Assessment of Non-Contrast Angiography in Diabetic Patients

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Purpose

Studies have shown that diabetic patients are four times more likely to develop peripheral artery disease (PAD) [1]. In addition, diabetes is the number one cause of kidney failure [2]. The combination of PAD onset and high risk of kidney failure associated with diabetes necessitates frequent angiographic exams for these patients. Contrast-enhanced MR Angiography (CE-MRA) has been shown to depict runoff vessels with a high degree of clarity. However, recent studies link the onset of Nephrogenic Systemic Fibrosis (NSF) in renal impaired patients. Non-contrast MRA techniques, such as Fresh Blood Imaging (FBI) [3,4] and Time-Spatial labeling Inversion Pulse (Time-SLIP) [5,6] have the ability to assess peripheral artery disease, identify stenoses and provide high resolution angiograms useful for diagnosis and treatment planning without the use of a contrast agent. FBI and Time-SLIP are safe and effective alternatives to CE-MRA and may be useful for diagnosis and treatment planning in diabetic patients. The aim of this study was to provide an initial assessment in the ability of non-contrast angiography techniques for diagnosing and treatment planning of diabetic patients.

Materials and Methods

All diabetic patients referred to Washington Hospital Center between August and October of 2009 for an MR abdominal and/or peripheral runoff angiography exam underwent non-contrast angiographic imaging (5 female age 70±6, 4 male age 71±20). MRI was performed on a 1.5-T system (Excelart/Vantage $_{TM}$ Titan, Toshiba, Japan), equipped with high-performance 30 mT/m gradients and maximal slew rate of 130 T/m per second. The non-contrast imaging data was used to determine how effective non-contrast imaging has been for diagnosis and treatment planning for these patients. Inclusion criteria were simply diabetic patients who had undergone non-contrast imaging within the past two months. For the peripheral runoff exams, the non-contrast FBI exam was utilized in three stations – iliac, femoral, and tibial. Imaging parameters were: TE/TR=80ms/2-3RR,

Flip Angle =90/180 , Matrix = 256x256, Slice Thickness = 3mm , 30-40 slices, ECG gating, parallel imaging factor = 2 , ECG gating, scan time = 3-6 minutes. Both systolic and diastolic 3D image sets were collected in one acquisition. Maximum intensity projection (MIP) was created off of the subtraction between diastolic and systolic datasets, as preset to automatically subtraction and MIP. For the abdominal renal exams, the non-contrast Time-SLIP technique was used. Imaging parameters were: TE/TR=2.5/5ms, Flip Angle = 120, Matrix = 256x256, Slice Thickness = 3mm, respiratory gating, parallel imaging factor =2, BBTI = 1200ms, CHESS fat saturation, scan time = 3-5minutes. Images were scored by a qualified radiologist qualitatively in terms of image quality and diagnostic confidence. Image Quality was ranked from 1-3, where 1 = poor, 2 = good, 3 = excellent. Diagnostic Confidence was ranked from 1-3, where 0 = non diagnostic, 1 = poorly defined, uncertain diagnosis, 2 = identified with probably diagnosis, 3 = clearly defined with highly probable/definite diagnosis.

Results

High image quality and diagnostic confidence scores were achieved on average for this group of patients. For image quality, the score was 2.2±0.8. Of these 9 patients, four were given an image quality score of excellent. For diagnostic confidence, the average score was 3±0. Figure 1 displays a three station runoff arterial MIP image from a diabetic patient with peripheral artery disease. As seen in the Figure 1, the arteries are depicted with excellent clarity from the abdominal aortal to the pedal arteries. Occlusions were found in the posterior tibial arteries bilaterally, with mild atherosclerosis in the remaining arteries. Results indicate that non-contrast imaging is a useful diagnostic tool for diabetic patients, especially those who cannot tolerate gadolinium.

Discussion

We have demonstrated that high quality diagnostic angiographic imaging in diabetic patients can be accomplished using non-contrast imaging techniques that do not require the use of a gadolinium based contrast agent. This is especially important for this patient group because of their increased risk for developing PAD [1], which is associated with numerous distal stenoses and occluded runoff vessels [7]. Diabetic patients have a five fold greater chance of developing critical limb ischemia compared to nondiabetic patients. In diabetic patients, critical limb ischemia requires aggressive interventional treatment which would require multiple angiography exams throughout their lifetime. Non-contrast MR angiographic techniques, such as FBI and Time-SLIP offer a safe and effective imaging solution that provides complete diagnostic information without the use of contrast media, which should be limited or even in avoided in diabetic patients.

Figure 1. Stitched Run-off Non-contrast angiography MIP images acquired with FBI in three stations. This diabetic patient was diagnosed with mild atherosclerosis and occluded posterior tibial vessels.

References

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