Septal Wall Appearance as a Function of Reconstruction Method for Myocardial Perfusion SPECT

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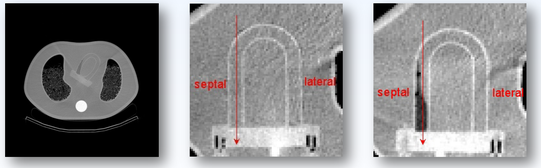
Introduction

In myocardial perfusion SPECT, changes in the size and apparent location of the cardiac septal wall are observed with FBP and iterative reconstructions with and without attenuation (AC) and other corrections. In particular, there is concern that the septal wall appears shorter from reconstruction with AC and resolution recovery in some clinical studies. We evaluated these differences in an anthropomorphic phantoms with a normal and an abnormal cardiac insert where the true distributions are known.

Methods and Materials

Phantoms

- Normal Phantom
  - Anthropomorphic phantom with normal cardiac insert
- Phantom with Tapered Septal Wall
  - Septal wall of the cardiac inserted in tapered towards the base with wax
- Activity distribution
  - Myocardium: ~0.4 mCi
  - Liver: ~1.5 mCi
  - Background ~2.5 mCi



1. Anthropomorphic phantom (left, showing only the phantom with tapered septal wall); normal cardiac insert (middle); and tapered cardiac insert (right).

Data Acquisitions

- CT
  - 1 mm isotropic voxel size
- SPECT
  - 20s per frame, 64 frames over 180°
  - 64 × 64 matrix size, 6.4 mm pixel size

SPECT Reconstructions

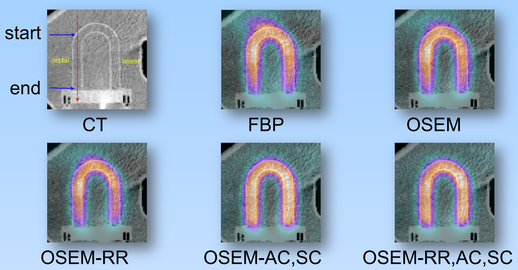
- FBP
- OSEM (no correction)
- OSEM-RR (with resolution recovery)
- OSEM-AC,SC (with AC and scatter correction)
- OSEM-RR,AC,SC (with RR, AC and SC)
- 4 iterations and 16 subsets used for OSEM

Data Processing

- SPECT and CT were registered and fused in horizontal long axis view
- Profiles drawn were along the red lines in Figure 1
- The starting and ending locations the septal wall were measured based on the profiles
  - Half of the global max value in myocardium region was used to determine the ends of the wall in SPECT images
- Length and mid-point location offset of the septal wall in SPECT images were compared to truth measured from CT image

Results and Discussions

Normal Phantoms

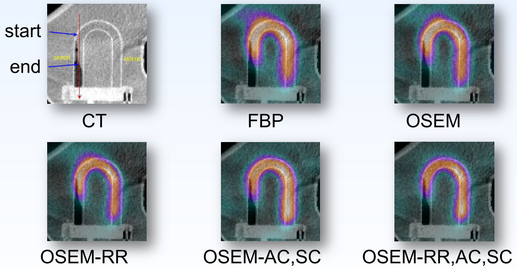


2. Reference CT and fused SPECT-CT images

Table 1. Locations of the septal wall from the normal phantom

Location (mm)	CT	FBP	OSEM	OSEM RR	OSEM AC,SC	OSEM RR, SC, AC
Start	100	88	94	95	96	98
End	171	167	168	166	173	170
Length	71	79	74	71	77	72
Offset	NA	-8	-4.5	-5	-1	-1.5

Tapered Phantoms



3. Referenced CT and fused SPECT-CT images

Table 2. Locations of the septal wall from the tapered phantom

Location (mm)	CT	FBP	OSEM	OSEM RR	OSEM AC,SC	OSEM RR, SC, AC
Start	100	91	91	99	100	102
End	141	145	144	142	143	139
Length	41	54	53	43	43	37
Offset	NA	-2.5	-3	0	1	0

- The fused images shows that, when AC was applied , the septal wall in the SPECT images corresponded more closely to the CT in both shape and locations.
- In FBP and other reconstructions without AC, the length of the septal wall can be misinterpreted due to apical distortions which falsely lengthen the wall and the attenuation effects that decrease the intensity near the base which can falsely shorten the wall.
- Table 1 show that RR helped to maintain the true length of septal wall in the normal phantom and AC helped to maintain the true location. Combinations of AC and RR made both length and location very close to the truth.
- Table 2 show that both AC and RR helped with maintaining both true length and true locations of the tapered phantom as compared to FBP and OSEM. Combinations of AC and RR made the wall length a little bit shorter than the true, but still much better than FBP and OSEM.

Conclusion

These data suggest cardiac images reconstructed with AC and RR provide a truer representation of the cardiac walls than those reconstructed without AC and RR or reconstructed with FBP.

Disclosures

All authors are employed by Philips Healthcare.

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