

Poster presentation

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The conundrum of ECG-gated carotid arterial imaging with navigator corrected respiratory motion

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Objective

To determine whether ECG-gating is necessary in carotid artery imaging and if navigator-compensation for respiration improves image quality.

Background

Black-blood carotid artery imaging offers excellent image quality with clear delineation of the vessel wall, but suffers from time inefficiency. 3D sequences combat this problem but swallowing [1] and respiratory motion [2] may cause motion artefact. Non-ECG gated imaging is reported to be qualitatively comparable to ECG-gated images in older people with thickened, less compliant vessel walls [3]. We used a cross-pair navigator to track respiratory motion with and without ECG-gating to assess image quality.

Methods

Ten healthy volunteers were scanned on a Siemens 1.5 T scanner with phased-array carotid coils. The carotid artery bifurcation was imaged. The subject's head was stabilised using a customised head and face mask (figure 1) and instructed not to swallow during the scans. Each subject was scanned four times: ECG-gated, navigator-gated, ECG-and-navigator-gated, none (randomised order). Two blinded independent observers graded the images on a 1-5 scale (1 = carotid wall not distinguishable, 2 = markedly blurred image +/- motion artefact, 3 = moderate blurring +/- motion artefact, 4 = minimal blurring +/- motion artefact and 5 = arterial wall clearly demarcated, no motion artefact).

Imaging parameters: A T1-weighted 2D TSE dark-blood sequence with TE = 10 ms, ETL 9 and 200% phase-over-sampling was used. Pixel size 0.4 × 0.4 mm and slice thickness 2 mm. Gated studies: TR set according to RR-interval. Non-gated studies: a simulated ECG set to each individual's average RR-interval. Accept/reject-algorithm navigators were incorporated into the study.

Results and discussion

All ten subjects (average age 30.3 years) completed the study successfully without swallowing. The improvement in image quality is documented in figures 2 and 3.



Figure 1
A customised head and face mask designed to stabilise the subject's head in order to minimise any bulk head motion during the scans. The detachable face mask was secured to an MRI-safe back board by plastic snap rivets.

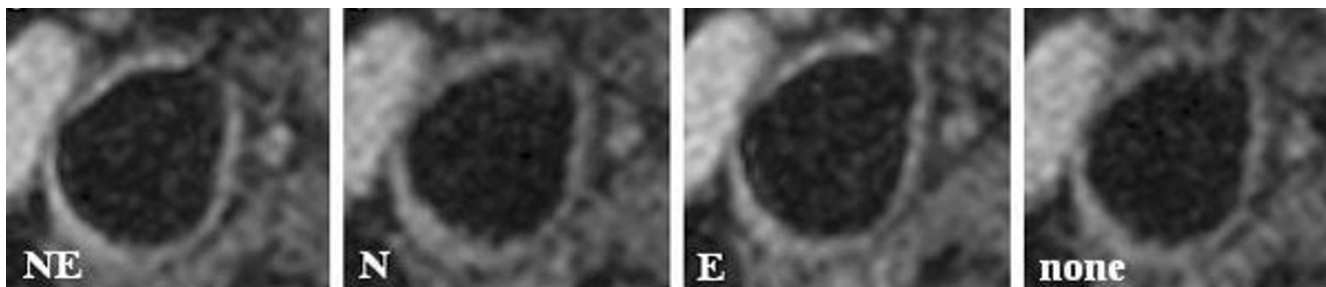


Figure 2
Four images from the same subject showing a right carotid artery at the bifurcation. The sharpness of the vessel wall is illustrated with the different imaging parameters. There was a significant improvement in the quality of the images in the NE and E images compared with the N and 'none' images. $p < 0.001$, where NE = navigator and ECG-gated, N = navigator gated only, E = ECG-gated only and 'none' = no gating.

There was borderline significant difference ($p = 0.06$) between scores from NE and E images: this may be because respiratory motion artefact affecting image quality is variable and occurs if it falls within the centre of K-space. A significant difference ($p < 0.001$) was found between E and "none" images, suggesting vessel wall sharpness is dependent on the cardiac cycle and arterial pulsatility. A borderline significant difference between N and "none" images was found ($p > 0.07$).

Conclusion

ECG-gated carotid artery imaging is important. Vessel pulsatility can affect image quality in a younger age group but we did not prove that the application of a respiratory navigator was useful in this study.

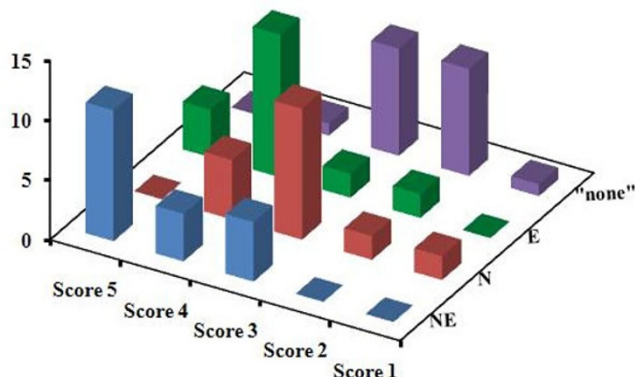


Figure 3
There was a significant correlation between the scores from both observers (Kendall's correlation coefficient = 0.78, $p < 0.001$). The scores demonstrated that images with NE were rated better than E, followed by N and then 'none'. In the consensus scores, 11/20 NE images were graded 5 out of 5, compared with only 4/20 in the E group, which were predominantly scored 4 out of 4. The images in the N and 'none' group were predominantly scored 3 or less (75% in the N group and 95% in the 'none' group).

References

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