The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 4, Issue 3, 2026

RISK FACTORS AND CORONARY ANGIOGRAPHIC VARIATION IN WELLENS SYNDROME PATIENTS PRESENTED AT TERTIARY CARE CENTERS IN PESHAWAR

Wasif Khan[1], Muhammad Ibrahim[2], Rafi Ullah[3], Usman Zaman[4], Jafar Shah[5], Hilal Ahmad[6], Musadiq Khan[*7]

[1]*Cardiology Lecturer at Allied health sciences & biological sciences Abasyn university Peshawar.*
[2]*Working as A Cardiology Internee at Hayatabad Medical Complex Peshawar.*
[3]*Cardiology Technician at Alkhidmat Hospital Nishtarabad Peshawar*
[4]*Working As a Cardiology Internee at Peshawar Institute of Cardiology.*
[5]*Cardiology Lecturer at Allied Health Sciences & Biological Sciences Abasyn University Peshawar.*
[6]*Cardiology Lecturer at North west institute of health sciences Peshawar*
[*7]*Academic Coordinator for distance education, SIAHS, SUIT, Peshawar*

[1]imwk48335@gmail.com, [2]ibra03461102006@gmail.com, [3]rafiullahhabib777@gmail.com, [4]usman976@gmail.com, [5]jafarshah9291@gmail.com, [6]cardiowithhilal@gmail.com, [*7]musadiq.siahs@suit.edu.pk

DOI: https://doi.org/10.5281/zenodo.19015885

Keywords
wellens syndrome, left anterior descending artery, angiography, electrocardiographic (ECG)

Article History
Received: 15 January 2026
Accepted: 28 February 2026
Published: 14 March 2026

Corresponding Author: *
Musadiq Khan

Abstract

Introduction: *Wellen's syndrome is a critical condition often associated with high cardiovascular risk, characterized by specific electrocardiographic changes. This study aimed to evaluate the clinical, demographic, and angiographic characteristics of patients diagnosed with Wellen's syndrome at Hayatabad Medical Complex, Peshawar, over a six-month period.*

Methodology: *A total of 125 patients were included in the study. Demographic data, including age and gender, were recorded, and the participants were categorized into different age groups. The types of angina (unstable and stable) were identified, and risk factors such as smoking, hypertension, diabetes, and high cholesterol levels were assessed. Coronary angiography was performed to evaluate the presence of stenosis in coronary arteries, and electrocardiographic findings were classified into two types of Wellen's syndrome (Type A and Type B).*

Results: *The majority of participants (75.6%) were aged between 50 and 70 years, with males constituting 68.8% of the sample. Unstable angina was more prevalent (62.4%) compared to stable angina (37.6%). The most common risk factors were hypertension (79.2%), high cholesterol (52.8%), and smoking (37.6%). Coronary angiography revealed proximal stenosis in the left anterior descending artery (LAD) in 91.2% of cases, followed by the left circumflex artery (24%) and right coronary artery (21.6%). Electrocardiographic analysis showed a higher prevalence of Type A Wellen's syndrome (97 cases) compared to Type B (28 cases). The findings emphasize the importance of early diagnosis and management of risk factors to mitigate adverse cardiovascular outcomes in patients with Wellen's syndrome.*

CONCLUSION: *The findings highlight the significance of early diagnosis and management of risk factors in patients with Wellen's syndrome to prevent adverse cardiovascular outcomes.*

Introduction

Cardiovascular diseases remain one of the leading causes of morbidity and mortality worldwide. Among these conditions, acute coronary syndrome (ACS) represents a major clinical emergency that requires rapid diagnosis and prompt treatment to prevent myocardial infarction and death. ACS occurs when blood flow to the heart muscle is suddenly reduced due to obstruction of the coronary arteries, usually caused by rupture of an atherosclerotic plaque followed by thrombus formation (Libby et al., 2019). Early identification of high-risk electrocardiographic patterns associated with ACS is therefore essential for timely intervention and improved patient outcomes.

The human heart is a cone-shaped muscular organ located in the mediastinum of the thoracic cavity between the lungs. It extends approximately from the second to the sixth rib, rests on the diaphragm, and projects slightly to the left behind the sternum. Anatomically, the right atrium forms the right border of the heart, the right ventricle forms most of the anterior surface, the left ventricle forms the left and inferior surfaces, and the left atrium forms most of the posterior surface (Hall & Hall, 2021). The heart is enclosed within a protective pericardial sac composed of fibrous and serous layers. The serous pericardium consists of parietal and visceral layers, with pericardial fluid present between them to reduce friction during cardiac movement. Structurally, the heart wall is composed of three layers: the epicardium, myocardium, and endocardium (Moore et al., 2018).

The heart functions as a powerful pump responsible for maintaining both pulmonary and systemic circulation. Deoxygenated blood from the body enters the right side of the heart and is pumped to the lungs for oxygenation, while oxygenated blood returns to the left side of the heart and is circulated to the body tissues (Hall & Hall, 2021). To maintain this continuous activity, the myocardium requires a constant supply of oxygenated blood through the coronary circulation. The right and left coronary arteries arise from the coronary ostia located at the base of the aorta. The left coronary artery further divides into the left anterior descending (LAD) artery and the circumflex artery, whereas the right coronary artery branches into the posterior descending artery and marginal artery, supplying different regions of the heart muscle (Klabunde, 2020).

Coronary blood flow is regulated by multiple physiological mechanisms including coronary perfusion pressure, vascular resistance, metabolic factors, and autonomic nervous system activity. Coronary perfusion pressure is determined by the difference between aortic diastolic pressure and left ventricular end-diastolic pressure. During increased physical activity or stress, myocardial oxygen demand rises, leading to vasodilation of coronary vessels mediated by metabolic signals such as adenosine and β-adrenergic stimulation, thereby increasing coronary blood flow (Klabunde, 2020).

One important but often underrecognized clinical entity associated with acute coronary syndrome is Wellens syndrome. Wellens syndrome is characterized by distinctive electrocardiographic (ECG) changes that indicate critical stenosis of the proximal left anterior descending (LAD) coronary artery (de Zwaan et al., 1982). The syndrome was first described in the early 1980s by de Zwaan and Wellens in patients presenting with unstable angina who exhibited characteristic T-wave abnormalities in the anterior precordial leads. These ECG findings are typically observed during pain-free periods and may occur even when cardiac enzyme levels remain normal or only slightly elevated (Rhinehardt et al., 2002).

The characteristic ECG features of Wellens syndrome include minimal or absent ST-segment elevation, preservation of normal R-wave progression, absence of pathological Q waves, and distinctive T-wave abnormalities in leads V2 and

V3. Based on the morphology of these T-wave changes, Wellens syndrome is classified into two types. Type A (Type 1) is characterized by biphasic T waves in the anterior precordial leads V2 and V3, while Type B (Type 2) shows deeply inverted and symmetrical T waves in the same leads. Among these two patterns, Type B is reported to be more common, accounting for approximately 75% of cases (Rhinehardt et al., 2002). Recognition of these ECG patterns is critical because they represent a pre-infarction stage and are strongly associated with severe stenosis of the proximal LAD artery.

The pathophysiology of Wellens syndrome is primarily related to rupture of an unstable atherosclerotic plaque within the coronary artery. When the plaque ruptures, its highly thrombogenic lipid core becomes exposed to circulating blood, triggering platelet aggregation, thrombus formation, and partial or transient occlusion of the coronary artery. This process leads to myocardial ischemia and may eventually progress to extensive anterior wall myocardial infarction if left untreated (Libby et al., 2019). Early studies demonstrated that nearly 75% of untreated patients with Wellens syndrome developed a large anterior myocardial infarction within weeks (de Zwaan et al., 1982).

Several risk factors are associated with the development of coronary artery disease and may contribute to the occurrence of Wellens syndrome. These include hypertension, diabetes mellitus, hyperlipidemia, smoking, metabolic syndrome, family history of coronary artery disease, and psychological stress (Yusuf et al., 2004). Identification of these risk factors plays a vital role in early diagnosis and prevention strategies.

Diagnosis of Wellens syndrome relies primarily on electrocardiographic findings and clinical presentation. However, definitive confirmation often requires coronary angiography, which typically reveals critical stenosis of the proximal LAD artery, often exceeding 90% luminal narrowing. Early coronary angiography followed by revascularization through percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) is recommended to prevent progression to myocardial infarction and sudden cardiac death (Rhinehardt et al., 2002).

Despite increasing recognition of Wellens syndrome in international literature, limited data are available regarding its risk factors and coronary angiographic variations in Pakistan, particularly in patients presenting to tertiary care hospitals. Understanding the distribution of risk factors, the most commonly involved coronary arteries, and the prevalence of different types of Wellens syndrome among local populations is essential for improving early diagnosis and management strategies. Therefore, this study aims to investigate the risk factors and coronary angiographic variations in Wellens syndrome patients presenting at tertiary centers in Peshawar, which may contribute to better clinical recognition and prevention of adverse cardiac events.

Aim and Objectives

1). To ascertain which kind of risk factor is most closely linked to Wellens syndrome.

2). To determined which coronary artery is more frequently impacted in Wellens syndrome patients.

3). To determined which kind of Wellens syndrome is most prevalent.

strategies, ultimately reducing the burden of this potentially life threatening condition.

Material and Methods

The present research study was conducted at Hayatabad Medical Complex (HMC), Peshawar, a tertiary care hospital that receives a large number of cardiac patients from the region. This study was designed as a descriptive cross-sectional study to evaluate the risk factors and coronary angiographic variations in patients with Wellens syndrome. The duration of the study was six months, conducted from June 2024 to November 2024.

A sample size of 196 patients was included in the study. The sample size was calculated using the standard formula:

$N = Z^2 p (1-p) / E^2$

where N represents the calculated sample size, Z is the Z-value corresponding to a 95% confidence

level (1.96), p represents the estimated prevalence (15% or 0.15), and E represents the standard sampling error (5% or 0.05).

The calculation was performed as follows:
N = (1.96)^2 (0.15) (1-0.15) / (0.05)^2
N = (3.8416)(0.15)(0.85) / 0.0025
N = 0.4898 / 0.0025
N = 196

Therefore, the final calculated sample size for this study was 196 patients. The convenience sampling technique, which is a form of non-probability sampling, was used for patient selection.

The study included adult patients aged above 20 years who presented with a recent history of angina. Patients having cardiovascular risk factors such as diabetes mellitus, hypertension, hypercholesterolemia, and smoking were included. Only patients who were hemodynamically stable at the time of diagnosis and during angiography and who underwent coronary angiography to confirm the presence of coronary artery disease were considered eligible for participation.

Patients were excluded from the study if they had incomplete or poor-quality electrocardiographic (ECG) data that prevented accurate diagnosis of Wellens syndrome. Individuals who had previously undergone percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) were also excluded. In addition, patients with markedly elevated troponin levels indicating established myocardial infarction were excluded from the study.

Data were collected using a structured proforma designed specifically for the study. The proforma consisted of several sections including the title and demographic profile, which recorded patient characteristics such as age, gender, height, and weight. The next section included medical history and cardiovascular risk factors, including smoking status, cholesterol levels, family history of coronary artery disease, hypertension, and diabetes mellitus. Another section recorded the clinical signs and symptoms of the patients. The final portion of the proforma documented electrocardiographic findings and coronary angiographic findings, along with patient consent and researcher details.

All collected data were analyzed using Statistical Package for Social Sciences (SPSS) version 22. For descriptive statistical analysis, mean, mode, and standard deviation were calculated for continuous variables. For categorical variables, frequencies and percentages were determined. The results were presented using tables and graphical representations, including bar charts and pie charts, to clearly illustrate the distribution of variables and study findings.

RESULTS

Age base distribution of wellnes syndrome

This data shows the distribution of individuals across different age groups, with the majority (45.6%) falling in the **60-70 years** range, followed by **50-60 years** (30.4%), **30-40 years** (23.2%), and a small percentage (0.8%) in the **20-30 years** range.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	20-30 Years	1	.8	.8	.8
	30-40 Years	29	23.2	23.2	24.0
	50-60 Years	38	30.4	30.4	54.4
	60-70 Years	57	45.6	45.6	100.0
	Total	125	100.0	100.0	

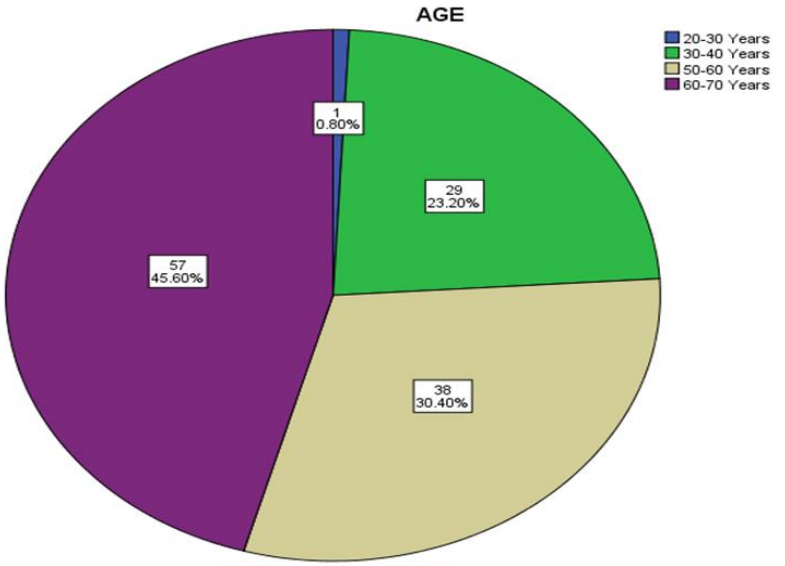


Figure 1: pie chart illustrating Wellen's Syndrome age-based distribution

Gender base distribution of wellens syndrome

The sample population consists of 125 individuals, with 86 males (68.8%) and 39 females (31.2%), reflecting a gender distribution that shows a higher proportion of male participants.

Table 2 Gender base distribution of wellens syndrome

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Male	86	68.8	68.8	68.8
	Femal	39	31.2	31.2	100.0
	Total l	125	100.0	100.0	

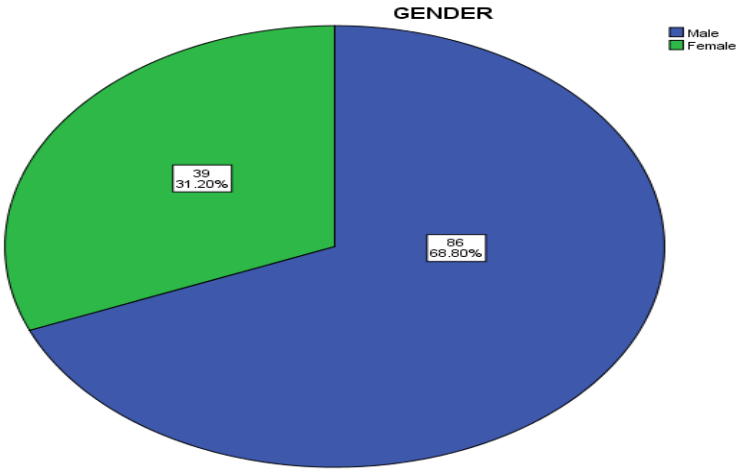


Figure 2 gender base distribution of wellen's syndrome

Types of angina

"The distribution of stable and unstable angina within the study population reveals that, among 125 participants, 78 individuals with unstable angina did not have stable angina, while 44 participants without unstable angina were diagnosed with stable angina

Case processing summary

	Case					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Unstable angina * Stable angina	125	100.0%	0	0.0%	125	100.0%

Unstable angina * Stable angina Cross tabulation

		Yes	No	
Unstable angina	Yes	0	78	78
	11	0	1	1
	No	44	2	46
Total		44	81	125

Table 3. type of angina

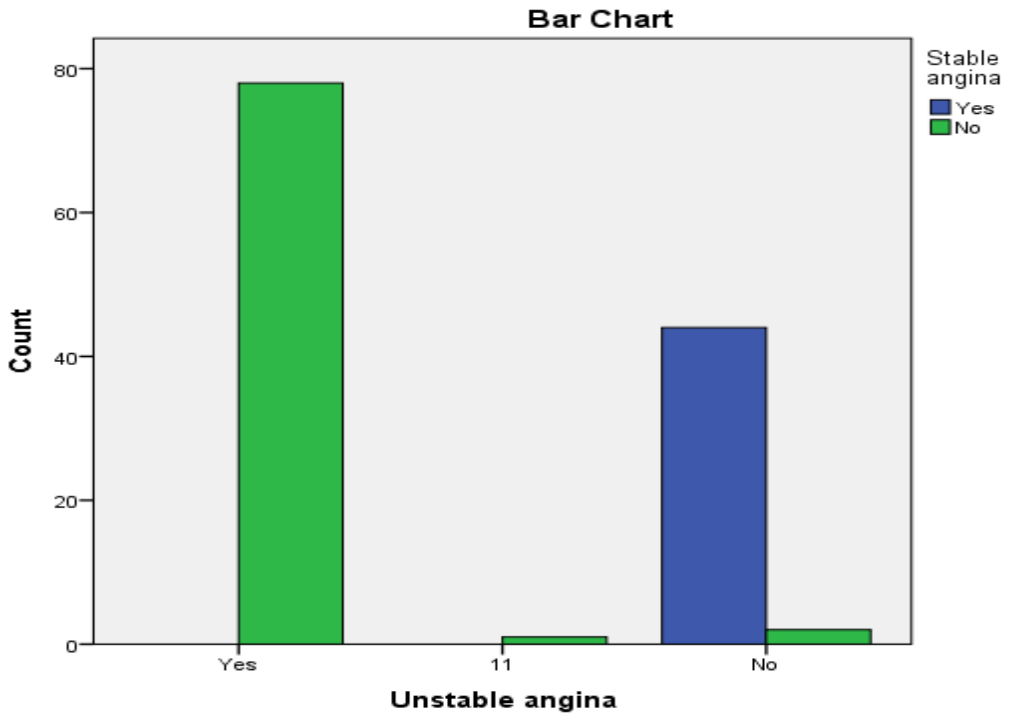
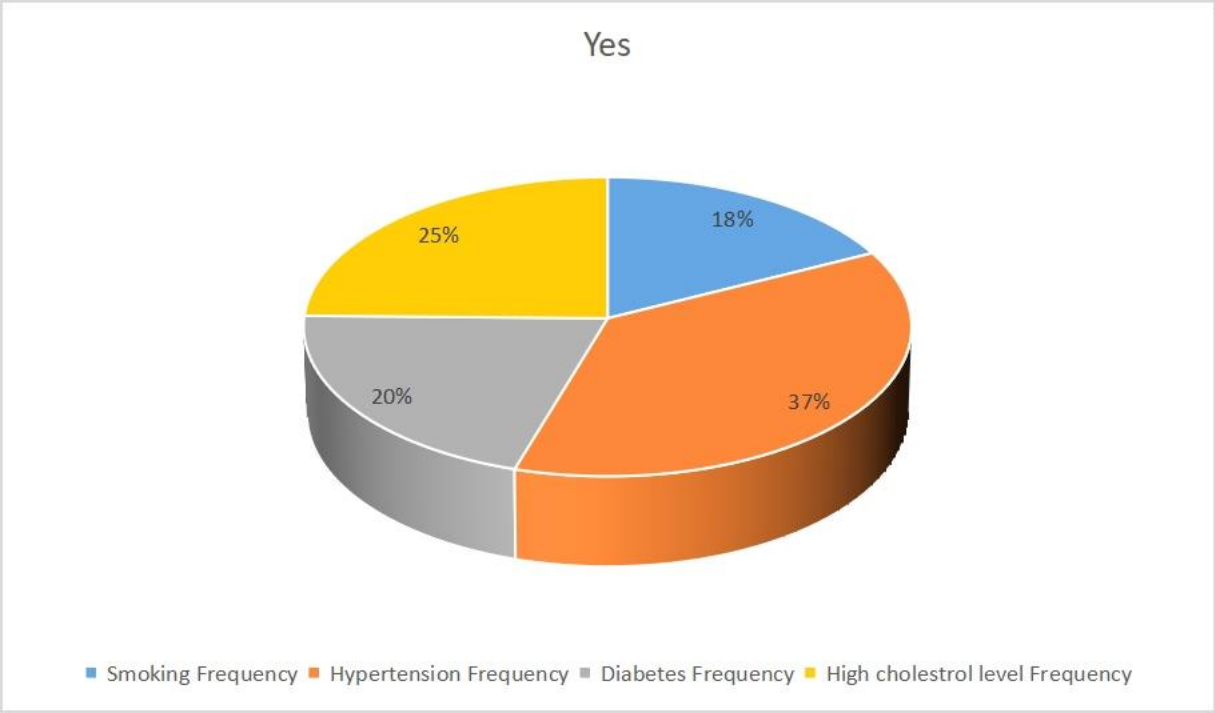


Figure 3 type of angina

RISK FACTORS OF WELLENS SYNDROME

The data collected from a sample of 125 individuals reveal the following patterns concerning smoking, hypertension, diabetes, and high cholesterol levels. Regarding smoking, 37.6% of participants reported smoking, while the remaining 62.4% did not smoke. The prevalence of hypertension was notably high, with 79.2% of the participants indicating that they had been diagnosed with this condition, leaving only 20.8% without hypertension. In terms of diabetes, 44% of individuals reported having diabetes, while 56% did not. Finally, 52.8% of participants had high cholesterol, whereas 47.2% did not have this condition.

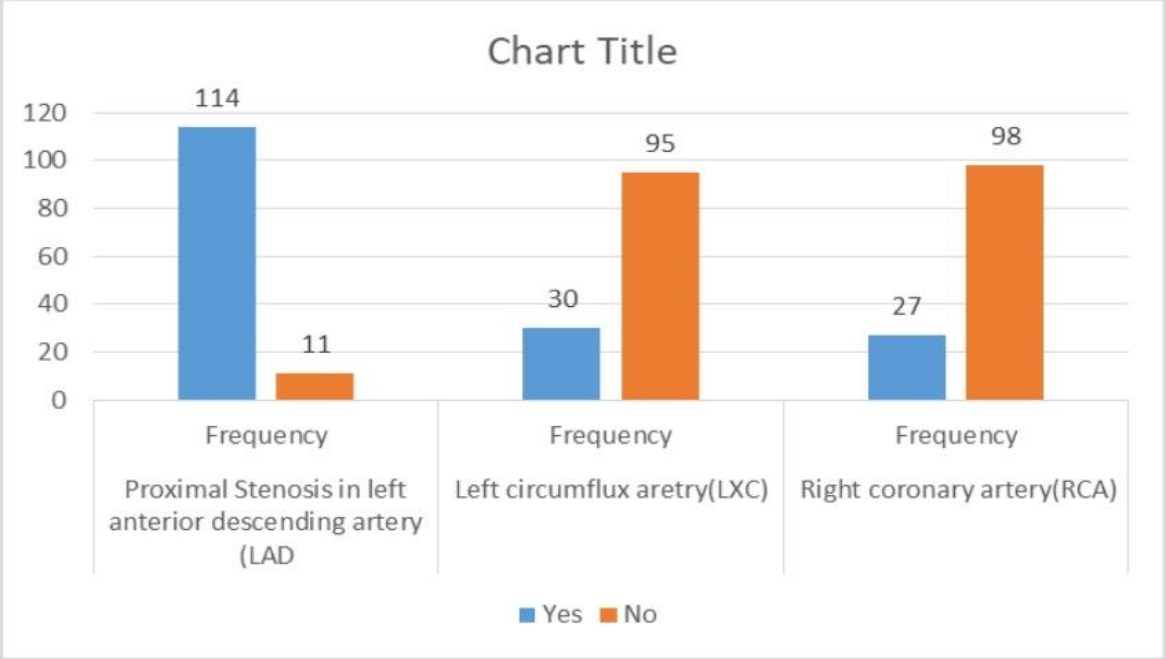
	Smoking		Hypertension		Diabetes		High cholestrol level	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	47	37.6%	99	79.2%	55	44.0%	66	52.8%
No	78	62.4%	26	20.8%	70	56.0%	59	47.2%
Total	125	100	125	100.0	125	100.0	125	100.0



CORONARY ANGIOGHRAPHIC VARIATION OF WELLENS SYNDROME

The analysis of coronary artery stenosis among 125 participants revealed the following findings. Proximal stenosis in the left anterior descending artery (LAD) was the most prevalent, with 91.2% of participants exhibiting this condition, while only 8.8% did not show any signs of stenosis in the LAD. In contrast, stenosis in the left circumflex artery (LXC) was less common, with 24.0% of participants affected, leaving 76.0% without any significant narrowing in this artery. Stenosis in the right coronary artery (RCA) was observed in 21.6% of the sample, while 78.4% of participants did not show any signs of stenosis in the RCA. These findings suggest a higher prevalence of stenosis in the LAD compared to the LXC and RCA within the studied population.

Proximal Stenosis in left anterior descending artery (LAD)			Left circumflux aretry(LXC)		Right coronary a rtery(RCA)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	114	91.2%	30	24.0%	27	21.6%
No	11	8.8%	95	76.0%	98	78.4%
Total	125	100.0	125	100.0	125	100.0



Types of Wellens Syndrome

The analysis of T wave abnormalities in leads V2-V3 revealed that among the 28 cases with an inverted T wave, 1 case also exhibited a biphasic T wave, while the majority (97 cases) with a non-inverted T wave showed biphasic characteristics, highlighting the distinct patterns and potential clinical significance of these T wave abnormalities in this lead region.

Case processing summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Biphasic T wave in V2-V3 Inverted T wave in V2-V3	125	100.0%	0	0.0%	125	100.0%

Biphasic T wave in lead V2-V3 * Inverted T wave in lead V2-V3 Cross tabulation

Count

		Inverted T wave in V2-V3		
		Yes	No	Total
Biphasic T wave in V2-V3	Yes	1	97	98
	No	27	0	27
Total		28	97	125

Table. Types of Wellens syndrome

The analysis of T wawave, 1 case also exhibited a biphasic T wave, while the majority (97 cases)

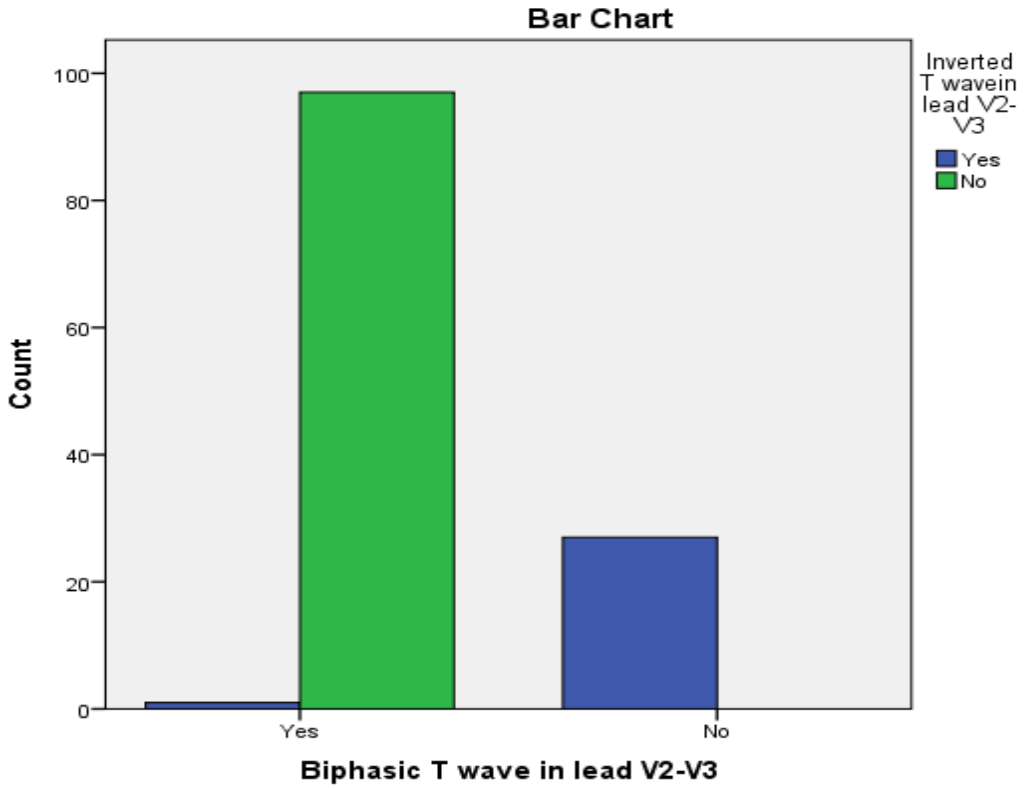


Figure 4 type of wellens syndrome

DISCUSSION:

In our study, we identified several key risk factors associated with Wellens syndrome and explored the variations observed in coronary angiography. Wellens syndrome, a clinical pattern of ischemic chest pain, is typically associated with critical stenosis of the coronary arteries, particularly in the left anterior descending artery.The risk factors identified in our study include hypertension, hyperlipidemia, high blood sugur level , and other underlying factors that lead to the Pathophysiology of the syndrome

In our study, hypertension is identified as a potential cause of harm for Wellens syndrome in 37% of participants. A comparable study was carried out at Capital Medical University's Beijing Friendship Hospital. where hypertension was found to be associated with risk in 66.5% of participants.This suggests that, according to our research, the prevalence of hypertension as a risk factor for wellens syndrome is lower than that similar study. (A weel know acs)

Our study reveals that high cholesterol levels are a risk factor for Wellens syndrome in 25% of participants. This finding contrasts with a similar study conducted at Ahmed Gasim Teaching Hospital, where hyperlipidemia was identified as a risk factor in 16.7% of participants. These results indicate that, in our study, hyperlipidemia appears to be a more significant increased risk of Wellens syndrome compared to the study conducted at Ahmed Gasim Teaching Hospital.(types of wellen)

In our study, diabetes was identified as a risk factor for Wellens syndrome in 44.0% of participants. In comparison, a similar study conducted at Govt. Medical College, Aurangabad, Maharashtra, India, reported diabetes as a risk factor in 37.0% of participants. This comparison indicates that the prevalence of diabetes as a risk factor for Wellens syndrome is higher in our study than in the study

from Aurangabad Maharashtra, India.(sign and symptom 1)

In our study, proximal stenosis of the left anterior descending (LAD) artery was observed in 91% of participants. In contrast, a similar study conducted at Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine, reported proximal stenosis of the LAD in 86.0% of participants. This comparison suggests that the prevalence of proximal LAD stenosis in our study is slightly higher than that observed in the study from Ukraine, indicating potential regional or methodological differences between the two studies.(1209)

In our study, proximal stenosis of the left circumflex (LCX) artery was observed in 24% of participants. In contrast, a similar study conducted at Ahmed Gasim Teaching Hospital,, reported proximal stenosis of the LCX in 18.8% of participants. This comparison suggests that the prevalence of proximal LCX stenosis in our study is higher than that observed in the study from Ahmed Gasim Teaching Hospital. (TYPES OF WELLEN)

RECOMENDATION

Future research on Wellens Syndrome should focus on conducting studies in multiple centers with a variety of populations. It should include long-term follow-ups and genetic research to understand risk factors. The studies should also assess how well risk factors are managed, using advanced diagnostic tools like coronary CT and MRI. Additionally, research should explore differences between genders, compare treatment methods, and evaluate public health strategies.

CONCLUSION

This six-month study at Hayatabad Medical Complex, Peshawar, examined the demographic, clinical, and angiographic features of Wellens Syndrome. The majority of participants (75.6%) were aged 50-70 years, with males comprising 68.8% of the sample. Unstable angina was more prevalent than stable angina, and common risk factors included hypertension (79.2%), high cholesterol (52.8%), diabetes (44.0%), and smoking (37.6%). Angiographic analysis revealed proximal stenosis in left anterior descending artery (91.2%) as the most frequent finding, followed by lower rates of stenosis in the left circumflex (24.0%) and right coronary arteries (21.6%).Biphasic T waves in leads V2-V3 were more common than inverted T waves. These findings emphasize the importance of early detection, risk factor management, and recognition of characteristic patterns for effective treatment of Wellens Syndrome.

REFERENCES

de Zwaan, C., Bär, F. W., & Wellens, H. J. J. (1982). Characteristic electrocardiographic pattern indicating a critical stenosis high in the left anterior descending coronary artery in patients admitted because of impending myocardial infarction. *American Heart Journal*, 103(4), 730–736. https://doi.org/10.1016/0002-8703(82)90480-x

Hall, J. E., & Hall, M. E. (2021). *Guyton and Hall textbook of medical physiology* (14th ed.). Elsevier.

Klabunde, R. E. (2020). *Cardiovascular physiology concepts* (3rd ed.). Wolters Kluwer.

Libby, P., Bonow, R. O., Mann, D. L., Tomaselli, G. F., & Bhatt, D. L. (2019). *Braunwald's heart disease: A textbook of cardiovascular medicine* (11th ed.). Elsevier.

Moore, K. L., Dalley, A. F., & Agur, A. M. R. (2018). *Clinically oriented anatomy* (8th ed.). Wolters Kluwer.

Rhinehardt, J., Brady, W. J., Perron, A. D., Mattu, A., & Holstege, C. (2002). Electrocardiographic manifestations of Wellens' syndrome. *The American Journal of Emergency Medicine*, 20(7), 638–643. https://doi.org/10.1053/ajem.2002.35464

Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanas, F., McQueen, M., Budaj, A., Pais, P., Varigos, J., & Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *The Lancet*, 364(9438), 937–952. https://doi.org/10.1016/S0140-6736(04)17018-9

Abulaiti, A., Aini, R., Xu, H., & Song, Z. (2013). A special case of Wellens' syndrome. *Journal of Cardiovascular Disease Research, 4*(1), 51–54. https://doi.org/10.1016/j.jcdr.2013.02.016

Alexander, J., & Rizzolo, D. (2023). Wellens syndrome: An important consideration in patients with chest pain. *Journal of the American Academy of Physician Assistants, 36*(2), 25–29. https://doi.org/10.1097/01.JAA.0000903146.15179.1a

Al-Assaf, O., Abdulghani, M., Musa, A., & Aljallaf, M. (2019). Wellens' syndrome: The life-threatening diagnosis. *Circulation, 140*(22), 1851–1852. https://doi.org/10.1161/CIRCULATIONAHA.119.041560

Avram, A., Iancu, A., Brezeanu, R. C., Chioncel, V., Andrei, C. L., & Sinescu, C. (2022). Wellens syndrome: Single-centre study and literature review. *Revista Romana de Cardiologie, 32*(4), 203–209.

Chen, H. (2022). *Wellens' syndrome: Incidence, characteristics, and long-term clinical outcomes.*

Cruz, M. C., Ferreira, I. L., & Cruz Ferreira, R. (2017). Wellens' syndrome: A bad omen. *Cardiology, 137*(2), 100–103. https://doi.org/10.1159/000455802

Jakkal, P., & Pandey, V. R. (2016). Clinical profile and angiographic characteristics in patients with Wellens syndrome. *International Journal of Medical Science and Clinical Research*, 105–107.

Junaideen, M. J. M., Soooriyagoda, S. K. G. P. H. K., Jayawickreme, S. R., Mayurathan, G., & Kularatne, A. (2024). Characteristics of patients with Wellens syndrome who underwent coronary angiogram: A single-center experience. *Sri Lanka Journal of Medicine, 33*(1), 39–48.

Khan, B., Alexander, J., Rathod, K. S., & Farooqi, F. (2013). Wellens' syndrome in a 24-year-old woman. *BMJ Case Reports*. https://doi.org/10.1136/bcr-2013-009321

Kyaw, K., Latt, H., Aung, S. S. M., Tun, N. M., Phoo, W. Y., & Yin, H. H. (2018). Atypical presentation of acute coronary syndrome and importance of Wellens' syndrome. *American Journal of Case Reports, 19*, 199–202. https://doi.org/10.12659/AJCR.907548

Mohamed, S., & Abdelaziz, S. (2024). Wellens syndrome: Prevalence, risk factors and coronary angiographic variation: A cross-sectional study. *BMC Cardiovascular Disorders, 24*(1), 1–13. https://doi.org/10.1186/s12872-024-03752-y

Obi, M. F., Namireddy, V., Noel, C., O'Brien, A., Sharma, M., Frederick, A., et al. (2023). Comparative assessment of Wellens' syndrome with proximal left anterior descending artery stenosis versus right coronary artery or circumflex artery stenosis and its prevalence: A systematic review. *Cureus, 15*(4). https://doi.org/10.7759/cureus.37790

Seredyuk, N., Serediuk, V., Vandzhura, Y., Skakun, O., & Parakhoniak, V. (2020). Wellens' syndrome: Focus on diagnosis and choice of myocardial revascularization strategy. *Archives of Clinical Medicine, 26*(2), 24–29.

Torelli, E., Sardeo, F., Nuzzo, E., Cicchinelli, S., Petrucci, M., Pignataro, G., et al. (2020). Wellens syndrome without chest pain: Is it possible? *European Review for Medical and Pharmacological Sciences, 24*(14), 7718–7721.