Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI :10.21474/IJAR01/22072
DOI URL : http://dx.doi.org/10.21474/IJAR01/22072

RESEARCH ARTICLE

URINARY TRACT INFECTION IN DIABETIC PATIENTS: A PROSPECTIVE STUDY IN MARRAKECH

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Manuscript Info

Manuscript History
Received: 21 August 2025
Final Accepted: 23 September 2025
Published: October 2025

Key words:
Diabetes Mellitus, Urinary Tract Infection, Antimicrobial Resistance, Escherichia coli, Asymptomatic Bacteriuria

Abstract

Urinary tract infections (UTIs) are common complications in diabetic patients due to immune dysfunction, glycosuria, and bladder abnormalit ies favoring microbial growth.Antimicrobial resistance further complic ates empirical therapeutic choices, highlighting the need for updated regional data to guide appropriate management. This prospective study aimed to determine the prevalence of UTIs in diabetic patients in Marrakech, identify the main causative pathogens and evaluate their antimicrobial resistance profiles. A total of 325 diabetic patients older than 15 years underwent urine culture between January and June 2024 i n private medical laboratories.Sociodemographic and clinical data were recorded using standardized forms. Urine analysis included semi-quantitative culture, biochemical identification and antimicrobial susceptibility testing.Among the samples analyzed, 59 were positive, indicating a UTI prevalence of 18 %. Most infections were observed in women (71 %) and in patients aged over 60 years (73 %). Asymptomatic bacteriuria was highly prevalent (75 %), stressing the risk of undetected progression to renal or systemic complications. Gram-negative bacteria predominated (≈80 %), mostly Escherichia coli (71.18 %) and Klebsiella pneumoniae (8.48 %). High resistance was observed to amoxicillin and fluoroquinolones, while third-generation cephalosporins, nitrofurantoin and fosfomycin remained effective. No resistance to imipenem was detected. These findings underscore the importance of culture-guided therapy and preventive strategies in diabetic care to reduce severe outcomes.

Introduction:-

Urinary tract infection (UTI) is defined as the invasion of the urinary tract by one or more microorganisms, leading to an inflammatory response associated with variable symptoms depending on the anatomical site and severity of the infection. UTIs represent a major public health concern due to their high prevalence, ranking as the second most common cause of antibiotic prescription after respiratory tract infections, and because of their significant impact on

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morbidity and mortality [1]. In diabetic patients, the frequency of UTIs is significantly increased. Several factors contribute to this vulnerability, including bladder dysfunction related to diabetic neuropathy, a higher rate of urological procedures, vascular alterations compromising epithelial defense mechanisms, and glycosuria, which promotes bacterial proliferation and reduces the effectiveness of neutrophil activity and phagocytosis. The diagnosis of UTIs relies on urine cytobacteriological examination (culture-based testing). The growing antimicrobial resistance among uropathogenic bacteria complicates empirical antibiotic selection and highlights the essential role of microbiology laboratories in providing accurate diagnosis and guiding targeted therapy. The objective of this study was to determine the etiological frequency of UTIs in diabetic patients and assess the antimicrobial resistance levels of the isolated bacteria. To achieve this, we conducted a prospective study in private laboratories over a six-month period, from January to June 2024.

Materials and Methods:-

This prospective, descriptive, and analytical study was carried out over a six-month period (January to June 2024) in several private clinical laboratories in Marrakech. This study aimed to determine the frequency of urinary tract infections (UTIs) in diabetic patients, identify the isolated uropathogens, and evaluate their antimicrobial resistance profiles. The study included diabetic patients aged over 15 years who underwent cytobacteriological urine examination during the study period. Patients receiving recent antibiotic therapy were excluded in order to avoid false-negative culture results. A total of 325 urine samples were collected: 59 cultures were positive (18%), while 266 were negative (82%). A standardized data collection sheet was used to record sociodemographic variables (age, sex), clinical characteristics (symptomatic vs asymptomatic), and microbiological findings.

Positive cases were categorized as follows:

•Age:with a predominance of patients older than 60 years(73%)
•Sex:mostly females(71%)
• Clinical presentation: asymptomatic bacteriuria in (75%) of cases

Urine samples were collected as midstream clean-catch specimens under strict aseptic conditions to minimize contamination. Samples were either processed immediately or stored under refrigeration for a limited period to preserve bacterial viability.

The cytobacteriological examination included:

• Microscopic leukocyte count
• Semi-quantitative culture using a calibrated 10 µL loop
• Inoculation onto selective or chromogenic media (CLED, BCP, etc.) ensuring optimal bacterial differentiation

Interpretation of significant bacteriuria was based on microbial species and clinical context.
Isolated colonies were identified using standard biochemical methods.Antimicrobial susceptibility testing was performed using the agar disk-diffusion method, covering the most commonly prescribed antibiotic classes in ambulatory settings in Marrakech, including:aminopenicillins, aminopenicillins with β-lactamase inhibitors, cephalosporins, fluoroquinolones, aminoglycosides, Fosfomycin, nitrofurans, and carbapenems.Data analysis was descriptive, based on frequency and percentage calculations. Results were presented in tables and graphs according to the parameters evaluated (age, sex, microorganism profile, antimicrobial resistance).

Results:-

A total of 325 urine cultures were collected during the study period. Among them, 59 tested positives, corresponding to an overall urinary tract infection (UTI) prevalence of 18 percent in diabetic patients.

Demographic and clinical profile:

The results showed a clear female predominance, with 71% of infected patients being women (male-to-female ratio = 0.40). The age group over 60 years was the most affected, accounting for 73 % of positive cases, indicating an increased vulnerability with advancing age and prolonged diabetes evolution (Figure 1).

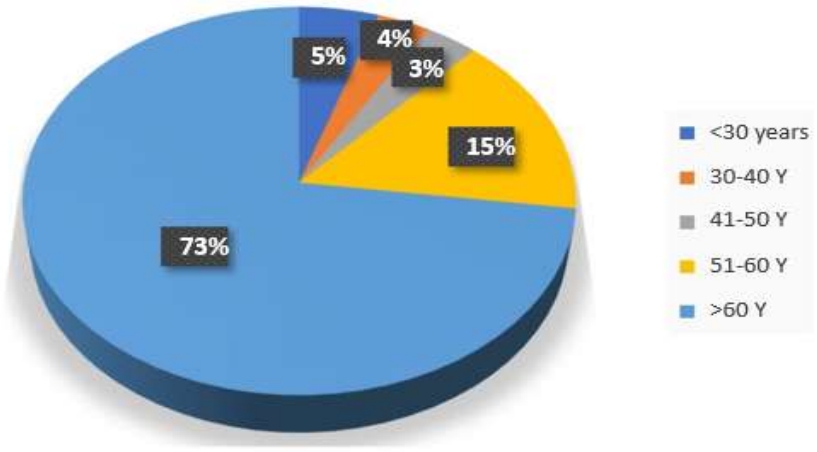

Figure 1: Distribution of positive urine cultures according to age

A high proportion of asymptomatic bacteriuria was also observed (75 %), representing a risk of undetected complications in diabetic patients.

Microbiological profile:
Gram-negative Enterobacterales were largely predominant, accounting for 79.66 % of isolated pathogens. Escherichia coli was the leading uropathogen,representing 71.18 % of isolates,followed by:
•Klebsiella pneumoniae: 8.48 %
•Candida spp.: 6.78 %
• Gram-positive cocci: a smaller but clinically relevant proportion (Figure 2)

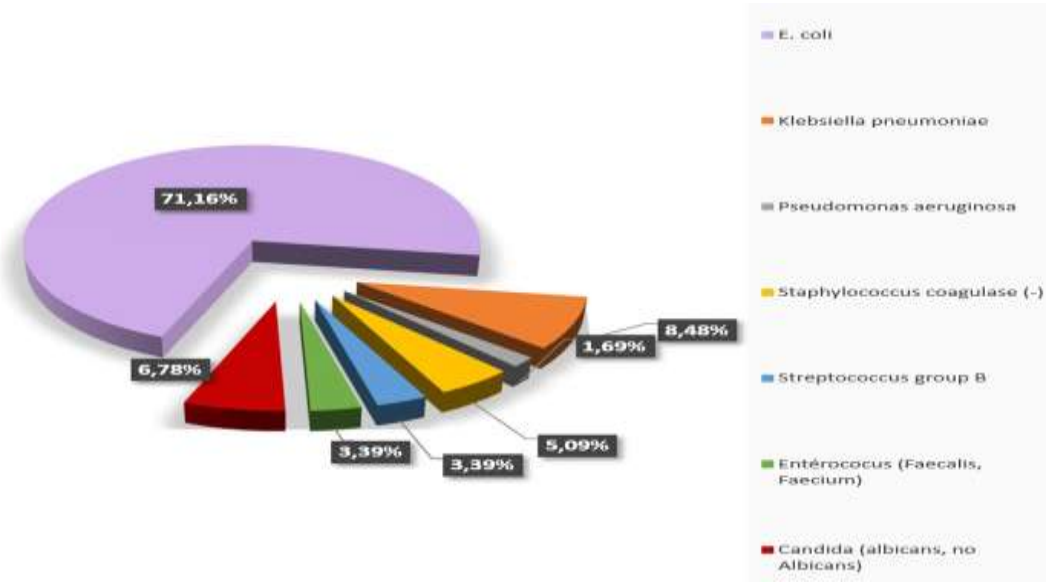

Figure 2: Distribution of uropathogenic bacteria in diabetic patients (n = 59)

Antibiotic resistance:
The isolated bacteria showed a concerning level of resistance to several antibiotics commonly used as empirical therapy (Figure 3). The complete sensitivity to imipenem confirms its status as a last-resort therapeutic option that must be preserved.

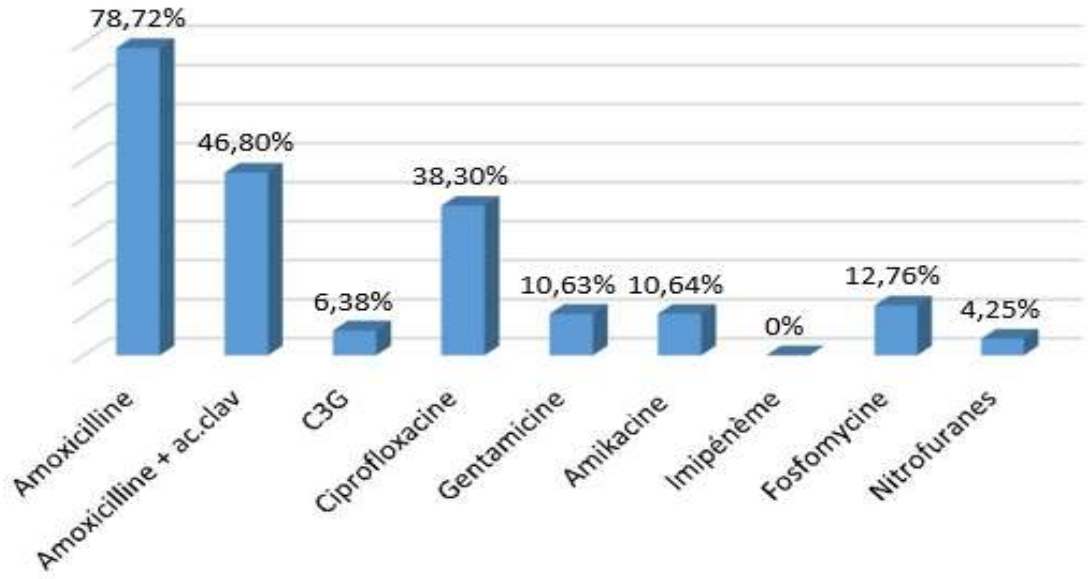

Figure 3: Percentage of antimicrobial resistance of Enterobacterales to the main antibiotics

Discussion:-

The prevalence of urinary tract infections (UTIs) observed in diabetic patients in our study (18 percent) is consistent with findings reported in the literature, confirming that diabetes is a major risk factor for UTIs [1–2]. This increased susceptibility is attributed to several physiopathological mechanisms, including glycosuria, impaired immune response, and bladder dysfunction secondary to neuropathy [3]. The marked female predominance (71 %) is in agreement with numerous studies, as anatomical and hormonal factors contribute to an increased risk of UTIs in women [4–5]. In addition, the high proportion of elderly patients (>60 years; 73 %) reflects the increased burden of comorbidities, diminished immune defenses, and prolonged duration of diabetes associated with aging [6]. The high rate of asymptomatic bacteriuria (75 %) highlights the existence of a significant reservoir of silent infections in diabetic patients [7]. This condition increases the risk of progression to complicated forms such as pyelonephritis or sepsis, justifying targeted screening among vulnerable individuals [8].

From a microbiological perspective, Escherichia coli remains the predominant uropathogen (71.18 %), followed by Klebsiella pneumoniae (8.48 %). This distribution aligns with global trends, where Enterobacterales account for the majority of community-acquired UTIs [9–10], reflecting their intestinal origin and strong ability to colonize the urinary tract [11]. The high resistance rates observed for amoxicillin (78.72 %) and fluoroquinolones (38.30 percent) represent a major therapeutic challenge in community settings [12–13]. Conversely, the low resistance observed for third-generation cephalosporins (6.38 %), nitrofurantoin, and fosfomycin supports their use as first-line therapy for uncomplicated lower UTIs in diabetic patients [14]. The absence of resistance to imipenem indicates that carbapenems remain an effective last-resort option, which must be preserved to prevent the emergence of multidrug-resistant strains [15]. Thus, our findings confirm the need for culture-guided antibiotic therapy in diabetic patients with UTIs, along with the implementation of preventive measures and regular follow-up to limit the progression of antimicrobial resistance and associated complications [16].

Conclusion:-

Urinary tract infections are frequent in diabetic patients due to glycosuria, impaired immunity, and bladder dysfunction. Despite this susceptibility, their management remains similar to that in the general population. However, the increasing resistance to commonly used antibiotics highlights the importance of antibiogram-guided therapy. Early diagnosis and appropriate preventive measures are essential to avoid severe complications, particularly renal impairment or sepsis.

References:-

[1] B. Foxman, « Epidemiology of urinary tract infections: Incidence, morbidity, and economic costs », Nat. Rev. Urol., vol. 7, no 12, pp. 653-660, 2010, doi: 10.1038/nrurol.2010.190.
[2] A. L. Flores-Mireles, J. N. Walker, M. Caparon, et S. J. Hultgren, « Urinary tract infections: epidemiology, mechanisms of infection and treatment options », Nat. Rev. Microbiol., vol. 13, no 5, pp. 269-284, May 2015, doi: 10.1038/nrmicro3432.
[3] L. E. Nicolle, « Urinary tract infections in diabetes mellitus », Diabetes Care, vol. 16, no 1, pp. 103-113, Jan. 1993, doi: 10.2337/diacare.16.1.103.
[4] W. E. Stamm et T. M. Hooton, « Management of urinary tract infections in adults », N. Engl. J. Med., vol. 329, pp. 1328-1334, 1993, doi: 10.1056/NEJM199310283291808.
[5] A. Ronald, « The etiology of urinary tract infection: traditional and emerging pathogens », Am. J. Med., vol. 113, Suppl. 1A, pp. 14-19, July 2002, doi: 10.1016/S0002-9343(02)01053-0.
[6] B. A. Lipsky et al., « Urinary tract infections in men: epidemiology, pathophysiology, diagnosis and treatment », Ann. Intern. Med., vol. 110, no 2, pp. 138-150, 1989, doi: 10.7326/0003-4819-110-2-138.
[7] L. E. Nicolle, « Asymptomatic bacteriuria: review and guidelines for management », Clin. Infect. Dis., vol. 55, no 6, pp. 779-784, 2012, doi: 10.1093/cid/cis540.
[8] K. Gupta et al., « International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women », Clin. Infect. Dis., vol. 52, no 5, pp. e103-e120, 2011, doi: 10.1093/cid/ciq257.
[9] B. Lee et al., « Etiology and antimicrobial susceptibility among diabetic patients with urinary tract infections », J. Infect. Dis., vol. 212, no 3, pp. 327-334, 2015, doi: 10.1093/infdis/jiv017.
[10] G. Kahlmeter, « Prevalence and antimicrobial susceptibility of pathogens causing community acquired urinary tract infections in Europe », J. Antimicrob. Chemother., vol. 56, Suppl. 2, pp. ii5-ii13, 2005, doi: 10.1093/jac/dki118.
[11] M. Totsika et al., « Uropathogenic Escherichia coli: the major cause of urinary tract infection », PLoSPathog., vol. 9, no 7, e1003210, 2013, doi: 10.1371/journal.ppat.1003210.
[12] J. A. Karlowsky et al., « Antimicrobial resistance among urinary tract pathogens in North America », Int. J. Antimicrob. Agents., vol. 34, no 5, pp. 389-397, 2009, doi: 10.1016/j.ijantimicag.2009.04.013.
[13] T. M. Hooton, « Fluoroquinolone resistance in urinary pathogens: a challenge for clinicians », Lancet Infect. Dis., vol. 10, no 12, pp. 790-791, 2010, doi: 10.1016/S1473-3099(10)70225-5.
[14] G. V. Sanchez, R. Master, M. Karlowsky, et J. E. Bordon, « Nitrofurantoin and fosfomycin for the treatment of uncomplicated urinary tract infections », BMJ Open, vol. 6, e009029, 2016, doi: 10.1136/bmjopen-2015-009029.
[15] D. L. Paterson et R. A. Bonomo, « Extended-Spectrum β-Lactamases: A clinical update », Clin. Microbiol. Rev., vol. 18, no 4, pp. 657-686, 2005, doi: 10.1128/CMR.18.4.657-686.2005.
[16] World Health Organization, « Global guidelines for the prevention of antimicrobial resistance: stewardship program recommendations », Geneva: WHO, 2020.