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ORIGINAL

Asymptomatic bacteriuria and antimicrobial resistance in bacteria isolated from medical students in a hospital in Maracay

Bacteriuria asintomática y resistencia antimicrobiana en bacterias aisladas de estudiantes de medicina en un hospital de Maracay

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ABSTRACT

General objective: To determine the frequency of asymptomatic bacteriuria and bacterial antibiotic resistance among medical students training at the Central Hospital of Maracay between March and September 2024. Materials and methods: A non-experimental, field-based, descriptive, analytical, exploratory, and cross-sectional study design was employed. The study was conducted at the Central Hospital of Maracay, located in Aragua State, Venezuela. A total of 120 students were surveyed, and 20 were selected for the study; variables such as age, sex, academic year, history of urinary tract infection (UTI), sexual activity, isolated pathogen, and antibiotic resistance were recorded. Results: The mean age of the participants was 21.90 years; all participants were female. Regarding academic standing, 55% of the students were in their sixth year of medical school, 35% in their fourth year, and 10% in their fifth year. A history of UTI was reported by 80% of the students, and 95% reported sexual activity. *Escherichia coli* was the most frequently isolated pathogen (100%) and demonstrated high sensitivity to multiple antibiotics, with the exception of trimethoprim/sulfamethoxazole, for which 20% resistance was observed. No bacterial growth was observed in 75% of the samples. Conclusion: The prevalence of potential asymptomatic bacteriuria among medical students at the Central Hospital of Maracay was 25%, which can be considered low. *Escherichia coli* was the most frequently isolated pathogen and showed high sensitivity to multiple antibiotics, confirming the absence of multidrug-resistant bacteria among the students evaluated.

Keywords: Urinary tract infection, urine culture, Escherichia coli, microbial resistance, antibiotics.

RESUMEN

Objetivo general: determinar la frecuencia de bacteriuria asintomática y resistencia antibiótica en bacterias en estudiantes de Medicina que cursan estudios en el Hospital Central de Maracay en el período marzo-septiembre del 2024. Materiales y métodos: Se utilizó un diseño no experimental, de campo, descriptivo, analítico, exploratorio y de corte transversal. Fue efectuado en el Hospital Central de Maracay ubicado en el Estado Aragua, Venezuela. Se encuestaron 120 estudiantes y se seleccionaron 20 estudiantes, se registraron variables como edad, sexo, año académico, antecedentes de infección urinaria, actividad sexual, germen aislado y su resistencia antibiótica. Resultados: la edad promedio de los participantes fue de 21,90 años, siendo todas mujeres. El 55% de los estudiantes cursaba el sexto año de medicina, el 35% el cuarto año y el 10% el quinto año. El 80% reportó antecedentes de infección urinaria y el 95% actividad sexual. Escherichia Coli fue el germen más frecuentemente aislado (100%), con una alta sensibilidad a múltiples antibióticos, excepto Trimetoprim/Sulfamethoxazole, donde se observó un 20% de resistencia. En el 75% de las muestras no se observó desarrollo bacteriano. Conclusión: La posible bacteriuria asintomática en estudiantes de medicina del Hospital Central de Maracay, presento una prevalencia del 25%, lo que se puede considerar como baja. La Escherichia coli fue el germen más frecuentemente aislado, y mostró una alta sensibilidad a múltiples antibióticos. Lo que confirma la ausencia se bacterias multiresitentes entre las estudiantes evaluadas.

Palabras clave: Infección del tracto urinario, urocultivo, Escherichia coli, resistencia microbiana, antibióticos

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INTRODUCTION

Urinary tract infections encompass a broad group of clinical conditions that vary depending on the portion of the urinary tract affected (1). The etiology of these infections is diverse and depends on factors such as age, sex, underlying diseases, and functional or anatomical disorders of the urinary tract (2). The clinical spectrum includes uncomplicated infections, such as asymptomatic bacteriuria, cystitis, or pyelonephritis in young women, and complicated infections affecting transplant patients, elderly individuals, and patients with neurogenic bladder, urinary diversion, or bladder augmentations, which are a frequent cause of morbidity and mortality (3,4).

Although both sexes are susceptible to asymptomatic bacteriuria (AB), women have an anatomical predisposition to develop this infection, even though the vaginal microbiota provides a defense mechanism through colonization by lactobacilli (L. crispatus, L. jensenii, L. gasseri, L. iners), which produce lactic acid and hydrogen peroxide, maintaining an acidic environment that protects against uropathogens (5). Therefore, any condition that decreases lactobacilli is considered a risk factor that increases the likelihood of urinary tract infections, where bacterial colonization may result from dysbiosis of the vaginal microbiota (6,7).

Urinary tract infections are treated with antibiotics; however, misuse of these antimicrobials promotes the emergence of multidrug-resistant strains (8). The presence of multidrug-resistant and extensively drug-resistant strains has reduced antibiotic effectiveness, not only against uropathogens such as Escherichia coli, but also against pathogens associated with other infections. Antibiotic resistance is driven by the production of extended-spectrum beta-lactamases (ESBL) and CTX-M enzymes, which hydrolyze β-lactam antibiotics and are frequently identified in strains causing drug-resistant urinary tract infections (9). Carbapenems are the treatment of choice for severe infections caused by ESBL-producing Escherichia coli; however, indiscriminate antibiotic use has led to the emergence of carbapenemase-producing bacteria, strengthening resistance mechanisms and reducing therapeutic options for these patients (10).

Any individual can develop a urinary tract infection (11); however, healthcare personnel are considered a high-risk group due to two key factors. The first is related to long working hours across various activities, which prevents regular bathroom use, and the second is the presence of multidrug-resistant microorganisms in healthcare facility bathrooms, which can cause contamination during use. One of the most vulnerable groups is university students, who attend classes or complete internships in hospitals, as they lack the experience and time to mitigate these two factors.

A study conducted by Ugwu, et al. (12), in the Faculty of Pharmaceutical Sciences of Nnamdi Azikiwe University, Awka, (Nigeria), determined the prevalence of BA in university students. The bacteria isolated were S. aureus, highly resistant (>60%) to almost all antibiotics, except for Gentamicin (13%), E. coli was sensitive >50% to antibiotics such as Ceftazidine, Cefixime, Ofloxacin, Nitrofurantoin and Ciprofloxacin, while S. saprophyticus was resistant to all antibiotics except Gentamicin. Al Youssef et al. (13) in a study done at the College of Medical Sciences of Hafr Al Batin University (Saudi Arabia) found that 33.33% of respondents reported having a history of urinary tract infection. It was found that 40.2% of patients had significant bacteriuria. E. coli was the most predominant microorganism, closely followed by S. aureus. Ciprofloxacin was the most effective antibiotic, followed by amikacin and nitrofurantoin.

Given that there are few reports of this type of study in the region and given that students who live in hospitals are exposed, it was proposed in this study to determine the frequency of AB and antibiotic resistance in bacteria isolated in a group of medical students who are studying at the Central Hospital of Maracay.

METHODS

The study had a non-experimental, field, descriptive, analytical, exploratory, cross-sectional design. It was conducted at the Hospital Central de Maracay, located in Aragua State, Venezuela. Medical students in the final three years of their degree at the Universidad Nacional Experimental "Rómulo Gallegos", who attend classes at the Hospital Central de Maracay, participated. Participants completed a written survey using a closed-ended questionnaire. Participants were selected through purposive non-probabilistic sampling and included those who met the following criteria: any sex, age 18–30 years, sexually active, with a history of symptomatic or asymptomatic urinary tract infection.

Sample collection was performed from March to September 2024. For urine culture, participants were instructed during the informed consent process to perform strict hygiene of the genital area prior to sample collection, including the use of antibacterial soap and drying of the external genitalia with a clean towel. Samples were transported in a cooler with ice to the clinical laboratory for processing.

The methodology proposed by Tamayo et al. (14) was used with modifications. Using a calibrated inoculation loop, 0,001 mL of the urine sample, without centrifugation and uniformly mixed, was aseptically inoculated onto mannitol salt agar, blood agar, and MacConkey agar. After overnight incubation at 37°C for 24-48 h, colony counts were performed to check for significant growth. Colony counts with bacterial growth of 105 CFU/mL of urine were considered significant for bacteriuria.

All positive urine cultures with significant bacteriuria were identified by colony characteristics, Gram staining, and the pattern of biochemical profiles using standard procedures. Enterobacteria were identified by H_2S production and carbohydrate utilization tests on TSI agar, motility tests, urease tests, oxidase tests, indole tests, and citrate tests. E. coli was confirmed by determination of β-galactosidase activity.

For antimicrobial susceptibility testing, the methodology proposed by Montesdeoca et al. (15) was used with some modifications. The method used was the Kirby-Bauer disk diffusion method, using the following antibiotics: Ceftriaxone, Ampicillin/Sulbactam, Cefazolin, Gentamicin, Nitrofurantoin, Levofloxacin, Ertapenem, Ceftazidime, and Trimethoprim/Sulfamethoxazole. Isolates were classified as susceptible, intermediate, or resistant according to the standardized table provided by INCL (16).

The data resulting from this research were placed in an Excel 2016 spreadsheet, to which statistical analysis was applied using the program "EPI INFO" Version 7.2.5.0. Quantitative variables were analyzed with measures of central tendency and qualitative variables, in absolute and relative frequencies, with a 95% confidence interval.

The research project was approved by the Research and Bioethics Committee of the Central Hospital of Maracay. In this context, an informative talk was given to medical students. The anonymity of the participants was maintained, and those who tested positive for the presence of microorganisms in their samples were referred to a specialist to assign appropriate treatment.

123 medical students from different years of the program were interviewed; of that group, only 20 met the inclusion criteria for the study. The mean age was 21.9 ± 1.4 years, with an age range between 20 and 26 years. The entire sample consisted of women, representing 100% of the participants. The epidemiological results are presented in the following table.

Table 1. Epidemiological characteristics of the Medical Students of the Hospital Central de Maracay in the period March-September 2024

Variables	Freq. (n=20)	%	IC95%	
			Min. CI	Max. CI
Sex				
Female	20	100.00	83.16	100.00
Male	0	0.00	0.00	0.00
Academic year				
4th year	7	35.00	15.39	59.22
5th year	2	10.00	1.23	31.70
6th year	11	55.00	31.53	76.94
History of urinary tract infection				
Yes	16	80.00	56.34	94.27
No	4	20.00	5.73	43.66
Sexual activity				
Yes	19	95.00	75.13	99.87
No	1	5.00	0.13	24.87

Source: Own elaboration.

Regarding the academic year, 55% were in the final year of the degree (sixth year), 35% were fourth-year students, and the remaining 10% were in the fifth year. In terms of history of symptomatic and asymptomatic urinary tract infection, 80% of the students reported having a history, while 20% did not.

Finally, regarding sexual activity, 95% of the students indicated being sexually active (see Table 1).

Of the 20 urine cultures performed, it was found that the frequency of a possible BA was 25% of the samples, while in the remaining 75% no bacterial growth was observed. The bacteria that was present in 100% of the samples was Escherichia coli. (Table 2), for this reason it was decided to evaluate resistance patterns with this microorganism. This group of patients underwent a second urine culture to confirm the diagnosis.

Table 2. Frequency of possible asymptomatic bacteriuria and isolated bacteria in Medical Students of the Central Hospital of Maracay in the period March-September 2024

Frequency of students with possible asymptomatic bacteriuria	Freq. (n=20)	%	IC95%	
			Min. CI	Max. CI
Possible asymptomatic bacteriuria	5	25,00	8,66	49,10
Without asymptomatic bacteriuria	15	75,00	50,90	91,34

Source: Prepared by the authors.

The presence of E. coli in all cultures was to be expected, since this is a bacterium that normally colonizes the large intestine and under conditions of poor hygiene can colonize the vagina causing infections.

To determine the resistance of the different E. coli strains isolated in the cultures, tests were performed against a battery of commercially used antibiotics. All of the evaluated strains were sensitive to almost all antibiotics tested, with the exception of Trimethoprim/Sulfamethoxazole, where 80% sensitivity was observed, with 20% resistance. This indicates that 4 of the 5 samples where E. coli was isolated were sensitive to this antibiotic, while 1 sample showed resistance. (Table 3).

The presence of 20% resistance for Trimethoprim/Sulfamethoxazole does not coincide with the findings reported by Tamayo-Contreras et al. (14), who reported 50% resistance, and by Sosa et al. (19), who observed 70.5% resistance, nor with the record of PROVENRA (20), which reports resistance greater than 60% in urine culture samples for this combination of antibiotics.

Table 3. Antibiogram of susceptibility of the different strains of E. coli isolated from urine cultures of female medical students.

Isolated bacteria	Pattern	Antibiotics								
		Amp/Sul	Cef	Cefta	Ceftri	Erta	People	Levo	Nitro	TMP/SMX
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
E. coli.	S	5(100)	5(100)	5(100)	5(100)	5(100)	5(100)	5(100)	5(100)	4(80)
	I	-	-	-	-	-	-	-	-	-
	R	-	-	-	-	-	-	-	-	1(20)

The antibiotics were: Amp/Sul (Ampicillin/Sulbactam), Cefa (Cefazolin), Cefta (Ceftazidime), Ceftri (Ceftriaxone), Erta (Ertapenem), Gent (Gentamicin), Levo (Levofloxacin), Nitro (Nitrofurantoin), and Tri/Sul (Trimethoprim/Sulfamethoxazole). S: Sensitive. I: Intermediate. R: Resistant.
Source: Own elaboration

DISCUSSION

Since the study population consisted of university students, the average age observed (21.90±1.40 years) is consistent with that reported in other similar studies, such as Al Youssef et al. (13) with 20.56±1.36 years, and Fetene et al. (17) with 21.00±2.30 years. Regarding sexual activity, 95% of the patients were found to be sexually active. However, these results could not be compared with previous research (12,13,17,18) because none included that question in the epidemiological data sheet. The absence of this question may be associated with the culture of the countries where the studies were conducted, as sexual interaction before marriage is discouraged in Muslim religion, which may have affected the objectivity of the respondents. Nonetheless, this finding is important because trauma during intercourse and lack of prophylactic measures could be a reason for urinary tract infections (17).

The presence of E. coli in all cultures is common and consistent with previous reports from similar studies (12,13,17,18), in which this enterobacterium is the most common cause of urinary tract infections, followed by S. aureus. As an exploratory study, the sample size was small compared with similar studies in other countries. However, the results are positive, as the presence of 1 resistant strain in 1 student suggests that the hygienic-sanitary measures applied in the sanitary environment where they spend long hours are adequate. Another contribution of the study was the identification of the resistant strain and notification of the student, allowing her to take appropriate measures to prevent transmission of the microorganism to implements or clothing and subsequently to patients receiving care at the hospital, thus avoiding complications in their condition.

CONCLUSIONS

The results revealed a low frequency of possible asymptomatic bacteriuria. Escherichia coli was the most frequently isolated bacterium and showed high sensitivity to most antibiotics evaluated in the antibiogram, except for Trimethoprim/Sulfamethoxazole, for which resistance was observed. The low frequency of asymptomatic bacteriuria indicates that, although various factors are related to this entity, it is not always associated with significant bacterial growth.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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