The influence of k-t BLAST on intracranial aneurismal PC velocity mapping data

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Purpose/Introduction

Phase contrast angiography (PCA) can be used to quantify blood flow near and in cerebral aneurysms to gain insight in local hemodynamics, possibly an important factor in aneurismal rupture. When k-space is undersampled to reduce the long measurement time, the k-t BLAST algorithm can be applied to reconstruct images, but some data will be lost. It is shown by Baltes et al. [1] that measurement time can be shortened by applying k-t BLAST with an acceleration factor of 5 in the aorta, without significant loss of accuracy. The goal of this study is to evaluate whether the k-t BLAST algorithm can be applied for flow quantification in intracranial aneurysms as well. For this cause, three full PCA measurements in intracranial aneurysms are undersampled and reconstructed in Matlab using the k-t BLAST algorithm [2] and compared with the full dataset.

Materials & Methods

Modulus and phase data of three patients were obtained by a fast field echo sequence on a 3T MR system (Philips Medical Systems, Best, The Netherlands). Scan parameters: FOV: 100 x 100 x 10 mm, voxel size: 0.89 x 0.89 x 1 mm, TE/TR: 5.0/9.5 ms, flip angle: 15°, number of averages: 2, venc: 100 x 100 x 100 cm/s. Cardiac phases: 15 (Retrospectively ECG-gated in patient 1, retrospectively PPU-gated in patient 2 and 3). The full dataset is sampled with an acceleration factor of 5 with the optimal sampling pattern [3] and training data with 20 center lines is created. The deviation in velocities between measured original data and k-t BLAST data is given by the mean difference over cardiac phases divided by the mean original velocity over cardiac phases averaged over the amount of pixels found in the aneurysm.

Results

The deviations between measured velocities and k-t BLAST velocities are given in table 1. In figure 1a, aneurysm 1 is displayed, in figure 1b a transverse cross-section with magnitude and direction of velocities in each pixel is shown. In figure 1c and 1d the velocity over cardiac phases for the measurement and for k-t BLAST in respectively pixel 1 and pixel 2 are given. In figure 2 and 3 the same figures are displayed for aneurysm 2 and 3.

Table 1: Size, location of the aneurysms and difference original and k-t BLAST

Aneu	Size (mm)	nr. pix.	Location	Deviation (%)
1	2.5 x 2.5 x 3	15	RA oftalmica	21
2	3 x 3.5 x 4.5	71	Right MCA	17
3	6 x 8 x 5	137	Left MCA	13

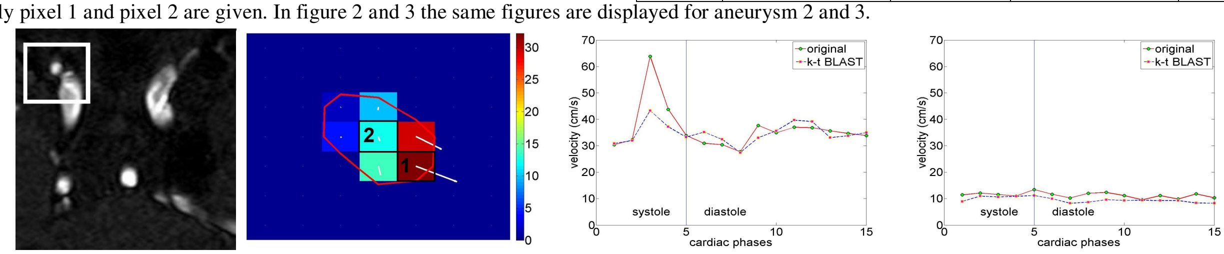

Fig 1a: Aneurysm 1 *b: Velocity pattern systole (cp = 2)* *c: Pixel 1 (ECG gated)* *d: Pixel 2*

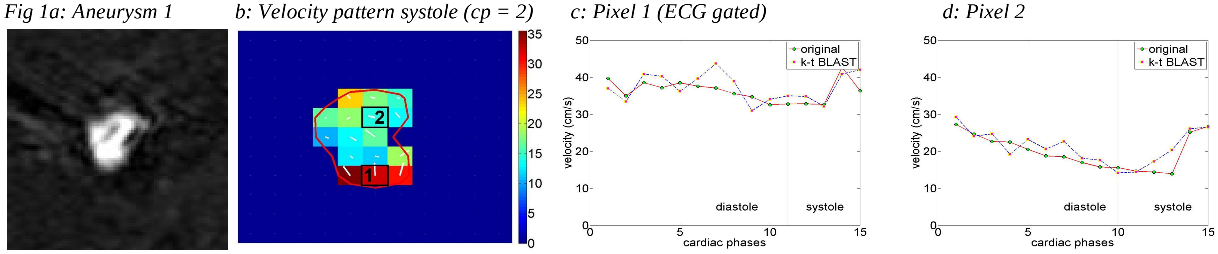

Fig 2a: Aneurysm 2 *b: Velocity pattern systole (cp = 13)* *c: Pixel 1 (PPU gated)* *d: Pixel 2*

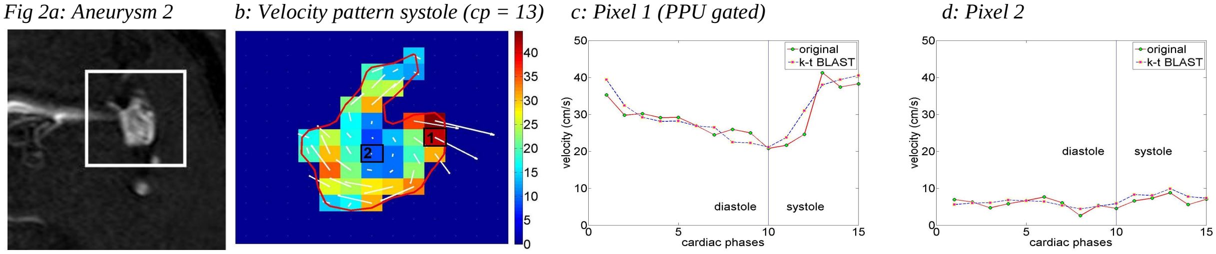

Fig 3a: Aneurysm 2 *b: Velocity pattern systole (cp = 13)* *c: Pixel 1 (PPU gated)* *d: Pixel 2*

Discussion/ Conclusion

The deviations in table 1 suggest that when k-t BLAST is used, less accuracy is obtained when the aneurysm is small than when the aneurysm is larger. This finding can be a result of the fact that when an aneurysm is smaller, flow will be low in relatively more pixels and hence deviation between full measurement and k-t BLAST in these pixels will be larger, as can be seen in figures 1d, 2d and 3d. This could be a reason for the difference in accuracy between this study and the results obtained by Baltes et al. [1] where more agreement was found between original and k-t BLAST measurements in the aorta, where flow is large in many pixels. It is clear that estimation of flow parameters in aneurysm 1 is more likely to contain inaccuracies than in aneurysm 2 and 2 more than 3, due to the lower amount of pixels and possibly a larger influence of partial volume effects. However, the data suggest that using k-t BLAST and accepting a small deviation of true flow parameters, an increase in spatial resolution or measurement time reduction can be gained in intracranial aneurysms, especially large ones (> 5 mm), as well.

References

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