# RENAL CORTICAL SCINTIGRAPHY IN THE ASSESSMENT OF ACUTE PYELONEPHRITIS IN CHILDREN

**Ashoke Kumar Paul,[1] Choudhury Habibur Rasul[2]**

## ABSTRACT

Acute pyelonephritis is a major cause of morbidity in children with urinary tract infection and can result in irreversible renal scarring leading to hypertension and end-staged renal disease. Tc-99m-dimercaptosuccinic acid (DMSA) scintigraphy is the imaging modality of choice for the detection of acute pyelonephritis and renal scarring. Forty-nine children (ages ranging from 9 months to 11 years) with urinary tract infection, having positive urine culture, were studied. A DMSA scan was performed within 72 hours of receiving antibiotic during acute infection. Follow-up scintigraphy was done at 6 months of initial scan in children with acute pyelonephritis documented by DMSA scan. Scintigraphy showed changes consistent with acute pyelonephritis in 27 (55.10%) children and the abnormalities were bilateral in 17 (63%) cases and unilateral in 10(37%) cases. Among these 44 abnormal kidneys, scintigraphy demonstrated solitary defect in 29 kidneys, multiple defects in 6 kidneys and diffused decreased uptake in 9 kidneys. Twenty children (34 kidneys) were available for follow-up evaluation and scintigraphy showed complete recovery in 21 of 34 (62%) kidneys and renal scarring in 13 of 34 (38%) kidneys. Renal scarring was found in 5 of 7 kidneys (71%) with diffuse decreased uptake, 2 of 5 kidneys (40%) with multiple cortical defect and 6 of 22 (27%) with single focal defect. From the study, it is observed that the scintigraphic pattern of acute pyelonephritis might be helpful to assess the risk of renal damage due to scarring following acute pyelonephritis.

**Key words:** Tc-99m-DMSA scintigraphy; children; acute pyelonephritis, renal scar

## INTRODUCTION

Renal cortical scintigraphy is used for the detection of acute pyelonephritis and renal scarring in children with urinary tract infection. The commonly used clinical and laboratory parameters are not reliable for the diagnosis of acute pyelonephritis. Several imaging techniques have been evaluated for the detection of renal parenchymal infection. Studies have shown that cortical scintigraphy is able to detect twice as many defects as ultrasonography and four times as many defects as intravenous urography.[1,2] Computed tomography has a similar sensitivity and specificity for the detection of acute pyelonephritis to cortical scintigraphy, but is more expensive and has a higher radiation exposure.[3,4] Acute pyelonephritis in childhood can result in renal scarring leading to hypertension and chronic renal failure. We have carried out this prospective study to evaluate the importance of renal cortical scintigraphy to identify children at risk from renal damage due to acute pyelonephritis.

[1] Ashoke Kumar Paul MBBS, DNM Senior Medical Officer Centre for Nuclear Medicine and Ultrasound, Khulna Bangladesh
[2] Choudhury Habibur Rasul Associate Professor Department of Paediatrics Khulna Medical College Hospital Bangladesh
**Corresponding address:** Dr. Ashoke Kumar Paul Principal Medical Officer Centre for Nuclear Medicine and Ultrasound, Khulna G.P.O. Box # 12, Khulna-9000 Bangladesh **E-mail<akpaul19@yahoo.com>**

## MATERIALS AND METHODS

Children with clinical symptoms of urinary tract infection and positive urine culture who were referred to us from paediatric unit, Khulna Medical College Hospital for imaging studies were evaluated. Urine culture was regarded as positive when there is a growth of single organism with a colony count of more than 105/ml on a clean catch specimen. All children had sonography to rule out abscess and obstruction. Children with known renal tract abnormalities were excluded from the study.

Renal cortical scintigraphy was performed within 72 hours of receiving antibiotic during acute infection. At our centre, we routinely image the kidneys 2 to 3 hours after intravenous injection of Tc-99m-DMSA in a dose of 50 μCi/kg body weight. Planar images of posterior and posterior-oblique views were obtained in a Siemens 37 Digitrac Basicam Gamma Camera with a high-resolution parallel-hole collimator for 500 Kcounts using a 256x256 matrix. Single or multiple areas of diminished cortical uptake with preservation of renal outline or diffuse decreased uptake in an enlarged kidney was considered for the diagnosis of acute pyelonephritis.

Follow-up scintigraphy was done at 6 months of initial scan in children with acute pyelonephritis documented by DMSA scan. Renal scarring was considered if the affected kidney shows cortical thinning or focal cortical defect with loss of volume or become small kidney.

## RESULTS

A total of 49 children were evaluated of whom 34 were girls and 15 were boys and age ranged from 9 months to 11 years. The organism isolated from the urine culture were Escherichia coli in 48 cases and staphylococcus in one. Scintigraphy showed changes consistent with acute pyelonephritis in 27(55.10%) children. The abnormality was bilateral in 17(63%) and unilateral in 10(37%) patients. Among these total 44 abnormal kidneys, scintigraphy demonstrated solitary cortical defect in 29(65.91%) kidneys of which 13 defects were in the upper pole, 11 were in the lower pole and 5 in the mid zone, multiple defects in 6(13.64%) kidneys and diffuse decreased uptake in 9(20.45%) kidneys (Figure.1.).

Of the 27 children with abnormal DMSA scan, 20(34 kidneys) were available for follow-up evaluation. Follow-up scintigraphy showed complete recovery in 21 of 34(61.76%) kidneys and renal scarring in 13 of 34(38.24%) kidneys. Initial and Follow-up scan appearances of these 34 kidneys are shown in Table-I. Renal scarring were found to develop in 5 of 7 kidneys (71%) with diffuse decreased uptake, 2 of 5 kidneys (40%) with multiple cortical defect (Figure.2.) and 6 of 22 (27%) with solitary defect.

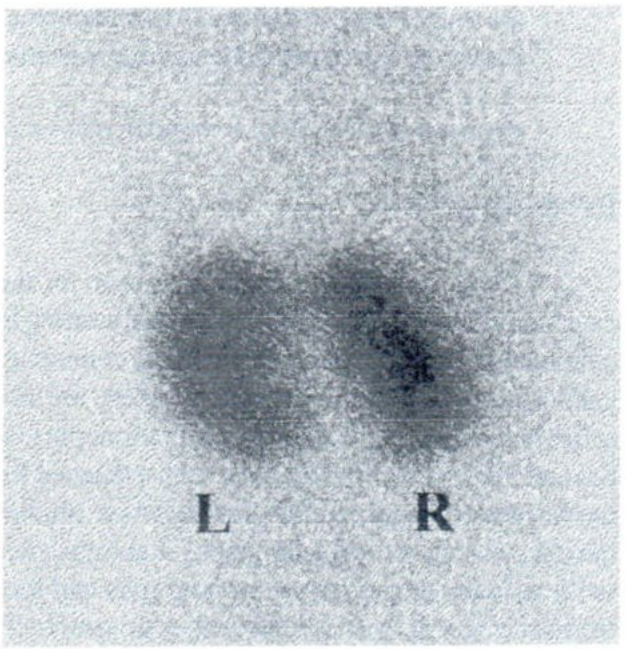


**Fig.1** Acute pyelonephritis in left kidney (L) in a 5 years old boy showing diffuse decreased uptake of isotope. Right kidney (R) is normal.

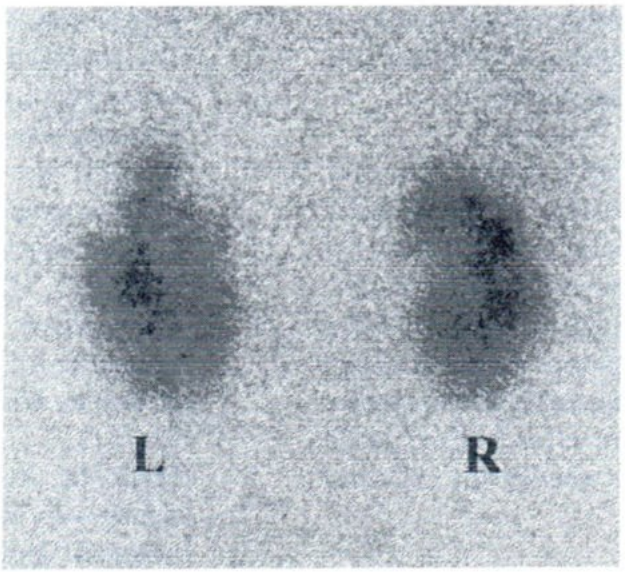


**Fig.2** Follow-up scintigraphy 6 months after acute infection in a 9 years old girl showing multifocal scars in upper pole of left kidney (L). Right kidney (R) is normal. During acute infection uptake defect was observed in each pole of left kidney.

**Table-I** Results of follow-up scintigraphy

| Scintigraphic findings | Initial scan | Follow-up scan | |
|---|---|---|---|
| | | Normal | Scar |
| Solitary cortical defect | 22 | 16 | 6 |
| Multiple cortical defect | 5 | 3 | 2 |
| Diffuse decreased uptake | 7 | 2 | 5 |
| Total | 34 | 21 | 13 |

## DISCUSSION

Renal scarring from acute pyelonephritis is an important cause of chronic renal failure in the pediatric population. Studies have shown that renal cortical scintigraphy using Tc-99m-DMSA is a highly sensitive and reliable technique for the detection of acute pyelonephritis and post-infection scarring.[5,6] It can detect the site and the extent of acute infection, which is helpful for the management of these patients. In our study, DMSA scan showing changes consistent with acute pyelonephritis were found in 55.10 % of the children. This is lower to other reports.[7,8] Here in our study, cortical imaging were done using parallel hole collimator that may not be able to detect smaller cortical defect. Of the DMSA abnormalities, unifocal

lesion showed highest incidence and the majority of these lesions occur in the upper or lower poles. This finding is consistent with other studies.[5]

Follow-up DMSA study were performed at six months of initial scan as healing of the acute lesion usually occur within this time.[9] Scars were seen in 38.24% of the acute lesions in our study population, which were close to other studies.[10] Recent studies reported that once acute pyelonephritis has occurred, ultimate renal scarring is independent of the presence or absence of vesicoureteral reflux.[2,10] Here, in the study, we do not consider whether the child has vesicoureteral reflux or not.

Renal scars developed more in kidneys with diffuse parenchymal involvement followed by multiple cortical lesions and solitary cortical defect in this study population. This is in good agreement with other study.[11] From the observation, it may be assumed that, children with diffuse parenchymal abnormalities at the time of acute infection has more chances to develop scars than that of multiple or single cortical lesion.

## CONCLUSION

Tc-99m-DMSA renal cortical scintigraphy is a simple, safe and noninvasive imaging modality for the detection, localization and follow-up of acute pyelonephritis. The DMSA renal scan findings at the time of acute pyelonephritis may predict which kidneys are at risk for renal damage due to subsequent renal scarring.

## REFERENCES


1. Jakobsson B, Nolstedt L, Svensson L, et al. Technitum-99m-dimercatosuccinic acid scan in the diagnosis of acute pyelonephritis in chil dren: relation to clinical and radiological findings. Pediatr Nephrol 1992; 6: 328-334
2. Kass EJ, Fink-Bennett D, Cacciarelli AA, et al. The sensitivity of renal scintigraphy and sonography in detecting nonobstructive acute pyelonephritis. J Urol 1992; 148: 606-608
3. June CH, Browning MD, Smith LP, et al. Ultrasonography and computed tomography in severe urinary tract infection. Arch Intern Med 1985; 145: 841-845
4. Montgomery P, Kuhn JP, Afshani E. CT evaluation of severe renal inflammatory disease in children. Pediatr Radiol 1987; 17: 216-222
5. Majid M, Rushton HG. Renal cortical scintigraphy in the diagnosis of acute pyelonephritis. Semin Nucl Med 1992; 22: 98-111
6. Handmaker H. Nuclear renal imaging in acute pyelonephritis. Semin Nucl Med 1982; 12: 245-253
7. Bjorgvinsson E, Majid M, Eggli KD. Diagnosis of acute pyelonephritis in children: Comparison of sonography and 99m Tc-DMSA scintigraphy. AJR 1991; 157: 539-543
8. Rosenberg AR, Rossleigh MA, Brydon MP, et al. Evaluation of acute urinary tract infection in children by dimercaptosuccinic acid scintigraphy: A prospective study. J Urol 1992; 148; 1746-1749.
9. Eggli DF, Tulchinsky M. Scintigraphic evaluation of pediatric urinary tract infection. Semin Nucl Med 1993; 23: 199-218.
10. Rushton HG, Majid M, Jantausch B, et al. Renal scarring following reflux and nonreflux pyelonephritis in children: Evaluation with 99mTechnetium-dimercaptosuccinic acid scintigraphy. J Urol 1992; 147: 1327-1332.
11. Orellana P, Baquedano P, Cavagnaro F,et al. Can acute renal scintigraphy abnormalities predict the evolution of renal damage in children with pyelonephritis? WJNM 2002; 1: 145.