Assessment of Serum Low Density Lipoprotein Concentration by Friedewald Formula and By Direct Measurment by Spectrophotometric Kits.

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Abstract:
Background and objective: *The serum Low density Lipoprotein Cholesterol Concentration can be estimated by Freidewald formula and also by the direct assay methods by a spectrophotometer. The National Cholesterol Education program recommends the direct assay for estimating serum LDL-C concentration, but it has not been evaluated whether there is any difference between Freidwald formula & LDL-C direct assay methods in assessing Patients for CVD (cardio vascular Disease).*
Methods: *This study included the samples of 28,346 patients whose serum triglyceride level was less than 400 mg%. The study was carried in the month of January to May 2018. Fasting samples and non fasting samples were collected for measurement of lipid profile and commercial kits adapted to autoanalyser were used for the direct assay and Friedewald formula was used to calculate the value.*
Results: *Serum LDL-C levels estimated by the direct method and Friedewald formula had a significant positive correlation (r = 0.968, p<0.001). The non fasting LDL-C level was higher than fasting sample. The LDL-C of fasting samples were in the same risk category in both the methods of estimation.*
Conclusion: *The correlation of serum LDL-C level by both methods was significant. The risk assessment for CVD by the serum LDL-C level by both methods was similar, but the higher LDL-C level of non fasting samples may over calculate the risk.*
Key Words: *Cholesterol, CVD, Lipid profile, Lipoprotein.*

I   Introduction

There are various guidelines and recommendations for the management of serum lipid profile, as it is associated with cardiovascular disease (CVD). Various recent studies have depicted the Indian scenario. India Heart WATCH study estimated the prevalence of dyslipidemia [1]. ICMR-INDIAB study also evaluated dyslipidemia in 2004 and observed a high TG and low HDL level in most Indians [2]. In developed and developing countries a major cause of mortality is CVD [3,4]. Globally high serum cholesterol levels, which is one of the risk factors of CVD affects 4.0 million deaths and causes 88.7 million disabilities [5]. Increase serum cholesterol has lead to 6.6% of total deaths in South-East Asia Region (SEAR), while in developed countries a decrease trend is observed [6,7] . In the total serum cholesterol the low density lipoprotein cholesterol (LDL-C) fraction is the primary risk factor for CVD [8-10]. According to the National Cholesterol Education Programme (NCEP) and Adult treatment Panel suggest LDL-C as the main risk factor [9] and a reduction of 1% in LDL causes a 1% reduction of CVD [11]. Hence the accuracy of LDL-C measurement is required [10] .

The serum LDL-C fraction can be estimated directly or by the Friedewald's formula [8, 9]. The Friedewald's formula has few limitations such as: (i) fasting samples are required and (ii) the serum TG level should be <400 mg% [8, 9]. The direct estimation is costly. Therefore, this study was undertaken to compare the LDL-C levels by direct measurement homogenous assay and the calculated value.

II   Material And Methods:

This study was conducted in RDC, SCB Medical College & Hospital, Cuttack during January 2018 to March 2018. Fasting blood samples were collected and lipid profile was estimated in the following manner:-
a)   Total cholesterol by CHOD-POD method
b)   TG by GPO-PAP
c)   HDL-C by Homogenous enzymatic assay

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d) LDL-C by direct and Friedewald's formula

$$LDL = TC - [HDL\text{-}C + TG/5]$$

e) VLDL-C formula TG/5

Statistical analysis was done by SPSS version 21. All data were represented as mean ± SD. A students paired 't' test was used to compare the data. A p value <0.05 was considered significant.

III Observation:

Table-1 shows the lipid profile of all the study participants. We observed 37.4% were obese, 40.4% were hypertensive and 28.6% were diabetic. Out of the total number of participants 49.8% has dyslipidemia among males and in 56.9% of females.

Table -1 Lipid profile and demographic data of the study participants

Parameter	Male	Female	Total
Number	12473	15873	28346
Age	52.06 ± 11.89	49.68 ± 17.18	51.54 ± 18.16
BMI	25.9 ± 5.4	26.2 ± 2.3	26.05 ± 2.2
Obese	3343 (26.80%)	7258(25.60%)	10601(37.4%)
Hypertension	4889(39.2%)	7428(46,8%)	11451(40.4%)
Diabetes	3766 (30.2%)	5809 (36.6%)	8106 (28.6%)
Dyslipidemia	6211 (49.8%)	9031 (56.9%)	

Table -2 Comparison of directly estimated LDL-C and calculated value with increasing TG level

	TG		
	<150 mg%	150-400 mg%	>400 mg%
LDL-C (Directly estimated	98.2 ± 12.18	116.8 ± 36.1	132.2 ± 45.7
LDL-C(calculated byFriedewald Formula)	97.6 ± 16.1	108 ± 40.5	86.4 ± 61.2
Mean difference	0.6 ± (- 3.32)	7.9 ± (- 4.4)	45.8 ± (-15.5)
'p' value	o.462	<0.001	<0.001

Fig-1 compares the direct estimation of LDL-C and calculated value.
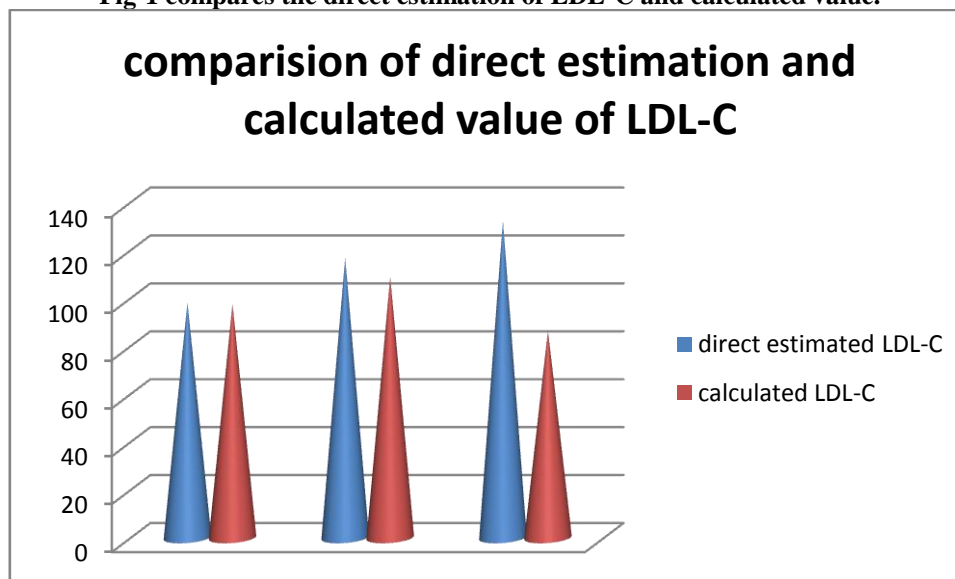
IV Discussion

We observed that in Diabetic and hypertensive patients Friedewald's formula under estimate the LDL-C level as Friedewald's formula is popularly used in various laboratories routinely [11,12] . Various studies conducted for comparing, have shown that the Friedewald's formula underestimate the LDL-C level [13,14] . The study by Choi SY et al depicted that though a positive correlation existed between measured & Friedewald's formula LDL-C values there was a significant difference of 11.51 mg% in both estimations [15] . Study by Boshtam M et al suggested an overestimation of LDL-C level by Friedwald's formula [16] . The multiethin Asian study by Chai Kheng EY et al observed a negative bias of LDL-C is essential when directly estimated LDL-C is near the lower cut off of risk assessment by Friedewald's formula [2] . The study by Anwar et al suggested that calculated LDL-C levels classified patients into wrong categories by NCEP. This negative bias of calculated

LDL-C levels was observed even lower TG level [11, 12,17] . The bias increased with an increase TG level [13] . In our study statistical significant difference was not observed in LDL-C level between calculated & direct estimation, when TG level was <150 mg% but in higher level of TG there was significant difference in the LDL-C level estimated by different methods. This is in agreement with previous studies ([11-13, 16, 17]) . Thus, the calculated value gives a false under estimation of cardiac risk assessment. The direct measurement methods of LDL-C are precise and accurate and not affected by the TG status. We observed that when the TG concentration of >177 mg% the Friedewald's formula under estimated the LDL-C level by around 28%.

V   Conclusion

We suggest the direct assessment of serum LDL-C level is better for risk assessment than calculated values, especially when the TG level >150 mg%.

Conflict of Interest: None.

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