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Lipid Abnormalities in Patients with Sudden Cardiac Death

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Abstract

Sudden cardiac death (SCD) remains a leading cause of mortality worldwide, with dyslipidemia being a major modifiable risk factor for atherosclerotic coronary artery disease, its primary underlying cause. A retrospective study was conducted in Community Based Medical College, Bangladesh (CBMC,B) Hospital, Mymensingh, Bangladesh, from July 2023 to June 2024, to evaluate the prevalence and pattern of lipid profile abnormalities among patients who had sudden cardiac death. A purposive sample of 125 SCD patients, confirmed via clinical and postmortem assessment were enrolled. Lipid profile was evaluated from patients' records. The mean age was 58.4±10.2 years and 68.8% were male. 89.6% of patients exhibited dyslipidemia. Low HDL-C (80.0%) and elevated LDL-C (64.8%) were predominant. Mean lipid levels were observed as follows: total cholesterol 212.4±42.7 mg/dL, LDL-C 142.8±38.9 mg/dL, HDL-C 32.6±8.4 mg/dL, and triglycerides 185.3±72.1 mg/dL. The most frequent combination was elevated LDL-C with low HDL-C, which was present in 57.6% patients. The combination of all three abnormalities i.e., high LDL-C, along with low HDL-C and high triglycerides was observed in 38.4% patients. 17.6% patients had low HDL-C with high TG (isolated atherogenic dyslipidemia). Isolated elevated LDL-C and Isolated low HDL-C were found in 7.2% and 22.4% patients respectively. Our study demonstrated profound association between dyslipidemia and SCD in our population, particularly with low HDL-C and high LDL-C. These findings underscore the critical need for aggressive lipid screening and management as a key preventive public health strategy.

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Introduction

Sudden cardiac death (SCD) is defined as an unexpected natural death from a cardiac cause, occurring within one hour of symptom onset in a person without any prior condition that would appear fatal.[1] It represents a critical public health challenge, accounting for an estimated 15-20% of all deaths in industrialized nations and a significant burden in developing countries.[2] The underlying pathophysiology in the majority of adult SCD cases is acute coronary ischemia, often triggered by the rupture of a vulnerable atherosclerotic plaque and subsequent thrombosis within the coronary arteries.[3] This inextricable link places atherosclerotic cardiovascular disease (ASCVD) at the epicenter of SCD prevention strategies. Dyslipidemia, characterized by abnormalities in plasma lipids and lipoproteins, is a cornerstone in the development and progression of atherosclerosis.[4] Elevated levels of low-density lipoprotein cholesterol (LDL-C) are fundamentally implicated in the initiation and growth of atheromatous plaques through endothelial dysfunction and lipid accumulation within the arterial intima.[5] Conversely, high-density lipoprotein cholesterol (HDL-C) is believed to exert

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atheroprotective effects via reverse cholesterol transport, yet recent evidence also points to the functional quality of HDL being as crucial as its quantity.[6] Epidemiological studies have consistently established a strong, graded, and independent association between elevated serum cholesterol, particularly LDL-C, and an increased risk of coronary heart disease and its fatal complications, including SCD.[7,8] The South Asian region, including Bangladesh, bears a disproportionately high burden of premature ASCVD. This population exhibits a unique risk profile, often marked by a higher prevalence of dyslipidemia characterized by elevated triglycerides, low levels of HDL-C, and a preponderance of small, dense LDL particles – a pattern sometimes described as the "atherogenic dyslipidemia of insulin resistance".[9,10] This distinct lipid phenotype may confer a different risk trajectory for acute coronary syndromes and SCD. While the association between dyslipidemia and ASCVD is well-established globally, population-specific data linking detailed lipid profile abnormalities directly to SCD victims are limited in Bangladesh. Therefore, this study aimed to investigate the prevalence and pattern of lipid profile abnormalities among patients who experienced SCD at a tertiary care hospital in Mymensingh region in Bangladesh.

Methods

This retrospective study was conducted in Community Based Medical College, Bangladesh (CBMC,B) Hospital, Mymensingh, Bangladesh, from July 2023 to June 2024. The study population comprised 125 patients who were pronounced dead due to sudden cardiac death (SCD), defined as unexpected natural cardiac death occurring within one hour of symptom onset or, if unwitnessed, within 24 hours of last being seen alive. Using a purposive sampling technique cases were enrolled. Lipid profiles (total cholesterol, triglycerides, LDL-C, HDL-C) were collected and evaluated from patients' recod form.

Data was analyzed using IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, NY, USA). Descriptive statistics were computed for demographic variables and lipid parameters. Continuous data was presented as mean±SD (standard deviation), while categorical data are presented as frequencies and percentages. Unpaired Student's t-test was applied to compare between male and female. A p-value <0.05 was considered as statistically significant. Data was presented in tabulated form.

Ethical clearance was obtained from the Ethical Review Committee of Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, Bangladesh.

Results

Our retrospective study enrolled 125 individuals of sudden cardiac death. The mean age of the cohort was 58.4±10.2 years, with a range from 35 to 78 years. A male predominance was observed (68.8%); females constituted 31.2%. Regarding conventional cardiovascular risk factors, hypertension was the most prevalent (68%), followed by smoking (56%, diabetes mellitus (44%), positive family history of premature coronary artery disease (35.2%). Obesity, as defined as a body mass index ≥30 kg/m², was observed in 32.8% of the cohort (Table-I). Regarding lipid profile, the mean total cholesterol was 212.4±42.7 mg/dL, while LDL-C was notably elevated at 142.8 ± 38.9 mg/dL; HDL-C was low at 32.6 ± 8.4 mg/dL, and triglyceride level was 185.3±72.1 mg/dL

(Table-II). The prevalence of individual lipid abnormalities, defined against standard cut-off points, was alarmingly high; the most common derangement was low HDL-C, as found in 80.0%, while elevated LDL-C was observed in 64.8%. Hypertriglyceridemia was observed in 56.0% and high total cholesterol in 52.8%. Overall, 112 patients (89.6%) had at least one abnormal lipid parameter (Table-III).

Table-I: Demographic and clinical characteristics of the patients (N=125)

Variables	Frequency	Percentage
Age group (in years)		
45	16	12.8
45–60	56	44.8
61–75	45	36.0
75	8	6.4
Gender		
Male	86	68.8
Female	39	31.2
Risk factors		
Hypertension	85	68.0
Diabetes mellitus	55	44.0
Smoking	70	56.0
Family history of CAD	44	35.2
Obesity (BMI ≥30)	41	32.8

Table-II: Lipid profile of the patients (N=125)

Lipid profile	Mean±SD (mg/dL)
Total cholesterol	212.4±42.7
LDL-cholesterol	142.8±38.9
HDL-cholesterol	32.6±8.4
Triglycerides	185.3±72.1

Table-III: Prevalence of individual lipid abnormalities among patients (N=125)

Abnormal lipid parameter	Cut-off value	Frequency (Percentage)
Low HDL-C	<40 (M), <50 (F)	100 (80.0)
Elevated LDL-C	≥130 mg/dL	81 (64.8)
Hypertriglyceridemia	≥150 mg/dL	70 (56.0)
High total cholesterol	≥200 mg/dL	66 (52.8)
Any abnormality	-	112 (89.6)

A comparative analysis of lipid profile between male and female revealed no statistically significant difference (p>0.05) (Table-IV). The most frequent combination was elevated LDL-C with low HDL-C, which was present in 57.6% patients. The combination of all three abnormalities i.e., high LDL-C, along with low HDL-C and high triglycerides was observed in 38.4% patients. 17.6% patients had low HDL-C with high TG (isolated atherogenic dyslipidemia). Isolated elevated LDL-C and Isolated low HDL-C were found in 7.2% and 22.4% patients respectively (Table-V).

Table-IV: Comparison of mean lipid profile between male and female (N=125)

Lipid profile	Male (n=86) Mean±SD (mg/dL)	Female (n=39) Mean±SD (mg/dL)	p-value
Total cholesterol	214.1±43.5	208.9±41.2	0.527^{NS}
LDL-cholesterol	143.1±39.2	142.2±38.5	0.901^{NS}
HDL-cholesterol	32.8±8.1	32.1±9.1	0.675^{NS}
Triglycerides	187.1±75.3	181.5±65.2	0.696^{NS}

Unpaired Student's t-test was applied; NS=not significant.

Table-V: Pattern of coexisting lipid abnormalities among patients (N=125)

Pattern of lipid abnormalities	Frequency (Percentage)
Elevated LDL-C + Low HDL-C	72 (57.6)
Elevated LDL-C + Low HDL-C + High TG	48 (38.4)
Low HDL-C + High TG (Isolated atherogenic dyslipidemia)	22 (17.6)
Isolated elevated LDL-C	9 (7.2)
Isolated low HDL-C	28 (22.4)

Discussion

The principal finding of this study is the alarmingly high prevalence of dyslipidemia among victims of sudden cardiac death (SCD) in our setting, with nearly nine out of ten patients (89.6%) exhibiting at least one abnormal lipid parameter. This observation powerfully reinforces the central role of dyslipidemia in the pathogenesis of atherosclerotic coronary artery disease, the most common substrate for SCD.[3,11] The pattern of abnormalities – dominated by low HDL-C (80%) and elevated LDL-C (64.8%) – provides critical, population-specific insights into the lipid-related risk profile associated with fatal cardiac events in Bangladesh. The strikingly high prevalence of low HDL-C aligns with the characteristic "atherogenic dyslipidemia" pattern frequently described in South Asian populations, which includes high triglycerides, low HDL-C, and a preponderance of small, dense LDL particles.[8,9] Our finding that HDL-C derangement was the most common abnormality, even more frequent than high LDL-C, underscores a potentially significant regional risk factor. While the causal role of HDL-C has been debated, low levels are a robust marker of increased cardiovascular risk and may reflect dysfunctional reverse cholesterol transport and a pro-inflammatory state, both of which promote plaque vulnerability.[6,12] The high rate of smoking (56.0%) and obesity (32.8%) in our cohort likely contributed to this depressed HDL-C. The mean LDL-C level of 142.8 mg/dL and the finding that 64.8% of SCD victims had levels ≥130 mg/dL are compelling evidence of suboptimal lipid management. This is consistent with the indisputable evidence from genetic, epidemiologic, and clinical studies that unequivocally establishes LDL-C as a primary causative agent in atherosclerosis.[5,7] The high proportion of patients with undiagnosed or inadequately treated hypercholesterolemia likely represents a critical missed opportunity for prevention. The concurrent presence of elevated LDL-C and low HDL-C, found in 57.6% of our patients, creates a synergistic atherogenic environment that significantly accelerates coronary plaque formation and instability.[13] The demographic profile of our SCD cohort, with a mean age of 58.4 years and the highest frequency (44.8%) in the 45–60-year group, highlights the burden of premature cardiovascular mortality. This aligns with regional data indicating that acute coronary events occur at younger ages in South Asians compared to Western populations.[8,14] The absence of significant gender differences in lipid profiles suggests that the atherogenic risk conveyed by dyslipidemia is equally potent in both men and women within this context, emphasizing the need for gender-neutral screening and treatment guidelines. Our study found no significant difference in lipid parameters across age groups, indicating that dyslipidemia is a pervasive risk factor across adult age cohorts experiencing SCD. Furthermore, the high prevalence of traditional risk

factors like hypertension (68.0%) and diabetes (44.0%) in conjunction with dyslipidemia points to a clustering of metabolic syndrome components, which multiplicatively increases the risk of fatal arrhythmic events.[15,16] The finding that only 10.4% of SCD victims had a completely normal lipid profile is particularly striking. It suggests that in our population, SCD with a normolipidemic profile is the exception rather than the rule, further strengthening the argument for lipid abnormalities as a near-ubiquitous finding in these tragic events. Our general population can be screened for routine lipid profile and other relevant clinical biomarkers, those at risk for SCD can be identified and preventative measures can be taken immediately.[17]

This single-center study used small sample size from a specific region of the country, which may potentially limit generalizability. Further studies with larger samples from different regions of the country are warranted.

Conclusion

This study reveals an exceptionally high prevalence of dyslipidemia, particularly low HDL-C and elevated LDL-C, among SCD victims in this cohort. These findings underscore dyslipidemia as a critical, modifiable risk factor for fatal arrhythmic events. They strongly advocate for the urgent implementation of aggressive population-wide lipid screening and management strategies as a cornerstone for reducing the burden of premature sudden cardiac death in Bangladesh. We also recommend implementing mandatory, widespread lipid screening programs in primary care settings. Aggressive management of dyslipidemia through lifestyle modification and statin therapy, aligned with national guidelines, should be prioritized to mitigate the risk of sudden cardiac death in this high-risk population.

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