Assessment of Significance of Attenuation Correction in Myocardial Perfusion SPECT

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Introduction:

Myocardial Perfusion Scintigraphy (MPS) is a common application for the diagnosis of CAD but it is increasingly being used for diagnosis of acute MI, risk stratification after infarction and assessment of viable myocardium versus scar in patients with chronic coronary disease. Despite the progress in the field of medical technology, soft tissue attenuation is still a hindrance in the path of the diagnostic accuracy of myocardial perfusion imaging. Several accepted methods of determining attenuation artifact are prone imaging, electrocardiography (ECG) gated SPECT imaging and attenuation correction [8]. The ideal technique for attenuation correction is to create attenuation maps from transmission tomographic image generation through an external source of photons using X-ray tube.

Methods:

A total of 102 patients were prospectively analyzed & were categorized either into the group with known CAD with ages ranging from 30-74 (mean age = 54.6±12.6) with male/female ratio of 36/6 or the group of low likelihood (< 15% pretest probability) with ages ranging from 30-75 (mean age=49.79±11.3) with male/female ratio of 30/30. The patients selected in the group with known CAD did not have MI, LBBB or cardiomyopathies. These patients underwent coronary angiography 3 months pre or post MPI SPECT .Coronary angiography was set as a gold standard. Stenosis of ≥70 % was regarded as significant. The patients selected in the group with low likelihood of CAD were all non diabetics.
Patients were stressed by exercise / pharmacologically to achieve an adequate workload (at least 85% of age-adjusted maximal predicted heart rate and five metabolic equivalents).

All the patients were injected with Tc-99m sestamibi. Both non-corrected (NC) and attenuation corrected (AC) images were visually analyzed according to 17- segment model of the left ventricular cavity. All coronary segments were assessed by 2 experienced nuclear physicians who experts were blinded to any computer generated myocardial perfusion scores or patient group information. They interpreted both images sets by rating each segment as normal or abnormal with a reversible or a fixed perfusion defect on short axis and long axis slices as well as the polar map. Visual assessment derived sensitivity, specificity and diagnostic accuracy of NC and AC sets of images was compared using McNemar test.

Results:

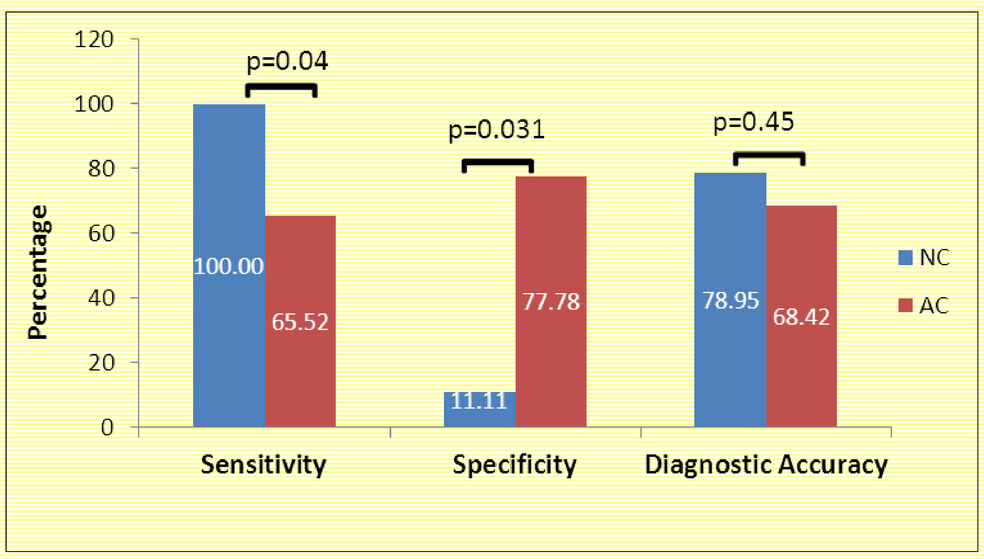
Sensitivity, specificity and diagnostic accuracy for detection of coronary artery disease was found to be 100%, 11% and 79% respectively for NC images and 66%, 78% and 68% for AC images. The p value was found to be significant in only the RCA territory. Individual analysis of the three vascular territories showed that attenuation correction increased the specificity in all three territories but it significantly enhanced it in RCA region i.e. from 10% to 79%. (<0.001).

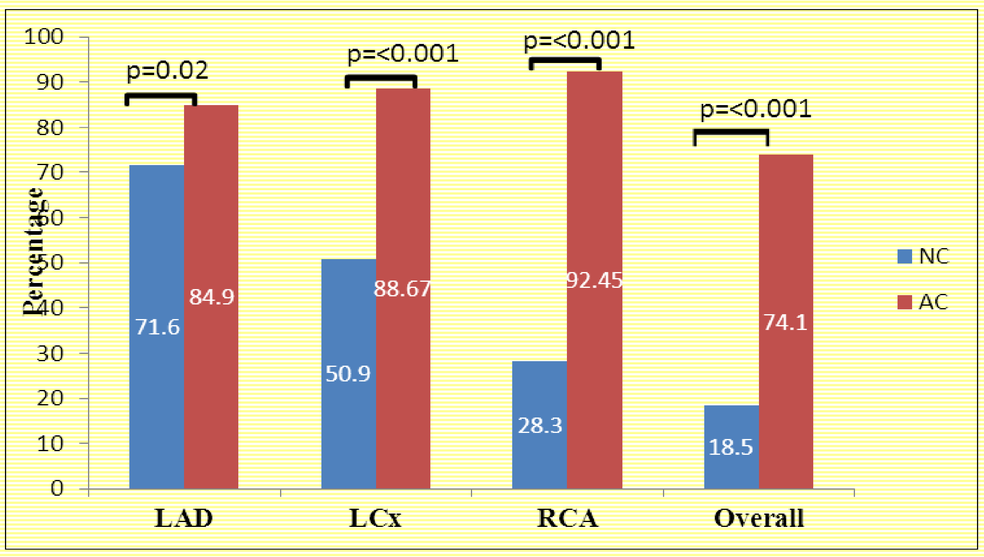
Number of patients with perfusion defects according to coronary arterial territories

		Patients with perfusion defects in LAD territory	Patients with perfusion defects in LCX territory	Patients with perfusion defects in RCA territory
Group A	NC	15	26	38
	AC	2	21	11
Group B	NC	16	26	38
	AC	7	6	4

NC and CT-AC Myocardial Perfusion SPECT by Coronary Region

Coronary Region		Sensitivity (%)	p value	Specificity (%)	p value	Diagnostic Accuracy (%)	p value
LAD	NC	61.90	1.0	88.24	1.0	73.68	1.0
	AC	57.14		94.12		73.68	
LCX	NC	92.86	0.25	45.83	0.25	63.16	1.0
	AC	71.43		58.33		63.16	
RCA	NC	88.89	0.375	10.34	< 0.001	28.95	0.001
	AC	55.56		79.31		73.68	





Overall Accuracy of MP SPECT in group A patients

Normalcy rates in group B patients

Overall, normalcy rates in the group B population were 19% for NC image set and 74% for the AC image set (p value <0.001). The normalcy rate showed significantly higher values in the attenuation corrected images in all three territories, more marked in the RCA region (p value <0.001).
In the male population of group A, specificity improved only in RCA territory (p value <0.001) but in female population it improved in LAD as well as RCA territory. However substantial improvement was noted in RCA region. In group B patients it was noted that female population benefitted upon attenuation correction considerably in all the three vascular regions while the male population largely benefitted in the RCA and LCX territories upon attenuation correction with p value <0.05. On basis of BMI, it is observed that obese patients (BMI >25) as well as patients with BMI ≤ equally benefitted from attenuation correction.

Conclusion:

This study demonstrates that CT based attenuation corrected Tc-99mm sestamibi SPECT myocardial perfusion imaging demonstrate significant improvement in specificity in the RCA territory in the RCA territory compared with non attenuation corrected Tc-99mm sestamibi SPECT myocardial perfusion imaging in both genders irrespective of BMI.