

CASE STUDY

Time-SLIP (Time-Spatial Labeling Inversion Pulse) in the diagnosis of renal artery stenosis by Magnetic Resonance



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Introduction

The arterial hypertension is considered the most prevalent disease of the world, afflicting about 10% to 20% of the adult population and approximately 50% of the population from seventh decade of life^{1,2}. Approximately from 5% to 10% have secondary arterial hypertension, and can reach 50% in a hypertensive population with well defined clinical picture².

The renal arterial stenosis (RAS) is the greater relevant injury, promoting the parenchyma ischemia and a rise of systemic arterial pressure of difficult medication control. With the over time, the stenosis evolves to occlusion and permanent reduction of the renal function. The importance of the hypertension as a public health problem and the consequence that the disease brings to the patient has directed studies in order to achieve a safe, fast and non-invasive method, for early diagnosis of EAR³.

Advantage: It is known that, the vast majority of diseases that affect the vascularization, the lesions are localized in the main branches of the renal artery and, in this case the MR-angio becomes a valuable practice.

Disadvantage: The use of paramagnetic contrast and the risk of development systemic nephrogenic syndrome. Therefore, the use of a non-contrast protocol with

applied techniques to the pathology allows the evaluation of the disease without to entail risks to patient¹.

Materials and Methods

Magnetic Resonance imaging performed on Canon Vantage Titan 1.5T equipment, used the Time-SLIP technique with breathing synchronism (GATE). The exam was performed comparatively with the contrast technique.

Time-SLIP – Technique

A negative gradient is applied followed by a positive and with this the stationary tissue is suppressed allowing that the final image have only the interest flow (Figure 1).

Time-SLIP is a arterial variation spin label (ASL) that can be combined with 3D phase sequences or SSFP to demonstrate the blood vessels in any orientation of image (Multidirectional Flow)^{4,5}, allowing the observation of hemodynamic speed and vascular visualization.

Time-SLIP allow the split arterial/venous, using a selective pulse or not selective of IR⁶.

Time-SLIP is categorized based on combinations of parameters and acquired as:

- "Move-In" or "in-flow"
- "Move-out" or "out-flow"
- Alternate

Move-In Principle (Figure 2)

- the selective IR pulse is applied at the specified region to invert the longitudinal magnetization. The levels of blood signal and the background on the region becomes low⁷.
- the blood outside of specified region is not affected by the IR pulse, thereby its signal will be of high intensity as far as it moves to the interest region.
- the data are acquired when the high intensity blood “moves” to the vessels of interest (this is, renal artery). The temporization of data acquisition is determined by BBTI configuration.

The background signal (inverted by selective IR impulse) recover over time.

Discussion

A report published by Food and Drug Administration in 2006 warned about the risk of development of systemic nephrogenic fibrosis¹, disease that, as the name suggest, causes generalized tissue fibrosis;

This condition can occur in patients after intravenous administration the medium of paramagnetic contrast medium to perform magnetic resonance imaging or



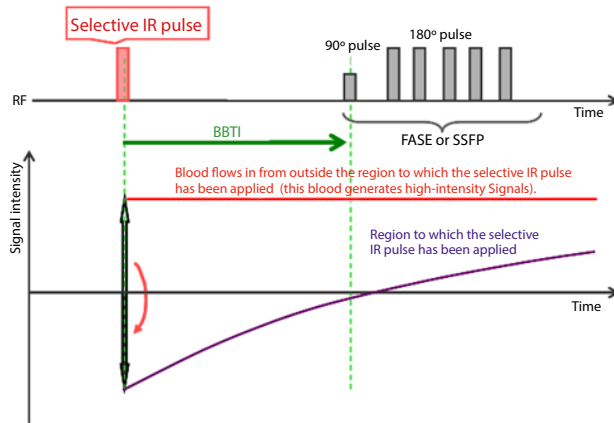
Figure 1
1- The sequence propagation is realized at the pure axial plane.
2- Always place respiratory trigger and peripher GATE.
3- Capture at the center of K space in expiration.

angio-resonance, angiographies or angio-TC⁸⁻¹⁰ and that have a renal disease in moderate-stage 4 phase (clearance of creatinine < 60 ml/min/1,73 m²) or grave-stage 5 (< 15 ml/min/ 1,73 m²), especially those which need of dialysis. There is description also of FNS development in patients with hepatorenal syndrome¹¹.

As a result, several techniques were developed such as Time-SLIP, which provides an image with good temporal and spatial resolution of small and complex anatomical structures such as the renal artery without the use of paramagnetic contrast medium¹².

As there is no need for the use of contrast medium, angio-MRI with Time-SLIP technique, can offer an additional contribution to angio-MRI as in cases where there is, during image acquisition, the patient's movement because the sequence can be repeated immediately, without the need to wait for paramagnetic contrast media clearance.

The angio-MRI with Time-SLIP technique also has a high value in individuals who have some contraindication to the use of paramagnetic contrast medium, as usually happens in patients with suspected renal artery stenosis.



Note: Signal in region to which selective IR pulse has been applied starts out low and recovers with time, while fresh, unsaturated blood flows in with high signal (red).

Figure 2 Sequence design of Time-SLIP

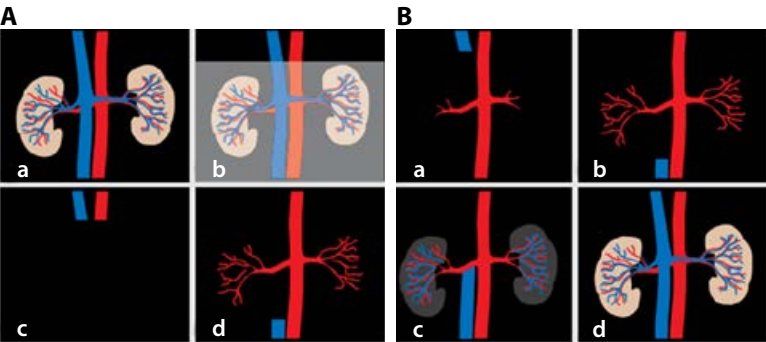
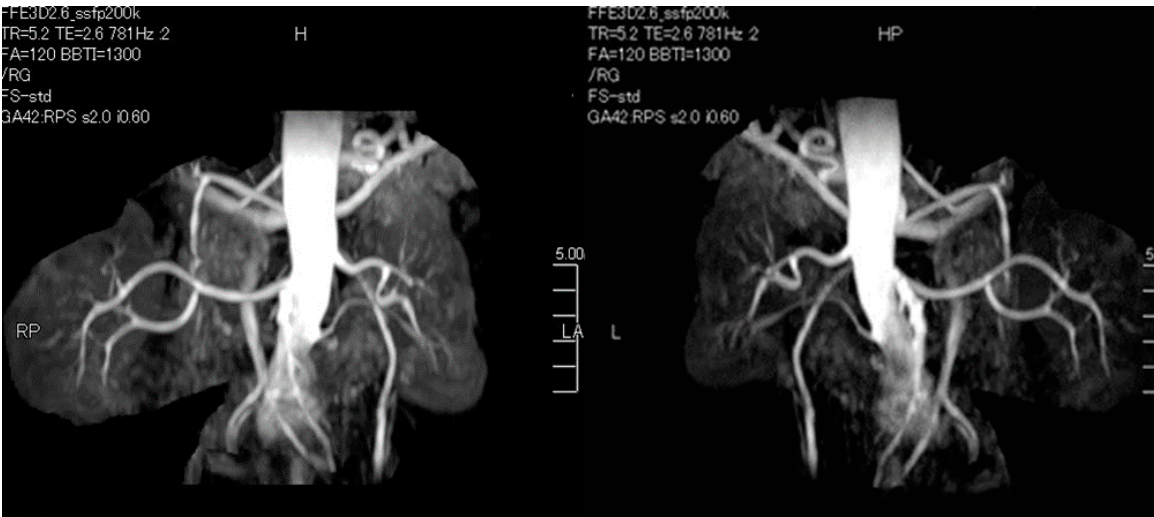


Figure 3
A-a) Region of interest
A-b) Highlighted, the region where will be applied the Time-SLIP sequence
A-c) The absence of signal in the region of interest represents decrease of signal after Time-SLIP pulse.
A-d) The blood that isn't affected by the Time-SLIP pulse appears with bright signal when the BBTI is used the right way.
B-a) Low BBTI causes low arterial signal.
B-b) Correct BBTI: elevated arterial signal.
B-c) BBTI over of ideal: Some background signals start to recover.
B-d) Very high BBTI: The venous and background signals totally recover.

Clinical Images

Angio MRI using the Time-SLIP technique



46 years old, Hypertensive, Angio MRI using the Time-SLIP technique



Time-SLIP Technique



Technique with paramagnetic contrast



Disclaimer: The clinical results, performance and views described in this document are the experience of the health care providers. Results may vary due to clinical setting, patient presentation and other factors. Many factors could cause the actual results and performance of Canon's product to be materially different from any of the aforementioned.

Conclusion

The Time-SLIP has a high value at the renal artery stenosis diagnose, because it has high resolution spatial giving higher precision of stenosis grade.

Patient with risk of systemic nephrogenic fibrosis development, disease that, as the name suggest, causes generalized tissue fibrosis has contraindication of paramagnetic contrast use and Time-SLIP is the important method for renal arterial exams.

Because Angio-RMI with contrast needs the patient's collaboration, because at the moment of the arterial phase the patient should remain in apnea and with this we often decrease the spatial resolution to reduce the acquisition time with this reduces the quality or even due to technical problems such as the lack of apnea can damage the final result.

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