Original Research Article

Diagnostic implication of hyperkinesia of the inferior septum for prediction of culprit artery in patients with inferior wall myocardial infarction

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Abstract

Background: Inferior wall MI is known for its diversity in clinical presentation due to substantial difference in clinical features in case of LCX and RCA occlusion. Hence prediction of culprit vessel of occlusion is very essential for anticipation of infarct related complications. However superposition of area of blood supply between LCX and RCA in inferior wall and adjacent lateral wall is a hindrance in prediction of culprit artery in inferior wall MI.Whereas adjacent inferior septum is supplied by both RCA &LAD but not supplied by LCX, so in case of LCX occlusion, adjacent myocardial fibres of inferior septum contracts vigorously to minimize the LV dysfunction and present as compensatory hyperkinesia. **Aim:** To study regional wall motion abnormality (RWMA), more specifically hyperkinesia in inferior septum for prediction of culprit artery in patients with acute inferior wall MI. **Materials and Methods:**A cross sectional study was conducted enrolling a total of 1429 patients with acute Inferior wall STEMI. All the patients were subjected to echocardiography to study RWMA in inferior septum. Taking into consideration of the inclusion & exclusion criteria total of 884 patients with single vessel disease as confirmed by angiography were finalised as the study participants.**Results:**Out of 884 patients, RCA was found as culprit artery in 645(73%) patients (group A) and LCX as culprit artery in 239(27.0%) patients (group B).While studying wall motion abnormality in the inferior septum, hyperkinesia was found in 87.4% cases in LCX disease as compared to 6.04% cases with in RCA disease with and the difference was found statistically highly significant.**Conclusion:** Hyperkinetic inferior septum can be an important diagnostic marker for distinguishing LCX lesion from RCA lesion in inferior wall MI.

Keywords: Inferior Wall MI, Hyperkinesia, Inferior Septum, LCX, RCA

Introduction

Inferior wall MI is known for its diversity in clinical presentation due to substantial difference in clinical features in case of LCX and RCA occlusion. RCA occlusion usually presents with electrical events like high grade AV block or RV failure,[1]whereas LCX occlusion presents with mechanical events like MR ,left ventricular failure[2]. So predicting the culprit vessel of occlusion becomes very important in view of prognosis and infarct related complications[3].As there is greatest superposition of area of blood supply between LCX and RCA in inferior wall and adjacent lateral wall,[4-6]it becomes very difficult to predict culprit artery in inferior wall MI.whereas adjacent inferior septum is supplied by both RCA & LAD and not supplied by LCX[7]. So during acute LCX occlusion, when contraction of myocardial fibres ceases , adjacent myocardial fibres of inferior septum contracts vigorously to minimize the total extent of ischaemic LV dysfunction and ultimately presents as hyperkinesias[8].So study of regional wall motion abnormality (RWMA), more specifically hyperkinesia in inferior septum may provide a clue for prediction of the culprit artery in inferior wall MI.

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Methodology

A cross sectional study was conducted enrolling total 1429 patients with acute Inferior wall STEMI ,admitted to the cardiology Department,VIMSAR,BURLA between Dec-2016 to Dec-2020.48 Patients having previous history of CAD were excluded from the study. Apart from clinical examination and other routine procedures,all the admitted patients with inferior wall myocardial infarction were subjected to echocardiography to evaluate RWMA . RWMA of each segment classified as 1.hyperkinesia (increased wall thickening & endocardial excursion),2.Normokinesia(normal wall thickening and endocardial excursion),3.hypokinesia (reduced wall thickening, reduced endocardial excursion) 4.akinesia (absence of either wall thickening or endocardial excursion) 5.dyskinesia (systolic outward stretching or thinning), 6.aneurysmal(bulging eccentrically during both systole and diastole). RWMA in inferior septum studied to predict coronary artery before the patients undergoing angiography, which is considered as the reference diagnostic procedure to establish culprit arterial occlusion. Out of the 1381 patients,1248 patients undergone angiography.133 Patients did not give consent/or did not undergo coronary angiography, excluded from the study. Double vessel disease, multi vessel disease and re-canalised RCA/LCX was noticed in 227(18.2%), 121 (9.7%) and 16(1.3%)patients respectively were also excluded from the study. Taking into consideration of the inclusion & exclusion criteria as depicted above and basing on angiographic findings a total of 884(70.8%) patients with single vessel disease were finalised as the study participants. Details of angiographic finding e.g., site, type,

number of lesion and degree of stenosisof the vessels was recorded. Basing on the culprit artery of occlusion ,the above study participants were categorised into 2 groups. RCA found as culprit artery in 645(73%) patients (group A) and LCX as culprit artery in 239(27.0%) patients (group B).

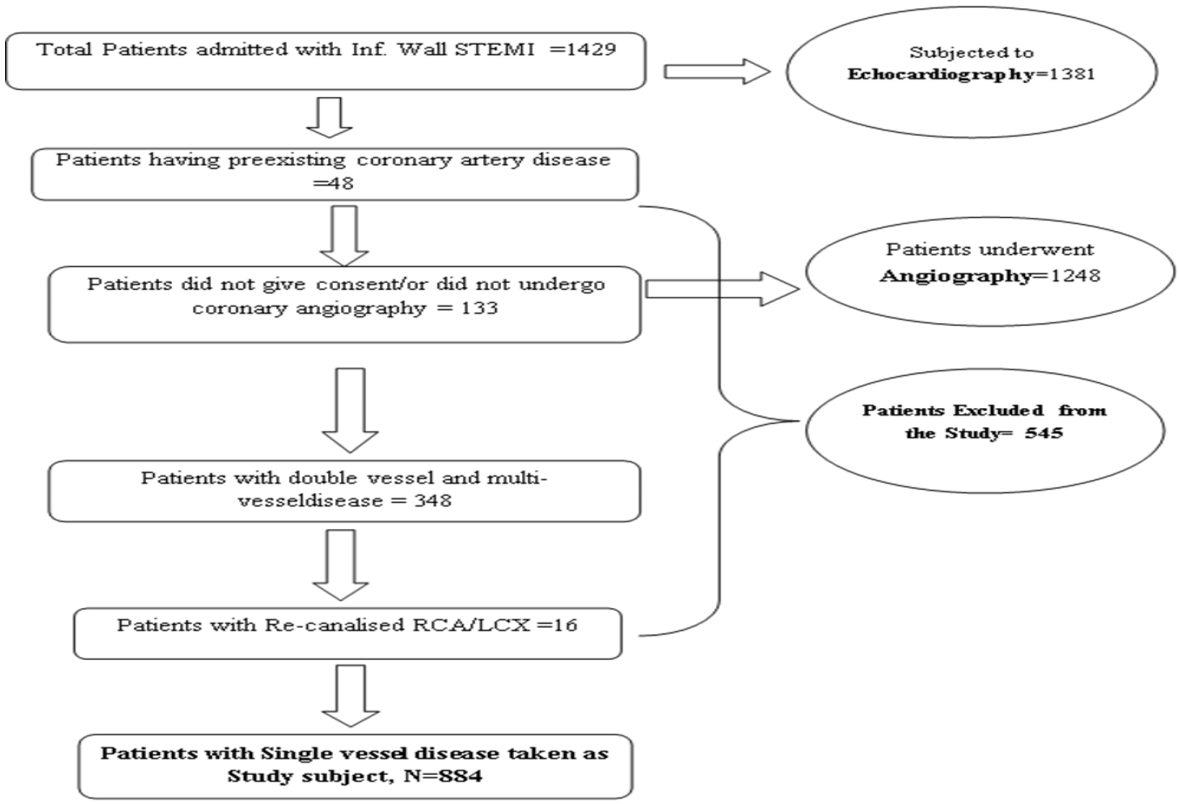

Fig 1:Flow diagram Showing Exclusion & Inclusion Criteria

Data with respect to each study participant like Baseline characteristics, Echocardiographic findings specifically wall motion abnormality in inferior septum were collected and compiled. The study findings were compared between the two groups to find out any statistically significant difference.

Statistical analysis

Study variables were described as the mean ± standard deviation. Proportions of the study groups were expressed as percentages (%). Unpaired t-test was applied to compare the means .Chi-square test was applied to find out any significant difference between patients with LCX disease and RCA single vessel disease. Sensitivity, specificity, positive predictive value (PPV),negative predictive value (NPV), diagnostic accuracy (DA) etc were calculated to evaluate the accuracy of the desired study objective i.e.to predict the culprit artery from hyperkinesias in inferior septum on echocardiography findings as an early screening tool.

Results

In group A, mean age of the patients 57.8 ± 13.63 where as in group B, mean age of the patients 56.2 ± 9.73.Out of 645 cases in group A, 514(79.7%) patients were male and 131(20.3%) patients are female, in group B out of 239 cases 184(77%) cases were male and 55(23.0%) cases were female. While comparing the above baseline characteristic between the two groups, no significant difference was found with respect to the above parameters.

While studying wall motion abnormality of inferior septum (Table-1), in group A (RCA disease), hyperkinesias was found in 39(6.04%) cases, whereas hypokinesia, normokinesia in 585(90.6%), 21(3.25%) cases respectively. However in group B (LCX lesion), hyperkinesia in inferior septum was noticed in 209(87.4%) cases, whereas hypokinesia, normokinesia noticed in 19(7.94%),11(4.6%) cases respectively. Hence hyperkinesia of inferior septum was recorded in proportionately higher number of cases with LCX occlusion (Group-B) and the difference was found statistically highly significant

Table 1:Outcome of wall motion study findings(Hyperkinesia)among the two different group of patients based on Occlusion of Culprit Artery

Parameter	Group-B **LCX Occlusion**	Group-A **RCA Occlusion**	**Significance (Chi-Square)**
Hyperkinesia present	209 (87.4%)	39 (6%)	X^2 = 572.5, df=1
Hyperkinesia absent	30(12.6%)	606(94%)	$P < 0.001$
Total	239 (100%)	645(100%)	(Highly significant)

Figure-2 shows, the relationship between echocardiographic detection of hyperkinesia of inferior septum as an early procedure to predict culprit artery with that of the angiographic findings which is the confirmatory & gold standard procedure to establish lesion in culprit artery. As per the study findings depicted in table No-1, majority { 209(87.4%) } of cases found with hyperkinesia of inferior septum on echocardiography was confirmed to have LCX occlusion on angiography taken as true positives (TP), so as to validate hyperkinesia as of inferior septum as the screening procedure. Similarly cases with hyperkinesia of inferior septum but with RCA occlusion found in 39(6%) cases were taken as false positives (FP). Likewise patients without hyperkinesia as of inferior septum (hypo/normokinesia) but confirmed to have LCX occlusion among 30(12.6%) patients taken as false negatives (FN) and there with RCA occlusion recorded among 606(94%) cases were taken as true negatives(TN).On statistical analysis as depicted in table-2 , it was found that, hyperkinesia in inferior septum detects LCX lesion from RCA lesion in inferior wall MI with accuracy 92.19 % with sensitivity=87.45%,specificity=93.95%,positive predictive value= 84.27 %, negative predictive value =95.28%.

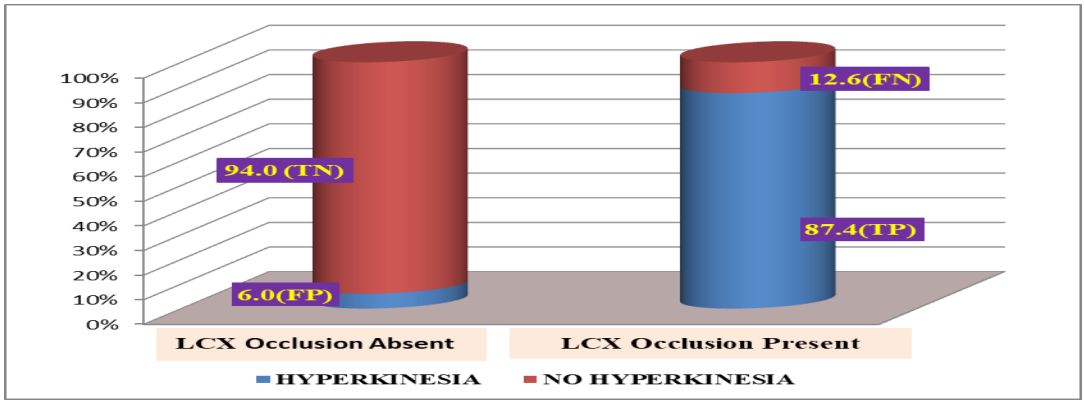

Fig 2: Figure showing comparative analysis of Hyperkinesia of Inferior septum basing on occlusion of culprit artery

Table 2: Evaluation of hyperkinesia of inferior septum as a screening test to establish culprit artery in inferior wall MI

Parameters	Estimates	Confidence Interval(CI)
Sensitivity(%)	87.45%	82.57% to 91.37%
Specificity(%)	93.95%	91.83% to 95.67%
PPV(%)	84.27%	79.75% to 87.94%
NPV(%)	95.28%	93.53% to 96.58%
DA(%)	92.19%	90.23% to 93.88%
LRP	14.46	10.63 to 19.68
LRN	0.13	0.10 to 0.19
DOR	235.1962	129.3890 to 427.5267

[CI confidence intervals, PPV positive predictive value, NPV negative predictive value, DA diagnostic accuracy , LRP likelihood ratio of a positive test, LRN likelihood ratio of a negative test, DOR diagnostic odds ratio.]

Discussion

Hyperkinesia defined as thickening of myocardium more than 30% along with,increased endocardial excursion[9].Hyperkinesia develops due to contraction of adjacent myocardium to decrease the extent of myocardial dysfunction. Although different mechanisms postulated for development of hyperkinesia in adjacent non-ischemic myocardium, however mechanism of hyperkinesia still remained controversial. During acute ischemia , left ventricular cavity dilation occurs, which evokes Frank-Starling response in the non-ischemic myocardium[10].As a result adjacent myocardial fibre stretches and contracts vigorously to develops hyperkinesia. Regional intra-ventricular unloading in non-ischemic areas into the ischemic areas can be an explanation for hyperkinesias[11].Thirdly sympathetic stimulation with release of neuro-hormones,[12] development of vascular reflex[13] during acute coronary occlusion can cause hyperkinesia. Hyperkinesia is an important positive prognostic sign in AMI, more commonly seen in uncomplicated AMI with lesser extent of infarction[14].However diagnostic value of hyperkinesia in AMI not studied yet. Prevalence of hyperkinesia is highly variable and depends on many factors like time of presentation, site of myocardial infarction , no of vessel diseased ,culprit vessel . Whereas length and amplitude of hyperkinesia depends on site of MI, culprit vessel . Hyperkinesia in inferior AMI more commonly found during the first 10 days of myocardial infarction . The amplitude of hyperkinesia decreases gradually and normalises during one year follow-up.(15)Hyperkinesia three times more commonly seen in inferior wall MI as compared to anterior wall MI[16]. Hyperkinesia found in around 2/3rd of patients in inferior myocardial infarction and it reaches 87%, when SVD taken into account[17].In animal studies hyperkinesia also more commonly demonstrated in LCX occlusion in 80 % cases[18].Amplitude of hyperkinesia are also more prominent in inferior wall MI, as compared to other type of AMI[18]. Length of hyperkinetic segment are longer in LCX or RCA occlusion as compared to other coronary artery occlusion[19].So Hyperkinesia can be more commonly and easily detected during early period of inferior wall MI with SVD .In the present study,while studying wall motion abnormality in inferior septum in LCX diseases, hyperkinesia predominantly found in inferior septum in 87.4%cases.As inferior septum is supplied by either LAD or RCA and not by LCX,So in case of LCX occlusion in inferior wall MI , non-ischemic myocardium of inferior septum contracts vigorously to maintain the EF and present as hyperkinesia. However hypokinesia in inferior septum also found in LCX diseasein 7.94 % cases,when inferior septum is not confined to LCX territory. Hypokinesia can also be seen in less than 10% cases in adjacent myocardium without any ischemia[20].Abnormalities of the mitochondria, tissue glycogen, and lactate depletion due to adjacent infaction may be a causative factor for above mechanism[21]. Parallel arrangement myocardial

fibres between Infarcted myocardium and adjacent normal myocardium develops a resistance,which may impede contraction of myocardial fibre leading to non-infarction hypokinesia[22].While studying wall motion abnormality in inferior septum in RCA disease, in current study hypokinesia predominantly found in inferior septum in 585(90.6 %) cases.This implies that, RCA more specifically supplies inferior septum. While comparing angiographic finding and SPECT images of patients with single vessel disease , Pereztoletal also found that ,Inferior septum more commonly atributed to RCA territory although it is supplied by both LAD and RCA[5].For the above reason ,we got more proportion of patients in RCA disease having hypokinesia in inferior septum. However in current study, normokinesia or hyperkinesia also observed in inferior septum in RCA disease in 21(3.25%),39(6.04%) cases respectively. As inferior septum can be supplied by LAD due to superposition of vascular territory between RCA and LAD ,[5] so the above finding can be justified in a small proportion of cases in RCA occlusion.While comparing hyperkinesia in inferior septum in both LCX and RCA, hyperkinesia in inferior septum found in 87.4 % cases in LCX disease as compared 6.04% cases with in RCA disease with p value <0.001, specificity 93.95%, sensitivity 87.4 %, positive predictive value (PPV) 84.27%, negative predictive value(NPV) 95.28%, diagnostic accuracy(DA) 92.19 %.

Conclusion

Hyperkinesia in inferior septum can be used as diagnostic marker for prediction of culprit artery in inferior wall MI distinguishing LCX lesion from RCA lesion.

Echocardiographic screening of hyperkinesias in inferior septum in patients with inferior wall MI can help in anticipation of infarct related complications, so that early preparation can be initiated to avoid devastating consequences in inferior wall MI during further management of cases .

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