

# Influence of attenuation correction in the MPI image reconstructed by the *Evolution for Cardiac™*

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## Introduction

The acquisition of a Myocardial Perfusion image (MPI) is of great importance for the diagnosis of the coronary artery disease, since it allows to evaluate which areas of the heart aren't being properly perfused, in rest and stress situations. This exam is greatly influenced by photon attenuation which creates image artifacts and affects quantification. (1,2,3)

The acquisition of a Computerized Tomography (CT) image makes it possible to get anatomic images which can be used to perform high-quality attenuation corrections of the radiopharmaceutical distribution, in the MPI image. (1,2,3)

Studies show that by using hybrid imaging to perform diagnosis of the coronary artery disease, there is an increase on the specificity when evaluating the perfusion of the right coronary artery (RCA). (1,2,3)

Using an iterative algorithm with a resolution recovery software for the reconstruction, which balances the image quality, the administered activity and the scanning time, we aim to evaluate the influence of attenuation correction on the MPI image and the outcome in perfusion quantification and imaging quality. (1,2,3)

## Subjects and Methods

The population incorporated two sets of individuals (ten male and ten female, with a body mass index (BMI) above 30Kg/m<sup>2</sup>). A Computed Tomography (CT) image was acquired prior to the MPI stress and rest studies. These were acquired based on EANM guidelines and reconstructed using the *Evolution for Cardiac™* software (1, 4, 5). For each patient, studies were reconstructed twice, the first time relying uniquely on the MPI and the second time relying on the MPI and on the attenuation correction map given by the CT image. For perfusion quantification purposes, images were segmented by coronary regions. For imaging quality analysis, 4 regions of interest (ROI's) were drawn in the short axis. The counts for each ROI were accounted and used to calculate the mean percentage of noise and the contrast. For the first calculation the following equation was used:  $\% \text{ Mean noise} = \left( \frac{\text{Standard deviation}}{\text{Mean counts}} \right) \times 100$

For the second calculation the equation used was  $\text{contrast} = \frac{(\text{Mean counts}_{\text{myocardium}}) - (\text{Mean counts}_{\text{background}})}{(\text{Mean counts}_{\text{myocardium}}) + (\text{Mean counts}_{\text{background}})}$

Each study was processed three times by the same operator and an average value was used. (4,5,6)

## Results

In regards to perfusion, as it is shown in Figure 1, the acquired data suggests this is higher for the studies with attenuation correction, for all the coronary arteries, for both genres.

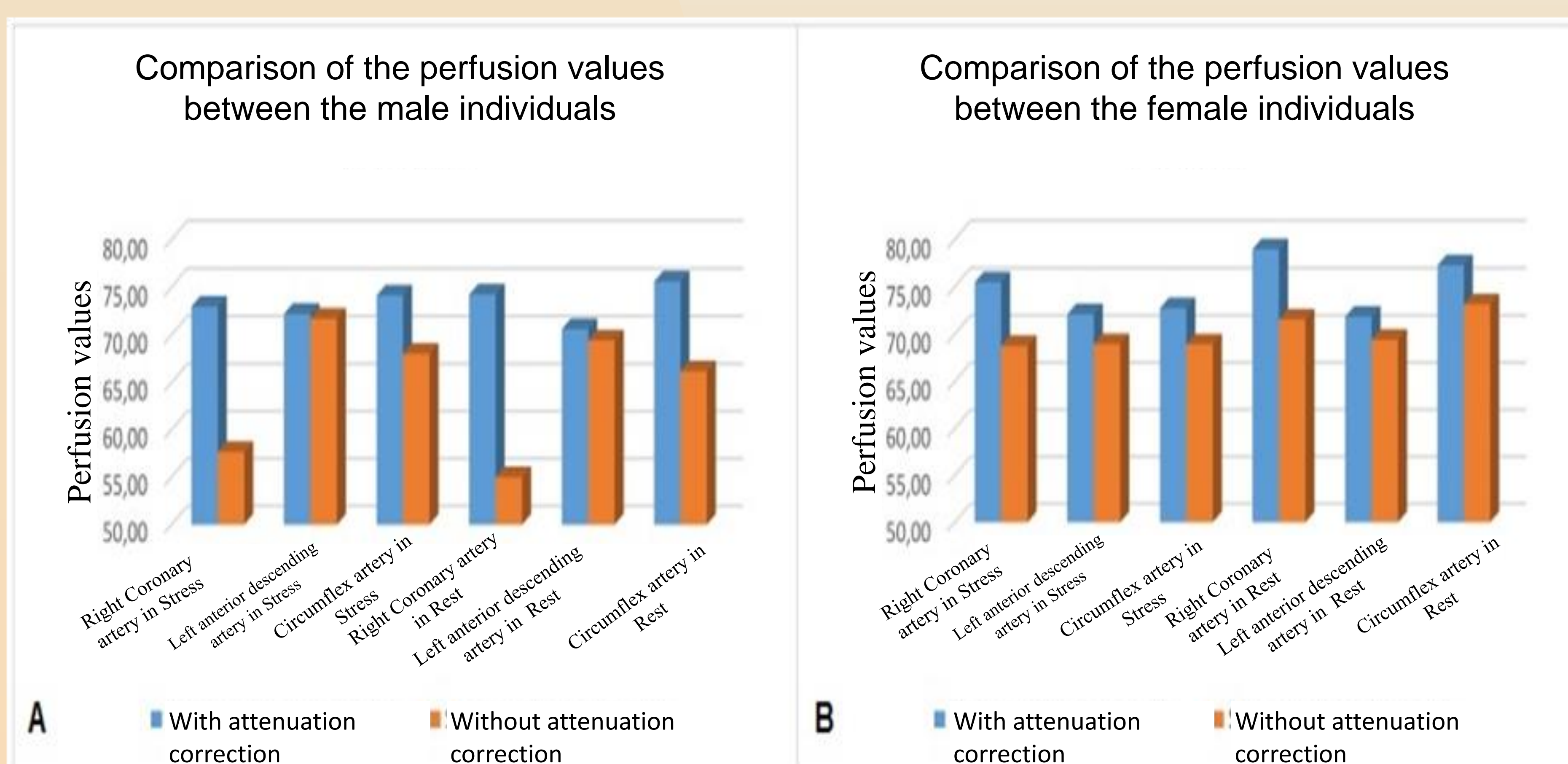


Figure 1- Graphic A, Comparison of the perfusion values between the male individuals; Graphic B, Comparison of the perfusion values between the female individuals.

In regards to noise and contrast, these were higher in the studies without attenuation, for both genres.

A comparison between the data acquired for the stress studies, in the same wall, with and without Attenuation Correction (AC), can be seen in Table 1.

## P-value for the differences in noise and contrast for stress studies

	Paired t-test			
	p-value for noise		p-value for contrast	
	Male genre	Female genre	Male genre	Female genre
Study with AC for the anterior wall - Study without AC for the anterior wall	0,486	0,148	0,000	0,004
Study with AC for the lateral wall - Study without AC for the lateral wall	0,096	0,007	0,000	0,000
Study with AC for the inferior wall - Study without AC for the inferior wall	0,014	0,005	0,049	0,001
Study with AC for the septum - Study without AC for the septum	0,007	0,074	0,000	0,000

The results presented in the above table have a level of significance of 1%.

A comparison between the data acquired for the rest studies, in the same wall, with and without Attenuation Correction (AC), can be seen in Table 2.

## P-value for the differences in noise and contrast for rest studies

	Paired t-test			
	p-value for noise		p-value for contrast	
	Male genre	Female genre	Male genre	Female genre
Study with AC for the anterior wall - Study without AC for the anterior wall	0,377	0,020	0,000	0,000
Study with AC for the lateral wall - Study without AC for the lateral wall	0,020	0,056	0,000	0,000
Study with AC for the inferior wall - Study without AC for the inferior wall	0,001	0,003	0,005	0,000
Study with AC for the septum - Study without AC for the septum	0,000	0,000	0,000	0,000

The results presented in the above table have a level of significance of 1%.

There were statistically significant differences in the right coronary for the stress and rest studies, and in the circumflex coronary artery in the rest study, for both genres. There were also statistically significant differences for the circumflex coronary artery, in stress, for the male genre.

Overall, and in regards to the noise and contrast comparisons, there were no major differences between the data acquired with and without the incorporation of attenuation correction. There were, however, statistically significant differences in noise, in the inferior wall and septum, in the rest studies, for both genres. In the male genre, there were statistically significant differences for the septum, in the stress studies. And in the female genre, there were statistically significant differences for the lateral and the inferior wall, in the stress studies.

The above data shows that there is a significant decrease in regards to the noise, when the attenuation correction is applied, specially in the stress studies

## Discussion/Conclusion

Although the cardiac anatomy is variable depending on the patient's weight, the coronary arteries can be correlated with the cardiac walls, in such way as the right coronary corresponds to the inferior wall, the left anterior descending artery corresponds to the anterior wall and the septum, and the circumflex coronary artery corresponds to the lateral wall. The results in the male genre show significant differences in regards to the perfusion in the right coronary and in the circumflex coronary arteries, when applying AC to the MPI image. These can be explained by the hemidiaphragm elevation. The results in the female genre show significant differences in regards to the perfusion in the circumflex coronary and right coronary arteries, when applying AC to the MPI image. These can be explained by breast attenuation to the antero-lateral wall, that can be seen when patients with a high BMI are in a supine position.

In regards to the noise and contrast data, there is a decrease when applying AC to the MPI image, which can be explained by the filter used for image reconstruction which reduces the weighing of high frequencies in the image. The algorithm will increase the counts in the image, overcompensating the attenuation correction in the walls that are not affected by attenuation artifacts.

The results in the research were affected by a few parameters. The first one being that the attenuation maps only consider the density of tissues but don't include extra-miocardium activity. This will decrease the differences between studies with and without AC, in regards to the inferior wall. The positioning of the ROI, which may not be representative of the wall being evaluated, as well as the incorrect alignment of the CT with the MPI image, may have also affected the results.

Overall, the results in this research and supported by the literature and a follow-up study that includes a gated component and an evaluation on the sagittal, coronal and axial axis, should be considered.

## References

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