DEFINITION

1. Pyelonephritis is an infection of the kidney. Pyelitis signifies involvement of the pelvis and calyces, which together form the irregularly shaped vessel leading to the ureters. Nephritis is infection of the parenchyma - the actual renal tissue. Pyelonephritis may be acute or chronic and may involve one or both kidneys and is classified as upper urinary tract infection.

2. Cystitis is an infection of the urinary bladder, which may occur alone or in association with pyelonephritis. The term's pyelo-nephro-cystitis and pyelo-cystitis are sometimes used but, where there is pyelitis, it is improbable that the renal tissue can be entirely unaffected. Together with prostatitis (see separate Appendix) and urethritis, cystitis is classified as a lower urinary tract infection.

ACUTE PYELONEPHRITIS

CLINICAL MANIFESTATIONS

3. Loin pain and fever are the classic symptoms, often accompanied by nausea and vomiting, sometimes with blood in the urine (haematuria). There is often extreme tenderness of the kidneys. Their may be preceding or accompanying bladder symptoms of frequency and dysuria (painful voiding) and many patients have a history of cystitis over the preceding 6 months.

4. Pyelonephritis sometimes occurs without characteristic symptoms, and may even to be asymptomatic. Coexisting diabetes, pregnancy and immunosuppression end to mask symptoms, while obstruction to the flow of urine or pre-existing damage exacerbates acute symptoms.

5. Laboratory evidence of infection includes pyuria (pus cells in the urine) and bacteriuria (bacteria in the urine). When haematuria is not obvious, chemical tests or microscopy may confirm the presence of red blood cells.

6. In the absence of complicating factors, i.e. in about 90% of cases, acute pyelonephritis responds well to antimicrobial treatment and heals without significant scarring and without impairment of renal function.

7. Possible complications include:

    7.1. Renal papillary necrosis may result from severe infection, particularly in the presence of diabetes or obstructive uropathy. The patient presents with continuing severe loin pain, fever and rigors. Papillary material is found in the urine and there is a characteristic radiological appearance.

    7.2. Very severe infection, with or without papillary necrosis, can result in focal or multifocal infection within the kidney. This is called acute bacterial interstitial nephritis and it may lead to abscess formation.

8. Perinephric abscess may form by direct spread from the renal parenchyma. These abscesses can develop insidiously and may be very large before definite clinical signs appear. Fever, loin pain and malaise persisting after the appropriate treatment of acute pyelonephritis suggest the presence of a perinephric abscess. The urine contains pus cells but may be sterile.

9. Bacteraemia is another possible complication. It is estimated that 15-20% of all cases of bacteraemia originate from urinary tract infection. Metastatic spread is most likely to infect bone, but is a rare event.

10. Xanthogranulomatous pyelonephritis is a rare condition resulting from chronic recurrent infection. Most cases occur in elderly women. Proteus is the commonest agent but other bacteria may be involved. The kidney is enlarged with abscess formation and the perirenal fat is inflamed.

11. Acute renal failure is uncommon in pyelonephritis. When it does occur, it is likely to be associated with pre-existing renal impairment, alcoholism and/or one or more of the aforementioned complications.

12. Renal cortical abscess (forming alone on the outer layer of the renal parenchyma) is not a complication of pyelonephritis, but is a result of blood-borne infection from elsewhere in the body.

13. The prevalance of hypertension in patients who have had uncomplicated urinary infection is the same as that in the general population.

AETIOLOGY

14. Acute pyelonephritis is most commonly due to infection by *E. Coli* and other coliforms (80% of all cases). Other causal organisms include proteus, staphylococci (more often in women), klebsiella, enterococci, pseudomonas and serratia.

15. The route of infection is by migration (ascent) of organisms from the exterior via the urethra and bladder. It is facilitated in women by sexual intercourse and the shortness of the urethra. In males, it is facilitated by poor general or preputial hygiene and homosexuals are at increased risk. Although theoretically possible, the role of blood-borne infection in causing pyelonephritis is, at present, no more than speculative.

16. Predisposing factors include vesico-ureteric reflux, diabetes mellitus, pre-existing renal disease, immunosuppression, stone formation, anatomic abnormality and any condition likely to delay or obstruct the normal flow of urine. Male gender, particularly in old age, carries a far greater risk of nearly all kinds of complication and it is therefore considered correct for clinical purposes to regard all male urinary infections as “complicated”.

17. Female gender is a major predisposing factor for the development of pyelonephritis. The predisposition is increased by the use of diaphragm contraceptives, probably because they alter the angle of the bladder neck and affect emptying. Both diaphragms and spermicides also encourage the growth of enterobacterial organisms. Women are also far more prone to ureteric reflux.

18. The condition may also arise following catheterisation, instrumentation of, or any operation on the urinary tract. Other than these and circumstances predisposing to stone formation by inadequate fluid intake and low-volume, concentrated urine (please see the Medical Appendix on urinary calculi), pyelonephritis does not arise from any environmental cause.

19. It is not known why some cases progress to the xanthogranulomatous condition.

CHRONIC PYELONEPHRITIS

20. Chronic pyelonephritis is traditionally regarded as a form of chronic interstitial nephritis resulting from long-standing or recurrent bacterial infection of the kidney. It may occur in the presence of urinary tract obstruction (obstructive chronic pyelonephritis) or it may occur without obstruction. It is sometimes unilateral.

21. It is estimated up to 20% of adults and 30% of children with end-stage chronic renal failure have chronic pyelonephritis. Patients with end-stage renal failure usually present late in the disease. In about 5% of all adult post mortem examinations, the kidneys show scarring due to chronic pyelonephritis, which has been, asymptomatic in most cases.

22. Despite the fact that urinary tract infection is at least ten times more common in women than in men, this post mortem finding is equally distributed between the sexes. This casts doubt on the actual relationship between infection and chronic pyelonephritis.

23. Leading authorities are now of the opinion that the major factor in most, if not all, cases of non-obstructive chronic pyelonephritis is likely to be the occurrence of vesico-ureteric and intra-renal reflux in childhood. One school of thought holds that this can cause nephropathy, even in the absence of infection.

CLINICAL MANIFESTATIONS

24. Chronic pyelonephritis is usually asymptomatic unless renal failure ensues. The commonest presentation is with raised blood pressure. The diagnosis is confirmed when renal scarring is identified radiologically, by ultrasonography or by renal biopsy. Renal epithelial cells and casts may be found in the urine. In adults, in the absence of obstructive uropathy, progressive renal damage is unlikely to occur if the blood pressure is appropriately controlled. Otherwise, further damage due to hypertension starts a vicious circle.

AETIOLOGY

25. Obstructive chronic pyelonephritis is related to physical obstruction of the urinary tract, the infection being secondary to the stasis of urine. Stasis is also a feature of neurogenic bladder, e.g. in paraplegia and is not, in itself, painful.

26. In the absence of obstruction, kidney damage due to ascending urinary tract infection occurs in young children in whom infection and vesico-ureteric reflux co-exist. In such cases intrarenal reflux carries infection into the renal parenchyma, the medulla (inner layer) of which is particularly vulnerable to damage. Intrarenal reflux only occurs in children under the age of four. Renal parenchymal damage and impairment of kidney growth are caused by a combination of infection, vescio-ureteric reflux and intrarenal reflux. Such damage does not usually cause renal failure in childhood or early adult life but may cause hypertension, which further compromises renal function. The propensity to vesico-ureteric reflux is believed to be genetically determined.

27. Renal scars due to chronic childhood pyelonephritis persist into adult life and themselves increase susceptibility to infection and raised blood pressure.

28. Chronic pyelonephritis is not caused by any environmental factor and the underlying disease process is not worsened by any such factor.

CYSTITIS

CLINICAL MANIFESTATIONS

29. The typical symptoms of cystitis include dysuria, frequency, urgency, voiding of small volumes of urine and suprapubic or mid-line lower abdominal pain. The urine may be foul smelling or cloudy and is visibly bloodstained in about 30% of cases.

30. The onset is usually abrupt, in contrast to urethritis due to sexually transmitted pathogens, which also cause dysuria but usually without the other symptoms characteristic of cystitis.

31. In the absence of factors such as anatomic abnormality, obstruction or neurological impairment of bladder emptying, treatment with an appropriate antibacterial agent is usually successful within a week.

AETIOLOGY

32. The infective organisms, route of entry and other aetiological factors are those involved in pyelonephritis.

CONCLUSION

33. Acute pyelonephritis, chronic pyelonephritis and cystitis are common conditions arising from spread of infection within the urinary tract. In chronic pyelonephritis the condition may arise as a complication of obstruction in the urinary tract or may have had its origin in childhood where physical obstruction was not present but where infection, vesico-ureteric reflux and intrarenal reflux were present. Except as mentioned in paragraph 13 above, there is no known evidence that pyelonephritis or cystitis are caused or worsened by any environmental factor.

REFERENCES

Asscher A W. Interstitial nephritis and urinary tract infections. In: (Eds) Weatherall D J, Ledingham J G G and Warrell D A. Oxford Textbook of Medicine. 2nd Ed. 1987. p18.75-18.77.

Bailey R R. In: (Eds) Weatherall D J, Ledingham J G G and Warrell D A. Oxford Textbook of Medicine. 3rd Ed. 1996. p3205-14 and 3214-20.

Cattell W R. In: (Eds) Davison A M, Cameron J S, Grünfeld J-P, Kerr D N S, Ritz E and Winearls C G. Oxford Textbook of Clinical Nephrology. 2nd Ed. 1998. p1252-58.

Dunnill M S. The Pathological Basis of Renal Disease. 2nd Ed. 1984. W B Saunders. Eastbourne. p368-72.

Stamm W E. Urinary Tract Infections. In: (Eds) Greenberg A, Cheung A K, Coffman T M, Falk R J, Jennette J C. Primer on Kidney Diseases. 2nd Ed. 1998. Academic Press. San Diego. p366-71.

Wilkins M J and Evans D J. Pyelonephritis. In: (Eds) McGee J O'D, Isaacson P G and Wright N A. Oxford Textbook of Pathology. 1992. p1477-1481.

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