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CASE REPORT

Uterine uptake in [^{99m}Tc]Tc-DMSA scan imitating abnormal bladder shape

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ABSTRACT

A 28-year-old woman with C3 glomerulopathy underwent a [^{99m}Tc]Tc-DMSA scan, revealing global cortical loss and multiple cortical defects in both kidneys. An unexpected finding of radiotracer uptake in the uterine wall was initially misinterpreted as abnormal bladder shape. However, a thorough review of the patient's clinical history and previous gynecologic evaluations did not indicate any underlying uterine abnormalities. The observed uptake was attributed to premenstrual hyperemia and blood pool retention of the radiotracer. This case highlights the importance of recognizing physiological uptake of [^{99m}Tc]Tc-DMSA in the uterine wall during the premenstrual period in female patients. It underscores the need for awareness of these physiological uptakes to improve diagnostic accuracy and enhance patient care.

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INTRODUCTION

A 28-year-old woman with a documented history of proteinuria and C3 glomerulopathy (dense deposit disease) underwent a [^{99m}Tc]Tc-DMSA scan to assess her renal function. The imaging results revealed global cortical loss and multiple cortical defects in both kidneys, as well as abnormal appearance of the bladder and dilation of the distal segment of the right ureter. Notably, further evaluation of the scan images disclosed an unexpected finding of radiotracer uptake in the uterine wall which was initially misinterpreted as abnormal bladder shape. A thorough review of the patient's clinical history and previous gynecologic evaluations did not indicate any underlying uterine abnormalities. Consequently, the observed uptake was attributed to premenstrual hyperemia and blood pool retention of the radiotracer.

CASE PRESENTATION

A 28-year-old woman presented with a history of proteinuria after her second pregnancy four years ago which later diagnosed with C3 glomerulopathy (dense deposit disease) and was referred for evaluation of her renal function following ultrasound findings indicative of decreased cortical thickness and multiple scattered cortical scars in both kidneys. The laboratory tests included serum creatinine and blood urea nitrogen (BUN) levels of 1.6 and 22 mg/dl, respectively. The scan was conducted after the administration of 185 MBq of [^{99m}Tc]Tc-DMSA, in multiple views (Figure 1A). The [^{99m}Tc]Tc-DMSA scan revealed global cortical loss with multiple cortical defects throughout the kidneys (Figure 1A). Additionally, the bladder appeared abnormal in shape (arrowheads in Figure 1A), and dilation was noted in the distal segment of the right ureter (green arrow in Figure 1A). Considering her negative history for neurogenic bladder and trauma, these findings necessitated repeat imaging after voiding. Two additional delayed planar images were acquired after voiding, in which the same pattern of uptake in the pelvic region was preserved, raising suspicion for potential uptake in the uterus (Figure 1B). After reviewing the clinical history regarding her menstrual cycle and previous gynecological disorders, it was noted that her menses were regular and expected to begin the day following the scan. The SPECT/CT images of the pelvic region confirmed that the uptake corresponds to the uterine wall (Figure 2). However, no abnormal lesions were detected in the CT component, and her previous gynecological ultrasound study also confirmed a normal uterine shape without any pathological findings. Considering the mildly elevated serum creatinine level, the hypothesis raised that the delayed clearance of [^{99m}Tc]Tc-DMSA may be the underlying reason for the retention of the radiotracer in the hyperemic uterine tissue. The clear visualization of the iliac arteries supported the hypothesis; however, the thoracic planar image also confirmed intense uptake in the cardiac blood pool, indicating retained radiotracer (Figure 1C).

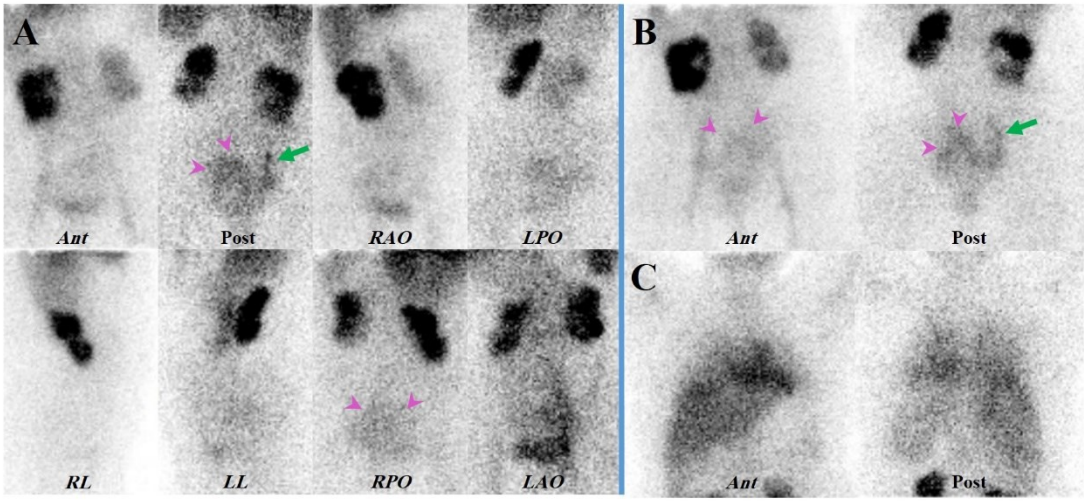

Figure 1. Planar images in multiple views (Ant (Anterior), Post (Posterior), Right Lateral (RL), Left Lateral (LL), RAO (Right Anterior Oblique), Left Posterior Oblique (LPO), Right Posterior Oblique (RPO), Left Anterior Oblique (LAO)), shows global cortical loss and multiple cortical defects throughout both kidneys. A zone of tracer activity in the pelvic region is seen which initially was misinterpreted as bladder with an abnormal shape (arrowheads). Moreover, retained activity is noted in the distal portion of the right ureter (green arrow) (A). Planar images after voiding, shows the same pattern as initial static images, raising suspicion for uterus uptake (B). The thoracic static images shows intense uptake in the cardiac blood pool (C)

On the other hand, dilation in the distal segment of the right ureter was the primary factor contributing to this initial misinterpretation. This dilation and retained radiotracer activity was not clearly visible on the SPECT/CT images (Figure 2, green arrows), potentially due to the excretion of active urine in the interval of the scan. Additionally, the pattern observed in the planar images may have been influenced by the overlapping of the iliac artery and the distal portion of the ureter, resulting in an apparently more intense uptake (Figure 1, green arrows).

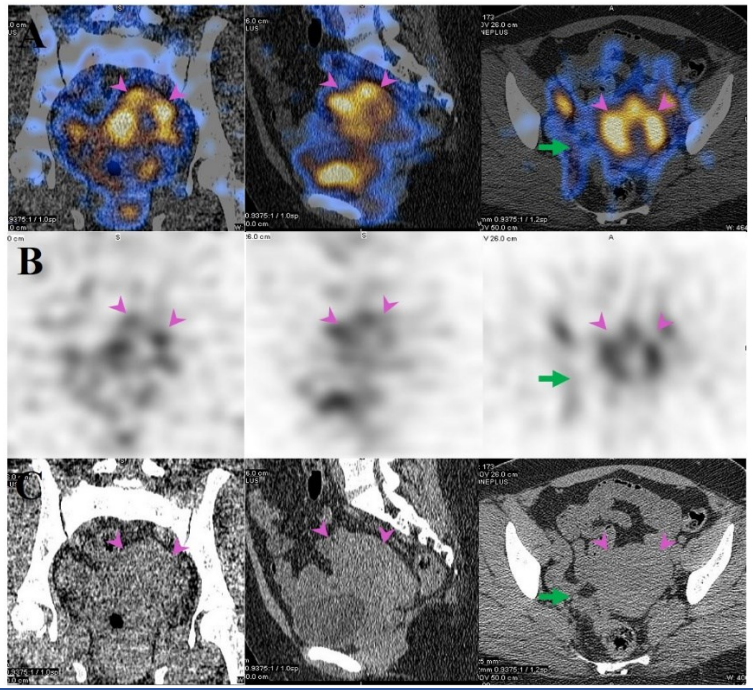

Figure 2. The SPECT/CT images (A) corresponded the zone of activity in the pelvic region better seen on the SPECT images (B) to the uterine wall (arrowheads) with no clear underlying pathology on the CT images (C). Minimal activity was also noted in the distal portion of distended right ureter (green arrow)

DISCUSSION

The [^{99m}Tc]Tc-DMSA scan is extensively employed for the functional and morphological assessment of the renal cortex, including the evaluation of cortical scars, particularly in children with a history of vesicoureteral reflux and recurrent urinary tract infections [1]. As a cortical agent, [^{99m}Tc]Tc-DMSA is mostly excreted through renal pathways, predominantly via peri-tubular uptake due to its high protein binding, with significantly less excretion occurring through glomerular filtration [2, 3]. Consequently, the occasional retention of tracer activity in the renal collecting system may interfere with the calculation of split renal function. From an alternative perspective, its excretion in urine may assist in identifying ureteral dilation or abnormal bladder morphology, thereby providing additional information to enhance the differential diagnosis. Abnormal bladder morphology may indicate the presence of conditions such as neurogenic bladder, vesicoureteral reflux, or obstruction [4]. Neurogenic bladder can be classified as either congenital or acquired. Acquired neurogenic bladder may result from conditions such as diabetes mellitus, multiple sclerosis, herniated lumbar disc, herpes zoster, stroke, and so on [5]. Given these differential diagnoses, the abnormal bladder shape observed in renal scintigraphy is of utmost significance in uncovering previously undiagnosed etiologies. Moreover, extra-renal uptake of [^{99m}Tc]Tc-DMSA is a rare occurrence. Increased uptake of [^{99m}Tc]Tc-DMSA has been documented in cases of bone metastases [6, 7], infantile hemangioma [8], and splenic amyloidosis [9]. Additionally, elevated uptake of [^{99m}Tc]Tc-DMSA is noted in hyper-vascular tissues and tumoral lesions, particularly in cases of renal failure [10]. An important consideration is to distinguish the causes of extrarenal uptake from commonly observed physiological uptakes, such as those in the bladder, in order to prevent misinterpretation.

The enhanced uptake of various radiopharmaceuticals in the uterus is attributed to increased blood flow and blood pooling as well as active uptake of the radiotracer by the

endometrium during the secretory phase of the normal menstrual cycle, and in cases of significant uterine muscular hyperplasia, such as during pregnancy [11]. It is essential to identify the uptake of radiopharmaceuticals in both the normal and gravid uterus and to distinguish it from pathological conditions, including adenomyosis and malignant tumors of the uterus [12, 13]. In this case, the uterine uptake appears to be attributable to congestion and the hyper-vascular nature of the uterine, particularly during the premenstrual period [14]. Initially, the planar images raised concerns for a refluxing ureter [4] and a neurogenic bladder, presenting a challenging scenario that was effectively clarified through delayed post-void images and finally was confirmed via SPECT/CT imaging.

In fact, SPECT/CT imaging not only offers a more precise assessment of renal differential function but also enhances the specificity of planar image findings through the use of a low-dose CT scan, particularly in cases where the patient has not undergone a prior ultrasound evaluation [15]. The incremental value of [^{99m}Tc]Tc-DMSA SPECT/CT in the assessment of renal masses and atypical kidney locations is increasingly recognized [16, 17]. Importantly, this evaluation can also elucidate [^{99m}Tc]Tc-DMSA uptake in areas beyond the kidneys, providing additional insights, such as the identification of an enterovesical fistula, or avoiding misinterpretation, as demonstrated in our case [18].

It is noteworthy that as the application of artificial intelligence (AI) in the interpretation of nuclear scans continues to grow, awareness and understanding of these false-positive uptakes can enhance deep learning analyses of [^{99m}Tc]Tc-DMSA renal scans [19].

CONCLUSION

It is essential to consider uptake of [^{99m}Tc]Tc-DMSA in the uterus during the premenstrual period in female patients for accurate interpretation of renal scans. Recognizing this physiological phenomenon can enhance diagnostic confidence, reducing the need for additional testing and minimizing radiation exposure. This approach ultimately enhances patient comfort and care.

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