

# GENERALIZED BONE MARROW UPTAKE OF $^{99m}\text{Tc}$ MAG-3 AND $^{99m}\text{Tc}$ DMSA IN A PATIENT WITH RENAL FAILURE

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## ABSTRACT

**Abstract:** Renal scintigraphy using  $^{99m}\text{Tc}$  MAG-3 and  $^{99m}\text{Tc}$  DMSA are the most commonly prescribed functional imaging for patients with various renal diseases. Visualization of bone marrow on renal imaging is an unusual finding. We present a case of chronic renal failure whose renal scans with  $^{99m}\text{Tc}$  MAG-3 revealed enhanced marrow perfusion and  $^{99m}\text{Tc}$  DMSA study showed uptake of tracer in axial and appendicular skeleton.

**Key Words:** Renal Scan;  $^{99m}\text{Tc}$  MAG-3;  $^{99m}\text{Tc}$  DMSA; bone marrow; hyperplasia; colloid

## Introduction

Radionuclide renal scintigraphy is the most commonly performed functional imaging to assist in the diagnosis and management of patients with a variety of urinary tract problems. Technetium-99m labeled Mercapto Acetyl Triglycine ( $^{99m}\text{Tc}$  MAG-3) is the most commonly used agent for dynamic renal imaging for assessment of renal perfusion, excretory and clearance functions.<sup>1</sup>  $^{99m}\text{Tc}$  Dimercaptosuccinic Acid ( $^{99m}\text{Tc}$  DMSA) is an excellent cortical imaging agent which is used primarily in children to evaluate relative function, pyelonephritis, and renal scarring globally.<sup>2</sup> In patients with impaired renal function, there is reduced perfusion, impaired renal uptake and clearance which is depicted on renal imaging as reduced renal perfusion, reduced renal cortical localization and enhanced uptake over liver, spleen and blood background (impaired clearance).<sup>3</sup> However, visualization of bone marrow on renal imaging in patients with chronic renal failure (CRF) is not well documented in literature. We present a case of patient with CRF

whose renal imaging studies performed with  $^{99m}\text{Tc}$  MAG-3 and  $^{99m}\text{Tc}$  DMSA revealed enhanced bone marrow uptake.

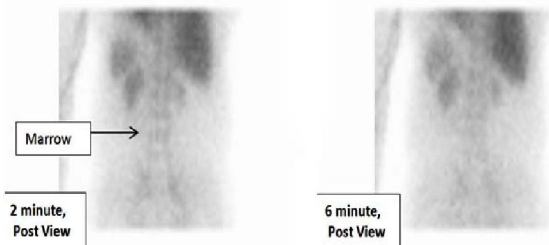
## Case History

This 07 year old girl was recently diagnosed to have raised serum creatinine (7 ng/100 ml) and her ultrasound abdomen revealed echogenic kidneys consistent with bilateral renal parenchymal disease. She was anemic (hemoglobin 7 gm/dl) and her blood urea was also raised (109 mg/dl). She was referred to Nuclear medicine Department for her renal function studies. On day 1, a dynamic renal scan was performed using 5 mCi of  $^{99m}\text{Tc}$  MAG-3 intravenously and 30 minute dynamic scan was acquired using single head gamma camera (Siemens, Germany) with low energy high resolution (LEHR) collimator. Scan showed reduced perfusion over both kidneys with good

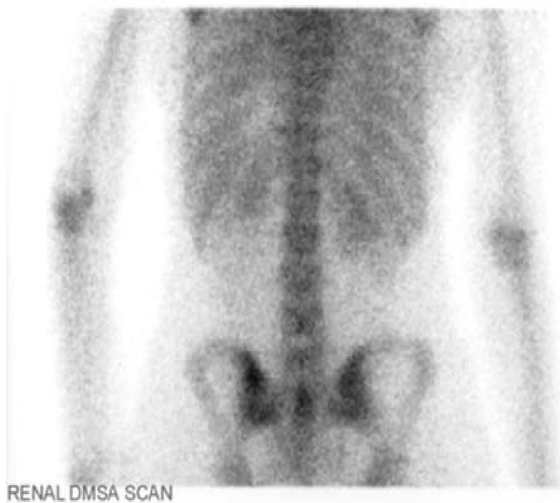
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tracer uptake over liver and spleen and increased background activity. We also noticed visualization of bone marrow over spine and both sacroiliac joints in early (perfusion) images with progressive decline in subsequent images (transient marrow visualization) (Fig. 1). After 48 hours, a renal cortical imaging study was performed with 5 mCi of  $^{99m}\text{Tc}$  DMSA injected intravenously and multiple static images were acquired after 3 hours. DMSA scan showed poorly outlined kidneys but very nice visualization of marrow in lumbar spine and visualized pelvic and both upper limb bones (Fig. 2). A whole body image (with  $^{99m}\text{Tc}$  DMSA) was also acquired which showed visualization of whole skeleton as good as in skeletal scintigraphy but with enhanced blood background activity (Fig. 3). Due to this unusual finding and possibility of faulty kit preparation, we have evaluated DMSA scan of other patient which was normal (Fig. 4).



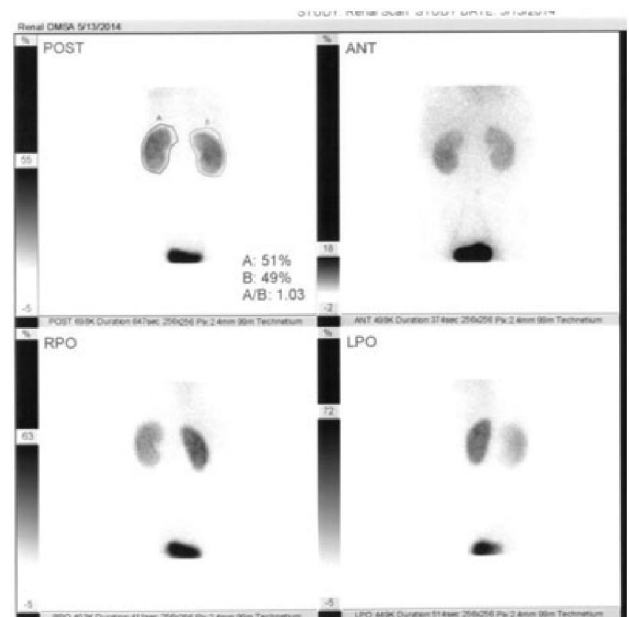
**Figure 1:**  $^{99m}\text{Tc}$ -MAG-3 dynamic imaging showing enhanced perfusion over bone marrow in lumbar and sacroiliac regions and poorly perfused and outlined kidneys.



**Figure 2:**  $^{99m}\text{Tc}$ -DMSA scan spot view showing poorly outlined kidneys with enhanced tracer uptake by bone marrow in lumbar and sacroiliac regions.



**Figure 3:**  $^{99m}\text{Tc}$ -DMSA whole body images showing generalized enhanced marrow uptake of radiotracer.



**Figure 4:**  $^{99m}\text{Tc}$ -DMSA scan spot views in another patient injected with same DMSA vial.

## Discussion

Renal scintigraphy using  $^{99m}\text{Tc}$  MAG-3 and  $^{99m}\text{Tc}$  DMSA are the most commonly prescribed functional imaging for patients with various renal diseases.  $^{99m}\text{Tc}$  MAG-3 is a highly protein bound with a extraction fraction of 40-50%.<sup>4</sup> It is from the basolateral membrane of the proximal renal tubules and then transported into the tubular lumen via organic anion transporters on the apical membrane.  $^{99m}\text{Tc}$  DMSA is an excellent cortical imaging agent and approximately 40% of the injected dose is retained by the renal tubules within 1 h after injection and remaining activity is slowly excreted in the urine over the subsequent 24 h. The uptake of  $^{99m}\text{Tc}$ -DMSA is dependent on renal blood flow, glomerular filtration, and proximal tubule receptor-mediated endocytosis.<sup>1</sup> Transient appearance of bone marrow on early  $^{99m}\text{Tc}$  MAG-3 images indicates an enhanced perfusion of bone marrow and this can be explained by enhanced bone marrow hyperplasia secondary to anemia in this patient. In patients with chronic renal failure, anemia is multifactorial and anemia of chronic disease (hyperplasia) is most common presentation seen in 45% followed by hypoplasia in 38% patients with CRF.<sup>5</sup> Peripheral bone marrow expansion often is associated with myelofibrosis, which in turn can occur as a secondary process induced by several neoplasms, toxic exposure, and systemic disease, including renal osteodystrophy.<sup>3</sup> However, the pathogenesis of bone marrow fibrosis in renal osteodystrophy is unknown.<sup>3</sup> Enhanced uptake of DMSA by marrow in axial and appendicular skeleton is considered to be due to be due to colloid formation due to altered mineral dynamic in patients with CRF.<sup>6</sup> Generalized marrow uptake of DMSA is due to hyperactive reticuloendothelial system (RES) in conjunction with bone marrow hyperplasia. Another possibility of marrow visualization is colloid formation due to entry of air in the vial.<sup>6</sup> However, we have excluded this possibility as another patient injected with same vial had normal DMSA distribution. Bone marrow visualization on renal imaging ( $^{99m}\text{Tc}$  MAG-3 and  $^{99m}\text{Tc}$  DMSA) in patients with chronic renal diseases is an expected finding. Bone marrow hyperplasia, colloid formation of DMSA due to altered mineral dynamic and an efficient RES are the possible mechanisms.

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