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A Prospective Study of Ct Imaging In Pyelonephritis in a Tertiary Care Hospital

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Abstract
Introduction: *Acute pyelonephritis is define as a renal inflammation, most commonly occurs in female population age group between 15-40 years. Most of times, the diagnosis of APN is made by clinical and laboratory tests. Various imaging technique are available to diagnose the renal inflammation cases. Computed tomography imaging provides better management of such cases because of its high sensitivity and specificity.*
Materials and Methods: *This is a prospective study over a period of 1 year from January 2019 to December 2019. A total of 30 patients were analysed retrospectively at the Department of Radiology, AJ Institute of Medical Sciences, and Mangalore. All patients who are referred to the department of Radiodiagnosis for Computed Tomography (CT) scan with clinical suspicion/ diagnosis of acute pyelonephritis were consecutively inducted into the study after receiving informed consent.*
Results: *Thirty patients were evaluated, whose age group ranged from 13 to 80 years, out of which 15 (50%) were males and 15 (50%) were females. The highest incidence of acute pyelonephritis in the study was found in 41-50 years' age group accounting for 32% of cases and least was seen in age group of 31-40 years constituting 0%.*
Conclusion: *CT is the imaging modality of choice for the diagnosis of acute pyelonephritis and its associated complications due to its wide availability and accurate depiction of the features, extent and severity of the disease. The incidence of pyelonephritis and its complications had a strong association with the presence of diabetes mellitus in patients and as such careful evaluation of these patients is required to reduce the risk of complications in such patients. CT plays a critical role in patient management by suggesting the correct diagnosis based on characteristic imaging findings, identifying the complications especially in critically ill patients and reducing the morbidity and mortality by immediate percutaneous nephrostomy or nephrectomy in cases of complications of pyelonephritis.*
Key Words: *Acute pyelonephritis, CT, nephrostomy, sensitivity, specificity.*

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I. Introduction

Acute pyelonephritis is define as a renal inflammation, most commonly occurs in female population age group between 15-40 years. Most of times, the diagnosis of APN is made by clinical and laboratory tests. Various imaging technique are available to diagnose the renal inflammation cases. Computed tomography imaging provides better management of such cases because of its high sensitivity and specificity. But its routine use is hindered by the risk of radiation exposure and allergic reactions and nephrotoxic risks due to contrast. Thus its utilization is basically restricted to cases of suspicion of complications, patients with an unfavorable clinical progression or in functional or morphological alteration of the urinary tract.[1]

Infection may also spread to the kidney by the hematogenous route and in such cases of hematogenous seeding as a result of of a septic localization in a patient with septicaemia, the most common pathogens involved are Staphylococci and Escherichia coli. The estimated annual incidence of pyelonephritis is 10.5 million to 25.9 million cases globally.[2]

Acute pyelonephritis is suggested by the constellation of fever, flank pain (typically unilateral), nausea and vomiting, and costovertebral angle tenderness.[3] Complaints typical of lower urinary tract infections such as dysuria and urinary frequency are variably present. The severity of symptoms ranges from a mild pyrexia illness to life-threatening sepsis. Laboratory findings may include pyuria, leucocyte casts, bacteriuria and a positive urine culture. Blood tests may show leukocytosis with a neutrophilic shift, elevated erythrocyte sedimentation rate, elevated C-reactive protein levels, and occasionally positive blood cultures that grow the same organism as cultured from the urine.[4,5]

II. Materials And Methods

This is a prospective study over a period of 1 year from January 2019 to December 2019. A total of 30 patients were analysed retrospectively at the Department of Radiology, AJ Institute of Medical Sciences, and Mangalore. All patients who are referred to the department of Radiodiagnosis for Computed Tomography (CT) scan with clinical suspicion/ diagnosis of acute pyelonephritis were consecutively inducted into the study after receiving informed consent. In this study, the diagnosis of PN was based on clinical and radiological criteria as explained below.

Clinical criteria were the presence of classical triad of PN i.e., fever with chills and rigor; presence of flank pain and pyuria. Radiological diagnosis of PN was made when CT abdomen showed evidence of infection of renal parenchyma, in the form of bulky kidney, compression of renal sinus, perinephric fat stranding, abscess and emphysematous changes.

Inclusion Criteria

The study included –

1. Patients with clinical features such as fever with chills, flank pain, nausea, vomiting, costovertebral angle tenderness.
2. Patients with laboratory findings such as pyuria, bacteriuria, leucocytosis, and positive urine culture.
3. Patients who needed computed tomography scan as a further investigation to rule out complications.

Exclusion Criteria

The study excluded the patients –

1. With history of chronic kidney disease whose serum creatinine values more than 1.2 md/dl.
2. In whom contrast medium was contraindicated such as those who were allergic to the contrast medium.
3. Pregnant females.
4. Who didn't give consent for the study.

Imaging was performed on the Toshiba Alexion CT scan machine and sections from above the level of Diaphragm to Pubic symphysis. Plain study was first performed and Intravenous contrast at the rate of 4 ml/sec was injected to have the Corticomedullary (20-45 sec.) and Nephrogram (60-100 sec) phases. Delayed (Excretory/Urogram) phase (5-15 min.) were performed as needed. The images were analysed by the research person/radiologist blinded to the clinical details and laboratory details.

Unenhanced CT was first used to identify calculi, haemorrhage, renal enlargement, inflammatory masses, wall calcifications and dilatation of collecting system. Calculi are seen as hyperdense foci of calcific densities. Once calculi were detected; number, size and location of the calculi were recorded. Presence or absence of renal enlargement, attenuation of the renal parenchyma, dilation of pelvicalyceal system and/or ureter were recorded. If the collecting system was dilated, the source of obstruction in the pelvicalyceal system and/or ureter as to the presence or absence of any calculi or soft tissue density lesions within the collecting system were evaluated.

Contrast enhanced CT was then used to detect wedge shaped Hypodensities, intrarenal abscesses and alternate striations of hypodensities. Other findings such as renal enlargement, perinephric fat stranding and thickening of Gerota's fascia were also evaluated on both plain and contrast enhanced CT scans. Presence of complications such as renal and/or perirenal abscesses, and the presence of gas were also identified. If abscesses were identified, then the number, size, location, internal characteristics, enhancement pattern, presence of air-fluid level or air foci within and around the abscesses were recorded. If air foci were identified, then the location, extent and spread of the air foci are recorded.

Pyelonephritis was classified into a) unilateral (right/left kidney or bilateral, b) focal or diffuse, c) with or without nephromegaly, and d) uncomplicated or complicated, based on different age groups and gender.

Reference Standard

The reference standard was clinical, urological and laboratory correlation.

Statistical Analysis

Descriptive statistics with percentages and proportions of the CT features of acute pyelonephritis and its associated complications were generated for the study patients according to-

- Age and sex.
- Gender.
- Presenting complaints.
- Diabetes mellitus.
- Urine examination.
- Urine culture.

- Unilateral/ bilateral involvement of kidneys.
- If unilateral, right or left kidney.
- Renal enlargement/ Bulky kidneys.
- Perinephric fat stranding/ thickening of perirenal fasciae or lateroconal fascia.
- Calculi.
- Dilation of pelvicalyceal system.
- Presence of focal or diffuse hypo enhancing areas within renal parenchyma.
- Paraaortic lymph nodes at the level of renal hila.
- Renal/ Perirenal abscesses.
- Air foci within renal parenchyma, collecting system or in the perirenal area – Emphysematous pyelonephritis.

III. Results

Thirty patients were evaluated, whose age group ranged from 13 to 80 years, out of which 15 (50%) were males and 15 (50%) were females. The highest incidence of acute pyelonephritis in the study was found in 41-50 years' age group accounting for 32% of cases and least was seen in age group of 31-40 years constituting 0%.

This differed from the literature wherein acute pyelonephritis was more common in males than in females due to increased incidence of obstructive pathologies including benign prostatic hyperplasia.

Fever with chills and flank pain were the most common presenting complaints. Other symptoms included nausea and vomiting and urinary symptoms such as dysuria. Unilateral pyelonephritis was seen in 92%, while 4 cases (8%) had bilateral pyelonephritis.

In this study, 20 patients (64%) were found to be diabetic and 10 patients (36%) were non diabetic. As was previously described by Yadla M et al, our findings also coincided with the fact that the incidence of pyelonephritis and its complication was almost twice in diabetics compared to non-diabetics. Hence, proper control of diabetes is essential to reduce the morbidity and mortality associated with pyelonephritis.

This study found that all patients with clinically suspected pyelonephritis had pyuria that is above the normal threshold. Out of the 20 cases with urine culture results, 17 cases (69%) had Escherichia coli infection. 3 cases (15%) had urine cultures positive for Klebsiella organisms. All these cases were diabetic and were associated with complications of pyelonephritis. These findings reiterate the results from literature that showed Klebsiella infection is more common in diabetics and is associated with increased rate of pyelonephritis associated complications such emphysematous pyelonephritis. Of the remaining 6 cases, 4 (10%) cases showed Candida positive 61 cultures and 2 (5%) cases showed polymicrobial growth with predominant Enterococcus infection. The findings in this study were similar to the results obtained by Bailey BL et al who studied the urine culture results of upper and lower urinary tract infections.

	No of cases	Extent of disease
Class 1	4	Collecting system
Class 1I	3	Renal parenchyma
Class 1II	1	Perirenal Extension
Class 1V	1	Bilateral

Table 1: Distribution of Cases of Emphysematous Pyelonephritis by Class

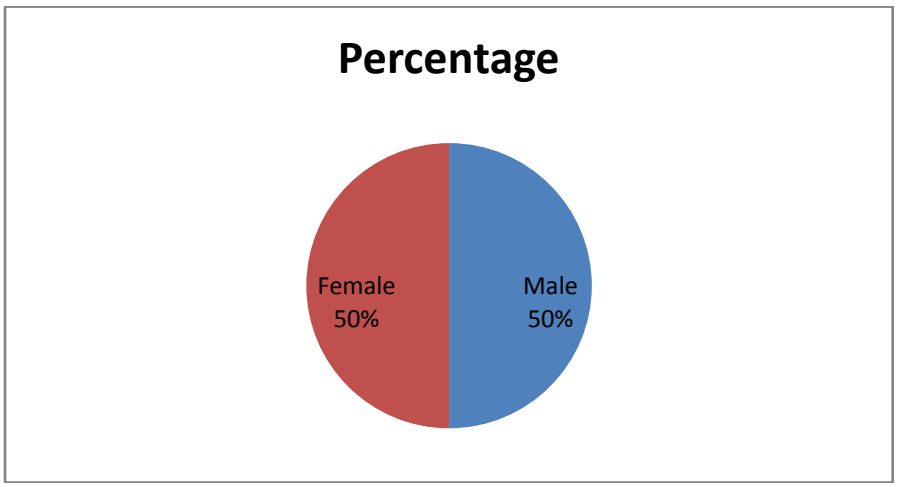

Figure 1: Pie Chart Representing Gender Distribution

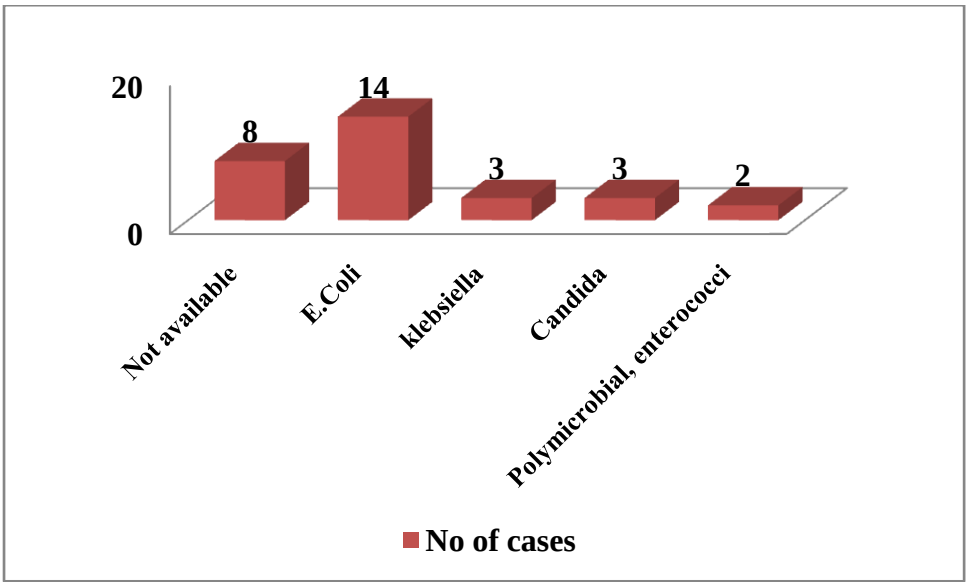

Figure 2: Columns Representing Results of Urine Culture Studies

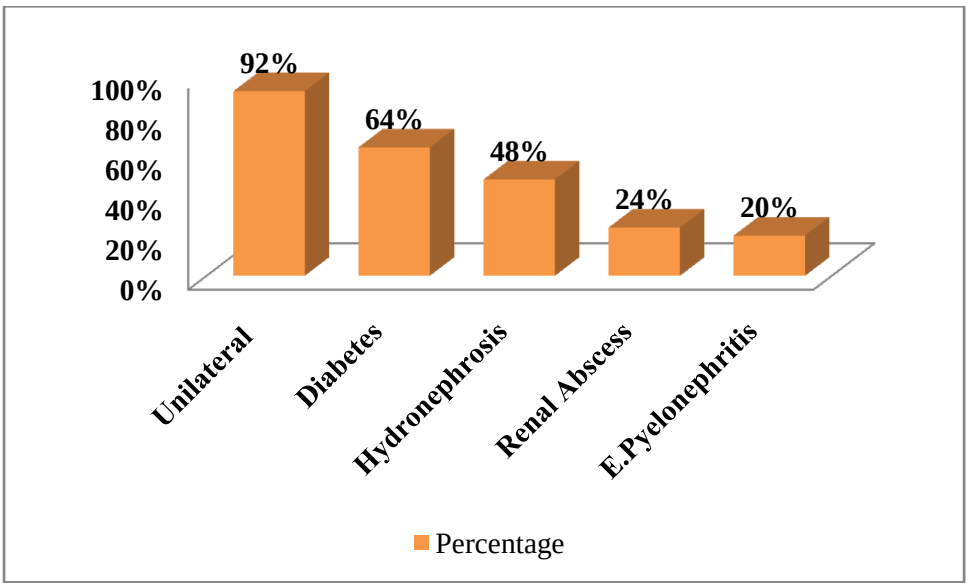

Figure 3: Distribution of Pyelonephritis

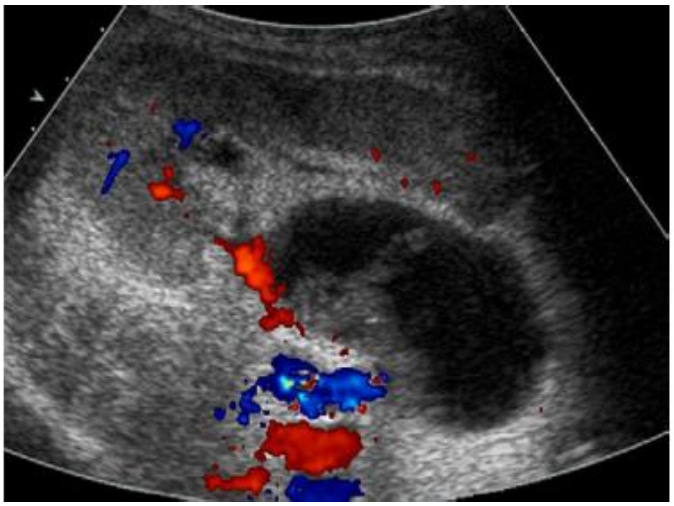

Figure 4: Ultrasound Image Showing Dilated Pelvis with Internal Echogenic Material Suggestive of Pyonephrosis

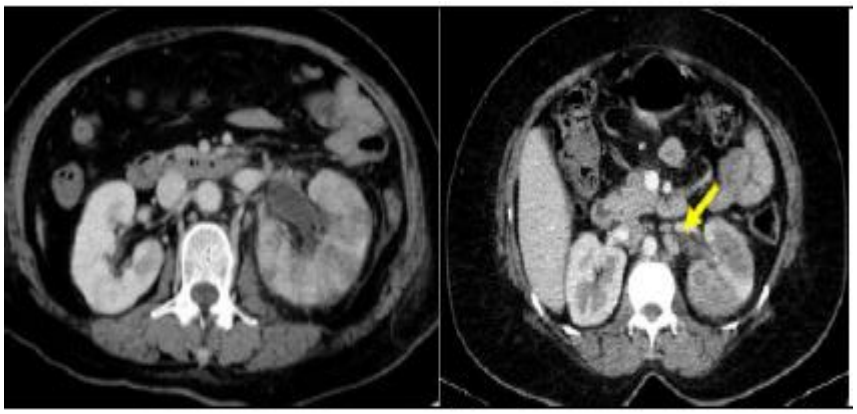

Figure 5: Axial CECT Images (A, B) Shows Features of Acute Pyelonephritis of Left Kidney: Renal Swelling, Heterogenous Hypoenhancing Renal Parenchyma, Perinephric Fat Stranding, Thickening of Perirenal Fasciae, Hydronephrosis and Urothelial Thickening and Enhancement. An Enlarged Paraaortic Lymph Node (Yellow Arrow) at The Level of Left Renal Hilum is Noted (B)

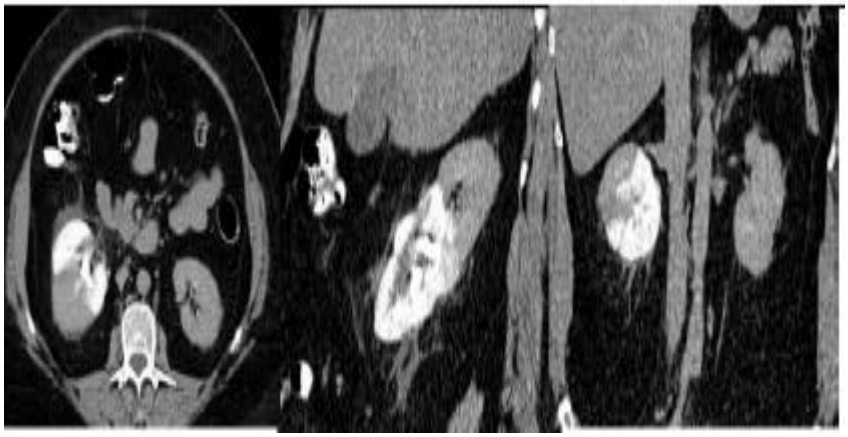

Figure 6: Axial, Sagittal, Coronal CECT Image Shows Features of Acute Pyelonephritis of Right Kidney: Renal Swelling, Focal Hypo Enhancing Renal Parenchyma, Perinephric Fat Stranding

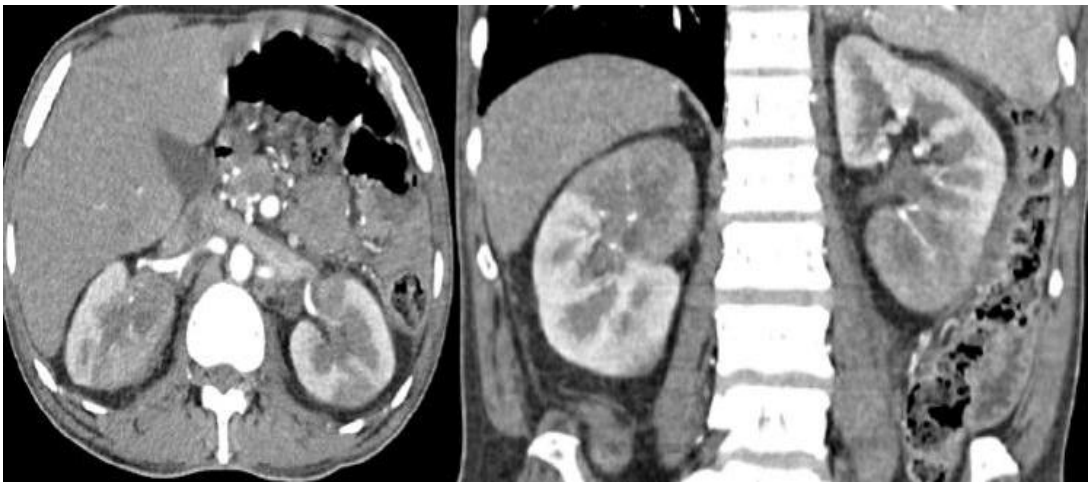

Figure 7: Axial and Coronal CECT Abdomen of a 45-Year-Old Male Patient Shows Mildly Enlarged Bilateral Kidneys with Focal Wedge- Shaped Hypo Enhancing Areas with Striated Pattern in Both Kidneys. There is Bilateral Thin Rim of Perinephric Fluid Collection. Features Suggestive of Bilateral Acute Pyelonephritis

Figure 8: Axial CECT Image Shows a FOCAL Rounded Area of Decreased Attenuation with Peripheral Rim Enhancement, Suggestive of Renal Abscess

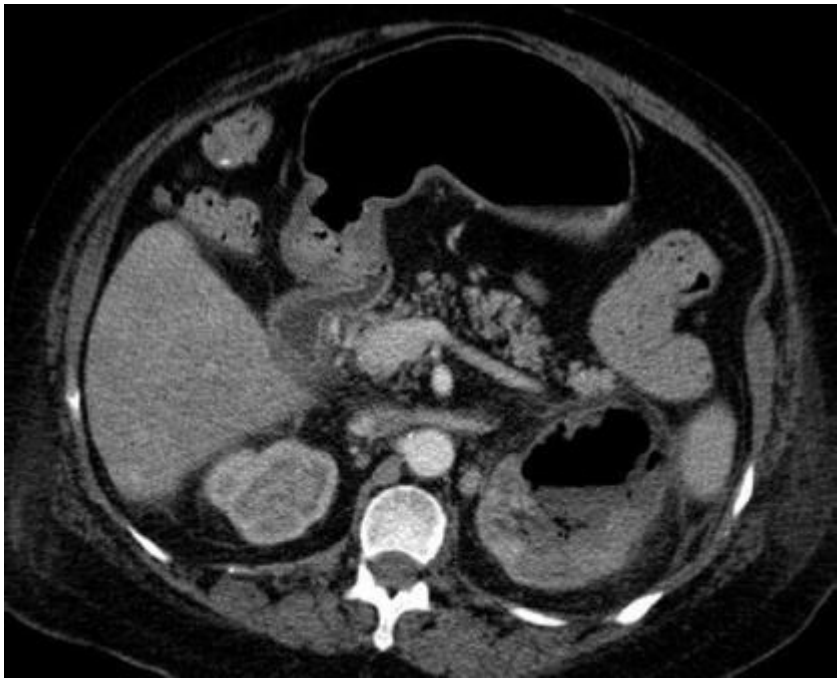

Figure 9: Axial CECT Image Shows Emphysematous Pyelonephritis of Left Kidney

Figure 10: Axial images of CECT Abdomen of a 51-Year-Old Female Patient Showing Enlarged Right Kidney with Heterogeneous Hypoenhanement, Air Foci within Renal Collecting System. There is a Non-Enhancing Hypodense Lesion with Peripheral Enhancement and Internal Air Fluid Level in the Upper Pole Causing Compression of the Kidney. Features Suggestive of Right Emphysematous Pyelonephritis with Renal Abscess

IV. Discussion

CT imaging is a non-invasive, multiplanar and highly accurate method with better inherent contrast that demonstrates the features of acute pyelonephritis and its complications accurately. This was a prospective observational study done aimed at studying the CT findings of acute pyelonephritis and its complications. In the present study for the same, we evaluated 30 patients.[6]

Acute Pyelonephritis

Acute pyelonephritis is defined as an infection of the upper urinary tract, specifically the renal parenchyma and renal pelvis. Non-enhanced CT may appear normal or show subtle changes in the presence of pyelonephritis. Therefore, contrast enhanced scans should be performed following the unenhanced scan.[7]

The recommended phases of CT scan for evaluating renal infections are a non-contrast scan, Corticomedullary (20-45 sec.), Nephrogram (60-100 sec) phases and delayed (Excretory/Urogram) phase (5-15 min.) if there is obstruction.[8]

Acute bacterial nephritis most commonly manifests as one or more wedge-shaped areas of decreased attenuation or a hypodense mass.[9]

These areas of focal hypoattenuation are also seen in tumours, renal infarcts, scarring and in medullary sponge kidney. However, in these scenarios, the hypoattenuating areas persist even after antibiotic therapy, whereas in acute pyelonephritis, the areas show resolution.

Pyonephrosis

Pyonephrosis is an infected and obstructed collecting system, which frequently is enlarged. Pyonephrosis should be suspected in any patient with a known urinary tract obstruction and accompanying fever and flank pain. CT demonstrates thickening of the renal pelvic wall (>2 mm), parenchymal or perinephric inflammatory changes, dilatation and obstruction of the collecting system, higher than usual attenuation values of the fluid within the renal collecting system, and layering of contrast material above and anterior to the purulent fluid on excretory studies.[10]

V. Conclusion

CT is the imaging modality of choice for the diagnosis of acute pyelonephritis and its associated complications due to its wide availability and accurate depiction of the features, extent and severity of the disease. The incidence of pyelonephritis and its complications had a strong association with the presence of diabetes mellitus in patients and as such careful evaluation of these patients is required to reduce the risk of complications in such patients. CT plays a critical role in patient management by suggesting the correct diagnosis based on characteristic imaging findings, identifying the complications especially in critically ill

patients and reducing the morbidity and mortality by immediate percutaneous nephrostomy or nephrectomy in cases of complications of pyelonephritis.

References

[1]. Gold RP, McClennan BL. Acute infections of renal parenchyma. In: Pollack HM, editor. Clinical urography. 2nd ed. Philadelphia, PA: Saunders, 1990 (5);799–821.
[2]. Papanicolaou N, Pfister RC. Acute renal infections. Radiol Clin North Am 1996; 34 (2):965–995.
[3]. D'Ippolito G, Abreu Jr L, Borri ML, Galvão Filho MM, Hartmann LGC, Wolosker AMB. Pielonefrite aguda: classificação, nomenclatura e diagnóstico por imagem. Rev Imagem 2005;27 (4): 183–194.
[4]. Stunell H, Buckley O, Feeney J, Geoghegan T, Browne RF, Torreggiani WC. Imaging of acute pyelonephritis in the adult. Eur Radiol 2007;17 (6): 1820–1828.
[5]. Ramakrishnan K, Scheid DC. Diagnosis and management of acute pyelonephritis in adults. Am Fam Physician 2005;71(1):933-42.
[6]. Lim SK, Ng FC. Acute pyelonephritis and renal abscesses in adults – Correlating clinical parameters with radiological (computer tomography) severity. Ann Acad Med Singapore 2011;40(5):407-13.
[7]. Zissin R, Osadchy A, Gayer G, Kitay-Cohen Y. Extrarenal manifestations of severe acute pyelonephritis: CT findings in 21 cases. Emerg Radiol 2006 (2);13:73–77.
[8]. Chen KC, Hung SW, Seow VK, Chong CF, Wang TL, Li YC, et al. The role of emergency ultrasound for evaluating acute pyelonephritis in the ED. Am J Emerg Med 2011;29 (3):721-4.
[9]. Shubhanker Mitra, Harshdeep Acharya et al. Role of emergency ultrasound screening in the management of acute pyelonephritis in emergency department: A large observational study from a tertiary care center of South India. Journal of Medical Society. 2017; 31(1).
[10]. Lim SK, Ng FC. Acute pyelonephritis and renal abscesses in adults – Correlating clinical parameters with radiological (computer tomography) severity. Ann Acad Med Singapore 2011;40(5):407-13.

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