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# T-SLIP (TIME-SPATIAL LABELING INVERSION PULSE) IN THE DIAGNOSIS OF RENAL ARTERY STENOSIS BY MAGNETIC RESONANCE IMAGING

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**Abstract:** The diagnosis of renal artery stenosis by Magnetic Resonance Imaging (MRI) is often made using paramagnetic contrast media. The Food and Drug Administration published a warning report about the risk of developing Systemic Nephrogenic Syndrome associated with the use of contrast media containing gadolinium. Recently, a non-contrast technique called Time-spatial Labeling Invertion Pulse (T-Slip) has shown great promise in the evaluation of renal artery stenosis. Objective: The objective is to describe the T.Slip technique and illustrate its importance in the diagnosis of renal artery stenosis.
**Keywords**: Resonancemagnetic; Magnetic resonance angiography; Renal arteries; Diagnostic technique.

## INTRODUCTION

Arterial hypertension is considered the most prevalent disease in the world, affecting approximately 10% to 20% of the adult population and approximately 50% of the population from the seventh decade of life.

Approximately 5% to 10% have secondary arterial hypertension, which may reach 50% in a hypertensive population with a well-defined clinical picture.

Renal artery stenosis (RAS) is the most relevant lesion, promoting parenchymal ischemia and an increase in systemic blood pressure that is difficult to control with medication. Over time, the stenosis progresses to occlusion and permanent reduction in renal function. The importance of hypertension as a public health problem and the consequence that the disease brings to the patient has directed studies towards achieving a safe, fast and non-invasive method for the early diagnosis of RAS.

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

**Disadvantage**: The use of paramagnetic contrast and the risk of developing systemic nephrogenic syndrome. Therefore, the use of a protocol without contrast with techniques applied to pathology allows the evaluation of the disease without posing risks to the patient.

## MATERIALS AND METHODS

Magnetic resonance imaging was performed in Canon Titan 1.5T equipment (Canon Tokyo, Japan), using the T-Slip technique with respiratory synchronism (GATE). The examination was performed in comparison with the technique with contrast.

### TECHNIQUE – T.SLIP

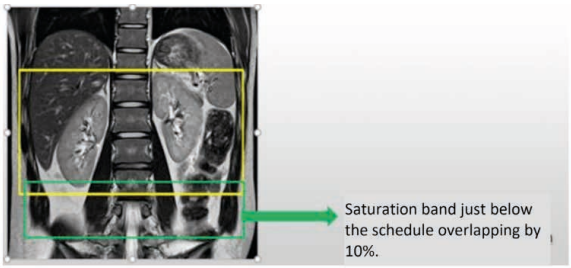
A negative gradient is applied followed by a positive one, thereby suppressing stationary tissue allowing the final image to contain only the flow of interest. Time Slip is an arterial spin label (ASL) variation that can be combined with 3D phase or SSFP sequences to demonstrate blood vessels in any image orientation (Multidirectional Flow), allowing observation of hemodynamic velocity and visualization vascular.

T.Slip allows arterial/venous separation using either a selective or non-selective IR pulse.

T. Slip is categorized based on combinations of parameters and acquired as:

"Move-In" or "in-flow"

"Move-out" or "out-flow"



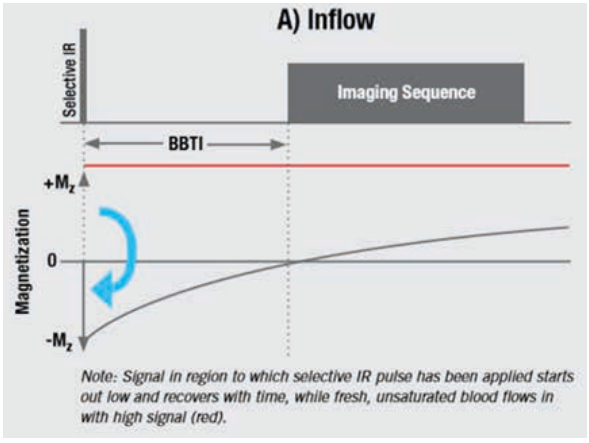

1 -The sequence programming is performed in the pure axial plane.

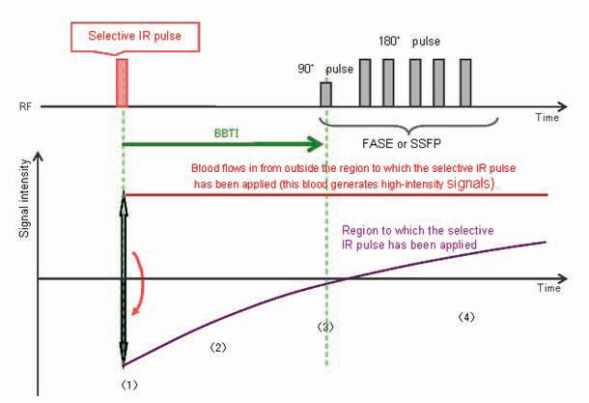
2 -Always place respiratory and peripheral trigger GATE

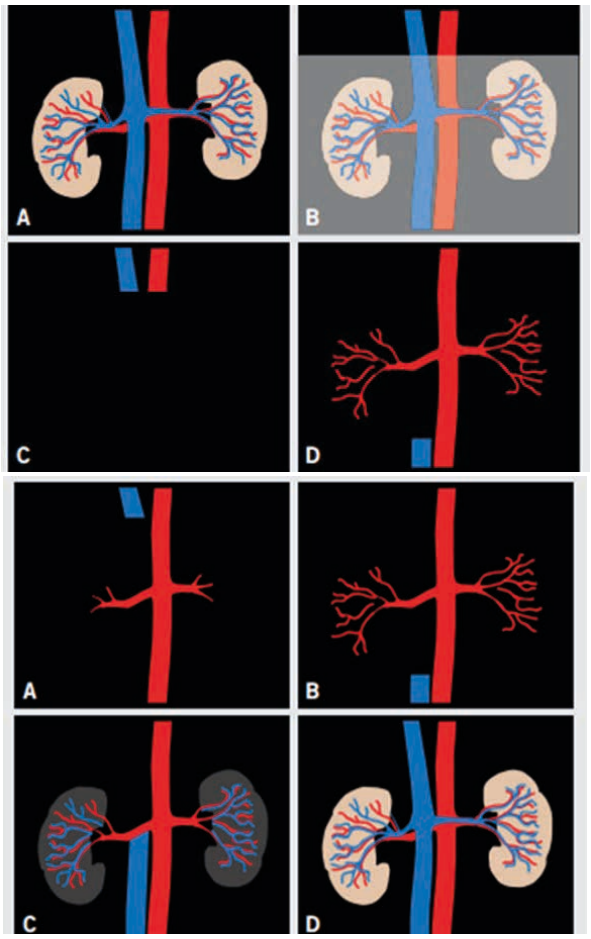
## MOVE-IN PRINCIPLE

- Selective IR pulse is applied to the specified region to reverse longitudinal magnetization. Blood and background signal levels in the region become low.
- Blood from outside the specified region is not affected by the IR pulse, so its signal will be of high intensity as it moves towards the region of interest.
- Data is acquired when high-intensity blood moves into the vessels of interest (ie, renal artery). The data acquisition timing is determined by the BBTI configuration.

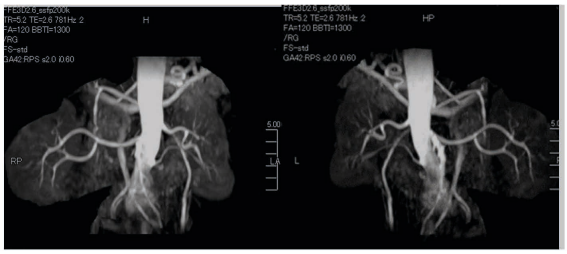
The background signal (inverted by the selective IR pulse) recovers over time.



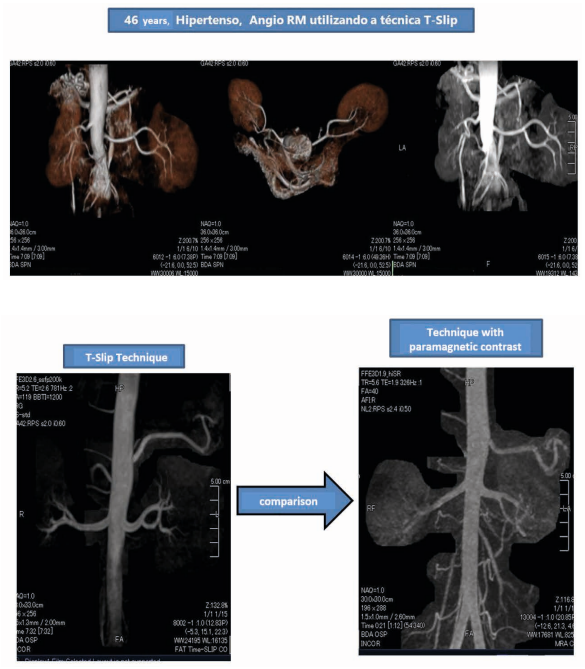




A) Region of interest B) The region where the T-Slip sequence will be applied is highlighted. C) The absence of a signal in the region of interest represents a decrease in the signal after the T-slip pulse. D) Blood that is not affected by the T-Slip pulse appears as a bright signal when using the BBTI correctly. A) Low BBTI causes low arterial signal. B) Correct BBTI: Elevated arterial signal. C) Above-ideal BBTI: Some bottom signals start to recover. D) BBTI too high: Venous and background signal recover fully.



MR angiography using T-Slip technique




## DISCUSSION

A report published by the Food and Drug Administration in 2006 warned about the risk of developing systemic nephrogenic fibrosis 2, a disease that, as the name implies, causes generalized tissue fibrosis;

This condition can occur in patients after intravenous administration of paramagnetic contrast medium for magnetic resonance imaging or magnetic resonance angiography, angiography or CT angiography and who have moderate-stage 4 renal disease (creatinine clearance < 60 ml/min /1.73 $m^2$) or severe-stage 5 (< 15 ml/min/ 1.73 $m^2$), especially in those requiring dialysis. There is also a description of the development of FNS in patients with hepatorenal syndrome 11.

As a result, several techniques were developed, such as the T-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 media 12.

As there is no need to use a contrast medium, angio-MR with the T-Slip technique can offer an additional contribution to angio-MR as in cases where there is, during image acquisition, patient movement as the sequence can be repeated immediately, without the need to wait for paramagnetic contrast medium clearance.

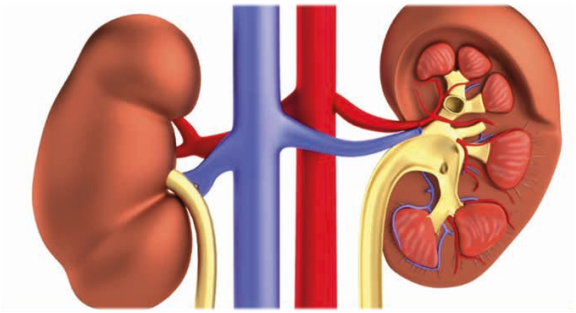
MRI angiography with the T-Slip technique is also highly valuable in individuals who have some contraindication to the use of paramagnetic contrast medium, as is usually the case in patients with suspected renal artery stenosis.

## CONCLUSION

The T-Slip has a high value in the diagnosis of renal artery stenosis, as it has high spatial resolution, providing greater precision in the degree of stenosis.

Patients at risk of developing systemic nephrogenic fibrosis, a disease that, as the name implies, causes generalized tissue fibrosis, are contraindicated for the use of paramagnetic contrast and the T-Slip is the important method for exams of the renal arteries.

Because Angio-RM- with contrast needs the patient's collaboration, because at the moment of the arterial phase the patient must remain in apnea and with that we often reduce the spatial resolution to reduce the acquisition time with this reducing the quality or even due to problems technical as the lack of apnea can harm the final result.



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