Lung lesion detectability on decimated and CNN-based denoised ^{18}F-FDG PET/CT

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Abstract:

Aim
^{18}F-FDG PET/CT is fundamental for lung nodule (LN) characterization. We investigated the impact of PET decimation and AI image denoising on LN detectability at different noise levels simulating lower injected activity relevant for lung cancer screening conditions.

Materials and Methods:
We retrospectively analyzed full statistics and decimated (30%, 10%, 5%, 2%, 1% of the full injected activity) ^{18}F-FDG PET/CT simulating decreasing levels of injected activity in 10 patients presenting at least one LN. Full statistic data was acquired on a Biograph Vision (Siemens Medical Solutions, Knoxville TN). . A CNN trained for denoising PET images generated output from a the full statistic and the decimated PET reconstructions. Three readers assessed in consensus the LN detectability score on total of 12 randomized images per subject. SUVmax as a function of the decimation level was reported. LN detectability and quantitative measurements were compared between full statistics and the different decimation levels.

Results:
We analyzed in total 20 lung lesions on 120 ^{18}F-FDG PET/CT reconstructions. The mean LN SUV_{max} and size were 6.7$\pm$ 9.3 and 20.3$\pm$22mm respectively. LN score (0,1,2,3) was: 15/15/17.5/52.5%, 27.5/2.5/15/55%, 30/17.5/7.5/45%, 30/22.5/10/37.5%, 45/20/15/20%, 52.5/25/10/12.5% for 100, 30, 10, 5, 2 and 1%, decimations respectively. We found significant differences in LN scores in 2 and 1% decimations but not with 30, 10 and 5% in comparison to full statistics (p=0.162 , p=0.272 , p=0.220, p=0.007 and p=0.000, respectively).
There was no significant difference of the SUV_{max} across decimation levels (p=0.099).

Conclusion: We found comparable lesion score detectability on different CNN-based denoised decimated images until 5% of the full injected activity. This result indicates the possibility of implementing CNN denoising on low-dose ^{18}F-FDG PET/CT relevant for lung cancer screening.

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