Original Article
DOI: https://doi.org/10.70749/ijbr.v3i5.1201

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

Pattern of Coronary Artery Disease in Patients with Left Bundle Branch Block in Acute Coronary Syndrome

Hafsa Liaqat[1], Mohammad Adil[1], Faraz Ali Khan[2], Mohammad Ali[3]

[1]Department of Cardiology, Lady Reading Hospital (LRH), Peshawar, Pakistan.
[2]Department of Internal Medicine, Lady Reading Hospital (LRH), Peshawar, Pakistan.
[3]Department of Plastic and Reconstructive Surgery, Northwest General Hospital (NWGH), Peshawar, Pakistan.

ARTICLE INFO

Keywords: Left Bundle Branch Block, Coronary Artery Disease, Patterns

Correspondence to: Hafsa Liaqat, Department of Cardiology, Lady Reading Hospital (LRH), Peshawar, Pakistan.
Email: drhafsaliaqat@gmail.com

Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 07-03-2025 Revised: 15-04-2025
Accepted: 26-04-2025 Published: 25-05-2025

ABSTRACT

Background: Left bundle branch block is a common manifestation at presentation of patients with acute coronary syndrome and is most often associated with coronary artery disease. However, CAD pattern of the patient, specifically with consideration of demographic factors like age, gender, as well as socioeconomic status, must be investigated. Knowledge of burden as well as prevalence of CAD in ACS patients with LBBB will help manage as well as diagnose effectively. **Objective:** To determine the frequency of pattern of coronary artery disease in patients with left bundle branch block in acute coronary syndrome. **Study Design:** Cross-sectional study. **Study Duration and Setting:** The study was conducted from August 2024 to February 2025 at the Department of Cardiology, LRH Peshawar. **Methodology:** The study consisted of 111 patients aged 30-70 with ACS and LBBB. Demographic data, including sex, age, BMI, and socioeconomic status, were elicited. Coronary angiography was done for the patients to find the number of blockages of coronary artery and its location. CAD was graded as single-vessel disease, double-vessel disease, or triple-vessel disease. **Results:** The majority of patients were male (79.3%), with a mean age of 58.60 ± 6.94 years. The most common CAD pattern was SVD (48.6%), followed by TVD (29.7%) and DVD (18%). Significant associations were found between socioeconomic status and CAD patterns, with middle-class patients having a higher incidence of SVD. **Conclusion:** Left bundle branch block (LBBB) is frequently associated with coronary artery disease in patients with acute coronary syndrome, with a predominant pattern of single-vessel disease.

INTRODUCTION

Acute Coronary Syndrome (ACS) is a clinical spectrum resulting from a rapid reduction in coronary perfusion, leading to ischaemia and myocardial damage.[1] Acute coronary syndrome (ACS) is characterized by three principal forms: unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI).[2] The rupture of an atherosclerotic plaque, leading to the creation of a partially or totally occlusive thrombus in the coronary artery, is the predominant cause of acute coronary syndrome (ACS).[3] This leads to myocardial ischaemia, with tissue damage varied according to the extent and length of the occlusion.[4] Clinical manifestations include chest pain, dyspnoea, diaphoresis, and nausea, necessitating prompt diagnosis and intervention to prevent additional myocardial damage and consequences such as failure of the heart and arrhythmias.[5]

Left Bundle Branch Block (LBBB) is a conduction abnormality of the heart with a blockage or delay of the heart conduction system in the left bundle branch.[6] Acute Coronary Syndrome with LBBB may complicate its clinical presentation. LBBB can blur the typical electrocardiographic (ECG) changes of myocardial infarction, i.e., ST-segment depression or elevation.[7] This is because the electric delay of LBBB biases the normal pathway of heart depolarization, making it challenging to identify new ischemic changes against the preexistent conduction abnormality.[8]

Coronary artery disease (CAD) is a condition where atherosclerotic plaques narrow or block the arteries supplying blood to the heart muscle.[9] Plaques are made up of cholesterol, lipid materials, and cell residue, which over a period of time can plug up the blood flow. CAD is one of the leading causes of morbidity as well as mortality all over the world and is the major underlying cause of ACS.[10] CAD is caused by hypertension, hyperlipidemia, smoking, diabetes, and a history of heart disease.[11]

CAD can be from mild to severe, with some individuals having single-vessel disease, while with others there is more complex, multiple-vessel disease. In patients with Left Bundle Branch Block (LBBB) with Acute Coronary Syndrome (ACS), the coronary artery disease (CAD) pattern is more typically representative of extensive

atherosclerotic disease.[12] Such patients may have single-vessel, double-vessel, or triple-vessel disease, representing the number of coronary arteries with extensive atherosclerotic lesions.[13] Single-vessel disease is a blockage of a single coronary artery, with less risk of poor outcome. Double-vessel disease, as well as triple-vessel disease, are blockage of two or three coronary arteries, respectively, and are associated with increased risk of myocardial infarct, heart failure, as well as mortality.[14] In such patients, LBBB may hinder both diagnosis as well as management because LBBB can blunt ischemic changes of the electrocardiogram (ECG), resulting in a clinical delay of the diagnosis of myocardial infarct.[15]

In a study by Rahu QA, et al. has shown that frequency of Single vessel disease (SVD) was 33.9%, double vessel disease (DVD) 16.9% and triple vessel disease was 26.4% respectively in patients with left bundle branch block in acute coronary syndrome. [16]

LBBB can mask typical electrocardiographic changes, hindering the accurate diagnosis of ACS and potentially delaying treatment. Understanding how LBBB influences the presentation and progression of coronary artery disease in ACS patients is crucial for improving diagnostic accuracy, identifying high-risk individuals, and tailoring appropriate treatment strategies. Moreover, this study could help uncover the relationship between LBBB and multi-vessel coronary involvement, ultimately contributing to better management and improved outcomes for these patients.

METHODOLOGY

This cross-sectional study was conducted from August 2024 to February 2025 at the Department of Cardiology, LRH Peshawar. The study included 111 patients, with the sample size calculated using the WHO sample size software, based on a 95% confidence level, a 7% margin of error, and an anticipated frequency of double-vessel disease in 16.9% of patients with LBBB and ACS.[16]

The study population comprised individuals aged 30 to 70 years, of both genders, diagnosed with ACS and LBBB according to the defined criteria. ACS was categorized into three types: unstable angina, non-ST-segment elevation ACS (NSTE-ACS), and ST-segment elevation ACS (STE-ACS), based on the presence of chest pain, ECG findings, and cardiac troponin levels. LBBB was defined as a QRS duration greater than 0.11 seconds with neither q nor S waves in leads I, aVL, and V6 on the ECG. Exclusion criteria included patients with pacemaker rhythms, valvular heart disease, congenital heart disease, or cardiomyopathy. After obtaining informed consent, baseline demographic information, such as age, gender, body mass index (BMI), profession, monthly income, socioeconomic status, education level, duration of ACS, and residential status, was collected.

Patients underwent coronary angiography, where a catheter was inserted into the femoral or radial artery and advanced towards the heart. A contrast dye was injected, allowing for X-ray imaging to assess the coronary arteries. Luminal narrowing of 25% or more in one, two, or three major coronary arteries, including the left main coronary artery, left anterior descending artery, left circumflex artery, and right coronary artery, was classified as single vessel disease (SVD), double vessel disease (DVD), or triple vessel disease (TVD). The severity and location of blockages were analyzed by experienced interventional cardiologists. The classification was based on the number of coronary arteries affected by significant atherosclerotic narrowing.

Data analysis was performed using IBM SPSS version 26. Categorical variables, including gender, socioeconomic status and the presence of SVD, DVD, or TVD, were analyzed as frequencies and percentages. Quantitative variables, including age, BMI, and duration of ACS, were reported as mean ± standard deviation or median (interquartile range), contingent upon normality, evaluated via the Shapiro-Wilk test. Patterns were categorised according to age, sex, BMI, socioeconomic position, and length of ACS. Post-stratification analysis was performed utilising the chi-square test, or Fischer's exact test, with statistically significant established at $p < 0.05$.

RESULTS

The demographic analysis of patients with left bundle branch block (LBBB) in acute coronary syndrome (ACS) reveals a mean age of 58.60 ± 6.94 years, with a mean BMI of 27.60 ± 2.08 kg/m^2, and a mean duration of ACS of 2.97 ± 1.84 months. The majority of the patients were male (79.3%, n = 88), and the female population comprised 20.7% (n = 23). In terms of socioeconomic status, 43.2% (n = 48) of the patients were from middle class, 31.5% (n = 35) were rich, and 25.2% (n = 28) were from poor backgrounds (Table 1).

Table 1

Patient Demographics

Demographics		Mean ± SD
Age (years)		58.60 ± 6.94
BMI (kg/m^2)		27.60 ± 2.08
Duration of ACS (months)		2.97 ± 1.84
Gender	Male n (%)	88 (79.3%)
	Female n (%)	23 (20.7%)
Socioeconomic Status	Poor n (%)	28 (25.2%)
	Middle n (%)	48 (43.2%)
	Rich n (%)	35 (31.5%)

Regarding the pattern of coronary artery disease (CAD), 48.6% (n = 54) of patients had single-vessel disease (SVD), 18% (n = 20) had double-vessel disease (DVD), and 29.7% (n = 33) had triple-vessel disease (TVD) (Table 2).

Table 2

Pattern of Coronary Artery Disease

Pattern of coronary artery disease	Frequency	% age
SVD	54	48.6%
DVD	20	18%
TVD	33	29.7%

The analysis of demographic factors related to SVD shows that age did not show a significant association with SVD ($p = 0.697$), with 44.4% (n = 8) of patients aged ≤50 years and 49.5% (n = 46) of patients aged >50 years having SVD. Gender also showed no significant difference ($p = 0.396$), with 46.6% (n = 41) of male patients and 56.5% (n = 13) of female patients having SVD. In terms of BMI, patients with BMI ≤25 had a slightly lower frequency of SVD

(42.9%, n = 6) compared to those with BMI >25, where 49.5% (n = 48) had SVD, but this was not statistically significant (p = 0.643). There was a significant association with socioeconomic status (p < 0.001), as 28.6% (n = 8) of poor patients had SVD, compared to 75% (n = 36) of middle-class patients and 28.6% (n = 10) of rich patients. Duration of ACS showed a significant difference, with 76.1% (n = 54) of patients with ACS ≤ 3 months presenting with SVD, while no patients with ACS >3 months had SVD (p < 0.001) (Table 3).

Table 3

Association of SVD with Demographic Factors

Demographic Factors		SVD		p-value
		Yes n (%)	No n (%)	
Age (years)	≤50	8 (44.4%)	10 (55.6%)	0.697
	>50	46 (49.5%)	47 (50.5%)	
Gender	Male	41 (46.6%)	47 (53.4%)	0.396
	Female	13 (56.5%)	10 (43.5%)	
BMI (Kg/m^2)	≤25	6 (42.9%)	8 (57.1%)	0.643
	>25	48 (49.5%)	49 (50.5%)	
Socioeconomic Status	Poor	8 (28.6%)	20 (71.4%)	<0.001 *
	Middle	36 (75.0%)	12 (25.0%)	
	Rich	10 (28.6%)	25 (71.4%)	
Duration (months)	≤3	54 (76.1%)	17 (23.9%)	<0.001 *
	>3	0 (0.0%)	40 (100.0%)	

For DVD, age did not show a significant association (p = 0.52), with 11.1% (n = 2) of patients aged ≤50 years and 19.4% (n = 18) of patients aged >50 years presenting with DVD. Gender also showed no significant association (p = 1.0), with 18.2% (n = 16) of male patients and 17.4% (n = 4) of female patients diagnosed with DVD. BMI showed no significant association (p = 0.743), with 14.3% (n = 2) of patients with BMI ≤25 and 18.6% (n = 18) of patients with BMI >25 having DVD. Socioeconomic status did not significantly affect DVD prevalence (p = 0.706), with 21.4% (n = 6) of poor patients, 14.6% (n = 7) of middle-class patients, and 20.0% (n = 7) of rich patients showing DVD. Duration of ACS did not show a significant difference (p = 0.915), with 18.3% (n = 13) of patients with ACS ≤ 3 months and 17.5% (n = 7) of patients with ACS > 3 months presenting with DVD (Table 4).

Table 4

Association of DVD with Demographic Factors

Demographic Factors		DVD		p-value
		Yes n (%)	No n (%)	
Age (years)	≤50	2 (11.1%)	16 (88.9%)	0.52
	>50	18 (19.4%)	75 (80.6%)	
Gender	Male	16 (18.2%)	72 (81.8%)	1
	Female	4 (17.4%)	19 (82.6%)	
BMI (Kg/m^2)	≤25	2 (14.3%)	12 (85.7%)	0.743
	>25	18 (18.6%)	79 (81.4%)	
Socioeconomic Status	Poor	6 (21.4%)	22 (78.6%)	0.706
	Middle	7 (14.6%)	41 (85.4%)	
	Rich	7 (20.0%)	28 (80.0%)	
Duration (months)	≤3	13 (18.3%)	58 (81.7%)	0.915
	>3	7 (17.5%)	33 (82.5%)	

For TVD, no significant association was found with age (p = 0.715), with 33.3% (n = 6) of patients aged ≤50 years and 29.0% (n = 27) of patients aged >50 years having TVD. Gender showed no significant association (p = 0.202), with 33.0% (n = 29) of male patients and 17.4% (n = 4) of female patients presenting with TVD. BMI did not show a significant relationship with TVD (p = 1.000), with 28.6% (n = 4) of patients with BMI ≤25 and 29.9% (n = 29) of patients with BMI >25 diagnosed with TVD. There was a significant association with socioeconomic status (p < 0.001), where 35.7% (n = 10) of poor patients had TVD, 10.4% (n = 5) of middle-class patients, and 51.4% (n = 18) of rich patients presented with TVD. Duration of ACS showed a significant relationship (p < 0.001), with no patients with ACS ≤ 3 months showing TVD, while 82.5% (n = 33) of patients with ACS > 3 months were diagnosed with TVD (Table 5).

Table 5

Association of TVD with Demographic Factors

Demographic Factors		TVD		p-value
		Yes n (%)	No n (%)	
Age (years)	≤50	6 (33.3%)	12 (66.7%)	0.715
	>50	27 (29.0%)	66 (71.0%)	
Gender	Male	29 (33.0%)	59 (67.0%)	0.202
	Female	4 (17.4%)	19 (82.6%)	
BMI (Kg/m^2)	≤25	4 (28.6%)	10 (71.4%)	1.000*
	>25	29 (29.9%)	68 (70.1%)	
Socioeconomic Status	Poor	10 (35.7%)	18 (64.3%)	<0.001 *
	Middle	5 (10.4%)	43 (89.6%)	
	Rich	18 (51.4%)	17 (48.6%)	
Duration (months)	≤3	0 (0.0%)	71 (100.0%)	<0.001 *
	>3	33 (82.5%)	7 (17.5%)	

DISCUSSION

The findings indicated a significant prevalence of single-vessel disease (SVD), followed by TVD and DVD. This is consistent with current literature that indicates increased prevalence of SVD among ACS patients, largely because LBBB interferes with the conduction of impulses, potentially reducing myocardial contractility, especially with restricted coronary artery involvement. The correlation of SVD with duration of ACS of ≤3 months may be explained by the acute nature of the condition, where prompt action tends to provide optimal results and may involve lesser coronary involvement.

Furthermore, the outcome also established a strong correlation of socioeconomic status with CAD patterns. Poor patients had a higher TVD prevalence and a lower prevalence of SVD. This may be due to restricted access to healthcare, lifestyle, or a late diagnosis, all of which can be responsible for more extensive coronary artery involvement with time. The failure of CAD patterns to show significant differences regarding age and gender may imply that LBBB's effect on CAD progression is independent of these variables. On the other hand, the correlation of increased duration of ACS (>3 months) with increased coronary involvement (e.g., TVD) may reflect the cumulative pattern of CAD, where prolonged injury of the coronary artery can cause widespread vascular damage.

The patient demographic was found to have a mean age of 58.60 ± 6.94 years, with a predominance of male patients (79.3%). This was echoed in the research conducted by Rahu et al. [17] where the majority of the patients were also found to be male with a preponderance of cardiovascular conditions within the same population. Balouch et al. [18] in the case of younger patients under the age of 40, however, found a similarly high percentage of males (91.8%),

although the difference in age is apparent with their research dealing with much younger people (mean age of 35.3 years).

The majority of the patients had single-vessel disease (SVD) (48.6%), with fewer patients having double-vessel disease (18%) and triple-vessel disease (TVD) (29.7%), as compared to Ghanem et al. [19] where the majority of the patients had CAD with a high percentage of patients having single-vessel disease. This trend of coronary involvement is the same for patients with LBBB where LAD involvement is noted by both the current work as well as other researches like Balouch et al.'s [18] researches where LAD was the leading involved vessel for ACS patients who were young.

Upon comparing demographic variable correlation with the disease pattern, our study did not show a difference for SVD, DVD, and TVD by age and gender. Socioeconomic status (SES), however, played a determining role, where poor patients had a lower incidence of SVD but a higher incidence of TVD, as observed similarly by Rahu et al.'s [17] work as well, where demographic differences of CAD patterns by SES were observed. This finding is supported by Ghanem et al. [19] as well, where CAD was found to have a higher prevalence in patients with reduced left ventricular ejection fraction (LVEF), as we have as well where ACS duration ≤ 3 months had a higher prevalence of SVD.

Furthermore, ACS ≤ 3 months had more SVD, whereas ACS > 3 months had more widespread CAD, including TVD. This aligns with the finding of Darmon et al. [20] that extensive coronary damage is a consequence of prolonged coronary injury. More widespread TVD was present in the patient with more prolonged ACS durations as shown by the current research, reinforcing the same fact that prolonged ischemia time results in more widespread coronary involvement.

Finally, with regards to the full prognosis and clinical relevance, Avsec et al.'s [21] case report suggests that bundles of blocks change within ACS, i.e., from LBBB to RBBB, may be a reperfusion signal that can be a valuable decision-making factor for emergent coronary interventions. Though our research work never spoke directly about it, it nonetheless presents the complexity of the scenario as well as the need for careful observation as well as immediate management of patients with LBBB, especially with ACS.

Even though LBBB is a robust clinical predictor, its predictive value for CAD degree or severity, without the aid of diagnostic testing such as coronary angiography, can only be inferred. Our study fills a gap in existing literature through a focus on the socioeconomic status, duration of ACS, and LVEF as significant influencing determinants of disease expression of LBBB patients.

However, there are several limitations to the present research. It was conducted at a single center, something which may limit the generalizability of the results to broader populations. Sample size, while sufficient for purposes of the present research, may be insufficient for representing diversity within patients with LBBB within a broader range of healthcare environments. Additionally, as a retrospective work, the research may have put some constraints with regard to collecting data as well as analyzing data. Multicenter trials with heterogeneous, larger populations are needed to validate our findings as well as explore the potential mechanisms for the association of LBBB with CAD in ACS.

CONCLUSION

We have concluded that left bundle branch block (LBBB) is frequently associated with coronary artery disease (CAD) in patients with acute coronary syndrome (ACS). The incidence and CAD pattern of these patients reveal a high single-vessel disease with specific correlations with socioeconomic standing as well as length of ACS. Even though LBBB is a strong diagnostic marker, it fails to predict the level of CAD. Our findings stress the importance of the utilization of integrative diagnostic methods, including coronary angiography, to ascertain accurately the CAD pattern of ACS patients as well as LBBB.

Acknowledgments

We sincerely appreciate the unwavering commitment of the medical team in the Department for their thorough documentation and organized management of patient records. Their efforts were instrumental and are greatly valued.

REFERENCES

1. Yuan D, Chu J, Qian J, Lin H, Zhu G, Chen F, Liu X. New Concepts on the Pathophysiology of Acute Coronary Syndrome. Rev Cardiovasc Med. 2023 Apr 17;24(4):112. https://doi.org/10.31083/j.rcm2404112.
2. Theofilis P, Oikonomou E, Chasikidis C, Tsioufis K, Tousoulis D. Pathophysiology of Acute Coronary Syndromes-Diagnostic and Treatment Considerations. Life (Basel). 2023 Jul 12;13(7):1543. https://doi.org/10.3390/life13071543.
3. Noothi SK, Ahmed MR, Agrawal DK. Residual risks and evolving atherosclerotic plaques. Mol Cell Biochem. 2023 Dec;478(12):2629-2643. https://doi.org/10.1007/s11010-023-04689-0.
4. Gherasie FA, Popescu MR, Bartos D. Acute Coronary Syndrome: Disparities of Pathophysiology and Mortality with and without Peripheral Artery Disease. J Pers Med. 2023 Jun 2;13(6):944. https://doi.org/10.3390/jpm13060944.
5. Schulte KJ, Mayrovitz HN. Myocardial Infarction Signs and Symptoms: Females vs. Males. Cureus. 2023 Apr 13;15(4):e37522. https://doi.org/10.7759/cureus.37522.
6. Ponnusamy SS, Vijayaraman P, Ellenbogen KA. Left Bundle Branch Block-associated Cardiomyopathy: A New Approach. Arrhythm Electrophysiol Rev. 2024 Sep 25;13:e15. https://doi.org/10.15420/aer.2024.14.
7. Lukas Laws J, Lancaster MC, Ben Shoemaker M, Stevenson WG, Hung RR, Wells Q, et al. Arrhythmias as Presentation of Genetic Cardiomyopathy. Circ Res. 2022 May 27;130(11):1698-1722. https://doi.org/10.1161/CIRCRESAHA.122.319835.
8. Catrina BI, Batar F, Manitiu I, Prodan L, Tanasescu C, Filip T. Concepts of Cardiac Dyssynchrony and Dynamic Approach. Diagnostics (Basel). 2024 Apr 30;14(9):937. https://doi.org/10.3390/diagnostics14090937.
9. Khalid K, Padda J, Ismail D, Abdullah M, Gupta D, Pradeep R, et al. Correlation of Coronary Artery Disease and Left

Ventricular Hypertrophy. Cureus. 2021 Aug 30;13(8):e17550. https://doi.org/10.7759/cureus.17550.
10. Ralapanawa U, Sivakanesan R. Epidemiology and the Magnitude of Coronary Artery Disease and Acute Coronary Syndrome: A Narrative Review. J Epidemiol Glob Health. 2021 Jun;11(2):169-177. https://doi.org/10.2991/jegh.k.201217.001.
11. Poznyak AV, Sadykhov NK, Kartuesov AG, Borisov EE, Melnichenko AA, Grechko AV, et al. Hypertension as a risk factor for atherosclerosis: Cardiovascular risk assessment. Front Cardiovasc Med. 2022 Aug 22;9:959285. https://doi.org/10.3389/fcvm.2022.959285.
12. Ng IKS, Chia YW, See KC, Teo DBS. Approach to acute chest pain and acute coronary syndrome in adults. Singapore Med J. 2024 Feb 1;65(2):111-118. https://doi.org/10.4103/singaporemedj.SMJ-2023-039.
13. Achim A, Péter OÁ, Cocoi M, Serban A, Mot S, Dadarlat-Pop A, et al. Correlation between Coronary Artery Disease with Other Arterial Systems: Similar, Albeit Separate, Underlying Pathophysiologic Mechanisms. J Cardiovasc Dev Dis. 2023 May 11;10(5):210. https://doi.org/10.3390/jcdd10050210.
14. Assamti M, Benahmed I, Ismaili N, El Ouafi N. Acute double coronary occlusion and its misleading presentation: An unusual case report. Ann Med Surg (Lond). 2021 Dec 3;73:103133. https://doi.org/10.1016/j.amsu.2021.103133.
15. Gurzău D, Dădârlat-Pop A, Caloian B, Cismaru G, Comșa H, Tomoaia R, et al. Major Left Bundle Branch Block and Coronary Heart Disease-Are There Any Differences between the Sexes? J Clin Med. 2021 May 25;10(11):2284. https://doi.org/10.3390/jcm10112284.
16. Rahu QA, Farman MT, Sial JA. Pattern of coronary artery disease in patients with left bundle branch block in acute coronary syndrome. Med Channel. 2009;15(4):176-9.
17. Rahu QA, Farman MT, Sial JA. Pattern of Coronary Artery Disease in Patients with Left Bundle Branch Block in Acute Coronary Syndrome. Med Channel. 2009;15(4):176-179.
18. Balouch IJ, Ahmed I, Farooq F, Raza SA, Soomro NA, Khan MN, et al. Pattern of Coronary Artery Diseases in Patients Under 40 Years of Age with Acute Coronary Syndrome. Pak Heart J. 2021;54(02):144-147. https://doi.org/10.47144/phj.v54i2.2089.
19. Ghanem I, El-damanhory A, Shaker A. Predictors and Morphologic Characteristics of Ischemic Left Bundle Branch Block. Zagazig University Med J. 2023. https://doi.org/10.21608/zumj.2022.165421.2650.
20. Darmon A, Ducrocq G, Elbez Y. Prevalence, Incidence and Prognostic Implications of Left Bundle Branch Block in Patients with Chronic Coronary Syndromes (From the CLARIFY Registry). Circulation. 2021.
21. 21. Avsec M, Fister M, Noč M, Radsel P. Alternating Bundle-Branch Block in Acute Coronary Syndrome. Cor Vasa. 2019;61:e68–e71. https://doi.org/10.1016/j.crvasa.2017.12.013.