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Prevalence of coronary artery ectasia and aneurysm, their segmental distribution, and clinical presentation

Abhishek Rathore[1], Shitij Shrivastava[2], Shashwat Shrivastava[2], Shailendra Trivedi[3], Vinod Somani[4], Sandeep shrivastava[5]

1. Associate consultant, department of cardiology, Medanta Superspeciality hospital, Indore, India
2. Undergraduate, St. Martinus University Faculty of Medicine, Willemstad, Curacao
3. Director, department of cardiology, Medanta Superspeciality hospital, Indore, India
4. Associate director, department of cardiology, Medanta Superspeciality hospital, Indore, India
5. Director, department of cardiovascular and Thoracic surgery, Medanta Superspeciality hospital, Indore, India

Corresponding author: Abhishek Rathore

Associate consultant cardiology

Medanta Superspeciality hospital, Indore, India

Phone- +91 731 4747000

Fax- +91 7314747001

Email- drabhishek.ind8@gmail.com

Orcid id-

Abhishek Rathore- http://orcid.org/0000-0002-6153-9689
Shitij Shrivastava- http://orcid.org/0000-0002-2728-2525
Shashwat Shrivastava- http://orcid.org/0000-0002-1608-3897
Shailendra Trivedi- http://orcid.org/0000-0002-5314-4038
Vinod Somani- http://orcid.org/0000-0002-5488-7888
Sandeep Shrivastava- http://orcid.org/0000-0003-0914-8039

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Abstract-

Introduction-

Coronary artery ectasia and aneurysm is an uncommon angiographic finding, which involves a part or complete length of the coronary artery. It leads to significant cardiovascular outcomes and is considered a risk factor for coronary artery thrombosis. This study aims to evaluate the prevalence of coronary artery ectasia and aneurysm, their segmental involvement, and clinical presentation in patients with and without coronary artery disease (CAD).

Material and methods-

We did a cross-sectional, retrospective analysis of 1764 coronary angiogramsperformed between July 2019 to June 2020. Segmental involvement of coronary artery ectasia and aneurysm is studied in patients with and without CAD.

Results-

Prevalence of isolated aneurysm was 1.1%, isolated ectasiawas 20.2%, and ectasia with the aneurysm was 2.9%. Prevalence of aneurysm was similar between CAD and non-CAD group

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(1.2 vs. 1.1%, p < 1.000). Prevalence of aneurysm with ectasia was also similar between CAD and non-CAD groups (2.9 vs. 3.2%, p = 0.785). The prevalence of isolated ectasia was more in the CAD vs. non-CAD group (22 vs. 13.7%, p < 0.001).
Most commonly, coronary artery aneurysm and ectasia are presented as NSTEMI (non-ST elevation myocardial infarction) followed by STEMI (ST-elevation myocardial infarction).

Conclusion-

Coronary artery ectasia is more common than aneurysms. Isolated coronary ectasiawas prevalent in patients with coexisting coronary artery disease, unlike the aneurysm. Coronary artery ectasia and aneurysm most commonly presented as NSTEMI, followed by STEMI.

Keywords- Coronary artery ectasia, coronary artery aneurysm, coronary artery disease, acute coronary syndrome, STEMI and NSTEMI

Introduction-

Coronary artery ectasia and aneurysm is an uncommon finding during angiography in patients with and without coronary artery disease[1]. Patients with coronary artery ectasia and aneurysm may present with adverse cardiovascular events due to coronary artery spasm, dissection, slow flow, or thrombus formation[2]. These adverse cardiovascular events ranges from chronic stable angina to acute coronary syndromes.
Due to paucity of data, there is a clear unmet need, to study the natural history of patients with coronary artery ectasia and aneurysm. In present study, we evaluated the prevalence, predilection site for coronary artery ectasia and aneurysm, and their clinical presentation, in patients with and without coronary artery disease.

Material and methods-

We have done a cross-sectional study with a retrospective analysis of 1764 coronary angiograms performed between July 2019 and June 2020 at Medanta heart institute, Indore, India. A panel of three interventional cardiologists assessed all angiograms.
Inclusion criteria- Patients more than 18 years of age came for a coronary angiogram.
Exclusion criteria- Patients with previous coronary artery bypass surgery, previous percutaneous coronary angioplasty, infections, connective tissue disorders and malignancy.

Segmental distribution of coronary arteries-

Left anterior descending artery (LAD) was divided into three segments: proximal (from origin to first major septal perforating branch), mid (from the origin of the first septal perforator to the 90˚ angle, at the second diagonal branch), and distal (from second diagonal to vessel end). Left circumflex artery (LCX) was divided into three branches: proximal (from vessel ostium to first major obtuse marginal branch), mid (between obtuse marginal one and two), and distal (vessel distal to the second obtuse marginal). Right coronary artery (RCA) was divided into proximal (ostium to first main right ventricular branch), mid (first main right ventricular branch to the acute marginal branch), and distal (acute marginal branch to the crux).[3]
Coronary artery ectasia was defined as dilatation of more than one-third of coronary artery length with diameter 1.5 times of adjacent normal coronary artery, while coronary artery aneurysm was defined as dilatation involving less than one-third of coronary artery length[1]**(Figure 1).**

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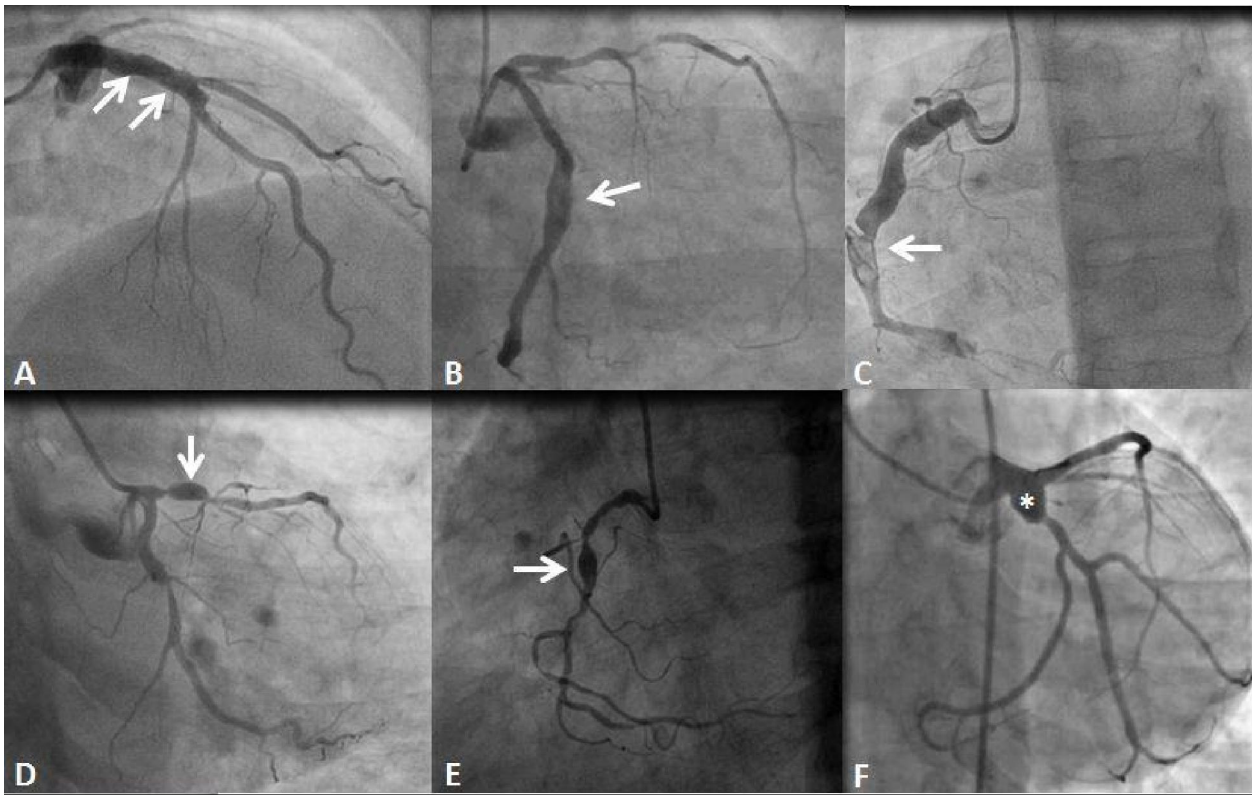

Figure 1- Diagnostic coronary angiogram showing: (A) ectasia (double arrow) in proximal to mid-left anterior descending artery (LAD), (B) ectasia (arrow) in the mid-left circumflex artery (LCX), (C) ectasia (arrow) in mid-right coronary artery (RCA) with thrombus, (D) aneurysm (arrow) in proximal LAD, immediately after stenosis, (E) aneurysm (arrow) in mid-RCA and (F) shows aneurysm (asterisk) of left main coronary artery extending into the proximal left circumflex artery

Coronary artery disease was defined angiographically, as ≥ 50% stenosis of the LMA, LAD, LCX, and RCA. The patients were divided into two groups, with and without coronary artery disease. Indications for coronary angiogram were STEMI, NSTEMI, unstable angina, chronic stable angina,valve surgery, intracardiac device implantation, pre-operative fitness, positive treadmill test, atypical chest pain, and unexplained dyspnea.
Left ventricular ejection fraction was determined by echocardiography using simpson's method.

Statistical analysis-
The Statistical software, namely SPSS 22.0 and R environment ver.3.2.2, were used to analyze the data. Descriptive and inferential statistical analysis was performed in the present study.P-value less than 5% was considered significant. Student t-test (two-tailed, independent) was used to find the significant differences of study parameters on a continuous scale between two groups (intergroup analysis) on metric parameters. Leven's test for homogeneity of variance has been performed. Chi-square/ Fisher Exact test was used to find the significance of study parameters on

ISSN:0975-3583,0976-2833 VOL13,ISSUE 03,2022

a categorical scale between two or more groups, the non-parametric setting for qualitative data analysis. Fisher exact test is used when cell samples are very small.

Results-

A total of 1764 coronary angiograms were evaluated. Patients were divided into two groups, one with coronary artery disease (CAD) and the other without coronary artery disease (Non- CAD). The mean age of the patients was 58.72±10.9 years. Males had a higher prevalence of coronary artery disease than females (P < 0.001). Diabetes, hypertension, smoking, and left ventricular dysfunction were more prevalent in patients with coronary artery disease**(Table 1).** Segmental involvement of coronary artery involvement is studied.

Table 1: Demographics and baseline characteristics of all patients

	Total (n = 1764)	**Non-CAD (n = 380)**	**CAD (n = 1384)**	**P value**
Age (in years)	58.72 ± 10.9	55.38 ± 10.7	59.64 ± 10.8	< 0.001*
Male	1296 (73.5%)	228 (60%)	1068 (77.2%)	< 0.001*
LV Ejection Fraction (%)	50.21 ± 10.89	54.95 ± 10.22	48.91 ± 10.72	<0.001*
Diabetes	671 (38%)	100 (26.3%)	571 (41.3%)	<0.001*
Hypertension	937 (53.1%)	181 (47.6%)	756 (54.6%)	0.016*
Smoking	62 (3.5%)	4 (1.1%)	58 (4.2%)	0.003*
Alcohol	19 (1.1%)	6 (1.6%)	13 (0.9%)	0.285
Obesity	257 (14.6%)	60 (15.8%)	197 (14.2%)	0.447
Chronic stable angina	244 (13.8%)	12 (3.2%)	232 (16.8%)	<0.001*
Unstable angina	100 (5.7%)	4 (1.1%)	96(6.9%)	< 0.001*
NSTEMI	496 (28.1%)	20 (5.3%)	476 (34.4%)	<0.001*
STEMI	392 (22.2%)	36 (9.5%)	356 (25.7%)	<0.001*
Others**	532 (30.2%)	308 (81.1%)	224 (16.2%)	<0.001*

*P-value < 0.05 shows statistical significance

ISSN:0975-3583,0976-2833 VOL13,ISSUE 03,2022

**Includes patient who underwent angiogram for other indications like, patient going for valve surgery, intracardiac device implantation, pre-operative fitness, positive treadmill test, atypical chest pain and unexplained dyspnea.
CAD: Coronary artery disease; LV: Left ventricular; NSTEMI: Non-ST elevation myocardial infarction; STEMI: ST-elevation myocardial infarction.
LMA: Left main artery; LAD: Left anterior descending artery; LCX: Left circumflex artery; RCA: Right coronary artery; NSTEMI: Non-ST elevation myocardial infarction; STEMI: ST-elevation myocardial infarction.
Overall, the prevalence of isolated coronary artery aneurysmwas 1.1%, isolated ectasia was 20.2%, and ectasia with the aneurysm was 2.9%**(Table 2)**. The most common artery involved with ectasia was RCA (15.6%), followed by LAD (13%), followed by LCX (9.6%), while the artery most commonly involved with the aneurysm was LAD (2.4%), RCA (0.7%) and LCX (0.5%)**(Table 3).**Prevalence of coronary aneurysm was similar between CAD and non-CAD group (1.2 vs. 1.1%, p < 1.000)**(Table 2)**.Prevalence of aneurysm with ectasia was similar between CAD and non-CAD groups (2.9 vs. 3.2%, p = 0.785).Prevalence of isolated ectasiawere more in CAD vs non-CAD group (22 vs 13.7%, p < 0.001)**(Table 2).**

Table 2: Overall prevalence of coronary artery aneurysm and ectasia

Parameter	Total (n= 1764)	Non-CAD (n=380)	CAD (n= 1384)	P Value
Aneurysm	20(1.1%)	4(1.1%)	16(1.2%)	1.000
Ectasia	356(20.2%)	52(13.7%)	304(22%)	<0.001*
Aneurysm with ectasia	52(2.9%)	12(3.2%)	40(2.9%)	0.785

*P-value < 0.05 shows statistical significance

Table 3: Segmental distribution of coronary arteries

(LAD-Left Anterior Descending Artery)	Total (n=1764)	Non-CAD patients (n=380)	CAD patients (n=1384)	P value
LAD Proximal ectasia	181(10.3%)	40(10.5%)	141(10.2%)	0.845
LAD Mid ectasia	16(0.9%)	4(1.1%)	12(0.9%)	0.760
Diffuse LAD ectasia	32(1.8%)	8(2.1%)	24(1.7%)	0.631
LAD Total ectasia	229(13%)	52(13.7%)	177(12.8%)	0.795
LAD Aneurysm Proximal	39(2.2%)	8(2.1%)	31(2.2%)	0.874
LAD Aneurysm Mid	3(0.2%)	0(0%)	3(0.2%)	1.000
LAD Aneurysm	42(2.4%)	8(2.1%)	34(2.5%)	0.874

ISSN:0975-3583,0976-2833 VOL13,ISSUE 03,2022

total				
LAD Stenosis	1148(65.1%)	0(0%)	1148(82.9%)	<0.001*
(LCX-Left Circumflex Artery)				
LCX Proximal ectasia	93(5.3%)	8(2.1%)	85(6.1%)	0.002*
LCX Mid ectasia	12(0.7%)	4(1.1%)	8(0.6%)	0.301
LCX Distal ectasia	8(0.5%)	4(1.1%)	4(0.3%)	0.071
LCX Diffuse ectasia	56(3.2%)	8(2.1%)	48(3.5%)	0.179
LCX ectasia total	169(9.6%)	24(6.3%)	145(10.5%)	0.005*
LCX Proximal aneurysm	8(0.5%)	0(0%)	8(0.6%)	0.214
LCX Stenosis	764(43.3%)	0(0%)	764(55.2%)	<0.001*
(RCA- Right Coronary Artery)				
RCA Proximal ectasia	96(5.4%)	8(2.1%)	88(6.4%)	0.001*
RCA Mid ectasia	32(1.8%)	4(1.1%)	28(2%)	0.209
RCA Distal ectasia	32(1.8%)	0(0%)	32(2.3%)	0.003*
RCA Diffuse ectasia	116(6.6%)	16(4.2%)	100(7.2%)	0.036*
RCA ectasia total	276(15.6%)	28(7.4%)	248(17.9%)	<0.001*
RCA Proximal aneurysm	12(0.7%)	4(1.1%)	8(0.6%)	0.301
RCA Mid aneurysm	0(0%)	0(0%)	0(0%)	1.000
RCA Distal aneurysm	0(0%)	0(0%)	0(0%)	1.000
RCA Total aneurysm	12(0.7%)	4(1.1%)	8(0.6%)	0.319

ISSN:0975-3583,0976-2833 VOL13,ISSUE 03,2022

RCA Stenosis	884(50.1%)	0(0%)	884(63.9%)	<0.001*

*P-value < 0.05 shows statistical significance

Prevalence of ectasia and aneurysm in the left anterior descending artery (LAD) was not significant in CAD and Non-CAD groups. Ectasia in the proximal LCX and diffuse LCX were prevalent in the CAD group. Also, in the CAD group, ectasia in proximal, distal, and diffuse RCA was more prevalent.

Single vessel coronary artery aneurysm was most common than the double and triple vessel involvement.Single vessel ectasia was most common than triple vessel ectasia, followed by double vessel ectasia (11.1% vs. 5% vs. 4.1)**(Table 4).** Coronary artery aneurysm and ectasia were more prevalent in setting of NSTEMI rather than STEMI. In the segmental analysis, NSTEMI was the most common presentation of left main artery (LMA) ectasia, followed by LMA aneurysm, LAD proximal ectasia, diffuse LAD ectasia, proximal and mid LAD aneurysm, proximal, distal and diffuse LCX ectasia, proximal LCX aneurysm, proximal, distal and diffuse RCA ectasia and LCX proximal aneurysm. While ectasia in mid-LCX and mid-RCA presented with STEMI, rather than NSTEMI.

(Table 5).

Table 4: Distribution of coronary artery aneurysm and ectasia

Parameter	**Total (n= 1764)**	**Non-CAD (n=380)**	**CAD (n= 1384)**	**P value**
Aneurysm				
Single vessel	20(1.1%)	4(1.1%)	16(1.2%)	1.000
Double vessel	0(0%)	0(0%)	0(0%)	1.000
Triple vessel	0(0%)	0(0%)	0(0%)	1.000
Ectasia				
Single vessel	196(11.1%)	24(6.3%)	172(12.4%)	0.001*
Double vessel	72(4.1%)	20(5.3%)	52(3.8%)	0.189
Triple vessel	88(5%)	8(2.1%)	80(5.8%)	0.004*
Aneurysm and ectasia				
Single vessel	16(0.9%)	8(2.1%)	8(0.6%)	0.005*
Double vessel	20(1.1%)	0(0%)	20(1.4%)	0.018*
Triple vessel	16(0.9%)	4(1.1%)	12(0.9%)	0.735

ISSN:0975-3583,0976-2833 VOL13,ISSUE 03,2022

*P-value < 0.05 shows statistical significance

Table 5: Clinical presentation according to distribution of coronary artery ectasia and aneurysm

variables		Final Diagnosis				
	Total (n=1764)	Others	Chronic Stable Angina	Unstable Angina	NSTEMI	STEMI
LMA Ectasia	135 (7.6%)	26(19.3%)	12(8.9%)	3(2.2%)	67(49.6%)	27(6.9%)
LMA Aneurysm	20 (1.1%)	4(20%)	0(0%)	0(0%)	12(60%)	4(20%)
LAD Proximal ectasia	181(10.3%)	36(19.9%)	16(8.83%)	8(4.4%)	81(44.8%)	40(22.1%)
LAD Mid ectasia	16(0.9%)	0(0%)	4(25%)	4(25%)	4(25%)	4(25%)
Diffuse LAD ectasia	32(1.8%)	12(37.5%)	0(0%)	0(0%)	16(50%)	4(12.5%)
LAD Ectasia total	229(13%)	48(21%)	20(8.7%)	12(5.2%)	101(44.1%)	48(21%)
LAD Aneurysm proximal	39(2.2%)	12(30.8%)	0(0%)	0(0%)	19(48.7%)	8(20.5%)
LAD Aneurysm mid	3(0.2%)	0(0%)	0(0%)	0(0%)	3(100%)	0(0%)
LAD Aneurysm Total (Proximal +Mid)	42(2.4%)	12(28.6%)	0(0%)	0(0%)	22(52.4%)	8(19%)
LCX Proximal ectasia	93(5.3%)	24(25.8%)	16(17.2%)	0(0%)	40(43%)	13(14%)
LCX Mid ectasia	12(0.7%)	3(25%)	0(0%)	0(0%)	4(33.3%)	5(41.7%)
LCX Distal ectasia	8(0.5%)	0(0%)	0(0%)	0(0%)	4(50%)	4(50%)
LCX Diffuse ectasia	56(3.2%)	12(21.4 %)	12(21.4%)	0(0%)	28(50%)	4(7.1%)
LCX Ectasia total	169(9.6%)	39(23%)	28(16.6%)	0(0%)	76(45%)	26(15.4%)
LCX Proximal aneurysm	8(0.5%)	0(0%)	4(50%)	0(0%)	4(50%)	0(0%)
RCA Proximal ectasia	96(5.4%)	12(12.5%)	24(25%)	4(4.2%)	32(33.3%)	24(25%)
RCA Mid ectasia	32(1.8%)	4(12.5%)	4(12.5%)	0(0%)	8(25%)	16(50%)
RCA Distal ectasia	32(1.8%)	0(0%)	12(37.5%)	0(0%)	12(37.5%)	8(25%)

ISSN:0975-3583,0976-2833 VOL13,ISSUE 03,2022

RCA Diffuse ectasia	116(6.6%)	28(24.1%)	20(17.2%)	12(10.3%)	32(27.6%)	24(20.7%)
RCA Ectasia total	276(15.6%)	44(15.9%)	60(21.7%)	16(5.8%)	84(30.4%)	72(26.1%)
RCA Proximal aneurysm	12(0.7%)	4(33.3%)	4(33.3%)	0(0%)	0(0%)	4(33.3%)
LCX Proximal aneurysm	8(0.5%)	0(0%)	4(50%)	0(0%)	4(50%)	0(0%)

Overall, among the CAD group, the patient presented more with NSTEMI (34.4%), followed by STEMI (25.7%), followed by chronic stable angina (16.8%).

Discussion-

The association between coronary artery disease and coronary artery ectasia or aneurysm and its clinical presentation is less well elucidated. The present study findsthe prevalence of coronary ectasia or aneurysm with or without coexisting coronary artery disease, segmental involvement of coronary arteries, and its clinical presentation. To the best of our knowledge, there is no study in which segmental distribution of coronary artery involvement is studied in detail. Previously coronary artery ectasia and aneurysm were considered to be associated with coronary artery disease. Nevertheless, some studies suggested the association of coronary artery dilation independent of an atherosclerotic lesion, in which inflammation may be the cause.[1] Risk factors associated with coronary ectasia or aneurysm are age, male sex, smoking, alcohol, tobacco, hypertension, dyslipidemia, but not diabetes mellitus.[1,4]Diabetes mellitus is inversely associated with coronary ectasia and aneurysm.[5-8] Reasoning behind inverse relation with diabetes mellitus is impaired compensatory coronary artery enlargement.[7,8]

Coronary artery aneurysms (CAAs) and ectasia occur in 0.2% to 5.3% of patients referred for angiography.[5]We found a very high prevalence of isolated coronary artery ectasia, which can be attributed to different geographic areas, dietary habits, and genetic predisposition. In the present study, the prevalence of aneurysms was similar between CAD and non-CAD groupswhich is in contrast with previous studies.[1,9]Also, the prevalence of aneurysms with ectasiawas similar between CAD vs. non-CAD group.Nevertheless, the prevalence of isolated ectasia was more in the CAD vs non-CAD group, which confirms the findings by Ovali et al.[4]

We found a high prevalence of aneurysm and ectasia in proximal segments of LAD and LCX. In RCA, diffuse RCA involvement is more common than proximal RCA **(Table 6).**LMCA was ectatic in 7.6% of patients, while a study by Willner et al. found the prevalence of 11.2% of patients.[10]Patients with coronary artery aneurysm or ectasia can be asymptomatic or can present with stable angina or acute coronary syndromes due to alteration in blood flow and stasis.[11,12]In coronary artery ectasia, myocardial infarction can occur in the absence of significant coronary artery stenosis and is usually attributed to distal microembolization or thrombotic occlusion of an ectatic segment.[12]

In the present study, the most common coronary artery aneurysm and ectasia presentation are NSTEMI, followed by STEMI.According to the segmental analysis, ectasia in mid-LCX and mid-RCA presented most commonly with STEMI, followed by NSTEMI.

ISSN:0975-3583,0976-2833 VOL13,ISSUE 03,2022

Management of risk factors like smoking, alcohol, tobacco, dyslipidemia, and hypertension may improve the prognosis of these patients. Management of coronary artery ectasia and aneurysm consists of medical management, stent implantation, and surgery.[12]

Conclusion-

Coronary artery ectasia is more common than the aneurysm. Isolated coronary ectasia was prevalent in patients with coexisting coronary artery disease, unlike the aneurysm.Segmental distribution of coronary artery ectasia or aneurysm may have a varying clinical presentation, with the most common presentation as NSTEMI followed by STEMI.

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Conflict of interest- None

Limitations of study-

Some variables like age, sex, ejection fraction and risk factors like diabetes, hypertension and smoking were not matched which may influence the results. Also, non-CAD group include patients presented with STEMI, who received thrombolytic therapy which may affect the results.

Authors contribution:

Rathore Abhishek- Concept and design of study, analysis and interpretation of data, drafting manuscript and editing.
Shitij Shrivastava- Acquisition of data, its analysis, drafting of the manuscript, and final approval.
Shashwat Shrivastava- Acquisition of data, its analysis, drafting of the manuscript, and final approval.
Trivedi Shailendra- Concept and design of the study with analysis and data interpretation. Manuscript review and final approval.
Somani Vinod- Concept and design of the study with analysis and data interpretation. Manuscript review and final approval.
Sandeep Shrivastava- Concept and design of the study with analysis and data interpretation. Manuscript review and final approval.

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