How much shorter is better? Investigating image acquisition time reduction on left ventricular phase analysis for cardiac dyssynchrony

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EDITORIAL

Myocardial perfusion imaging is a widespread technique with proven added value for CAD diagnosis, prognostication, and therapeutic monitoring.[1] In the last decade, there have been many improvements in gamma-camera hardware, software reconstructions algorithms including resolution recovery methods, and cardiac evaluation software.[2,3] This has led to shortening of the acquisition time as compared to previous guidelines, going from 30 seconds down to 15 seconds per projection (the so-called ''half-time'' acquisition).[4] Gating the acquisition with ECG has the ability to measure cardiac wall motion and thickening and left ventricular systolic and diastolic volumes, as well as ejection fraction (EF). The shortening of the acquisition time brings advantages in terms of images degradation due to patient movement, upwards heart creep in post-stress period, patients throughput, as well as in patients comfort at the expense of perfusion defects detectability due to increase in image noise.[5]

A developing application of gated-SPECT MPI has been the investigation of left ventricular dyssynchrony using the phase analysis technique.[6-10] This method delivers unique information about the intrinsic contractile ventricular properties, which can help deciding on which to refer patients to resynchronization therapy,[11,12] as well as adding prognostication.[13] There has not been any investigation published on examining the effect of SPECT acquisition time reduction on phase analysis. This is exactly the aim of the work by Kortelainen and co-authors published in this issue.[14] The authors investigated the relation of left ventricular functional parameters and phase histogram to acquisition time reduction in a population of 24 patients referred for stress/rest gated-SPECT MPI. Among these patients, 20 (83%) had at least some slight perfusion abnormalities at rest and 9 (37.5%) patients had previous cardiac infarct or heart failure. Methodologically, the authors used list-mode acquisitions and recording of the ECG to mimic shorter acquisition times (80%, 60%, 50%, 40%, 30%, 20%) than the initial 30 seconds per projection (100%).

In a nutshell, the authors found that reducing acquisition time from 30 seconds down to 15 seconds had no clinically significant effect in left ventricular EF (Figure 1), wall motion, or wall thickening. When decreasing acquisition time further, statistically lower values were noted in end diastolic volume (EDV) and stroke volume (SV). Interestingly, end systolic volume (ESV) and EF were not affected (Figure 1). In contrary, contrast-to-noise ratio (CNR) already presented significant differences when acquisition time was reduced down to 60% (18 seconds per projection), with differences at half-time acquisition reaching −15% and −11% for systolic and diastolic CNR, respectively. Moreover, it was the same with phase analysis, where already statistically significant differences were encountered when the acquisition duration was only decreased to 80% (phase histogram bandwidth, BW), or 60% (phase histogram standard deviation, StDev and entropy, ENT), with already large errors at half-time acquisition

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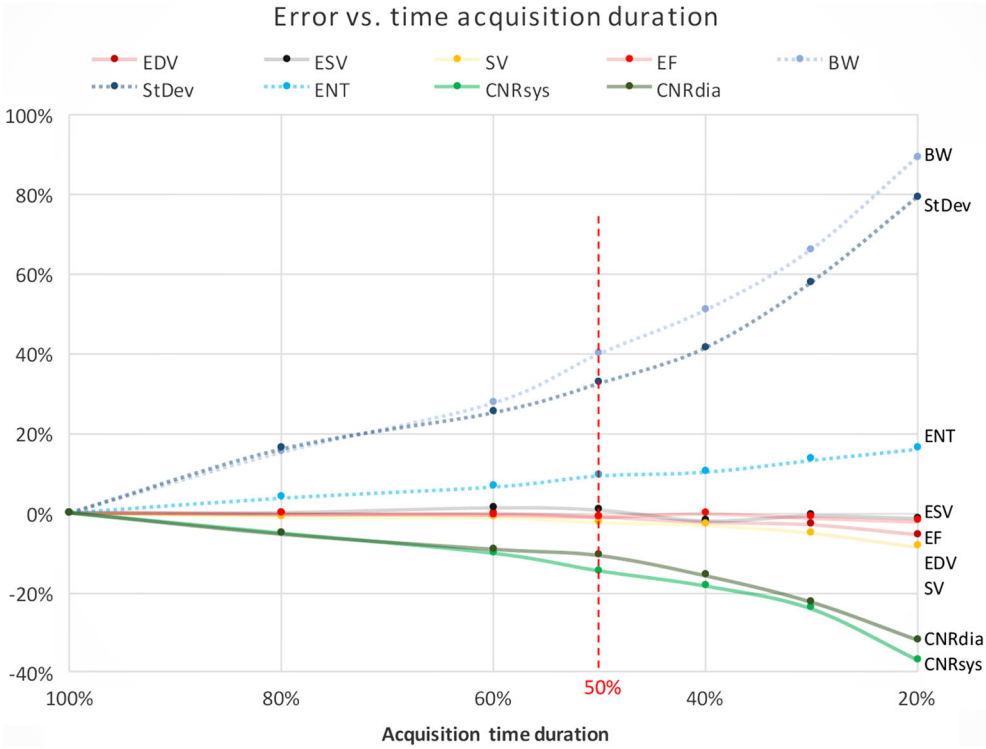

Figure 1. Representation of the error compared to the full (100%) acquisition time in relation to varying acquisition time duration in the study by Kortelainen et al.[14] The horizontal axis represents the time duration in percentage of the full, normal acquisition duration (30 seconds per projection). Conventional LV function parameters (ESV, end systolic volume; EF, ejection fraction; EDV, end diastolic volume; SV, stroke volume), as well as wall motion and wall thickening (both not presented on this graphics and <6%) were not significantly affected by acquisition time reduction up to half-time acquisition (50%). This is contrast to phase analysis, where main parameters differed already significantly for acquisition time less or equal to 80% (BW = phase histogram bandwidth) or 60% (StDev = phase histogram standard deviation, ENT = phase histogram entropy), similarly to contrast-to-noise ratio (CNRdia = contrast-to-noise ratio at diastole, CNRsys = contrast-to-noise ratio at systole).

(+40% for phase histogram BW; +32% for phase histogram standard deviation; 9% for phase histogram entropy), as illustrated in Figure 1. Accordingly, if phase analysis is to be used for clinical decisions, half-time acquisitions may introduce errors on phase analysis indices and may not be equivalent to full-time acquisitions. This is the important finding of this work.

Of course, several study limitations existed, but the authors[14] correctly addressed them. One could add that: (i) this work was performed in a population that may not reflect the true population of patients normally referred for cardiac dyssynchrony studies; and (ii) it had been performed using only one specific commercially-available software package. Whether these results would hold in the population of patients referred for cardiac dyssynchrony characterization and if identical results would be obtained with a different software package are still open questions.

The present study by Kortelainen et al[14] has the merit of asking a legitimate question and providing an answer. Future trials can already integrate this knowledge in their design, as well as more specifically addressing the effect of reducing acquisition time in patient populations needing cardiac dyssynchrony analysis or in relation to other phase analysis software packages.

Disclosure

John O. Prior has no conflict of interest to declare.

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