Correlation of corneal arcus and serum lipid profile

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Abstract
Arcus senilis is depositionin the peripheral cornea and is considered a part of the normal ageing process usually seen in the elderly. However, there is a strong association of altered lipid metabolism and presence of arcus. We conducted a study at our hospital to find out if corneal arcus is an indicator of deranged lipid metabolism or only a consequence of normal ageing process. It was found that almost all patients with 360 degree corneal arcus had deranged lipid metabolism. Since eleveated serum lipids are a strong risk factor for cerebro vascular accidents and cardio vascular disease it is important to study the correlation between arcus and altered lipid profile. As slit lamp examination of arcus nis a simple, easy and inexpensive method to screen patients for hypercholesterolemia.

Keywords: Arcus, Corneal arcus, Familial dysbetalipoproteinemia, Familial hypercholesterolemia.

Introduction
Corneal arcus or arcus senilis is known to be a corneal finding in most of the aging population. It is has been documented that at the age of 60 about 50-60% of the general human population have arcus and by the age of 80 almost 100% of the population has corneal arcus. It is found to be more common in men than in women. And more common in natives of African American races than in other ethnic groups. In these ethnic groups it tends to occur much earlier than the rest of the population. When it appears in the younger population it is called arcus juvenilis and is frequently associated with familial hyperlipidemia syndromes. Arcus may occasionally be seen as a congenital anomaly (arcus juvenilis), usually involving only a portion of the peripheral cornea and may not associated with abnormalities in lipid metabolism.. It is due to the lipid deposition in the peripheral cornea. It is known to be made up of phospholipids, cholesterol and triglycerides. Of the three lipid parameters serum triglyceride levels are frequently found to be elevated in patients with corneal arcus. This suggests a positive correlation between deranged lipid metabolism and corneal arcus. Diagnosis with slit lamp examination of the arcus is relatively easy and inexpensive, and can be made even in the out patient setting with no access to laboratory testing. The arcus has a hazy gray-white appearance, a sharp outer margin with a indistinct inner margin. A lucid interval of Vogt is usually present between the peripheral edge of the arcus and the limbus. Senile arcus appears first in the inferior and superior sections of the cornea, gradually involves the entire circumference of the cornea in later stages. Arcus is only the macroscopic sign of lipid deposition, and amounts of lipid can be deposited in the perivascular ground substance of the eye without producing a visible arcus. The overall distribution of lipid along with the structure and size of the lipid molecules may influence the threshold of deposition for arcus visibility.Opacities in the peripheral cornea due to deposits other than lipids and different forms of corneal degenerations and dystrophies have to be ruled out before concluding the deposits to be due to lipids. Cornea has a temperature gradient which can affect the deposition of lipid s. It also has a gradient regarding how dense the collagen fibers of the cornea are packed and this effects what size of particle can move towards the center. Furthermore, the cornea is normally avascular, with only the periphery close to limbal capillary beds, which are the source of the lipid in arcus. Arcus and atherosclerotic coronary artery disease increase with age and the incidence of both is greater in males than in females. One major difference between cholesterol deposition in the cornea and atherosclerotic lesions is that cholesterol deposition in atherosclerotic lesions is accompanied by an infiltration of macrophages. These macrophages secrete substances (e.g., cytokines, proteases, complement factors, coagulation factors) that may influence the development of lesions. Some patients may also have Xanthelasma palpebrarum which are plaque-like yellow lesions near the inner canthus of the eyelids that are caused by lipid deposition in the dermis of the eyelids. Studies have linked corneal arcus with alcoholism, diabetes mellitus and atherosclerotic heart disease. Unilateral arcus is a rare entity that is associated with carotid artery disease or ocular hypotony. Corneal arcus, along with a central corneal opacity, is seen in Schnyder's crystalline stromal distrophy. Once correlated with an altered lipid profile, intensive treatment may be warranted, particularly in patients with suspected familial dyslipidemias. Hence the need for study. We conducted a study at our institute to find the correlation between corneal arcus and serum lipid levels in the adult population attending our out patient department in the rural set up.

Materials and Methods
A hospital based cross sectional study on 60 consecutive patients attending the medicine out patient centre at our rural hospital were included in the study. Sampling methodused was simple random sampling. Demographic data such as name, age, sex and geographical location was collected. The presence of systemic risk diseases like

diabetes mellitus, hypertension, ischemic heart disease was noted. Any significant past history and family history were noted. History of chronic smoking and alcohol addiction was ruled out and these patients were excluded from the study. The age group included was between 40-80 years. The fasting plasma concentrations of total cholesterol (TC), LDL and high-density lipoprotein (HDL) were determined by enzymatic assays. Total cholesterol (CHOL), triglyceride (TG) and high density lipoprotein (HDL) were measured. An ophthalmic history was taken from all subjects, and the following examinations were performed: (1) Visual acuity (VA) was measured with the patient's own optical correction. If the acuity was less than 20/20 it was re-examined with a pinhole in front of each eye. A Snellen chart placed at 20 feet (6 m) and a Jaeger reading chart were used for distance and near vision respectively. The presence of arcus was determined by standardised slit lamp examination technique. It was categorised into three groups first being absent arcus, second group those with less than 180 degrees(patial) and third group those with greater than 180 degrees(total). Both eyes were examined and the eye with the higher grade of arcus was taken into consideration. The width of the arcus of the more involved eye at its widest point was taken into account. The exclusion criteria were pregnant and lactatating women. Those with severe uncontrolled hypertension or recent myocardial infarction in the last 6 months, those with liver or pancreatic diseases or gall bladder disease..

Results

The study group was divided into subgroups those with arcus and those without arcus. Of the 60 patients studied 35 were males and 25 were females (Table 1). Of the 35 males 30 had co morbidities such as diabetes or hypertension. Of the 25 females 18 had either diabetes or hypertension. Arcus greater than 180 degress was found in 33 males and 24 females. (Table 2). The total cholesterol was less than 300 mg/dl in 12 males and 9 females with greater than 180 degree of arcus. Was between 301-400 in 11 males and 7 females with arcus greater than 180 degree. Levels between 401-500 were found in 10 males and 8 females. And levels greater than 500 were found in 2 males and 1 female. All of the above had arcus greater than 180(TABLE 3).Correlating LDL levels with arcus levels between 70-100 were found in 13 males and 8 females. Levels between 100-160 were found in 8 males and 9 females. Levels greater than 160 were found in 14 males and 8 females. (Table 4).Correlating hdl cholesterol with arcus all the 50 patients had HDL levels within normal limits. Increasing values of lipids were seen with incteasing in age. Female patients were found to have increased values when compared to males. Almost all the males and female patients were found to have eleveated blood pressure recordings and elevated blood sugar levels. None of the patients included in this study gave any history of cardio vascular disease or previous cerebro vascular accident. In this study, we have found that patients with corneal arcus, the mean lipid profile, the TC, LDL, and VLDL were statistically significantly higher. It is possible that the cases with higher lipid values might develop cardio vascular disease or diseases like cerebro vascular accidents, if not treated for properly. Thus, screening of lipid profile can be helpful in early detection of the high-risk cases and recommending preventive measures through lifestyle modifications for them in order to prevent untoward consequences.

Table 1: Age wise distribuition of arcus senilis

			Percentage
41-50	12	11	91.6%
51-60	14	14	100%
61-70	18	17	94.4%
Above 70	16	16	100%

Table 2: Sex wise distribuition of patients with arcus senilis

Sex	Number screened	positive	Percentage
Males	35	33	94.28%
Females	25	24	96%

Table 3: Correlating lipid levels with arcus greater than 180 degrees

	Males	Females	Total
<300	12	9	21
301-400	11	7	18
401-500	10	8	18
>500	2	1	3

Table 4: Correlating ldl levels with arcus

Ldl levels	Male	Female	Total
70-100	13	8	22
100-160	8	9	15
>160	14	8	22

Discussion

Corneal arcus is a common finding in the aging population.It is a known fact that in people below 50 arcus juvenilis may be associated with familial hyperlipidemia syndromes. Studies done earlier have found a correlation of arcus with age and with low density lipo protein levels. A beneficial effect of raised high density lipoprotein levels in protection against cardiovascular disease has been found. Also some studies have proven that females have less chance of developing arcus when compared to males. The German pathologist Rudolf Virchow is credited with the hypothesis that atherosclerosis reflects insudation of pathogenic agents into tissue. He noted, in 1852, the association of corneal arcus and atherosclerosis, and hypothesized a similar mechanism of formation of arcus and atherosclerotic plaques.[1] In contrast, William Osler, in 1892, suggested that arcus senilis had little utility in the diagnosis of "fatty degeneration" of the heart[2] Arcus lipidalis corresponds to the selective deposition of phospholipids and noncrystalline cholesterol in the Descemet membrane, Bowman's zone, and the peripheral corneal stroma. This opacification often appears in the upper and lower parts of the cornea, and may coalesce to form a full ringall around

the section of the cornea. Characteristically, there is a thin, clear sector separating the arcus from the limbus, known as the lucid interval of Vogt.[3] In individuals over the age of 60 years, it usually represents an aging phenomenon known as arcus senilis and is generally not related to metabolic disorders of lipids. In contrast, the presence of arcus lipoides in younger individuals, known as arcus lipoides juvenilis, can alert the clinicians to the presence of dyslipidemia2 and the need to obtain a comprehensive lipid profile analysis. [4]

Waltens had reported a 60% incidence in his study in the age group between 40 and 60 years whereas in our study the incidence was almost 100% as all patients with elevated lipid levels were found to have corneal arcus[5]. This can be a good screening tool for serum lipid levels in rural set up such as ours considering the low socio economic status of most of our patients attending the medicine out patient department. It is well known that males are more vulnerable to coronary heart disease than females, that coronary heart disease is more frequent in the elderly, and that high levels of serum cholesterol and LDL are among its most important risk factors

In our present study we studied 60 patients where in 35 were males and 25 were females. We found the presence of greater the 180 degrees of arcus and correlated the serum lipid levels. Of the 35 males studied we found that 30 had either diabetes or hypertension and of the 25 females 18 had these risk factors for impending cardio vascular disease. Elevated total cholesterol and and LDL levels were found in almost all the patients with 360 degree arcus suggesting a strog positive correlation between arcus lipidalis and serum cholesterol levels. Which is a major risk factor for cerebro vascular accidents and cardio vascular disease related mortality. Visual diagnosis of hyper lipidemia is relatively easy and inexpensive, and can be made even in settings with no access to laboratory testing. Once correlated with an altered unfavourable lipid profile, intensive and aggressive management strategies may be warranted, particularly in patients with suspected familial dyslipidemias who would have high risk for mortality or morbidity due to cardiovascular disease, myocardial infection, stroke or cerebro vascular accidents. Since the sample size in our study was small larger ohort studies need to be be conducted to determine if corneal arcus is associated with dyslipidemia is associated with any other systemic conditions which are detrimental to life.

Conclusion

Corneal arcus reflects widespread tissue lipid deposition and is correlated with both atherosclerosis and cardiovascular disease in patients. Patients with 360 degree arcus were found to have evelated serum lipid levels. Which is a risk factor along with diabetes and hypertension for cardio vascular disease.

Conflict of Interest: None.

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