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Predicting the lower count limit for adequate scatter correction using dynamic data with low count frames on Siemens mMR

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AIM:
Scatter correction is applied in PET imaging to reduce signal from scattered coincidence events, thereby improving image quality and quantitative accuracy. In dynamic PET imaging, predefined time frames with the aim of reflecting tissue metabolism over time contain the net coincidence count registered within a specific time window. Short time frames are often desired to obtain precise time-activity curves as the tracer accumulates. This study was motivated by a coincidental finding in a time-activity curve from a dynamic PET brain scan using Oxygen-15, which displayed peaks in several time frames that were inconsistent with tracer biology. Further, the corresponding scatter fraction factor values were noticeably low compared to the remaining frames. The objective of this study was to explore the lower limit for the amount of net true count in individual time frames while still preserving adequate scatter correction.

METHODS:
Image reconstruction was performed on three dynamic PET brain studies from Siemens Biograph mMR with tracer injections of Oxygen-15, Carbon-11 and Flourine-18 respectively. From each study, three patients were randomly selected. Reconstructions were performed offline using e7-tools (Siemens) with reconstruction settings identical to clinical protocol. Time frames matching clinical protocols were used as reference, and a subsequent shorter time frame designed to find a breaking point was estimated from the hypothesis that the net true count influences the scatter correction accuracy. Net true count for individual time frames was recorded and the corresponding time-activity curve extracted.

RESULTS:
The mean net true count for each tracer deviated ±8% at most from the total mean (1.8 mil) at the breaking point. Similar values are observed in all patients within each tracer and across different tracers. The scatter correction failure ranges from the lowest value in Oxygen-15 (1.5 mil) to the highest value in Fluorine-18 (2.1 mil).

CONCLUSIONS:
Results suggest net true count is related to the failure of scatter correction, independent on injected tracer, and time frames with net true counts below a certain value may provoke a failure. Predicting lower limit for frame time appears feasible based on injected tracer, dose and post injection time. Further studies and larger patient populations are necessary before definitive conclusions can be derived.

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