J Prev Epidemiol. 2024;9(1):e35236 Mini-Review

doi 10.34172/jpe.2024.35236 Journal of Preventive Epidemiology http jprevepi.com

Renal complications of tuberculosis; a mini-review

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Received: 30 Sep. 2023
Accepted: 26 Dec. 2023
ePublished: 29 Dec. 2023

Keywords: Renal tuberculosis, Long-term complications, Tuberculosis-associated glomerulopathy, Focal segmental glomerulosclerosis, Minimal change disease

Citation: Farnam Nia S, Nasri H, Mazaheri Tehrani S, Rouzbahani S. Renal complications of tuberculosis; a mini-review. J Prev Epidemiol. 2024;9(1):e35236. doi: 10.34172/jpe.2024.35236.

Abstract

Tuberculosis (TB) is a chronic infectious disease caused by Mycobacterium tuberculosis, which primarily affects the lungs but can also involve other organs, including the kidneys. TB has the potential to result in the development of chronic renal failure and requires prompt diagnosis and treatment for effective management. Renal TB can lead to various complications, including renal failure, perinephritis, perinephric abscesses, fistulae, psoas abscesses, and non-functioning kidneys. Additionally, TB-associated nephropathy is an infrequent variant of glomerulonephritis characterized by the deposition of immune complexes containing TB antigens in the kidney's glomeruli.

Introduction

Tuberculosis (TB) is a chronic infectious disease caused by *Mycobacterium tuberculosis*, primarily affecting the respiratory system. However, it can also affect several organs, such as the renal system (1). Kidney TB is a rare extra-pulmonary disease, accounting for less than five percent of all TB cases (2,3). Kidney TB can lead to significant morbidity and mortality if not diagnosed and treated promptly. The renal complications of TB can be classified into two categories: tuberculous nephritis and obstructive uropathy (4). Tuberculous nephritis is characterized by granulomatous inflammation of the renal parenchyma, which can lead to renal failure. Obstructive uropathy arises from the formation of ureteral strictures or renal calculi due to the scarring and fibrosis caused by the infection. This condition has been reported worldwide, but its prevalence varies depending on geographic location, socioeconomic status, and healthcare accessibility factors (5,6). This mini-review sought to provide a concise overview of the current knowledge on TB-associated nephropathy.

Key point

Renal TB is an uncommon disease; however, it is the serious complications of this disease that can lead to significant morbidity and mortality. Complications of renal TB include chronic kidney disease, end-stage renal disease, and urosepsis. The prognosis for patients diagnosed with renal TB is typically favorable when early detection and prompt treatment are implemented. Early diagnosis and prompt treatment are essential to prevent long-term complications.

Search strategy

For this review, we conducted a comprehensive search across many academic databases, including PubMed, Web of Science, EBSCO, Scopus, Google Scholar, Directory of Open Access Journals (DOAJ), and Embase, using a range of relevant keywords, including renal tuberculosis, long-term complications, tuberculosis-associated glomerulopathy, focal segmental glomerulosclerosis, minimal change disease.

Renal tuberculosis in brief

Renal TB can cause various complications, including fistulae, psoas abscesses, renal failure, perinephritis, perinephric abscesses, and non-functioning kidneys (7,8). According to a study, the prevalence of renal dysfunction is reported to be 24% (4). Several investigations have described several mechanisms of kidney failure following kidney infection, including: first, direct kidney tissue infection which initiates obliterative endarteritis, along with widespread dystrophic calcification or secondary kidney amyloidosis, both of which result in kidney injury. Secondly, post-obstructive atrophy due to numerous strictures and, finally, subtle but progressive

tubulo-interstitial nephritis are also responsible for renal failure in this disease (9). A short look at the published cases of kidney TB, shows this condition may be asymptomatic or display the disease with damaging the renal parenchyma. In addition, site-dependent nonspecific urinary complications include pelvic or abdominal pain, abdominal mass, urinary frequency, hematuria, and sterile pyuria. Moreover, an unresponsive urinary tract infection to antibiotics is highly suggestive of urinary TB (10,11).

Risk factors for kidney tuberculosis

The risk factors associated with renal TB comprise previous TB infection, immunosuppression (HIV infection, corticosteroids or immunomodulatory drugs, transplant individuals), malnutrition, diabetes, chronic renal and liver disease, alcohol and substance abuse, smoking, homelessness, poor housing, pneumoconiosis, genetics, vitamin deficiency, immunosuppressive drugs, renal transplantation, chronic renal disease, and dialysis or end-stage renal failure. Moreover, a previous study demonstrated that a high creatinine level at the diagnosis reflects the progression of urinary TB and the destruction of the kidney structure (12,13).

Long-term complications of renal tuberculosis

Renal TB can lead to various long-term complications and sequelae. This disease can result in the formation of abscesses in the kidney, which can initiate further damage and complications. Additionally, this condition can result in the formation of strictures or fistulas in the urinary tract, leading to obstruction and urinary complications. Renal TB also can increase the risk of developing kidney stones or calculi, which can cause pain and urinary problems. Likewise, hydronephrosis can occur due to this disease (14,15). Meanwhile, untreated or poorly managed renal TB can lead to chronic renal failure, defined by gradually lessening renal function over time. Finally, in severe cases, renal TB can destroy the renal parenchyma, leading to a non-functioning kidney (16).

Tuberculosis-associated glomerulonephritis

Tuberculosis-associated glomerulopathy is a rare form of glomerulonephritis caused by *M. tuberculosis* infection. This condition can present as rapidly progressive glomerulonephritis or crescentic glomerulonephritis, which are life-threatening diseases. Crescentic glomerulonephritis is associated with poor outcomes if treatment is inadequate and delayed (17,18). In addition, TB-associated IgA nephropathy is reported as a rare form of glomerulonephritis following Mycobacterium tuberculosis infection. There is growing evidence that TB can be associated with IgA nephropathy. This disease is a common form of glomerulonephritis characterized by the accumulation of IgA in the glomerular mesangium. It is a leading cause of chronic kidney disease worldwide (19). A case report described a 59-year-old man with disseminated TB and IgA nephropathy, presenting with microscopic hematuria, red cell casts, and normal renal function (20). Notably, previous case reports of TB-associated IgA nephropathy are from different regions, including Africa (19). One of the most common glomerular diseases associated with TB is also membranous nephropathy. This glomerulopathy is characterized by thickening of the glomerular basement membrane and deposition of immune complexes, which can lead to proteinuria, hypoalbuminemia, and edema (21,22). Focal segmental glomerulosclerosis (FSGS) is an additional glomerular disease that has been linked to TB. This glomerulopathy is characterized by scarring of the glomeruli, leading to proteinuria and eventual kidney failure. It is thought that TB-induced inflammation and cytokine release may contribute to the development of FSGS (23,24).

Similarly, minimal change disease (MCD) has also been reported in association with TB. MCD is characterized by diffuse loss of podocyte foot processes, leading to proteinuria. Previous studies showed that TB-induced cytokine release may contribute to the development of MCD (25). Finally, acute interstitial nephritis has also been reported in association with TB. This condition is characterized by inflammation of the interstitial tissue of the kidney, leading to acute kidney injury. It is thought that TB-induced inflammation and immune response may contribute to the development of acute interstitial nephritis (26).

Kidney pathology of nephropathy-associated TB

Renal TB can cause various morphologic and pathologic lesions inside the kidneys. These lesions include granulomatous inflammation, caseating necrosis, tubular atrophy, interstitial fibrosis, and calcification (27). Granulomas are a hallmark of TB and are located in the renal parenchyma, renal pelvis, and ureters. The presence of granulomas can lead to the formation of strictures and obstruction of the urinary tract. Caseating necrosis can also occur in the renal parenchyma and lead to renal failure. Tubular atrophy and interstitial fibrosis are caused by chronic inflammation and may result in irreversible damage to the kidneys (28,29). Calcification will occur in the renal parenchyma, renal pelvis, and ureters, leading to the formation of stones and urinary tract obstruction. Overall, renal TB's morphologic and pathologic lesions are diverse and result in significant renal dysfunction if not diagnosed and treated promptly (30).

Clinical presentation of renal TB

The clinical presentation of renal TB can be nonspecific, including symptoms such as fever, fatigue, weight loss, and night sweats. Hematuria, flank pain, and dysuria may also be present. The diagnosis of renal TB requires a high index of suspicion and is based on a combination of clinical, radiological, and microbiological findings (31,32).

Treatment of renal TB

Treating renal TB involves a combination of anti-TB medications for at least six months. Surgical intervention may be necessary in obstructive uropathy or a lack of response to medical therapy (33).

Conclusion

Renal TB can be asymptomatic or present with nonspecific urinary manifestations such as pelvic or abdominal pain, abdominal mass, urinary frequency, sterile pyuria, and hematuria. A resistant urinary tract infection to common antibiotics highly suggests urinary TB. The risk factors associated with this disease include prior TB, previous liver or renal disease, and immunosuppression therapy.

It has also been detected that a high serum creatinine at the time of TB detection indicates an advanced stage of urinary TB along with destruction of the kidney structure. Previous investigations also Indicated that following treatment of this disease, recovery of a destroyed kidney could be problematic.

Authors' contribution

Conceptualization: Sadaf Farnam Nia, Hamid Nasri.
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Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

Funding/Support

None.

References

1. Smith I. Mycobacterium tuberculosis pathogenesis and molecular determinants of virulence. Clin Microbiol Rev. 2003;16:463-96. doi: 10.1128/CMR.16.3.463-496.2003.
2. Daher Ede F, da Silva GB Jr, Barros EJ. Renal tuberculosis in the modern era. Am J Trop Med Hyg. 2013;88:54-64. doi: 10.4269/ajtmh.2013.12-0413.
3. Sivanandam LK, Jhoond MK, Sujanyal SA, Sridhar S, Nasser N, Sanker V, et al. A rare extrapulmonary manifestation of tuberculosis in a chronic kidney disease patient. Clin Case Rep. 2023;11:e7807. doi: 10.1002/ccr3.7807.
4. Merchant S, Bharati A, Merchant N. Tuberculosis of the genitourinary system-Urinary tract tuberculosis: Renal tuberculosis-Part I. Indian J Radiol Imaging. 2013;23:46-63. doi: 10.4103/0971-3026.113615.
5. Meehan SM, Josephson MA, Haas M. Granulomatous tubulointerstitial nephritis in the renal allograft. Am J Kidney Dis. 2000;36:E27. doi: 10.1053/ajkd.2000.17735.
6. Romanowski K, Clark EG, Levin A, Cook VJ, Johnston JC. Tuberculosis and chronic kidney disease: an emerging global syndemic. Kidney Int. 2016;90:34-40. doi: 10.1016/j.kint.2016.01.034.
7. Wei HL, Wang L, DU XG, Wu Y, Li H, Cai Y, et al. Renal tuberculosis and iliopsoas abscess: Two case reports. Exp Ther Med. 2014;7:1718-1720. doi: 10.3892/etm.2014.1623.
8. DHANGAR S, Kothawala I, Patil S, Kumar A, Whatkar A. Radiologic signs of genitourinary tuberculosis: an aid for earlier diagnosis. Intern J Med Res. 2016;1:01-8.
9. Maeda H, Shirai C. [Health examination in future at the era of low tuberculosis incidence--from contacts examination toward active epidemiological studies]. Kekkaku. 2013;88:323-35. [Japanese].
10. Jha SK, Rathish B. Genitourinary Tuberculosis. [Updated 2023 Apr 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK557558/
11. Abbara A, Davidson RN; Medscape. Etiology and management of genitourinary tuberculosis. Nat Rev Urol. 2011;8:678-88. doi: 10.1038/nrurol.2011.172.
12. Cheng KC, Liao KF, Lin CL, Liu CS, Lai SW. Chronic kidney disease correlates with increased risk of pulmonary tuberculosis before initiating renal replacement therapy: A cohort study in Taiwan. Medicine (Baltimore). 2018;97:e12550. doi: 10.1097/MD.0000000000012550.
13. Hussein MM, Mooij JM, Roujouleh H. Tuberculosis and chronic renal disease. Semin Dial. 2003;16:38-44. doi: 10.1046/j.1525-139x.2003.03010.x.
14. Merchant S, Bharati A, Merchant N. Tuberculosis of the genitourinary system-Urinary tract tuberculosis: Renal tuberculosis-Part II. Indian J Radiol Imaging. 2013;23:64-77. doi: 10.4103/0971-3026.113617.
15. Zádor L. Renal Tuberculosis, Kidney Stone and Calcification. Urologia J. 1968;35:165-72.
16. Wagaskar VG, Chirmade RA, Baheti VH, Tanwar HV, Patwardhan SK, Gopalakrishnan G. Urinary Tuberculosis with Renal Failure: Challenges in Management. J Clin Diagn Res. 2016;10:PC01-3. doi: 10.7860/JCDR/2016/16409.7017.
17. Solak Y, Gaipov A, Anil M, Atalay H, Ozbek O, Turkmen K, et al. Glomerulonephritis associated with tuberculosis: a case report and literature review. Kaohsiung J Med Sci. 2013;29:337-42. doi: 10.1016/j.kjms.2012.10.008.
18. Torpiano P, Holwill S, Pace D. Mesangiocapillary glomerulonephritis complicating pulmonary tuberculosis. CEN Case Rep. 2022;11:17-21. doi: 10.1007/s13730-021-00626-6.
19. Wang Y, Tao Y. Tuberculosis-associated IgA nephropathy. J Int Med Res. 2018;46:2549-2557. doi: 10.1177/0300060518774127.
20. Cohen AJ, Rosenstein ED. IgA nephropathy associated with disseminated tuberculosis. Arch Intern Med. 1985;145:554-6.
21. Lai WL, Yeh TH, Chen PM, Chan CK, Chiang WC, Chen YM, et al. Membranous nephropathy: a review on the pathogenesis, diagnosis, and treatment. J Formos Med Assoc. 2015;114:102-11. doi: 10.1016/j.jfma.2014.11.002.
22. Shang MH, Zhu N, Hao J, Wang L, He ZY, Yang M, et al. Membranous Nephropathy Associated with Tuberculosis. Chin Med J (Engl). 2016 Mar 5;129:622-3. doi: 10.4103/0366-6999.176986.
23. de Mik SM, Hoogduijn MJ, de Bruin RW, Dor FJ. Pathophysiology and treatment of focal segmental glomerulosclerosis: the role of animal models. BMC Nephrol. 2013;14:74. doi: 10.1186/1471-2369-14-74.
24. Srinivasaprasad ND, Chandramohan G, Praveen V, Fernando ME. Collapsing glomerulopathy associated with pulmonary tuberculosis. Indian J Nephrol. 2016;26:373-375. doi:

10.4103/0971-4065.175981.
25. Purohit S, Piani F, Ordoñez FA, de Lucas-Collantes C, Bauer C, Cara-Fuentes G. Molecular Mechanisms of Proteinuria in Minimal Change Disease. Front Med (Lausanne). 2021 Dec 23;8:761600. doi: 10.3389/fmed.2021.761600.
26. Do Vale CL, Naicker S, Lippincott CK. Acute Interstitial Nephritis in Tuberculosis-Associated Immune Reconstitution Inflammatory Syndrome. Kidney Int Rep. 2021;7:920-923. doi: 10.1016/j.ekir.2021.12.008.
27. Das P, Ahuja A, Gupta SD. Incidence, etiopathogenesis and pathological aspects of genitourinary tuberculosis in India: A journey revisited. Indian J Urol. 2008;24:356-61. doi: 10.4103/0970-1591.42618.
28. Mallinson WJ, Fuller RW, Levison DA, Baker LR, Cattell WR. Diffuse interstitial renal tuberculosis--an unusual cause of renal failure. Q J Med. 1981;50:137-48.
29. Mantica G, Ambrosini F, Riccardi N, Vecchio E, Rigatti L, De Rose AF, et al. Genitourinary tuberculosis: a comprehensive review of a neglected manifestation in low-endemic countries. Antibiotics (Basel). 2021;10:1399. doi: 10.3390/antibiotics10111399.
30. Krishnamoorthy S, Gopalakrishnan G. Surgical management of renal tuberculosis. Indian J Urol. 2008;24:369-75. doi: 10.4103/0970-1591.42620.
31. Cruz AT, Starke JR. Clinical manifestations of tuberculosis in children. Paediatric respiratory reviews. 2007;8:107-17.
32. Almazloum A, Elgazzar T, Alkhayat M, Alansari LA, Almustanyir S. A case report of renal tuberculosis with associated unusual pulmonary findings. Cureus. 2021;13:e19972. doi: 10.7759/cureus.19972.
33. Kadhiravan T, Sharma SK. Medical management of genitourinary tuberculosis. Indian J Urol. 2008;24:362-8. doi: 10.4103/0970-1591.42619.