PERIÓDICO TCHÊ QUÍMICA
ARTIGO ORIGINAL

A PREVALÊNCIA DE INFECÇÕES DO TRATO URINÁRIO EM PACIENTES COM ESCLEROSE MÚLTIPLA

THE PREVALENCE OF URINARY TRACT INFECTIONS WITH MULTIPLE SCLEROSIS PATIENTS

انتشار التهابات المسالك البولية لدى مرضى التصلب المتعدد

Amal Jasim Mussa*
Department of Biology, College of Science, University of Kerbala, Kerbala, Iraq.

Haider Hashim Mohammed Ali
Department of Biology, College of Science, University of Kerbala, Kerbala, Iraq.

Kawkab Abdullah Al Saadi
Department of Biology, College of Science, University of Kerbala, Kerbala, Iraq.

** Amal J. Mussa*
e-mail: amal.j@uokerbala.edu.iq

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RESUMO

Introdução: A esclerose múltipla (EM) é uma doença autoimune caracterizada pela desmielinização dos axônios no sistema nervoso central (SNC). A infecção do trato urinário (ITU) afeta milhões de pessoas a cada ano. A ITU é um fator de risco comum que piora os surtos em pacientes com EM. **Objetivos**: A pseudo-exacerbação mais comum em pacientes com EM é a ITU, além da influência da ITU na atividade e no desenvolvimento da doença; portanto, a pesquisa visa estudar a prevalência de infecções do trato urinário. **Métodos**: O estudo incluiu sessenta pacientes com EM, com idades entre 15 e 57 anos, de maio de 2023 a março de 2024, na clínica de EM da cidade médica Imam Al-Hussein em Kerbala, no Hospital Saad Al-Witry para Neurociências em Bagdá e na clínica de EM do centro de neurociências do Eufrates Médio em Najaf. Dez ml de amostras de urina foram coletadas de pacientes com EM, e então foi feito um exame geral de urina (EGU). A amostra de urina foi inoculada no meio de cultura e, em seguida, diagnosticada pelo sistema VITEK. **Resultados**: A prevalência de ITU em pacientes com EM foi de cerca de 23%, sendo a E. coli a bactéria mais frequente, enquanto outras bactérias foram menos frequentes, variando entre 15-7%. **Discussão**: A infecção urinária é um fator de risco em doenças autoimunes. **Conclusões**: Pacientes com esclerose múltipla têm maior probabilidade de desenvolver ITU. As infecções podem ser adquiridas tanto na comunidade quanto no hospital, especialmente por E. coli. Além das doenças autoimunes, isso representa um risco de infecções sistêmicas.

Palavras-chave: *Infecção do trato urinário, ITU, VITEK, EM, Esclerose múltipla.*

ABSTRACT

Background: Multiple sclerosis (MS) is an autoimmune disease characterized by the demyelination of axons in the central nervous system (CNS). Urinary tract infection (UTI) affects millions of people each year. UTI is a common risk factor that worsens attacks in patients with MS. **Aims**: The commonest pseudo exacerbations in patients with MS is UTI, in addition to the influence of UTI on disease activity and development; therefore, the research aims to study the prevalence of urinary tract **Methods**: The current study included sixty MS patients aged 15-57 years from May 2023 to March 2024 in MS clinic at Imam Al- Hussein medical city in Kerbala, Saad Al-Witry Hospital for Neuroscience in Baghdad and MS clinic at Middle Euphrates center for Neuroscience in Najaf. Ten ml of urine samples were collected from MS patients, and a general urine examination (GUE) was done. The urine sample was inoculated into the culture media, after which VITEK diagnosed it. **Results**: The UTI prevalence in patients with MS was about 23%; *E. coli* was the most frequent, while other bacteria were less frequent, ranging between (15-7%). **Discussion**: UTI infection is a risk factor in autoimmune diseases. **Conclusions:** Multiple sclerosis patients are likely to have UTI. They are community- and hospital-acquired, especially because of E. coli. In addition to autoimmune diseases, it is a risk of systemic infections.

Keywords: *Urinary tract infection, UTI, VITEK, MS, Multiple sclerosis.*

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الملخص:
المقدمة: التصلب المتعدد هو مرض مناعي ذاتي يتميز بإزالة المايلين من المحاور العصبية في الجهاز العصبي المركزي. تؤثر التهابات المسالك البولية على ملايين الناس كل سنة. التهاب المسالك البولية عامل خطر شائع يزيد من شدة الهجمات في مرضى التصلب المتعدد. الهدف: تعد التفاقمات الكاذبة الأكثر شيوعا لدى مرضى التصلب المتعدد هي عدوى المسالك البولية, بالإضافة الى تأثر عدوى المسالك البولية على نشاط المرض وتطوره وبالتالي تهدف الدراسة الى دراسة انتشار عدوى المسالك البولية . الطرق: شملت الدراسة ستون مريضاً مصاب بالتصلب المتعدد تتراوح أعمارهم 15- 57 عاماً, من شهر مايو 2023 الى مارس 2024 في عيادة التصلب المتعدد في مدينة الامام الحسين الطبية في كربلاء, ومستشفى سعد الوتري للعلوم العصبية في بغداد وعيادة التصلب في مركز الفرات الأوسط للعلوم العصبية في النجف. تم جمع 10 مل من عينات ادرار مرضى التصلب المتعدد ثم اجراء فحص عام للادرار وتم تلقيح عينة الادرار في أوساط زرعية وتم التشخيص بوساطة الفايتك . النتائج: انتشار عدوى المسالك البولية حوالي 23 بالمية . الاشريكية القولونية الأكثر تردداً بينما بقية البكتيريا اقل تردداً يتراوح بين (7-15%) . المناقشة: تعد عدوى المسالك البولية عامل خطر في الامراض المناعة الذاتية. الاستنتاجات: يعاني مرضى التصلب المتعدد من عدوى المسالك البولية ويمكن ان تكون العدوى مكتسبة من المجتمع او المستشفى وخاصة بسبب الاشريكية القولونية. بالإضافة الى الامراض المناعة الذاتية التي تمثل خطراً للاصابات الجهازية.

المفتاحية الكلمات : عدوى المسالك البولية ,UTI , VITEK, MS , المتعدد التصلب

1. INTRODUCTION:

Multiple sclerosis (MS) is an autoimmune disease characterized by inflammation, demyelination of axons, glial proliferation, and neurodegeneration in the CNS. About 2.8 million people have MS worldwide (Kamma et al., 2022), or 5–300 per 100,000 people worldwide (McGinley *et al*., 2021). Multiple sclerosis is more susceptible to females than males by a ratio of approximately 3:1. It most often affects young people aged 20-40 years (Manjunatha *et al*., 2022).

Different courses include Multiple sclerosis, relapsing-remitting Multiple sclerosis, secondary progressive- MS, primary progressive Multiple sclerosis, and progressive relapsing Multiple sclerosis (Manjunatha *et al*., 2022).

As a result, MS patients suffer different sensory and motor symptoms that affect life quality (Shobeiri *et al*., 2022). Immunotherapy reduces the rate of relapses, and life quality improves, but multiple sclerosis is a progressive degenerative disease of the CNS that results in persistent disability that has no cure (Trapp and Nave, 2008).

The MS etiology has been yet not yet been established, but it is regarded as a complicated autoimmune disease triggered by abnormal immune reaction (Sarkar *et al*., 2024). Multifactorial risk predisposes the development of MS, including age, gender, race, genetic predisposition, environment, and infection (Dighriri *et al*., 2023). Females are two to three times possibly to develop MS than males, suggesting a hormonal contribution to the onset of MS (Walton *et al*., 2020).

Multiple sclerosis presents with various clinical manifestations. Lesions occur in CNS at various times and locations (disseminated with time and space). Severity and symptoms vary among patients with MS. The period of symptoms worse (relapse) followed by cure (remission) in relapsing-remitting- MS (Thornton *et al*., 2024). Dissemination into space can be achieved by demonstrating MRI lesions in various regions “periventricular, juxtacortical/cortical, infratentorial brain, spinal cord (Mey *et al*., 2022).

Although there is no cure for MS yet, immunotherapies through regulation or suppression of immunity have reduced the number of relapses and improved patient life (Mansilla *et al*., 2021). To manage and treat relapse of MS using corticotrophin or corticosteroids, as it increases the speed of recovery from relapses. However, it does not prevent new relapses or influence long-term disability (Myhr and Mellgren, 2009). Disease-modifying therapies (DMTs) depend on concepts of immunopathogenesis of MS (Constantinescu *et al*., 2011). DMTs are mainly used for the treatment of MS. There are several options of DMT available: (interferon, glatiramer acetate, fingolimod, dimethyl fumarate, natalizumab, and ocrelizumab) (Thornton *et al*., 2024). Interferon-B and glatiramer acetate were among the initial medications commonly described to MS patients (Engel and Zipp, 2022). Immuno-therapies have grown rapidly to include nineteen US Food and Drug Administration-accepted immunotherapies usable in 2021 (Cross and Riley, 2022).

MS symptoms can be exacerbation or relapse due to new CNS inflammation, pseudo exacerbation due to psychological stressors or general medical, or progression of MS chronic symptoms. Exacerbations might profit from high doses of corticosteroids, and pseudoexacerbations require finding and treating the main medical triggers. Patients with greater MS disability are especially prone to pseudo-exacerbations; the commonest is UTI, so a urine

dipstick with reflex culture is required to evaluate all patients with acute or progressive MS (Spain, 2022).

A UTI is an infection of the urinary system, including the kidneys, urethra, and bladder. Bacterial infections are the most common cause of UTIs (Tullus and Shaikh, 2020).

MS patients with high UTI prevalence due to a disorder of the urinary system. The symptoms of UTI in MS patients are polyuria, urinary urgency, urinary retention, nocturia, and incontinence. *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae* were the most common bacteria. Moreover, UTI may precipitate outbreaks, worsen MS patients, and cause further damage and deterioration in neurons (Medeiros *et al*., 2020; Abood Yasir OKAB, and B. Salih, 2020).

In a study conducted in Poland on urinary tract infection, it was considered one of the three comorbidities most closely associated with MS (Pierzchala *et al*., 2015).

When patients with MS develop a UTI, they do not necessarily suffer from the symptoms reported by the general people, such as fever, suprapubic or flank pain in cases of pyelonephritis, urgency, increased frequency, urinary incontinence, and hematuria. Therefore, it is difficult to diagnose UTI in patients with MS. Urgency, frequency modification, and incontinence may occur in MS patients without UTI due to the effects of MS (Massa *et al*., 2009; Phé *et al*., 2016).

Infections are associated with MS pathogenesis and may affect MS susceptibility and course. An infection may exacerbate a relapse. One of the most common is UTI (Ascherio and Munger, 2007). Sibley et al. (1985) were the first to identify a risk period of two weeks before the onset of infection and five weeks after the onset of infection, during which the risk of MS relapse increases, perhaps because of enhanced immune activity resulting from the infection.

The study aimed to screen the extent of the prevalence of urinary tract infections in patients with multiple sclerosis and determine the most common type of bacteria causing urinary tract infections.

2. MATERIALS AND METHODS:

2.1. Methods

2.1.1. Patients

The study was conducted on MS patients (without treatment new diagnosis (naïve MS)) from May 2023 to March 2024, and urine samples were collected from MS patients from the MS clinic at Imam Al-Hussein Medical City in Kerbala, Saad Al-Witry Hospital for Neuroscience in Baghdad and MS clinic at Middle Euphrates center for Neuroscience in Najaf. A physician diagnosed MS patients using McDonald's 2017 criteria (Oh, 2022) concerning their clinical signs and symptoms and magnetic resonance imaging (MRI).

2.1.1. 1. Patients and Exclusion Criteria

All patients in this study were newly diagnosed (naïve) with MS according to McDonald's 2017 criteria by a physician. The history of each patient was recorded as age and gender. The exclusion criteria of all patients in this study included other autoimmune diseases, such as diabetes and hypertension.

2.1.2. Urine sample collection

The current study included sixty MS patients. Ten ml of urine samples from MS patients were collected in a sterile container. Urine samples were taken and examined under a microscope. The urine sample is inoculated onto blood agar and MacConkey agar, then incubated at 37 ºC overnight. A culture sample is diagnosed based on bacterial growth ≥100 colonies (105 cfu/ml), while ≤ 100 colonies are excluded (Kranz et al., 2024). Bacteria are identified using microscopic identification, and biochemical tests to determine the diagnosis of isolates are performed by VITEK-2.

2.1.3. Preparation of media

MacConkey agar and Blood agar base agar were prepared according to manufacturer instructions (Oxoid-UK). MacConkey agar and Blood agar base agar were sterilized by autoclave at 121ºC and pressure 15 pounds/Inch for 15 min (Paul, 2019).

2.1.4. Diagnosis of bacterial isolates by VITEK-2 apparatus system

All bacterial isolates were identified using the VITEK-2 apparatus (bioMérieux, France). The suspension of bacteria was adjusted to 0.5 McFarland standard in 2.5ml sodium chloride solution (0.45%). The period between the preparation of the inoculum and the identification card filling was less than 30 minutes. The card was

placed on the cassette in the VITEK-2 apparatus, and the card was automatically filled via a vacuum and sealed, then manually inserted in an incubator (incubation temperature, 37 ºC) and automatically subjected to kinetic fluorescence measurement every 15 minutes for 8 hours. They were analyzed via a database to identify the organism in a kinetic mode starting 180 minutes after the start of incubation (Nimer *et al*., 2016).

3. RESULTS AND DISCUSSION:

3.1. Results

The current study included the collection of 60 patients with MS (14 with UTI and 46 without UTI). The average age of MS patients was 32.13333±11.32938, where females were 33.425± 11.93763 while in males 29.55± 9.773622. The average age of MS patients with urinary tract infections was 26.5 years, and the infection rate in females was greater than in males (approximately 2:1). Table 1 shows that the number of female MS patients is higher than that of males.

Gram-negative and positive bacteria cause UTIs. The current study shows that about 64% of Gram-positive bacteria while 36% of Gram-negative bacteria. It shows that 36% of urine culture samples contained strains of Staphylococcus spp. The results were shown the types of bacteria that cause UTI in MS patients (Figure 1).

The most prevalent bacteria were Escherichia coli 36%, and *Staphylococcus haemolyticus* 15% while lower rates of other bacteria, about 7% each one (*Aerococcus viridans*, *Staphylococcus warneri*, *Staphylococcus aureus*, *Staphylococcus lentus*, *Streptococcus agalactiae*, *Lactococcus gravieae*, *Enterococcus faecalis*).

3.2. Discussion

UTIs are more common in females for several reasons, one of which is the anatomy of the female urinary tract (Assouma *et al*., 2023).

In the postulate, the X chromosome might be related to autoimmune disease (Selmi, 2008). In experimental autoimmune encephalomyelitis (EAE), the presence of a 2X increased susceptibility to EAE has been shown to be completely independent of hormones (Smith-Bouvier *et al*., 2008; Harbo *et al*., 2013).

All MS patients had a urine sample taken, a positive bacterial culture of urine defined as $>10^5$ colonies forming unit (CFU)/mL or $>10^4$ CFU/mL, as determined by the physician regarding the symptoms. Urinalysis is useful. However, this is not enough to confirm a UTI, which requires a urine culture.

Escherichia coli and *Pseudomonas* spp. were more common bacteria cultured with multiple sclerosis patients (Li *et al*., 2020). Infection is a risk factor in autoimmune diseases, and it often causes strong inflammatory responses in different organs. MS exacerbations often occur while patients are suffering from an infection (Marrodan *et al*., 2019).

About 5–10% of UTIs are caused by *E.faecalis*, *S.agalactiae*, and *Staphylococcus* spp. *Staphylococcus warneri* is a rare found in UTI and urosepsis, and in the state, immunocompromised is an induce factor for *S. warneri* infection (Kanuparthy *et al*., 2020; Assouma *et al*., 2023). *S. aureus* is most common among *Staphylococcus* sp., while *S. lentus* (zoonosis) represents rare and opportunistic pathogens causing UTI (Wu *et al*., 2010; Rivera *et al*., 2014). *S. haemolyticus* was recorded to cause UTI (Eltwisy *et al*., 2022).

Different species of *Aerococcus* spp. cause UTI, among them *A.urinae* is the most common, followed by *A.sanguinocola,* while *Aerococcus viridans* is a rare bacteria that causes UTI (Mohan *et al*., 2017; Ezechukwu *et al*., 2019). *Lactococcus garvieae* is known for producing fish infections. It was not known until recently when multiple case reports showed these pathogenic bacteria causing UTI, abscess in the liver, and infective endocarditis (González-Bravo *et al*., 2021).

4. CONCLUSIONS:

We conclude from this current study of all patients suffering from multiple sclerosis that the prevalence of urinary tract infection was 23%, and the most common bacteria is *E. coli*. We note that most infections with bacteria are rare for causing UTI and may be related to immunocompromised.

5. DECLARATIONS

5.1. Study Limitations

The cross-sectional study provides a quick overview of the prevalence rate at a specific time, which limits the sample size. AS well as the exclusion criteria, including multiple sclerosis patients treated with immunomodulatory treatments, in addition to MS patients with other diseases such as diabetes and hypertension, and it is worth noting even MS patients under-diagnosis and being treated with medications for UTI have been excluded.

5.2. Acknowledgements

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5.3. Funding source

The corresponding author funded this research.

5.4. Competing Interests

The authos declare no conflict of interest.

5.5. Open Access

6. HUMAN AND ANIMAL-RELATED STUDIES

6.1. Ethical Approval

The university has approved the current study of Kerbala/College of Science/Research ethics committee referred to the approval letter (no. 004CSE- on 26/6/2024).

6.2. Informed Consent

All patients were accepted as volunteers in this research.

7. REFERENCES:

1. Kamma, E., Lasisi, W., Libner, C., Ng, H. S., & Plemel, J. R. (2022, February 10). Central nervous system macrophages in progressive multiple sclerosis: relationship to neurodegeneration and therapeutics. Journal of Neuroinflammation. Springer Science and Business Media LLC. Retrieved from http://dx.doi.org/10.1186/s12974-022-02408-y
2. McGinley, M. P., Goldschmidt, C. H., & Rae-Grant, A. D. (2021, February 23). Diagnosis and Treatment of Multiple Sclerosis. JAMA. American Medical Association (AMA). Retrieved from http://dx.doi.org/10.1001/jama.2020.26858
3. Talanki Manjunatha, R., Habib, S., Sangaraju, S. L., Yepez, D., & Grandes, X. A. (2022, May 10). Multiple Sclerosis: Therapeutic Strategies on the Horizon. Cureus. Springer Science and Business Media LLC. Retrieved from http://dx.doi.org/10.7759/cureus.24895
4. Shobeiri, P., Seyedmirzaei, H., Karimi, N., Rashidi, F., Teixeira, A. L., Brand, S., Sadeghi-Bahmani, D., et al. (2022, September 26). IL-6 and TNF-α responses to acute and regular exercise in adult individuals with multiple sclerosis (MS): a systematic review and meta-analysis. European Journal of Medical Research. Springer Science and Business Media LLC. Retrieved from http://dx.doi.org/10.1186/s40001-022-00814-9
5. Trapp, B. D., & Nave, K.-A. (2008, July 1). Multiple Sclerosis: An Immune or Neurodegenerative Disorder? Annual Review of Neuroscience. Annual Reviews. Retrieved from http://dx.doi.org/10.1146/annurev.neuro.30.051606.094313
6. Sarkar, S. K., Willson, A. M. L., & Jordan, M. A. (2024, January 4). The Plasticity of Immune Cell Response Complicates Dissecting the Underlying Pathology of Multiple Sclerosis. (R. A. Diotti, Ed.)Journal of Immunology Research. Hindawi Limited. Retrieved from http://dx.doi.org/10.1155/2024/5383099
7. Dighriri, I. M., Aldalbahi, A. A., Albeladi, F., Tahiri, A. A., Kinani, E. M., Almohsen, R. A., Alamoudi, N. H., et al. (2023, January 2). An Overview of the History, Pathophysiology, and Pharmacological Interventions of Multiple Sclerosis. Cureus. Springer Science and Business Media LLC. Retrieved from http://dx.doi.org/10.7759/cureus.33242
8. Walton, C., King, R., Rechtman, L., Kaye, W., Leray, E., Marrie, R. A., Robertson, N., et al. (2020, November 11). Rising prevalence of multiple sclerosis worldwide:

Insights from the Atlas of MS, third Edition. Multiple Sclerosis Journal. SAGE Publications. Retrieved from http://dx.doi.org/10.1177/1352458520970841
9. Thornton, K. K., Cockerell, K. L., & Spencer, M. (2024, January). Understanding multiple sclerosis and the nurse's role. Nursing Made Incredibly Easy! Ovid Technologies (Wolters Kluwer Health). Retrieved from http://dx.doi.org/10.1097/nme.0000000000000025
10. Mey, G. M., Mahajan, K. R., & DeSilva, T. M. (2022, August 10). Neurodegeneration in multiple sclerosis. WIREs Mechanisms of Disease. Wiley. Retrieved from http://dx.doi.org/10.1002/wsbm.1583
11. Mansilla, M. J., Presas-Rodríguez, S., Teniente-Serra, A., González-Larreategui, I., Quirant-Sánchez, B., Fondelli, F., Djedovic, N., et al. (2021, May 6). Paving the way towards an effective treatment for multiple sclerosis: advances in cell therapy. Cellular & Molecular Immunology. Springer Science and Business Media LLC. Retrieved from http://dx.doi.org/10.1038/s41423-020-00618-z
12. Myhr, K. M., & Mellgren, S. I. (2009, August). Corticosteroids in the treatment of multiple sclerosis. Acta Neurologica Scandinavica. Wiley. Retrieved from http://dx.doi.org/10.1111/j.1600-0404.2009.01213.x
13. Constantinescu, C. S., Farooqi, N., O'Brien, K., & Gran, B. (2011, October). Experimental autoimmune encephalomyelitis (EAE) as a model for multiple sclerosis (MS). British Journal of Pharmacology. Wiley. Retrieved from http://dx.doi.org/10.1111/j.1476-5381.2011.01302.x
14. Engel, S., & Zipp, F. (2022, April 20). Preventing disease progression in multiple sclerosis—insights from large real-world cohorts. Genome Medicine. Springer Science and Business Media LLC. Retrieved from http://dx.doi.org/10.1186/s13073-022-01044-8
15. Cross, A., & Riley, C. (2022, August). Treatment of Multiple Sclerosis. CONTINUUM: Lifelong Learning in Neurology. Ovid Technologies (Wolters Kluwer Health). Retrieved from http://dx.doi.org/10.1212/CON.0000000000001170
16. Spain, R. (2022, August). Approach to Symptom Management in Multiple Sclerosis With a Focus on Wellness. CONTINUUM: Lifelong Learning in Neurology. Ovid Technologies (Wolters Kluwer Health). Retrieved from http://dx.doi.org/10.1212/CON.0000000000001140
17. Tullus, K., & Shaikh, N. (2020, May). Urinary tract infections in children. The Lancet. Elsevier BV. Retrieved from http://dx.doi.org/10.1016/S0140-6736(20)30676-0
18. Medeiros Junior, W. L. G. de, Demore, C. C., Mazaro, L. P., de Souza, M. F. N., Parolin, L. F., Melo, L. H., Junior, C. R. W., et al. (2020, November). Urinary tract infection in patients with multiple sclerosis: An overview. Multiple Sclerosis and Related Disorders. Elsevier BV. Retrieved from http://dx.doi.org/10.1016/j.msard.2020.102462
19. Pierzchala, K., Adamczyk-Sowa, M., Dobrakowski, P., Kubicka-Baczyk, K., Niedziela, N., & Sowa, P. (2014, July 11). Demographic characteristics of MS patients in Poland's upper Silesia region. International Journal of Neuroscience. Informa UK Limited. Retrieved from http://dx.doi.org/10.3109/00207454.2014.937002
20. Massa, L. M., MD, MS, MB, Hoffman, J. M., PhD, & Cardenas, D. D., MD, MHA. (2009, January). Validity, Accuracy, and Predictive Value of Urinary Tract Infection Signs and Symptoms in Individuals With Spinal Cord Injury on Intermittent Catheterization. The Journal of Spinal Cord Medicine. Informa UK Limited. Retrieved from http://dx.doi.org/10.1080/10790268.2009.11754562
21. Phé, V., Pakzad, M., Curtis, C., Porter, B., Haslam, C., Chataway, J., & Panicker, J. N. (2016, February 18). Urinary tract infections in multiple sclerosis. Multiple Sclerosis Journal. SAGE Publications. Retrieved from http://dx.doi.org/10.1177/1352458516633903
22. Ascherio, A., & Munger, K. L. (2007, April). Environmental risk factors for multiple sclerosis. Part I: The role of infection. Annals of Neurology. Wiley. Retrieved from http://dx.doi.org/10.1002/ana.21117

23. SIBLEY, W. (1985, June). CLINICAL VIRAL INFECTIONS AND MULTIPLE SCLEROSIS. The Lancet. Elsevier BV. Retrieved from http://dx.doi.org/10.1016/S0140-6736(85)92801-6
24. Oh, J. (2022, August). Diagnosis of Multiple Sclerosis. CONTINUUM: Lifelong Learning in Neurology. Ovid Technologies (Wolters Kluwer Health). Retrieved from http://dx.doi.org/10.1212/CON.0000000000001156
25. Kranz, J., Bartoletti, R., Bruyère, F., Cai, T., Geerlings, S., Köves, B., Schubert, S., et al. (2024, July). European Association of Urology Guidelines on Urological Infections: Summary of the 2024 Guidelines. European Urology. Elsevier BV. Retrieved from http://dx.doi.org/10.1016/j.eururo.2024.03.035
26. Paul, A. G. Lab Manual and Workbook in Microbiology 12th Edition. McGraw-Hill Education. 2019.
27. Nimer, N. A., Al-Saa'da, R. J., and Abuelaish, O. (2016). Accuracy of the VITEK 2 system for a rapid and direct identification and susceptibility testing of Gram-negative rods and Gram-positive cocci in blood samples. EMHJ-Eastern Mediterranean Health Journal, 22(3), 193-200 https://iris.who.int/handle/10665/255230
28. Assouma, F. F., Sina, H., Dossou, A. D., Socohou, A., Hounsou, M. C., Avogbe, P. H., Boya, B., et al. (2023, January). Antibiotic Resistance Profiling of Pathogenic Staphylococcus Species from Urinary Tract Infection Patients in Benin. (S. Hassan, Ed.)BioMed Research International. Wiley. Retrieved from http://dx.doi.org/10.1155/2023/6364128
29. Selmi, C. (2008, October). The X in sex: how autoimmune diseases revolve around sex chromosomes. Best Practice & Research Clinical Rheumatology. Elsevier BV. Retrieved from http://dx.doi.org/10.1016/j.berh.2008.09.002
30. Smith-Bouvier, D. L., Divekar, A. A., Sasidhar, M., Du, S., Tiwari-Woodruff, S. K., King, J. K., Arnold, A. P., et al. (2008, April 28). A role for sex chromosome complement in the female bias in autoimmune disease. The Journal of Experimental Medicine. Rockefeller University Press. Retrieved from http://dx.doi.org/10.1084/jem.20070850
31. Harbo, H. F., Gold, R., & Tintoré, M. (2013, May 13). Sex and gender issues in multiple sclerosis. Therapeutic Advances in Neurological Disorders. SAGE Publications. Retrieved from http://dx.doi.org/10.1177/1756285613488434
32. Li, V., Barker, N., Curtis, C., Porter, B., Panicker, J. N., Chataway, J., & Pakzad, M. (2020, October). The prevention and management of hospital admissions for urinary tract infection in patients with multiple sclerosis. Multiple Sclerosis and Related Disorders. Elsevier BV. Retrieved from http://dx.doi.org/10.1016/j.msard.2020.102432
33. Marrodan, M., Alessandro, L., Farez, M. F., & Correale, J. (2019, January 14). The role of infections in multiple sclerosis. Multiple Sclerosis Journal. SAGE Publications. Retrieved from http://dx.doi.org/10.1177/1352458518823940
34. Kanuparthy, A., Challa, T., Meegada, S., Siddamreddy, S., & Muppidi, V. (2020, May 28). Staphylococcus warneri: Skin Commensal and a Rare Cause of Urinary Tract Infection. Cureus. Springer Science and Business Media LLC. Retrieved from http://dx.doi.org/10.7759/cureus.8337
35. Assouma, F. F., Sina, H., Dossou, A. D., Socohou, A., Hounsou, M. C., Avogbe, P. H., Boya, B., et al. (2023, January). Antibiotic Resistance Profiling of Pathogenic Staphylococcus Species from Urinary Tract Infection Patients in Benin. (S. Hassan, Ed.)BioMed Research International. Wiley. Retrieved from http://dx.doi.org/10.1155/2023/6364128
36. Wu, Q., Li, Y., Wang, M., Pan, X. P., & Tang, Y. F. (2010, November). Fluorescence in situ hybridization rapidly detects three different pathogenic bacteria in urinary tract infection samples. Journal of Microbiological Methods. Elsevier BV. Retrieved from http://dx.doi.org/10.1016/j.mimet.2010.08.015
37. Rivera, M., Dominguez, M. D., Mendiola, N. R., Roso, G. R., & Quereda, C. (2014, June). Staphylococcus lentus Peritonitis: A Case Report. Peritoneal Dialysis International: Journal of the International Society for Peritoneal Dialysis. SAGE Publications. Retrieved from

http://dx.doi.org/10.3747/pdi.2012.00303
38. Abood Yasir OKAB, A., & B SALIH, M. (2020, June 20). ANTIBIOTIC SUSCEPTIBILITY OF ESCHERICHIA COLI ISOLATE FROM URINARY TRACT INFECTION OF THALASSEMIC PATIENTS IN THI-QAR PROVINCE. SOUTHERN BRAZILIAN JOURNAL OF CHEMISTRY. Southern Brazilian Journal of Chemistry. Retrieved from http://dx.doi.org/10.48141/SBJCHEM.v28.n28.2020.04_OKAB_pgs_22_33.pdf
39. Eltwisy, H. O., Twisy, H. O., Hafez, M. H., Sayed, I. M., & El-Mokhtar, M. A. (2022, May 31). Clinical Infections, Antibiotic Resistance, and Pathogenesis of Staphylococcus haemolyticus. Microorganisms. MDPI AG. Retrieved from http://dx.doi.org/10.3390/microorganisms10061130
40. Mohan, B. (2017). Aerococcus Viridans : A Rare Pathogen Causing Urinary Tract Infection. JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH. JCDR Research and Publications. Retrieved from http://dx.doi.org/10.7860/JCDR/2017/23997.9229
41. Ezechukwu, I., Singal, M., & Igbinosa, O. (2019, May 15). Aerococcus Viridans: Case Report, Microbiology, and Literature Review. American Journal of Case Reports. International Scientific Information, Inc. Retrieved from http://dx.doi.org/10.12659/AJCR.914866
42. González-Bravo, D. H., Alegre-Boschetti, S., Silva-Cantillo, R., Mercado-Maldonado, J., Ramos-Márquez, R., Torres-Rivera, G., Cortés, C., et al. (2021, July 11). Lactococcus garvieae: An Uncommon Human Pathogen Causing Infective Endocarditis in a Valve-in-Valve Transcatheter Aortic Valve Replacement. (T. Liu, Ed.)Case Reports in Cardiology. Hindawi Limited. Retrieved from http://dx.doi.org/10.1155/2021/5569533

Table 1. *Patients' demographics*

Variable	MS with UTI	MS without UTI
Number of patients (n=60)	n= 14	n= 46
Average age ±SD	28.42857±10.65338	33.26087 ± 11.3987
Gender (M/F)	4/10	16/30
Pus cell	Presence	Absence

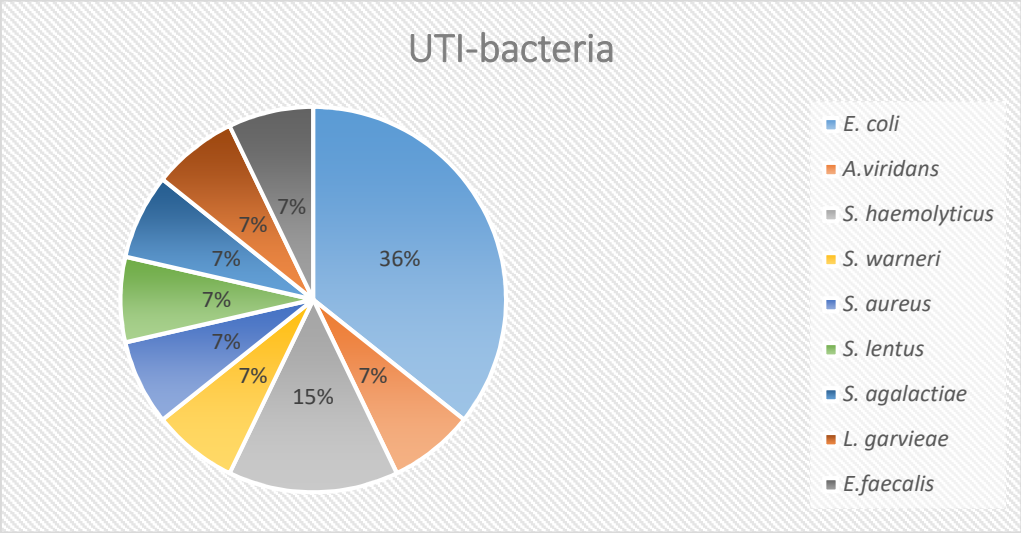

Figure 1. Bacteria causing UTI in MS patients