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Original Research Article

Assessment of serum lipoprotein (a) and total cholesterol in children of CAD parents

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ABSTRACT

Background: More and more Indians are falling prey to coronary artery (CAD) which is one of the genetic diseases attributed to numerous gene-environment interactions. There are various reasons for this including a sedentary lifestyle, genetic predisposition, pollution, smoking, drinking, a fatty diet and a general ignorance about what causes heart ailments. In India, 10% of the present infant mortality may be accounted for by CAD.
Aim: This study was conducted to take appropriate measurements in the children of parents with diagnosed of CAD who are at high risk in relationship to serum Lp (a) and total cholesterol.
Materials and Methods: Two groups 50 each of both sexes between 5-18 years children were compared for the risk factors of CAD and data was analysed statistically by using student's t test and Pearson correlation coefficient analysis.
Results: It shows that Group A had increased values of serum Lp (a) and total cholesterol ($p<0.001$) than Group B. Diastolic BP values were also significantly higher in Group A children. In addition, Lp (a) level was directly corelated with total cholesterol levels ($r=0.734$; $p<0.001$).
Conclusion: The familial environment pay a very important role for the severity of CAD in childhood and children of CAD parents should be screened regularly. It also serves as an important diagnostic marker of CAD in youth at early stage.

1. Introduction

Cardio Artery Disease (CAD) also known as atherosclerotic heart disease, coronary heart disease or ischemic heart disease which is the common cause of heart attacks. The CAD is caused by plaque building up along the inner walls of arteries of the heart, which narrows the arteries and reduces blood flow of the heart. There are many risk factors for heart disease out of which the major are family history, age, obesity, smoking, hypertension, diabetes, total cholesterol, low HDL cholesterol, Lipoprotein (a) and elevated LDL cholesterol. However, these traditional risk factors do not predict all future CAD events but they are one of the genetic diseases attributed to numerous gene-environment interactions leading to dyslipidaemia which are disorder of lipoprotein metabolism resulting in hyperlipidemia or hypolipidemia.

The various etiologies of CAD all result in an imbalance between the supply and demand of oxygen. It more over tends to run in families and hyperlipidaemia contributes

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largely known as familial aggregation in CAD's. Elevated total cholesterol [TC] and lipoprotein (a) [Lp (a)] levels in serum had a high incidence of atherosclerosis which had been demonstrated as its silent beginning during childhood. Atherosclerosis begins in childhood and progresses to CAD in adults.[1] Numerous studies conducted since the 1950s have demonstrated that there is a gradient of risk from lowest to highest TC and that TC is substantially and independently connected to the development of CAD. Another significant lipid risk factor is Lp (a), whose amount usually stays rather consistent throughout life. However, it is highly heritable and is likely influenced by sex hormones.[2–4]

Lp (a) particles are a genetic variant of low-density lipoprotein [LDL] particles linked via apo B-100 to apolipoprotein (a) and high Lp (a) concentrations are associated with atherosclerotic/ thrombotic disease or premature ischemic disease. Early-life coronary atherosclerosis is thought to have a greater hereditary component than environmental factors. Lp (a) has been demonstrated in multiple epidemiologic studies to be a risk factor for CAD. So it is important to pay more attention to risk factors from an early age.[5,6]

This study was performed with the aim to identify the children of parents with diagnosed of CAD and find the relationship with high risk of CAD in terms of TC and Lp (a). It was also an appropriate measurement in early life to prevent or delaying the diagnosis. The research and ethic committee of Dolphin Institute approved this study protocol.

2. Materials and Methods

Fifty children (Group A) were included in the study whose parent's or their mother or father had the CAD at the age of 45 to 55 years. Children from these patients aged between 15 to 18 years irrespective of their sex were included in the study. The factors which affect the levels of Lp (a) or cholesterol like obesity, renal and liver failures, endocrine disorders, taking systemic drugs, beta blockers and diuretics, alcohol user or passive smokers were excluding from the study. Only one child from each family was selected randomly. Fifty children (Group B) were also included of parent's age between 45 to 55 years who do not have personal or family history of hypercholesterolemia or CAD and served as control.

Informed consent on a standard performa was taken from both the groups regarding age, sex, BMI, blood pressure, smoking or alcohol drinking, use of medication and family history. This was used for the discrimination of CAD patients. Both the groups were from middle class families and had vegetarian diet which is not affecting Lp (a) or cholesterol levels. Fasting blood was drawn from the anti- cubetan vein and serum was stored at -20^0 C till further analysis. Lp (a) were estimated by in vitro turbidometric immunoassay using a ELISA kits. TC in serum was estimated by the formation of quinoneimine using commercially available kits.

2.1. Statistical analysis

The data collected from study group subjects were entered separately in Microsoft Excel sheet of windows 2007 and values were expressed as Mean ± SD. The significance of mean difference between study group subjects was compared by using Student's t test. The distribution of 't'- probability was calculated depending on 'n' and significance of test was obtained. P value <0.05 and <0.001 were considered as significant and highly significant respectively. In addition, correlation analysis between Lp(a) and Total cholesterol level was performed by using Pearson correlation test.

3. Results

The results of variables and biochemical characteristics of both the groups are shown in Table 1. The mean age in years (standard deviation-SD) of group A and B were 12.4±2.2 and 11.9±1.9 respectively with no significant differences. Male to Female ratio among the group A were 28:22 whereas in group B this ratio was 26:24 and BMI among both groups was noted to be almost same.

Among the group A 05 (1%) individual were found to be occasionally smokers whereas in group B only 02 (0.5%) individual were occasionally smokers. Systolic blood pressure in both the groups did not differ significantly but the diastolic blood pressure was higher in Group A as compared to Group B. Regarding the biochemical parameters the TC in Group A was 190±32.3 mg/dl whereas in Group B it was noted to be in normal limits. Same observations were observed in Lp (a) values. It shows that Group A had increased values of serum Lp (a) and TC had significant differences between both the groups (p<0.001), as depicted in Figures 1 and 2 respectively. On correlation analysis, it has been observed that Lp (a) level was directly corelated with total cholesterol levels (r=0.734; p<0.001); as represented in Figure 3.

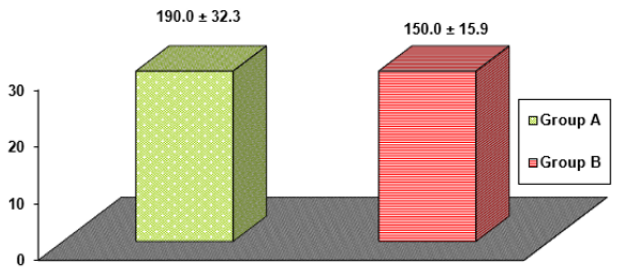

Figure 1: Serum total cholesterol levels of study group subject

Table 1: Demographic profile, serum total cholesterol and Lp (a) levels of the study group subjects (Mean±SD)

S.No.	Parameters	Group A (n=50)	Group B (n=50)
1	Age in years (Mean±SD)	12.4±2.2	11.9±1.9
2	Male: Female Ratio	28:22	26:24
3	BMI in kg/m^2(Mean±SD)	21.9±4.2	22.1±3.6
4	Systolic BP in mmHg	108±7.3	107±7.8
5	Diastolic BP in mmHg	72±7.0	66±5.8
6	Total Cholesterol (mg/dl)	190 ± 32.3	150 ± 15.9
7	Lp (a) (mg/dl)	30.3±8.2	24.1±6.2

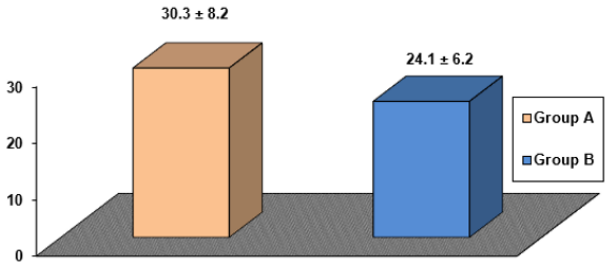

Figure 2: Serum lipoprotein (a) levels of study group subject (Mean ±S.D)

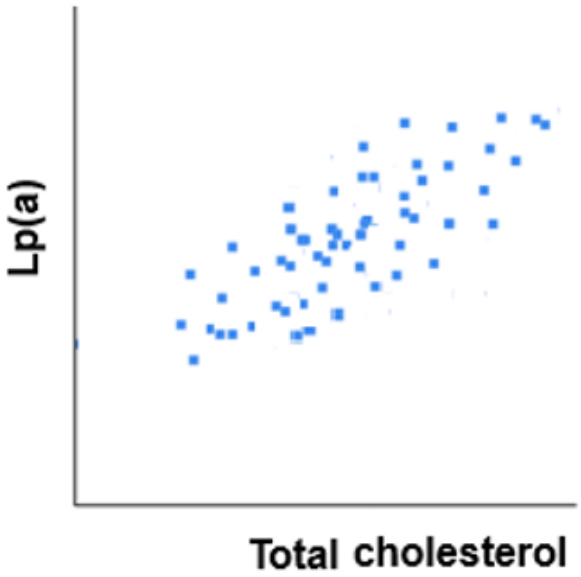

Figure 3: Correlation of Lp(a) level with total cholesterol level in the study group subjects

4. Discussion

Globally, CAD is the leading cause of death and a significant contributor to hospital admissions. It is multifactional caused by interaction of genetic and transitional risk factors like smoking, hypertension, elevated levels of lipids and diabetes. Atherosclerosis, which silently starts in childhood, is caused by the severity of this condition. Given that atherosclerosis tends to run in families, the genetic component is thought to be the more important aspect when it manifests in children.[7,8]

Apolipoprotein (a), a highly glycosylated protein found in Lp (a) lipoprotein particles, is connected to apolipoprotein B 100 by a disulfide bridge. Lp (a) is a lipoprotein particle that shares similarities with LDL in terms of lipid and protein contents.[9]

The main aim of our study was to detect the serum levels of TC and Lp (a) in children who are having a family history of CAD and found a relationship with high risk of CAD so that an appropriate measurement should be taken for early diagnosis. It was detected that children of both sexes between the age group 5 to 18 years who had family history of CAD had higher Lp (a) and TC when compaired with group of children whose family do not had CAD history. A similar finding was observed in the studies conducted by others on children with familial hypercholesterolemia and healthy children.[10,11] The elevation is associated with an increased risk of CAD because Lp (a) is one of the most influential indicators of cervical atherosclerosis and is associated with cerebral infarction. Functionally, Lp (a) transport cholesterol through the bloodstream and contain additional information that is relevant for CAD prediction.[12]

Numerous studies have also reported that elevated levels of Lp (a) are an independent risk factor for premature CAD in both sexes and are primarily determined by autosomal dominant transmission. Children with a family history of CAD and high Lp (a) levels exhibit a conventional risk factor for CAD.[13] A high Lp (a) level (>30 mg/dl) was found to be an independent risk factor for the development of CAD in males under the age of fifty-five in the Framingham offspring study. The risk was similar in magnitude to a total cholesterol level of >240 mg/dl.[14]

The two groups' diastolic blood pressures differed significantly, which could lead to hypertension, a risk factor for heart disease. A systolic blood pressure of 140 mmHg or higher and/or a diastolic blood pressure of 90 mmHg or higher are considered high blood pressure. The highest and lowest pressure in the arteries during a heartbeat are known as the diastolic and systolic blood pressures, respectively. The diastolic pressure is between 63 and 74, and the systolic pressure spans from 104 to 116. Atherosclerosis, or the narrowing of blood arteries

caused by hypertension, increases the risk of blood clots or fragments of fatty material rupturing from the blood vessel wall. The results of the study demonstrated that offspring of CAD patients had higher than normal levels of Lp (a) and total cholesterol, indicating that Lp (a) is a potent lipid variable that predisposes individuals to CAD. Although the genetic propensity is stronger because Lp (a) levels are strongly and genetically defined, the familial environment may also play a role.[15,16]

Increased Lp (a) in CAD patients is consistent with the findings of Armstrong et al.,[17] who demonstrated that a five-fold increase in low-density lipoprotein and Lp (a) increases the relative risk of CHD. In patients with familial hypercholesterolemia who had elevated Lp (a) concentrations, lowering total cholesterol is crucial because there is essentially no long-term treatment that lowers elevated Lp (a) levels. Recently, Sturzebecher et al.,[18] observed that serum lipoprotein (a) levels in children are not associated with BMI, age and sex. However, assessment of lipoprotein (a) levels can be used as an important and early diagnostic marker of CAD in youth.

5. Conclusion

Thus, it is obvious that TC and Lp (a) were considered an independent predictor for severity of CAD in childhood and all children of CAD parents should be screened for the same. Therefore, dietary management for healthy lipid profile and regular exercise with inclusion of outdoor sports activity can be recommended to the youth with elevated lipoprotein (a) levels.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Giussani M, Orlando A, Tassistro E. Is lipoprotein(a) measurement important for cardiovascular risk stratification in children and adolescents? *Ital J Pediatr*. 2024;50:161. doi:10.1186/s13052-024-01732-8.
2. Berenson GS, Srinivasan SR, Bao W, Newman WP, Tracy RE, Wattigney WA, et al. Association between multiple risk factors and atherosclerosis in children and young adults. *N Engl J Med*. 1998;338(23):1650–6.
3. Grundy SM, Cleeman JI, Merz CN, Jr HB, Clark LT, Hunninghake DB, et al. Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III guidelines. *Circulation*. 2004;110(2):227–39.
4. American Academy of Pediatrics. National Cholesterol Education Program: Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. *Pediatrics*. 1992;89(3 Pt 2):525–84.
5. Kate LP, Borman H, Daiger SP, Motulsky AG. Familial aggregation of coronary heart disease and its relation to known genetic risk factors. *Am J Cardiol*. 1982;50(5):945–53.
6. Utermann G. The mysteries of lipoprotein (a). *Science*. 1989;246(4932):904–10.
7. Mabuchi H, Koizumi J, Shimuzu M. FH-CHD study group. Development of coronary heart disease in familial hypercholesterolemia. *Circulation*. 1989;79(2):225–32.
8. Blumenthal S, Jesse MJ, Hennekens CH, Klein BE, Ferrer PL, Gourley JE, et al. Risk factors for coronary artery disease in children of affected families. *J Pediatr*. 1975;87(6 Pt 2):1187–92.
9. Kinpara K, Okada H, Yoneyama A, Okubo M, Murase T. Lipoprotein (a)-cholesterol: a significant component of serum cholesterol. *Clin Chim Acta*. 2011;412(19-20):1783–7.
10. Barth JA, Deckelbaum J, Starc TJ, Shea S, Mosca L, Berglund L, et al. Family history of early cardiovascular disease in children with moderate to severe hypercholesterolemia: relationship to lipoprotein (a) and low-density lipoprotein cholesterol levels. *J Lab Clin Med*. 1999;133(3):237–44.
11. Bailleul S, Coudere R, Rossignol C, Fermanian J, Boutouchent F, Farnier MA, et al. Lipoprotein(a) in childhood: relation with other atherosclerosis risk factors and family history of atherosclerosis. *Clin Chem*. 1995;41:241–5. doi:10.1093/clinchem/41.2.241.
12. Mcgill HC, Geer JC, Strong JP. Atherosclerosis and its origin. In: Sander M, Bourne G, editors. The natural history of human atherosclerotic lesions. New York: Academic Press; 1983. p. 38–65.
13. Mcgill HC, Mcmahan A, Zieske A, Tracy RE, Malcolm GT, Herderick EE, et al. Association of coronary risk factors with microscopic qualities of coronary atherosclerosis in youth. *Circulation*. 2000;102(4):374–9.
14. Castelli WP, Garrison RJ, Wilson PWF, Abbott RD, Kalousdian S, Kannel WB, et al. Incidence of coronary heart disease and lipoprotein cholesterol levels. The Framingham Study. *JAMA*. 1986;256(20):2835–8.
15. Alberty R, Albertyova D. Lipoprotein (a) in Children of Asian Indian Descendants and Their Caucasian Neighbors: The Slovak Lipid Community Study. *Indian J Clin Biochem*. 2012;27(3):231–8.
16. Fesharakinia A, Kazemi T, Zarban A, Sharifzadeh GR. Comparison of lipoprotein (a) and apolipoproteins in children with and without family history of premature coronary artery disease. *Iran J Pediatr*. 2008;18(2):159–62.
17. Armstrong VW, Cremer P, Eberle E. The association between serum Lp (a) concentration and angiographically assessed coronary atherosclerosis dependence on serum LDL levels. *Atherosclerosis*. 1986;62(3):249–57.
18. Stürzebecher PE, Uttinger KL, Vogel M. Lipoprotein(a) serum concentrations in children in relation to body mass index, age and sex. *Pediatr Res*. 2024;96:177–83. doi:10.1038/s41390-024-03108-4.

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