Selective visualization of Blood flow using SSFP Non-Contrast MRA with Time-Spatial Labeling Inversion Plus

Y. Yamashita[1], T. Yamamoto[1], M. Suzuki[1], A. Ninomiya[1], I. Aoki[1], M. Yui[2]
[1]TOSHIBA MEDICAL SYSTEMS CORPORATION, Bunkyo-ku, Tokyo, Japan, [2]TOSHIBA MEDICAL SYSTEMS CORPORATION, Nasu, Tochigi, Japan

ABSTRACT

In acquisition using True SSFP combined with Time-SLIP, blood vessels can be selectively visualized without the use of contrast medium. In addition, hemodynamics can be observed by acquiring images with various BBTI settings. In order to observe hemodynamics, however, several scans should be performed, and as a result, the total scanning time becomes longer and imaging parameter setting becomes more complicated. The findings of the present study suggest that the Continuation Sampling method permits hemodynamics to be observed in a single scan with no need to change settings.

INTRODUCTION

In the Time-Spatial Labeling Inversion Pulse (Time-SLIP) method, blood flowing into the imaging slice is extracted or suppressed by setting the location where the Black Blood prepulse is applied independently of the imaging slice. Conventionally, scanning must be performed as many times as the number of Black Blood Inversion Time (BBTI) pulses. The present study was conducted to determine whether hemodynamics can be observed in a single scan using the Continuation Sampling method in which multiple images are acquired with a single BBTI pulse.

METHODS

All experiments were performed using a 1.5-T clinical imager (EXCELART Vantage^{TM}, Toshiba, Japan). Healthy volunteers were scanned using the Continuation Sampling method with various BBTI settings ranging from 200 to 700 ms in increments of 100 ms. The changes in the signal values of fat, muscle, and blood vessels were compared with those in images acquired using the conventional method. In addition, the relationships between hemodynamics and the flip angle in the Continuation Sampling method were examined. The basic imaging parameters were TR/TE = 4.2/2.1 ms, a matrix of 128 $\times$ 256, 5-mm thin slices, and a scan time of 0:27.

RESULTS

In the conventional method, blood vessels, fat, and muscle were visualized with roughly the same level of contrast even when the BBTI value was varied. In the Continuation Sampling method, fat signals decreased in the early phase, but fat signals increased and muscle signals decreased as the BBTI became longer. It is thought that the BBTI pulse and continuous application of an RF pulse functioned as STIR. The signals of inflowing blood increased and the visualization range expanded as the BBTI became longer. This suggests that the signal changes reflected the actual blood flow velocity. The contrast between blood vessels and background increased as the flip angle became larger, but detectability decreased as the BBTI became longer.

CONCLUSION

Hemodynamics can be observed in a single scan using the Continuation Sampling method (Fig. 2). This method simplifies imaging parameter setting, shortens the scanning time, and permits hemodynamics to be observed in a shorter time. It also allows blood vessel morphology and the relationships between blood vessels and other tissues to be evaluated. It is expected that this method should prove applicable to a wide range of anatomical regions and clinical purposes.

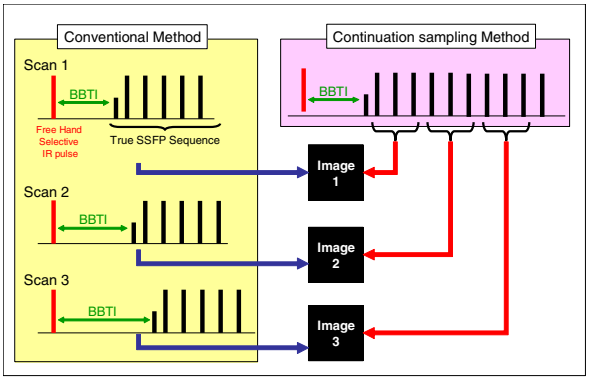

Fig.1) Time-SLIP comparison diagram

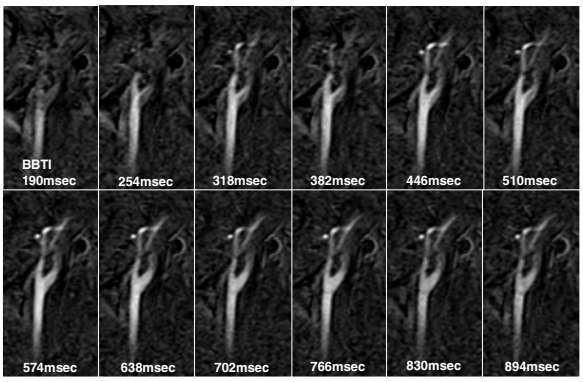

Fig.2) Blood flow of the internal carotid artery