to J.H.Kinoshita the oxidative stress and glucid

stress are the responsibility of cataract and it is hoped that a new drug for fighting aldose reductase activity will become true⁶

Cardiovascular disease, atherosclerosis and cataract

In Angiang province a previous study on people 20 years or older showed 13% of arterial hypertension. There is an increasing of BG, BP with age group 50s, 60s, 70s between cataract and non-cataract but no significance in our study as the same to Japanese study¹⁰. In the table II we chose the limited high BP 140/90mmHg to analyze in pairs: The relationship of SBP \geq 140mmHg and $<$ 140 mmHg; DBP \geq 90mmHg and $<$ 90mmHg showed no difference in statistics.

In 1977 The Framingham Eye Study was one of the first to suggest an association between cataract and a number of cardiovascular risk factors as systemic hypertension diabetes mellitus and elevated serum phospholipid. To identify a causal association, these authors examined the data from the large population based prevalence study of 4926 adult's age 43 to 86 years, known as Beaver Dam Eye Study. These epidemiology studies suggested that serum lipids, glycated hemoglobin and oxidative stress may play a role in cataractogenesis^{1, 2}. The Beaver Dam Study: Cardiovascular disease and its risk factors have little effect on incidence of any age- related cataract².

Street *et al* found a weak association between atherosclerosis related morbidity and visually significant cataract which was strongest for people aged 65 to 69 years and which decreased with patient age. As the prevalence of both atherosclerosis and cataract increased with age, a biologic association between the two may be observed in younger individuals¹.

High blood pressure, hyperglycemia in cataract

High BP is a late complication of diabetes. According to some authors noted: White 53% after 35 years, Roach 0.5% after 4 years and 70% after 35 years. In the other hand high BP patients have a trouble of glycemia 5 times as much non high BP patients.

Datta *et al* offered a new hypothesis regarding the poorly understood pathogenesis of these metabolic cataracts in type I diabetic patients. A high level of glycosylated hemoglobin HbA_{1c}, prolonged duration of hyperglycemia prior to diagnosis, an adolescent age group and preponderance of females were all noted to be significance¹. The Beaver Dam Eye Study have found significant relations of glycemia with incidence nuclear and cortical cataract in persons with older - onset diabetes and have found little evidence of association of cardiovascular disease and its risk factors to incident cataract. These changes may be related to level of glycemia².

In our study, we examined relationship between the level of blood glucose and blood pressure in age-related cataract. BG, systolic blood pressure (SBP), diastolic blood pressure (DBP) between two groups: cataract and no cataract are not different in statistics (Table I, figure 1) but there was an increasing with age group¹⁰.

In the table III: Compared BG \geq 6.1mmol/l associated with SBP \geq 140mmHg: OR=1.4; p=0.25 BG \geq 6.1mmol/l associated with DBP \geq 90mmHg: OR=1.3; p=0.4. The relationship of BG \geq 6.1mmol/l associated with BP \geq 140/90mmHg between cataract and no cataract group has a significant difference in statistics (OR=2.1 [1 - 4.3]; p=0.04) although small sample

and blood glucose at a single point in time does not reflect accurately the patients' exposure.

In the figure 2 and 3 showed a strict relationship BG associated with mean arterial pressure (mean arterial pressure =MAP and $MAP=1/3[SBP+2DBP]$) in 2 groups: cataract group $r=0.72$ vs. no cataract group $r=0.72$.

Future prospective study and clinical trial are needed to better understand these relationships; particularly a cohort study may be done in these risk factors in order to determine the prevalence, the incidence and the progression of nuclear sclerosis cataract, cortical cataract and posterior subcapsular cataract.

This finding may have direct preventive utility, can be primarily manipulated risk factors by general practitioners in detecting retinopathy as soon as possible and may be a marker of parameters for follow-up the progression of cataract in ophthalmic practice.

CONCLUSION

Level of blood glucose ≥ 6.1 mmol/l associated with blood pressure $\geq 140/90$ mmHg was related in cataract subjects who were 50 years or older although small sample. This finding may have a preventive utility, can be primarily manipulated risk factors by general practitioners in detecting early onset retinopathy. For eye doctors, this may be a marker of parameters for follow-up the progression of cataract in ophthalmic practice.

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