Diagnostic Value of 3.0T Non-contrast Enhanced Magnetic Resonance Angiography for Lower Extremity Arterial Stenosis

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Purpose To develop an optimized protocol for non-contrast enhanced magnetic resonance angiography of lower extremity arterial stenosis on 3T MR scanner.

Introduction Contrast enhanced MR angiography (CE-MRA) has become an excellent diagnostic tool for peripheral arterial occlusive disease (PAOD) in clinical routine [1]. Nevertheless, with the recognition of Nephrogenic Systemic Fibrosis, which is associated with renal failure[2], much attention has been drawn on the non-contrast-enhanced MR angiography (NCE-MRA). Delta-Flow MRA is one non-enhanced MR angiography technique which is based on ECG-gated 3D partial-flourier FSE sequence[3]. The purpose of this study is to evaluate the diagnostic value of Delta-Flow NCE-MRA for lower extremity arterial stenosis with 3.0T MR.

Materials & Method Thirty patients including 24 men and 6 women ranged in age from 49 to 85 (mean 69±10 year) with suspected peripheral arterial diseases in lower extremity underwent NCE-MRA before CE-MRA. They were examined on a 3.0 T whole-body MR system (MR750,GE Healthcare, America) with 16-channel coil. The parameters of NCE-MRA were as follows: TR depends on RR interval and patient's heart ratio ,FOV 460mm×460mm , matrix 320×224;In abdomen and thigh regions, TE=10ms, slice thickness=3.0mm； In thigh regions, TE=60ms，slice thickness= 2.2mm；In calf regions, TE=80ms，slice thickness= 2.0mm. Acquisition time of NCE-MRA amounted to approximately 30 min. The arterial vascular system was divided into 18 anatomic segments (right and left common iliac artery, internal iliac artery, external iliac artery, femoral artery, deep femoral artery, popliteal artery, anterior tibial artery, posterior tibial artery, and peroneal artery).The degree of stenosis for each artery segment was defined (no stenosis/occlusion, low-grade stenosis＜50%, high-grade stenosis 50-99%, occlusion). High-grade stenosis and occlusion were specified as significant stenosis. The number of stenosis and occlusions was counted for each segment in both MRA techniques. Image quality and diagnostic accuracy of NCE-MRA for detecting significant artery stenosis(≥ 50%)were evaluated using CE-MRA defined as a standard reference, Cohen's kappa was used to assess the coherence between the two methods in diagnosis of significant artery stenosis(≥50%).

Experiment & Result All patients successfully underwent both NCE-MRA and CE-MRA study, 532 diagnostic valuable arterial segments were obtained from NCE-MRA. In calf regions, vein appeared more frequently on CE-MRA; In abdomen and thigh regions, vein appeared more frequently on NCE-MRA, there were statistically significant difference(P＜0.01)between the two methods. Considering the total number of stenoses, 16 low-grade stenoses at CE-MRA were upgraded to high-grade stenoses at NCE-MRA;10. high-grade stenoses at CE-MRA were upgraded to occlusion; The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of NCE-MRA for the diagnosis of significant lower extremity arterial stenosis were 97.89%,97.69%,93.92%,99.22% and 97.74%, respectively, and there was content consistency (Kappa=0.94) between the two methods for the diagnosis of arterial significant stenosis(Fig. 1, Fig. 2).

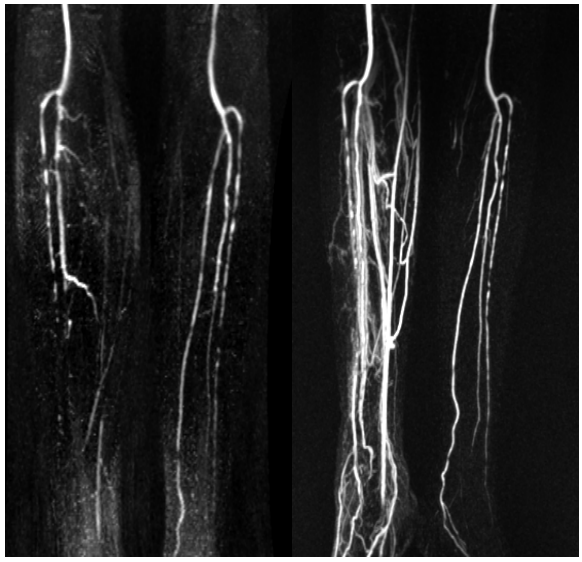

Fig.1 (a) Delta-Flow NCE-MRA depicts multiple stenoses involving different segments of the calf arterys(arrows), which correlates closely with the findings on CE-MRA (b)

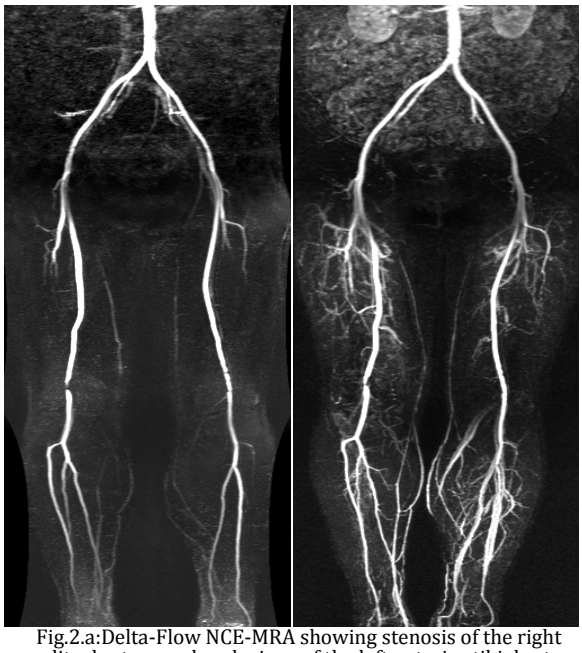

Fig.2.a:Delta-Flow NCE-MRA showing stenosis of the right popliteal artery and occlusions of the left anterior tibial artery (arrows).b: CE-MRA of the same patient as in Fig. 2a with identical results concerning the grading of stenoses

Conclusion and discussion Delta-Flow NCE-MRA is sensitive to flow patterns, that is the reason for overestimations in NCE-MRA[4]. Besides, selection of an inappropriate diastolic TD would lead to vein artifacts in NCE-MRA. NCE-MRA owns reliable image quality and high diagnostic accuracy, which could be an alternative choice for patients with lower extremity arterial diseases and renal insufficiency..

Reference

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