NTU Journal for Administrative and Human Sciences (2024) : 245 - 262
DOI: https://doi.org/10.56286/ntujahs.

IRAQI Academic Scientific Journals

JAHS NTU

P-ISSN: 2789-1240 E-ISSN:2789-1259

NTU Journal for Administrative and Human Sciences

Available online at: https://journals.ntu.edu.iq/index.php/NTU-JMS/index

Prevalence of Bacterial Vaginitis among Women with IUD's

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Article Informations

Received:1. 05. 2024
Accepted:15.05. 2024
Published online: 01. 06. 2024

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Key Words:
IUDs,
Hormonal IUDs,
Copper IUDs,
Vaginitis,
PID

A B S T R A C T

A coil, also known as an intrauterine contraceptive device (IUCD or ICD), is a small birth control method that is put into the uterus to stop pregnancy. It usually starts in the endocervix and vagina and spreads up the body, causing endometritis, salpingitis, tubo-ovarian abscesses, parametritis, oophoritis, and/or pelvic peritonitis.The aim of the current study was to investigate the prevalence of bacteria causing vaginitis among women using different types of intra uterine devices

The study was conducted in Kirkuk city from November 1, 2023, to April 30, 2024, using high vaginal swabs from 186 fertile women using intrauterine devices (IUDs). Demographic, medical, and gynecologic histories were recorded, and all patients underwent pelvic examinations. Deep endocervical swabs were taken for microbiological analysis. The study included women aged 18-45 using IUDs, and excluded those who had received antibiotics, had preexisting systemic or infectious diseases, or experienced bleeding. Ethical approval was obtained, and informed consent was signed by all participants. The swabs were cultured on blood agar , MacConkey agar, Mnnitol salt agar and deman rosa sharpe agar and incubated at 37°C for 24 hours. The colonies were picked, purified, and identified through a series of biochemical tests, including Gram staining, motility tests, and enzyme and fermentation tests. The Vitek 2 system was used for microbial identification and susceptibility testing.In a study of 148 women using copper IUDs, 66 (44.59%) tested positive for vaginal swab cultures, while 82 (55.41%) tested negative. Similarly, among 38 women using hormonal IUDs, 17 (44.74%) had positive culture results, and 21 (55.26%) tested negative. Overall, out of 186 women tested, 83 (44.62%) had positive cultures. Among the 83 positive cases, 66 (79.52%) were in copper IUD users, and 17 (20.48%) were in hormonal IUD users. Escherichia coli was the most common bacterium, found in 40.91% of positive cultures, followed by Staphylococcus epidermidis (13.64%), and other bacteria including Staphylococcus aureus, Actinomyces israelii, and Proteus mirabilis, each at 9.09%. In women with positive cultures using copper IUDs, E. coli was most prevalent (47.06%), followed by Staphylococcus aureus and Staphylococcus epidermidis (17.65% each). Among women with positive cultures, 13.25% had diabetes, compared to 4.85% with negative cultures. Hypertension was present in 3.61% of women with positive cultures versus 1.94% with negative cultures. Duration of IUD use also showed a significant correlation with culture results. Women with positive cultures using copper IUDs had the highest percentage in the 1-2 year duration category (43.94%), while those using hormonal IUDs had the highest in the same category (47.06%). Antibiotic sensitivity testing revealed that Imipenem, Meropenem, Tigecycline, and Colistin were 100% effective against E. coli isolates from women using IUDs. However, high resistance rates were observed for Ampicillin/Sulbactam (71.79%) and Ciprofloxacin (84.62%). Ceftolozane/Tazobactam and Gentamicin had relatively high sensitivity rates, while Ceftazidime/Avibactam showed moderate sensitivity.

Introduction

A coil, also known as an intrauterine contraceptive device (IUCD or ICD), is a small birth control method that is put into the uterus to stop pregnancy. It is usually shaped like a T. It is important for an intrauterine device (IUD), which is the most popular form of long-acting reversible birth control, to be easy to use, cheap, safe, and effective. It works as well as surgical treatment, but it doesn't involve surgery, which is an added benefit (2). 22.8% of women who use birth control around the world do so with intrauterine devices (3). It's interesting that differences in geography, government policy, and the level of education of healthcare workers have a bigger effect on the practical use of IUC than medical eligibility criteria (4). Pelvic inflammatory disease is an infection problem that affects the upper genital tract in women. It usually starts in the endocervix and moves up to the vagina, causing endometritis, salpingitis, tubo-ovarian abscess, parametritis, oophoritis, and/or pelvic peritonitis (5). Lots of different things, including sexually transmitted diseases like Neisseria gonorrhoeae and Chlamydia trachomatis, are thought to cause PID. Some germs that live in the vaginal flora, like anaerobes, Gardnerella vaginalis, Haemophilus influenza, intestinal Gram-negative rods, and Streptococcus agalactiae, can also cause PID in some people. PID has a big effect on public health because it happens so often and can cause infertility, ectopic pregnancy, and ongoing pelvic pain. Most of the time, it happens to young, sexually active women who have had no children. Women between puberty and menopause are most likely to get pelvic inflammatory disease, which is the worst and most expensive STD in this area (7). These infections can be short-term, long-term, or severe, and they can lead to problems like infertility, ectopic pregnancy, pelvic adhesion, chronic pelvic pain, pelvic abscesses, and even premature birth (3). A pelvic infection is more likely to happen if you are older, sexually active, use a reproductive device, smoke, have a lower income, or have recently started seeing someone sexually (1). Microorganisms from the normal cervico-vaginal flora then colonize these devices and make biofilms, which are made up of layers of host cells and bacteria or fungi buried in a matrix material. A layer of exopolysaccharides is the main part of the biofilm that bacteria and/or fungus make. This layer is what controls how biomaterial-centered infections behave. Most of the time, antimicrobials and human phagocytes can't kill the biofilm bacteria. This is one reason why it's hard to treat illnesses caused by these microbes without taking out the devices(5,6). Women all over the world often get RTIs, or infections in the reproductive system. There are three types: "sexually transmitted diseases," "endogenous infections" (like bacterial vaginosis), and infections that happen during medical procedures that touch the genital tract, like unsafe abortion, pelvic examination, and IUD insertion (7, 8). Most women of childbearing age get bacterial vaginosis (BV) in their vaginal area(9). Many studies have found a link between using an IUD and BV. Some people think that the tail of the IUD might help bacteria that cause BV grow in the vaginal area. However, it has been suggested that having BV during the IUD insertion could also increase the chance of complications in the first three months of use, such as PID(10). The aim of the current study was to investigate the prevalence of bacteria causing vaginitis among women using different types of intra uterine devices

Materials and methods

This cross-sectional, privet clinics based study was conducted in Kirkuk city from 1st of November 2023 to end of April 2024.

High vaginal swabs were collected from 186 fertile women who attended the privet clinics in Kirkuk city (148 women used copper IUDs and 38 women using hormonal IUDs). Demographic, medical and gynecologic histories as well as information about duration of IUD use were obtained, and a pelvic examination was performed in all patients. For each patient Deep endocervical swabs samples were taken by swabs for microbiological study according to standard procedures of microbiology.

Inclusion criteria

- Women of reproductive age (18- 45) who used IUDs were included in the study

Exclusion criteria

- Any woman who has received antibiotic therapy for any reason during the preceding two weeks was excluded from the study.
- Patients with any preexisting systemic or infectious disease were excluded.
- Patients suffer from bleeding for any reason.

Ethical approval

Before participating in the project, each patient received detailed information about the study and signed an informed consent form

Methods

Isolation of bacteria from vagina

From November 2023 to April 2024, 211 high vaginal swabs were taken from women who went to Kirkuk privet clinics. Of these women, 148 used copper IUDs, 38 used hormonal IUDs, and 25 did not use any kind of IUD. The vaginal swabs collection had the following:

1-Part of the test package was opened.

2-The swab was carefully put into the vagina about 5 cm (2 inches) past the introitus and turned slowly for 10 to 30 seconds.

3-The swab was taken out without touching the skin after it hit the vaginal walls and soaked up the moisture.

4-The swabs were sent to the lab within an hour of being picked up.

5-Swabs were put in blood agar and MacConkey agar and left there for 24 hours (89).

The media were prepared and sterilized according to the manufacturer's instructions, used for isolation, viable count determination, identification, and susceptibility testing after solidification. Swabs were inoculated onto MacConkey, nutrient, and blood agars, and the inoculated plates were incubated at 37°C for 24 hours. The colonies grown on these media were then picked, purified, and identified according to standard procedures, which included a series

of biochemical tests to determine the characteristics and behaviors of the isolated bacteria.

Biochemical Tests and Diagnosis

A variety of tests were conducted to identify the bacterial isolates. Gram stains were prepared from bacterial colonies and examined under a light microscope. For the motility test, motility medium was inoculated and incubated at 37°C for 24 hours. The biochemical tests included:

- **Catalase Test:** Immediate release of oxygen bubbles upon adding hydrogen peroxide indicated a positive result.
- **Methyl Red Test:** A color change to red after adding methyl red solution indicated complete sugar hydrolysis and acid production.
- **Oxidase Test:** A color development within 10 seconds upon application of the oxidase reagent indicated a positive reaction.
- **Voges-Proskauer Test:** Formation of a pink to red color after adding VP reagents indicated a positive test.
- **Indole Test:** Formation of a pink ring after adding Kovac's reagent indicated a positive result.
- **Mannitol Fermentation Test:** Yellow color change indicated mannitol fermentation, typical of Staphylococcus aureus.
- **Citrate Test:** Color change from green to blue indicated a positive result.
- **Urease Test:** Color change to purple pink indicated urease production.
- **Carbohydrate Fermentation and Gas Production:** Color changes, gas, and H2S production indicated positive fermentation results.

Microbial Identification Using Vitek 2 System

The Vitek 2 system, an automated microbiology system, was used for microbial identification and susceptibility testing. It uses growth-based biotechnology and accommodates various reagent cards for different organism classes. The Vitek 2 system automates all necessary steps, including inoculation, incubation, and reading of identification cards. This automation enhances safety, reduces manual operations, and speeds up results.

To prepare the microorganism suspension, a sterile swab or applicator stick was used to transfer colonies into sterile saline. The turbidity was adjusted and measured using a turbidity meter. Identification cards were inoculated with the microorganism suspensions using an integrated vacuum apparatus. These cards were then incubated at 35.5 ± 1.0°C and read every 15 minutes. The Vitek 2 system provides rapid and reliable identification and susceptibility results, aiding in efficient bacterial analysis and diagnosis.

Statistical analysis.

Computerized statistically analysis was performed using IBM SPSS ver 23.1 statistic program. Comparison was carried out using Chi-square (X2).

Results

In Table 1, among the total of 148 women who used copper IUDs, 66 (44.59%) tested positive for the vaginal swab culture, while 82 (55.41%) tested negative.

Table 1: Vaginal swab culture results in women used copper IUD

Culture result of vaginal swab	Women used Cupper IUDs	
	No.	%
Positive	66	44.59%
Negative	82	55.41%
Total	148	100

Among the 38 women using hormonal IUDs, 17 (44.74%) tested positive for the vaginal swab culture, while 21 (55.26%) tested negative, Table 2

Table 2: Vaginal swab culture results in women used copper IUD

Culture result of vaginal swab	Women used hormonal IUDs	
	No.	%
Positive	17	44.74%
Negative	21	55.26%
Total	38	100%

Among those with copper IUDs, 66 cases (44.59%) tested positive for the culture, while 82 cases (55.41%) yielded negative results. Similarly, among women with hormonal IUDs, 17 cases (44.74%) showed positive culture results, while 21 cases (55.26%) were negative. Overall, out of 186 women tested, 83 cases (44.62%) were positive for the culture, and 103 cases (55.38%) were negative, irrespective of the type of IUD used. In the total of 83 positive culture cases, 79.52% (66) were observed in women using copper IUDs, while 20.48% (17) were observed in women using hormonal IUDs

Table 3: Comparison of vaginal swab culture results in women used copper and hormonal IUD

Culture result	used copper IUDs		used hormonal IUDs		Total	
	No.	%	No.	%	No.	%
Positive	66	44.59%	17	44.74%	83	44.62%
Negative	82	55.41%	21	55.26%	103	55.38%
Total	148	100%	38	100%	186	100%

Chi-square: 0.016 P-value: 0.98 (Non-siginifcant)

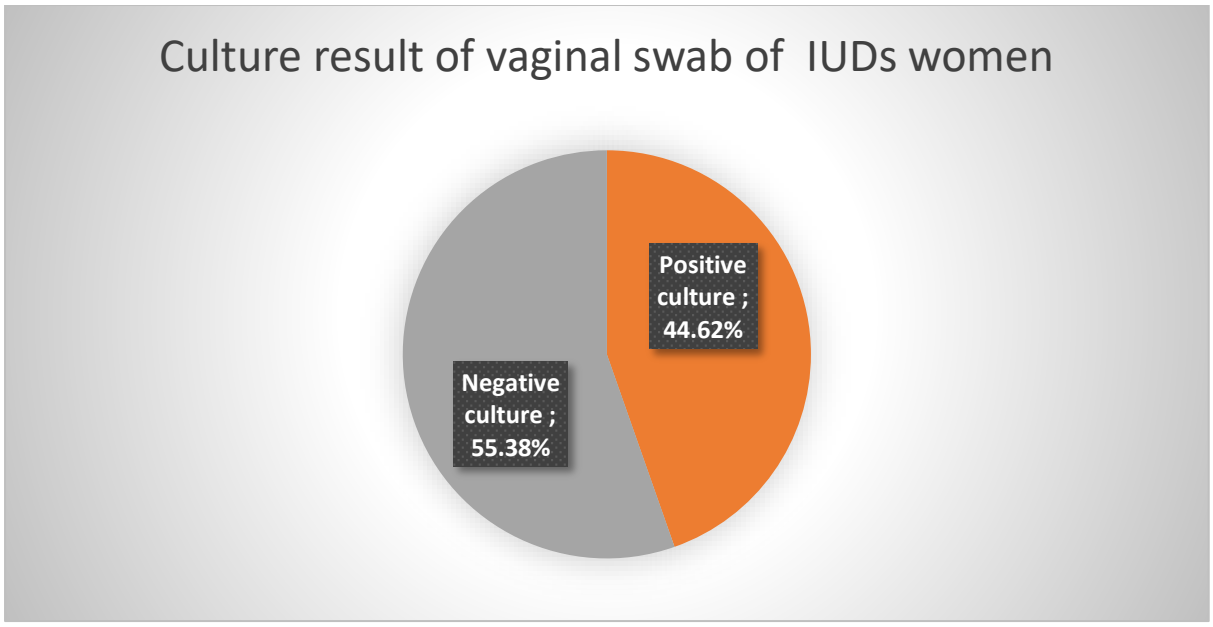

Figure 1: Vaginal swab culture results in women used IUDs

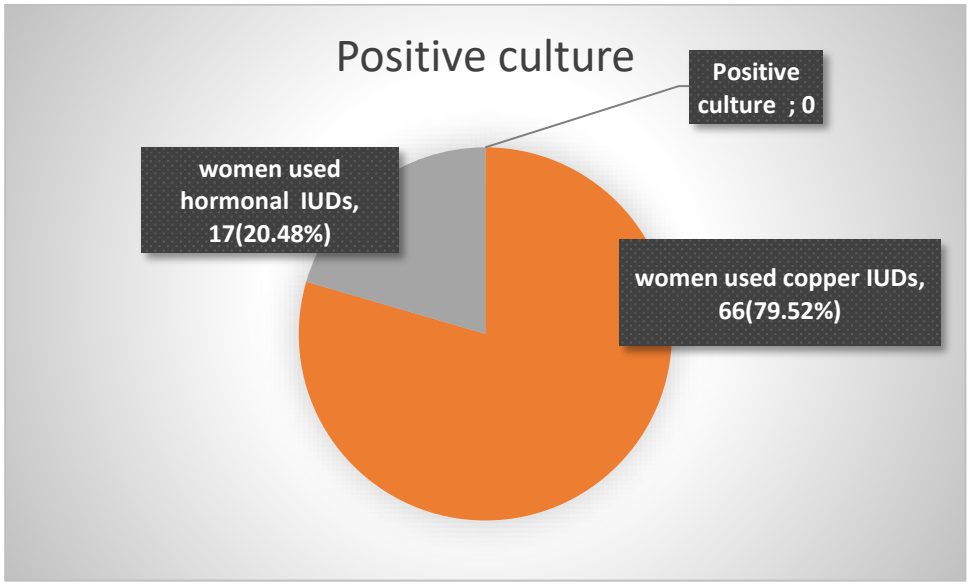

Figure 2: Frequency of positive vaginal swab culture results in women used copper and hormonal IUD

In the current study, Escherichia coli emerged as the predominant bacterium, constituting 27 (40.91%) of the total isolates. Following closely, Staphylococcus epidermidis was the next most frequently encountered bacterium, comprising 9 (13.64%) of the isolates. Staphylococcus aureus, Actinomyces israelii, and Proteus mirabilis were each identified in 6 (9.09%) cases. Klebsiella aerogenes and were present in 5 (7.58%) of the isolates, respectively. Acinetobacter lwoffii and Pseudomonas aeruginosa each accounted for 3 (4.55%) of cases. Enterobacter cloacae and Klebsiella oxytoca constituted 3.03% of the isolates, respectively.

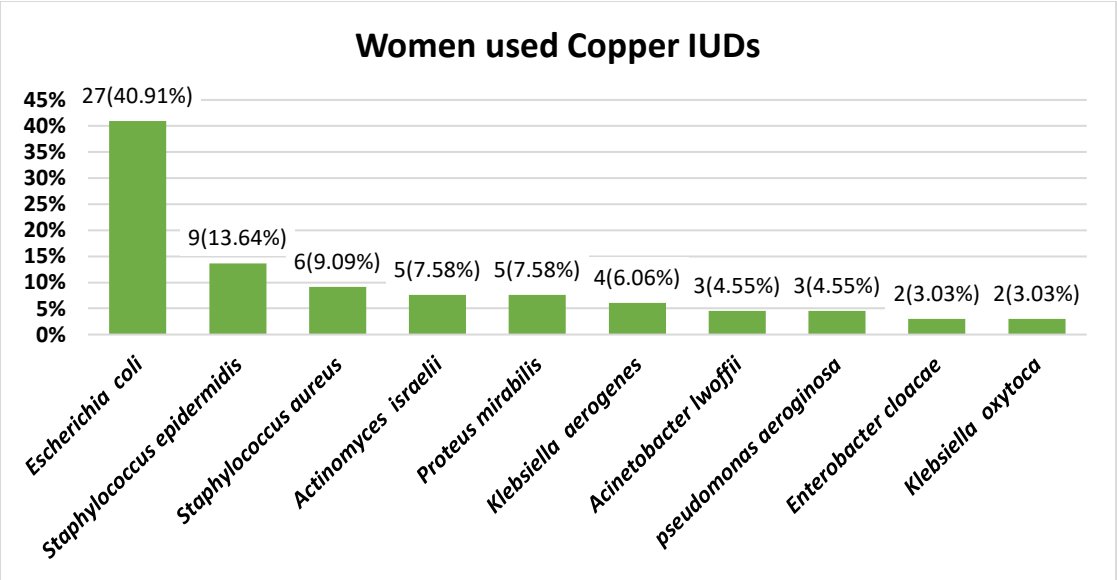

Figure 3: Isolated bacteria from vaginitis women used copper IUD

Escherichia coli constituted the majority at 47.06%, followed by Staphylococcus aureus and Staphylococcus epidermidis, both at 17.65%. Enterobacter cloacae, Klebsiella oxytoca, and Proteus mirabilis each represented 5.88% of the isolates

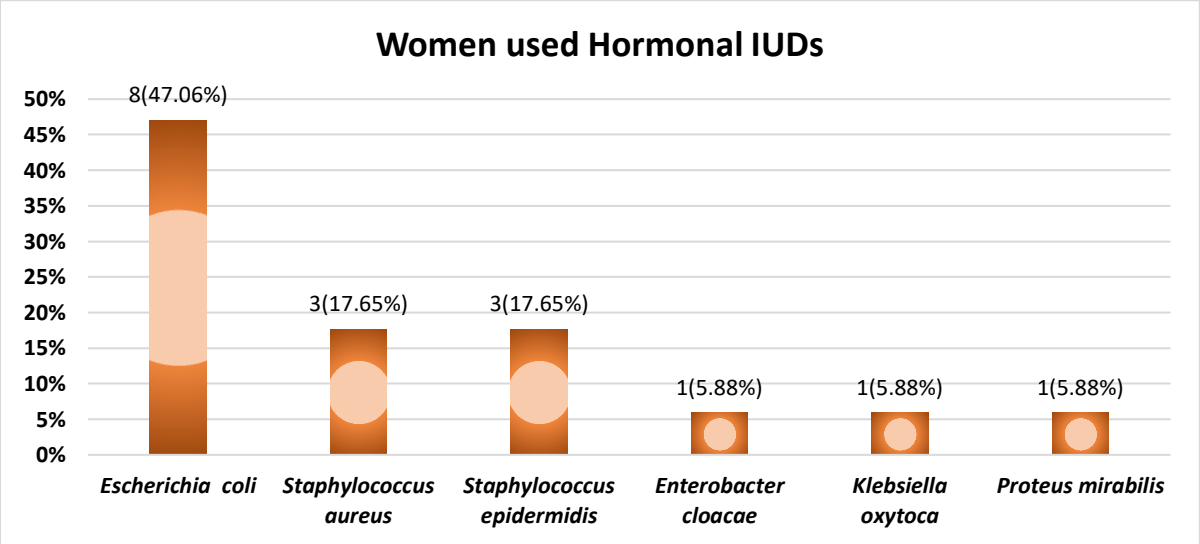

Figure 4: Isolated bacteria from vaginitis women used hormonal IUD

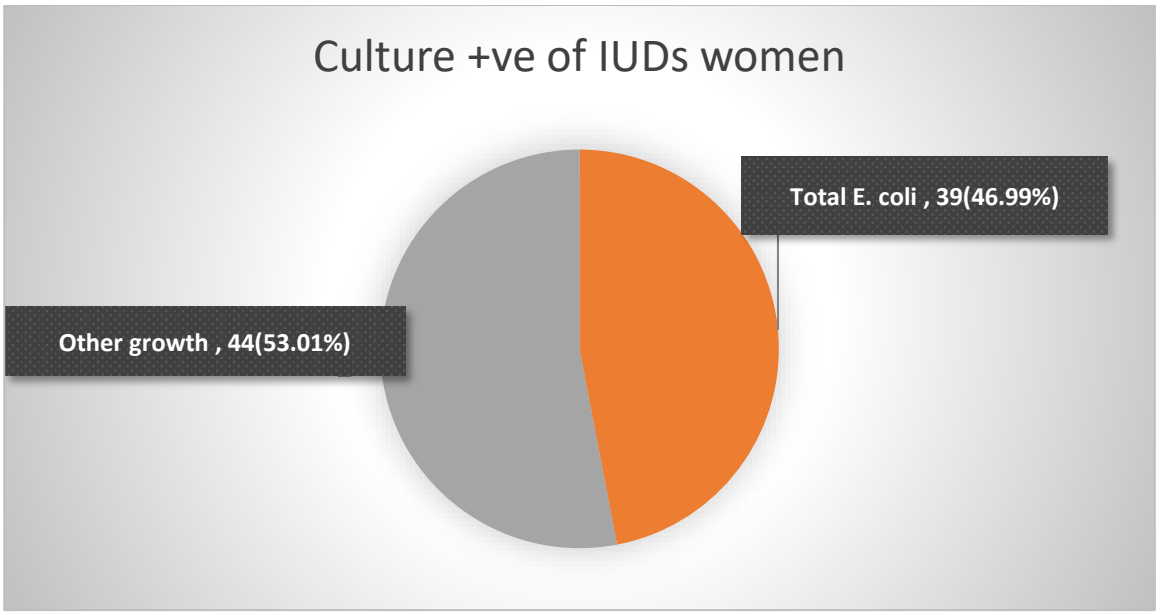

Figure 5: Frequency of E. coli from total isolated bacteria from IUDs women

Clinical features of vaginitis in women using copper and hormonal IUDs reveal significant differences in symptom presentation between those with positive and negative cultures. Among women with positive cultures, a significantly higher proportion reported experiencing burning sensation (65.06%) compared to those with negative cultures (20.39%). Similarly, abnormal vaginal discharge was more prevalent in women with positive cultures (84.34%) compared to those with negative cultures (17.48%). Vaginal dyspareunia was also more commonly reported among women with positive cultures (85.54%) compared to those with negative cultures (75.73%). Additionally, fever was reported by a higher percentage of women with positive cultures (31.33%) compared to those with negative cultures (20.39%). Vaginal itching was markedly more prevalent among women with positive cultures (83.13%) compared to those with negative cultures (10.68%). Lastly, pelvic pain was reported by a significantly higher proportion of women with positive cultures (87.95%) compared to those with negative cultures (12.62%)..

Table 4: Clinical features of women used IUDs regarding culture result

Clinical features		Women used IDs			P-value
		Positive culture	**Negative culture**	**Total**	
Burning	Yes	54(65.06%)	21(20.39%)	75(40.32%)	Chi-square: 38.1 P-value: 0.001
	No	29(34.94%)	82(79.61%)	111(59.68%)	
	Total	83(100%)	103(100%)	186(100%)	
Abnormal vaginal discharge	Yes	70(84.34%)	18(17.48%)	88(47.31%)	Chi-square: 37.4 P-value: 0.001
	No	13(15.66%)	85(82.52%)	98(52.69%)	
	Total	83(100%)	103(100%)	186(100%)	
Vaginal dyspareunia	Yes	71(85.54%)	78(75.73%)	149(80.11%)	Chi-square: 4.77 P-value: 0.041
	No	12(14.46%)	25(24.27%)	37(19.89%)	
	Total	83(100%)	103(100%)	186(100%)	

Fever	Yes	26(31.33%)	21(20.39%)	47(25.27%)	Chi-square: 4.91 P-value: 0.040
	No	57(68.67%)	82(79.61%)	139(74.73%)	
	Total	83(100%)	103(100%)	186(100%)	
Vaginal itching	Yes	69(83.13%)	11(10.68%)	80(43.01%)	Chi-square: 98.4 P-value: 0.001
	No	14(16.87%)	92(89.32%)	106(56.99%)	
	Total	83(100%)	103(100%)	186(100%)	
Pelvic pain	Yes	73(87.95%)	13(12.62%)	86(46.24%)	Chi-square: 104 P-value: 0.001
	No	10(12.05%)	90(87.38%)	100(53.76%)	
	Total	83(100%)	103(100%)	186(100%)	

Among women with positive cultures, 13.25% of those using IUDs had diabetes, whereas only 4.85% of those with negative cultures had diabetes. Similarly, for hypertension, 3.61% of women with positive cultures had hypertension, while only 1.94% of those with negative cultures had hypertension. Additionally, there's a substantial difference in the mean BMI between the two groups, with women with positive cultures having a higher mean BMI of 28.17 ± 3.92 kg/m2 compared to 23.57 ± 3.46 kg/m2 among those with negative cultures.

Table 5: Relation of IUDs using with some risk factors regarding culture result

Risk factors		Women used IDs			P-value
		Positive culture	**Negative culture**	**Total**	
Diabetes	Yes	11(13.25%)	5(4.85%)	16(4.30%)	Chi-square: 3.7 P-value: 0.91
	No	72(86.75%)	108(95.15%)	180(95.69%)	
	Total	83(100%)	103(100%)	186(100%)	
Hypertension	Yes	3(3.61%)	2(1.94%)	5(2.69%)	Chi-square: 37.4 P-value: 0.001
	No	80(96.39%)	95(92.23%)	175(94.09%)	
	Total	83(100%)	103(100%)	186(100%)	
BMI (kg/m^2)		28.17±3.92	23.57±3.46	25.17±3.02	T-test: 13.51 P-value: 0.001

The table presents a comparison of the duration of IUD usage among women with vaginitis who tested positive for cultures, distinguishing between those who used copper and hormonal IUDs. Among women with positive cultures, those using copper IUDs had the highest percentage in the 1-2 years duration category (43.94%), followed by less than 1 year (27.27%). In contrast, women with hormonal IUDs showed the highest percentage in the 1-2 years duration category (47.06%).

Table 6: Relation of IUDs duration of using with culture result

Duration of IUDs using (years)	Vaginitis women							
	Used cupper IUDs				Used hormonal IUD			
	Culture +ve		Culture -ve		Culture +ve		Culture -ve	
	No.	%	No.	%	No.	%	No.	%
<1	18	27.27%	10	12.20%	3	17.65%	2	9.52%
1-2	29	43.94%	22	26.83%	8	47.06%	5	23.81%
3-4	10	15.15%	13	15.85%	4	23.53%	5	23.81%
5-6	7	10.61%	27	32.93%	1	5.88%	5	23.81%
>6	2	3.03%	10	12.20%	1	5.88%	4	19.05%
Total	66	100%	82	100	17	100%	21	100%

Chi-square: 29.9 P-value: 0.005 (Siginifcant)

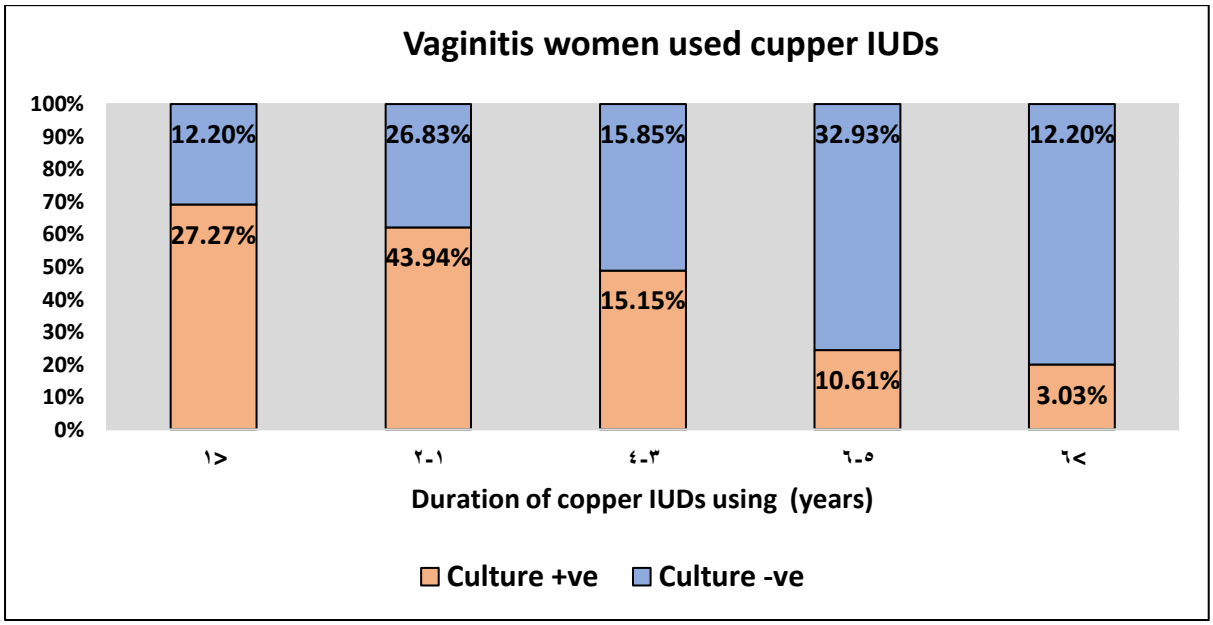

Figure 6: Relation of duration of copper IUDs usage among vaginitis women with cultures result

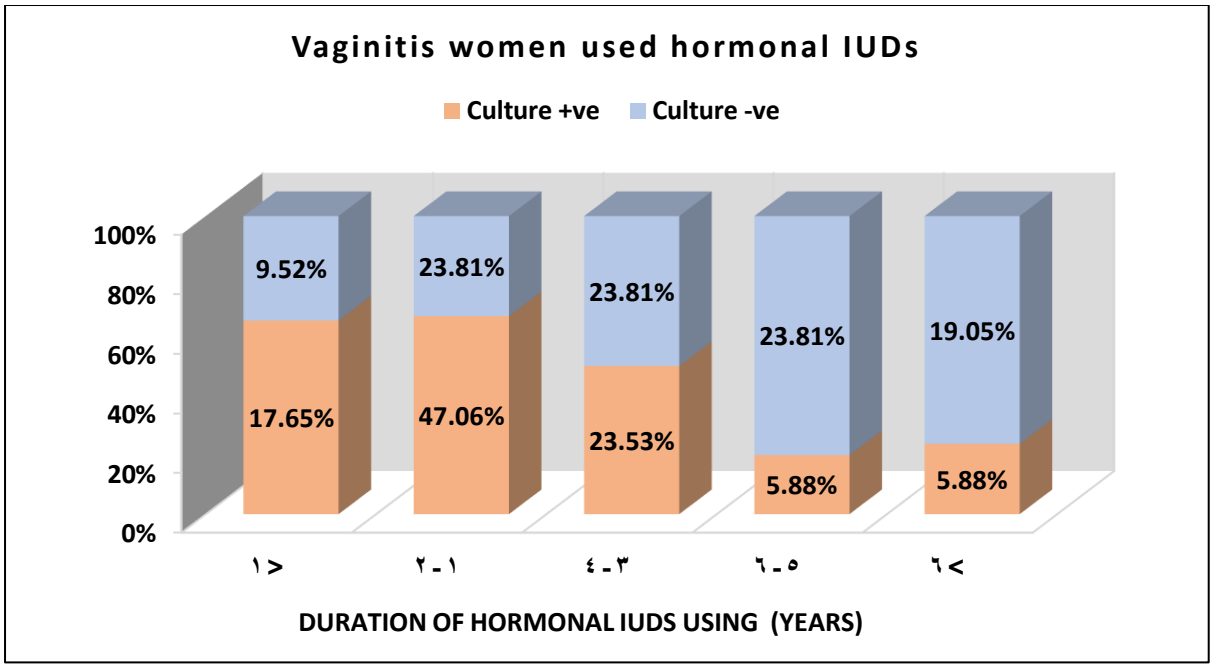

Figure 7: Relation of duration of hormonal IUDs usage among vaginitis women with cultures result

Table 7 presents the sensitivity and resistance patterns of various antibiotics against E. coli isolates obtained from women using intrauterine devices (IUDs). Remarkably, antibiotics including Imipenem, Meropenem, Tigecycline, and Colistin exhibited impeccable sensitivity, with all showing 100% effectiveness in inhibiting bacterial growth. In contrast, Ampicillin/Sulbactam and Ciprofloxacin demonstrated significantly higher resistance rates, with 71.79% and 84.62% resistance, respectively. Ceftolozane/Tazobactam and Gentamicin displayed relatively high sensitivity rates, while Ceftazidime/Avibactam showed moderate sensitivity.

Table 7: Antibiotics sensitivity of E. coli isolates obtained from women used IUDs

Antibiotics	Sensitive		Resistant	
	No.	%	No.	%
Imipenem	39	100%	0	0%
Meropenem	39	100%	0	0%
Tigecycline	39	100%	0	0%
Colistin	39	100%	0	0%
Ceftolozane/Tazobactam	34	87.18%	5	12.82%
Gentamicin	34	87.18%	5	12.82%
Ceftazidime/Avibactam	26	66.67%	13	33.33%
Amikacin	25	64.10%	14	35.90%
Piperacillin/Tazobactam	24	61.54%	15	38.46%
Ceftazidime	23	58.97%	16	41.03%
Cefotaxime	19	48.72%	20	51.28%
Trimethoprim/ Sulfamethoxazole	18	46.15%	21	53.85%
Ampicillin/Sulbactam	11	28.21%	28	71.79%
Ciprofloxacin	6	15.38%	33	84.62%

Discussion

This study found that 44.59% of women with copper IUDs had positive bacterial cultures and 55.41% had negative ones. In the same way, 44.74% of women with hormonal IUDs had good culture results and 55.26% had negative ones. Out of the 186 women who were checked, no matter what kind of IUD they used, 44.62% were positive for bacterial cultures and 55.38% were negative. Abid (5) found a similar study that agreed with ours. He found that 51% of women who use copper IUDs have a positive deep cervical swab for culture, compared to 44% of women who use other types, such as hormonal or barrier IUDs (control group). Several studies from the past have looked at how IUDs affect the usual flora in the vaginal area and can explain these results. Based on how it affected the spread of pathogenic microorganisms and the role of rising infection, one study linked this to the tail and string of the IUD. In a second study, the infection was linked to the IUD's mechanism of action. The IUD causes an inflammatory response that is thought to stop fertilization. At the same time, the IUD was seen as any other device or catheter, so it could cause infections related to foreign bodies (7). In contrast to what we found, Odaranle et al. (8) found that among women using different types of birth control, 8.1% of those using mixed hormonal birth control, 2.53% of those using the barrier method, and 1.97% of those using IUDs had bacterial infections. It's important to note that only 10% of the 50 women in the control group had bacterial illnesses. There are a few possible reasons why the results of our study and that of Odaranle et al. are not the same. First, differences in the study groups, such as their age, gender, where they live, and their socioeconomic status, may cause differences in how common bacterial infections are. The results might also be different because of changes in how the studies were done, such as sample size, sampling methods, and lab methods for finding bacteria. Also, the people who took part in the studies may have used different types of birth control between the two studies. This is because different types of birth control may have different effects on the vaginal microbiota and the risk of getting bacterial diseases. Other things, like sexual activity, hygiene habits, and underlying health problems, might also affect the number of bacterial infections and make the differences between studies even bigger (5,6). The study found that Escherichia coli was the most common type of bacteria, making up 27 (40.91%) of all the isolates. It was followed by Staphylococcus epidermidis and other types of bacteria. It was found in 5 (7.58%) of the samples, along with 4.5$ of Acinetobacter lwoffii and Pseudomonas aeruginosa. In line with our findings, Jabuk (9) found that Escherichia coli was isolated from 16% of women who used copper IUDs. This was followed by Staphylococcus aureus and Klebsiella pneumoniae at 12% and Proteus mirabilis and Acinetobacter lwoffii at 10% and 8%, respectively. A study by Ádám et al. (10) and Subha (11) found that E.coli was the organism that caused vaginitis in almost two-thirds of cases, followed by Klebsiella pneumoniae and Proteus mirabilis. Other research suggested that Staphylococcus aureus might only be organisms that cause local vaginal infections since they didn't show up in the endocervix and might not have been the cause of the upper genital tract infection that spread (12). In contrast, Dutta et al. (13) said that Staphylococcus aureus is one of several germs that have been linked to pelvic infections. Other research on vaginitis from the past few years also looked at microorganisms that got into the uterus when tools weren't properly sterilized. Escherichia coli and staphylococci were the most common

organisms that were linked to this problem(14,15). According to Ahmadi et al. (16), M. hominis made up 39.06% of the 128 bacterial samples from vaginitis cases, Escherichia coli made up 22.6%, Klebsiella pneumonia made up 14.8%, and Lactobacillus spp. made up 6.2%. This difference could be due to different ways of isolating and identifying the causes of vaginal diseases. The difference mentioned above could also be due to environmental factors or differences in the people who took part in the study (17). It's possible that these different microbial strains were found because the vaginal area is exposed to different amounts of gynecological and obstetric risks. When estrogens directly affect certain mechanisms, they cause an increase in vaginal glycogen, a decrease in vaginal pH, and easier adhesion to epithelial cells. This is linked to a high microbial colonization of the vagina (7). In our study of women with positive cultures, the reported symptoms were similar to those found by Abdelmonem et al. (18). They looked at 100 IUD users and reported symptoms like back pain, abdominal pain, irregular periods, and vaginal discharge. In a follow-up study of IUD users, those who had bacterial vaginosis also had vaginal discharge, vaginal dyspareunia, fever, vaginal itching, and pelvic pain (19). A lot of the people in our study had pelvic pain compared to the control group. This is similar to what other researchers have found: women using IUDs in different groups experience damage of the cervical spine (20,21). Neale et al. also found that women were much more likely to have problems with their vaginal fluid 4 to 6 weeks after getting an IUD (22). Several things may have caused the symptoms our study found in women with positive cultures, especially those who used intrauterine devices (IUDs). First, using an IUD has been linked to a higher chance of bacteria infections and pelvic inflammatory disease (PID). PID can show up as abnormal vaginal discharge, burning sensation, fever, itching in the vaginal area, and pelvic pain (8,9). Also, having an IUD in the uterus can sometimes cause irritation or inflammation in the area, which can cause vaginal itching, a burning feeling, and pain in the pelvis. Also, the pain or discomfort during sexual activity (dyspareunia) that is linked to IUDs could be caused by where the device is placed or other causes. Additionally, infections connected to IUD use can make current symptoms worse or cause new symptoms like fever, which shows a systemic response to infection. Lastly, cervical erosion, which is common in women who use IUDs, can make symptoms like vaginal flow and bleeding worse (16,17). Our study showed that women with positive cultures were more likely to have diabetes, especially those who used IUDs. This fits with what other study has found about a possible link between diabetes and a higher risk of vaginal infections. Studies have shown that people with diabetes may have weaker immune systems, which makes them more likely to get illnesses, even those in the reproductive tract. Additionally, having diabetes can lead to changes in vaginal bacteria, which can make it easier for infections to spread (23,24). In the same way, the fact that women with good cultures are more likely to have high blood pressure is interesting. There isn't a strong link between high blood pressure and infections in the reproductive tract, but high blood pressure can be a sign of other health problems or changes in the body that may weaken the immune system or make infections more likely to happen. Lifestyle choices, like diet and exercise, can also be linked to high blood pressure, which may indirectly affect the chance of getting infections (25). A higher body mass index (BMI) can weaken the immune system and cause inflammation, making people more likely to get illnesses. Besides that, adipose tissue can hold pathogens, which raises the chance of infection even more. This result matched those of other studies that found fat to be a risk factor for bacterial vaginosis in the vaginal area (26).

According to Daubert et al. (27) women who are overweight are less likely to have bacterial vaginosis. The fact that copper IUD users had the highest percentage in the group of having used it for one to two years suggests that this may be a key time for the development of vaginitis in copper IUD users. This finding fits with earlier study that said copper IUDs might change the vaginal flora and make it more likely for vaginal infections like bacterial vaginosis and yeast infections, especially in the first few years of use (28). Other research found that women who use copper intrauterine devices (Cu-IUDs) have a higher risk of bacterial vaginosis (BV). This higher risk lasts for up to 18 months after the user starts using a Cu-IUD. Importantly, they also showed that BV risk goes back to where it was before the Cu-IUD was used (18,19). The device may throw off copper ions that could upset the balance of vaginal microbiota. This could change the pH and make it easier for pathogenic germs to grow (28,29). Hormonal IUD users, on the other hand, had the biggest percentage in the 1-2 year duration group, showing a similar trend but with a slightly higher proportion in this timeframe than copper IUD users. Other studies (30,31) also came to the same conclusion, which showed that hormonal IUDs may also change the vaginal environment, though not as much as copper IUDs. Hormonal IUDs mostly work inside the uterus to stop pregnancy, but they can still change hormone levels and maybe even vaginal bacteria, especially in the first few years of use. It was amazing how well antibiotics like Imipenem, Meropenem, Tigecycline, and Colistin worked to stop the growth of germs. They were all 100% effective. But, Ampicillin/Sulbactam and Ciprofloxacin had much higher resistance rates, with 71.79% and 84.62% resistance rates, respectively. The sensitivity rates for Ceftolozane/Tazobactam and Gentamicin were pretty high, while the sensitivity rates for Ceftazidime/Avibactam were about average. Our results about how well different antibiotics stop bacterial growth are in line with what other research has found. This shows how important it is to test drug susceptibility in order to make sure that treatment plans work. Antibiotics like Imipenem, Meropenem, Tigecycline, and Colistin showed perfect sensitivity, which is in line with earlier research showing how well they work against a wide range of bacterial pathogens (31, 32, 33). Because they kill microbes so well and don't show much resistance, these antibiotics are usually only used for serious illnesses or cases of organisms that are resistant to more than one drug (31,34). On the other hand, resistance to Ampicillin/Sulbactam and Ciprofloxacin was much higher in our study, which is in line with what other studies have found (35). Resistance to these antibiotics is very common, which shows how important it is to be careful when using antibiotics and look at local resistance trends when choosing empirical therapy. In our study, Ceftolozane/Tazobactam and Gentamicin had pretty high sensitivity rates, which is in line with the fact that they are known to be effective against some Gram-negative bacteria (36,37). The sensitivity of ceftazidime/avibactam was modest, which is in line with its ability to kill multidrug-resistant Gram-negative bacteria, though resistance may still happen (38). These results make it clear how important it is to customize antibiotic therapy based on local susceptibility patterns and the unique traits of each patient in order to get the best results from treatment and stop antibiotic resistance from spreading. Also, the strong effectiveness of some antibiotics shows how important they are in fighting bacterial infections, especially those caused by organisms that are immune to multiple drugs (39). The fact that E. coli is very resistant to Ampicillin/Sulbactam and Ciprofloxacin shows that antibiotics should only be used with care, and people who use IUDs should think about other ways to treat vaginitis. These results are in line with world trends that show more and more E. coli isolates are

becoming resistant to antibiotics, especially when the infections keep coming back (40,41). E. coli bacteria found in women with vaginitis who use IUDs have become resistant to antibiotics. This could be because they have been exposed to antibiotics before, biofilm formation, or the selective pressure from the local flora (42.43). In addition, having an IUD may change the environment in the vaginal area, which could affect the growth of germs and how well antibiotics work (28).

Conclusions

1. The study reveals a significant proportion of women with copper and hormonal IUDs tested positive for vaginal infections, with Escherichia coli being the predominant bacterium isolated.

2. Significant differences were noted in the clinical presentation and comorbidities of women with positive cultures compared to those with negative cultures. Symptoms such as vaginal burning, abnormal discharge, dyspareunia, itching, pelvic pain, along with underlying conditions like diabetes and hypertension, were more prevalent among women with positive cultures.

3. study identified antibiotics with high sensitivity rates against E. coli isolates, such as Imipenem, Meropenem, Tigecycline, and Colistin, highlighting potential treatment options for IUD-associated infections caused by multidrug-resistant strains. Conversely, antibiotics like Ampicillin/Sulbactam and Ciprofloxacin demonstrated high resistance rates.

Recommendations

1. Healthcare providers should emphasize regular gynecological screenings and monitoring for vaginal infections in women using IUDs, with particular attention to clinical symptoms and risk factors associated with positive cultures.

2. Antimicrobial susceptibility testing should be routinely performed in cases of IUD-associated vaginitis to guide appropriate antibiotic therapy, considering both the prevalence of virulence factors and the resistance patterns of bacterial isolates.

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