



(RESEARCH ARTICLE)



EVALUATION OF MIXED CANDIDA AND BACTERIAL INFECTION IN WOMEN WITH VAGINITIS

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ABSTRACT

Background: Female genital tract infections, including vaginitis and cervicitis, are common infectious conditions that may be caused by a variety of bacterial and fungal microorganisms.

Aim of the Study: The aim of this study was to investigate the microbial agents associated with female genital tract infections. **Materials and Methods:** A total of 120 of high vaginal swabs (HVS) were collected from women aged 18–40 years who presented with clinical symptoms associated with female genital tract infections, including vaginitis and cervicitis, were enrolled in the study. The participants attended the private outpatient clinics in Kirkuk City during the period from November 2025 to August 2026.

Results: Among the 120 high vaginal swab specimens examined, 80 (66.7%) were positive, whereas 40 (33.3%) were negative. Among the positive specimens, bacterial isolates were the most frequently detected microbial group, accounting for 29 cases (36.3%), followed by mixed yeast and bacterial isolates in 20 cases (25.0%). Mixed bacterial isolates were detected in 16 cases (20.0%), while yeast isolates were identified in 15 cases (18.7%). Overall, bacterial-associated findings, including both single and mixed bacterial isolates, accounted for 45 cases (56.3%), whereas yeast-associated findings accounted for 35 cases (43.7%). Among the 20 specimens showing mixed bacterial and yeast growth, *Escherichia coli*, *Staphylococcus aureus*, and *Candida* spp. were the most frequent combination, detected in 7 cases (35%), followed by *Klebsiella pneumoniae* and *Candida* spp. in 5 cases (25%). The combinations of *E. coli* + *Candida* spp. and *Pseudomonas aeruginosa* + *Candida* spp. were each detected in 3 cases (15%), whereas *Proteus mirabilis* + *Candida* spp. was identified in 2 cases (10%).

Conclusion: The findings indicate a considerable occurrence of microbial agents among women with clinical symptoms of female genital tract infections.

Keywords: Female genital tract infection; High vaginal swab; Bacterial infection; *Candida* spp.

1 INTRODUCTION

The vagina's natural microbial flora is now thought to have a significant role in shielding the vagina from many pathogenic illnesses [1]. Aerobic vaginitis (AV), bacterial vaginosis (BV), and vulvovaginal candidiasis (VVC) are the three main vaginal disorders brought on by vaginal micro-ecological abnormalities. Infertility and poor pregnancy

outcomes can result from severe cases[2]. An infected or non-infectious inflammation of the vaginal mucosa that occasionally affects the vulva (external genitalia) is called vaginitis. Itching, burning, irritation, discharge, and discomfort are frequently brought on by this inflammation. Instead of the obligatory anaerobic bacteria that colonize the vagina in bacterial vaginosis, facultative bacteria populate the vagina in desquamative inflammatory vaginitis [3, 4].

Human vaginal infections are associated with significantly increased risk of preterm birth in women. If untreated, they can lead to pelvic inflammatory diseases (PID), which can cause tubal infertility, ectopic pregnancy, reproductive dysfunction, and adverse pregnancy outcomes (including preterm delivery and low birth weight) [5]. The bacteriological agents associated with vaginitis include a wide variety of bacteria that are dominated by overgrowth and marked by deficiency of hydrogen peroxide-producing *Lactobacilli* spp., the most bacterial agents causing vaginitis include *Staphylococcus aureus*, *Escherichia coli*, Group B streptococci (GBS), *Listeria monocytogenes*, *Klebsiella pneumoniae*, *Acinetobacter* spp., *Neisseria gonorrhoea*, and the bacteria that cause bacterial vaginosis in addition to *Chlamydia*[6]. In bacterial vaginosis (BV), the lactobacilli concentration decreases, while the bacterial load of other bacteria increases. A hallmark of BV is the presence of clue cells, now known as the result of a polymicrobial biofilm formed in vaginal epithelial cells [7].

Candidiasis is a common fungal infection among women during reproductive ages. Although, *Candida albicans* is accounted as the main etiologic agent of vaginitis. The yeast causes itchiness and a burning-sensation in the vagina tissues, a white cheesy discharge. Non-*albicans* species have arisen during last years. Resistant to antifungal drugs especially, fluconazole has been more reported by researchers from around the world[8]. Fungi are known to form biofilms, biofilms of fungal origin are important aspects of human infection and fungal pathogenicity, as the fungal infection is more resistant to antifungals[9].

2 MATERIALS AND METHODS

2.1 Subject

A total of 120 of high vaginal swabs (HVS) were collected from women aged 18–40 years who presented with clinical symptoms associated with female genital tract infections, including vaginitis and cervicitis, were enrolled in the study. The participants attended the Private outpatient clinics in Kirkuk City during the period from November 2025 to August 2026

2.2 Sampling Collection

The patients were clinically diagnosed by specialist doctors as suffering from recurrent vaginitis. With an assistance of clinicians the specialist doctors, sterile unlubricated speculum was inserted into the vagina after the patient had washing the genital area with water and soap to avoid contamination by normal flora and specimens were collected from the lateral vaginal wall and posterior fornix using sterile cotton-tipped swabs rotated there before withdrawing them.

The swab with transport media (amies) to keep it moist until taking to the laboratory. Cultured aerobically on Blood Agar, MacConkey Agar, Mannitol Salt Agar and Sabouraud Dextros Agar (SDA), then incubated at 37°C for a period of (24-48) hours.

2.3 Morphological and microscopic identification for bacteria and yeast

Morphological Examination, Gram stain, Biochemical Tests: (Catalase test, Oxidase Test, Coagulase Test, Carbohydrates Fermentation and Gas Production, Citrate Utilization Test, Urease Production Test, Mannitol Motility Test, Indole Production test). For isolated bacteria primarily identified by phenotypic characteristics such as colony color, texture, and hemolytic ability. Microscopically, the isolates were examined with an oily lens after fixing them with heat on the surface of the glass slides and staining them with a gram dye, in order to distinguish the staining ability, the shape and arrangement of bacteria [10].

3 RESULTS

The results of the high vaginal swab (HVS) examination are presented in Figure (1). A total of 120 vaginal swab specimens were examined. Among these, 80 specimens (66.7%) were positive, whereas 40 specimens (33.3%) were negative. Thus, positive findings were detected in approximately two-thirds of the examined vaginal samples.

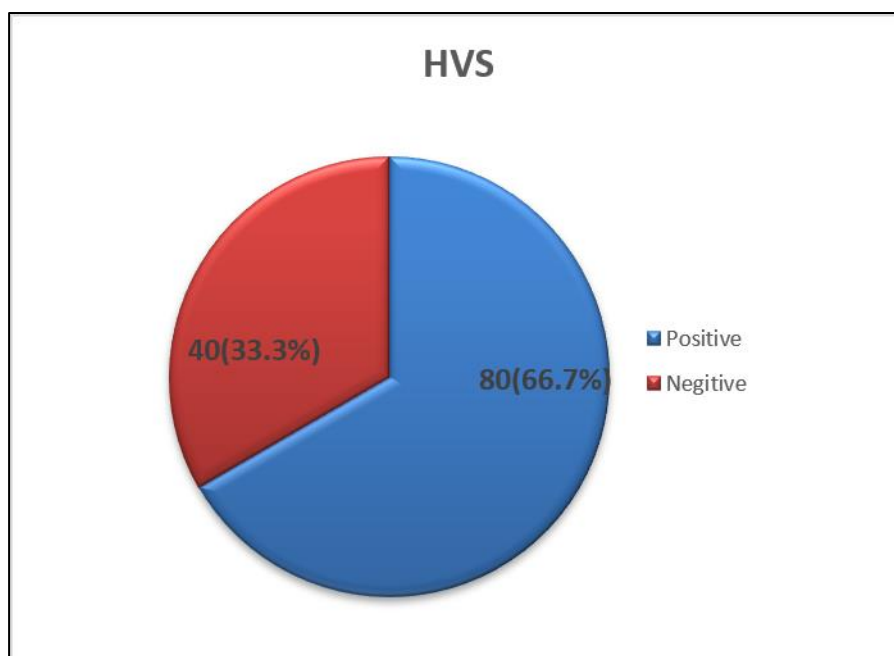


Figure 1: Results of HVS Culture of the patients

The distribution of microbial isolates recovered from the 80 positive high vaginal swab specimens is presented in Table (1). Bacterial isolates were the most frequently detected microbial group, accounting for 29 cases (36.3%), followed by mixed yeast and bacterial isolates, which were detected in 20 cases (25.0%). Mixed bacterial isolates were identified in 16 cases (20.0%), whereas yeast isolates were detected in 15 cases (18.7%). Overall, bacterial-associated findings, including both single and mixed bacterial isolates, accounted for 45 cases (56.3%), while yeast-associated findings accounted for 35 cases (43.7%).

Table 1: Types of microbial isolates

Microbial isolates groups	No.	%
Bacterial isolates	29	36.3
Mixed bacterial isolates	16	20
Yeast isolates	15	18.7
yeast and bacteria isolates	20	25
Total	80	100

The distribution of mixed bacterial and yeast growth among the examined specimens is presented in Table (2). A total of 20 specimens showed mixed growth involving bacterial species and *Candida* spp. The most frequently detected combination was *E. coli* + *Staphylococcus aureus* + *Candida* spp., accounting for 7 cases (35%), followed by *Klebsiella pneumoniae* + *Candida* spp., which was detected in 5 cases (25%). The combinations of *E. coli* + *Candida* spp. and *Pseudomonas aeruginosa* + *Candida* spp. were each identified in 3 cases (15%), while *Proteus mirabilis* + *Candida* spp. was detected in 2 cases (10%). These findings demonstrate considerable diversity in the bacterial–yeast combinations recovered from the examined vaginal specimens.

A total of 80 microbial isolates were recovered from the examined samples, comprising Gram-negative bacteria, Gram-positive bacteria, and *Candida* spp. Among all isolates, *Candida albicans* was the most frequently isolated microorganism, accounting for 18 isolates (22.5%), followed by *Escherichia coli* with 10 isolates (12.5%). Both *Staphylococcus aureus* and *Candida glabrata* were isolated at a frequency of 9 isolates (11.3%) each. *Klebsiella pneumoniae* and *Candida krusei* were each detected in 5 isolates (6.3%), whereas the remaining microbial species were detected at lower frequencies ranging from 1.3% to 3.8%. Table (3)

Among the Gram-negative bacterial isolates, *E. coli* was the predominant species, representing 12.5% of the total isolates, followed by *K. pneumoniae* at 6.3%. *Pseudomonas aeruginosa* accounted for 3.8%, while *Proteus mirabilis*,

Acinetobacter baumannii, *Serratia marcescens*, and *Gardnerella vaginalis* each represented 2.5%. The least frequently isolated Gram-negative bacteria were *Klebsiella oxytoca* and *Pantoea agglomerans*, each accounting for 1.3%.

Table 2: Numbers and percentage of mix growth of bacteria and yeast

Mix growth of bacteria and yeast	No	%
<i>E. coli</i> + <i>Candida</i> spp.	3	15
<i>P.mirabilis</i> + <i>Candida</i> spp.	2	10
<i>K pneumonia</i> + <i>Candida</i> spp.	5	25
<i>E. coli</i> + <i>Staph.aureus</i> + <i>Candida</i> spp.	7	35
<i>P. aeruginosa</i> + <i>Candida</i> .spp	3	15
Total	20	100

Regarding the Gram-positive bacterial isolates, *S. aureus* was the most frequently detected species, with 9 isolates (11.3%). *Enterococcus faecalis*, *Staphylococcus epidermidis*, and *Micrococcus luteus* were each represented by 2 isolates (2.5%), whereas *Streptococcus agalactiae* and *Listeria monocytogenes* were each detected in 1 isolate (1.3%).

Among the *Candida* species, *C. albicans* was the predominant yeast, accounting for 18 isolates (22.5%), followed by *C. glabrata* with 9 isolates (11.3%), *C. krusei* with 5 isolates (6.3%), and *C. tropicalis* with 3 isolates (3.8%). Overall, Gram-negative bacteria comprised 28 isolates (35.0%), Gram-positive bacteria comprised 17 isolates (21.25%), and *Candida* spp. accounted for 35 isolates (43.75%). These findings demonstrate considerable microbial diversity among the examined samples, with *C. albicans* representing the most prevalent individual microorganism.

Table 3: Numbers and Percentages of isolated species from the patient vaginal swabs

Microbial species	No.	%
<i>Gram negative isolates</i>		
<i>Escherichia coli</i>	10	12.5
<i>Klebsiella pneumonia</i>	5	6.3
<i>Klebsiella oxytoca</i>	1	1.3
<i>Proteus mirabilis</i>	2	2.5
<i>Acinetobacter baumannii</i>	2	2.5
<i>Pseudomonas aeruginosa</i>	3	3.8
<i>Serratia marcescens</i>	2	2.5
<i>Gardnerella vaginalis</i>	2	2.5
<i>Pantoea agglomerans</i>	1	1.3
<i>Gram-positive isolates</i>		
<i>Staphylococcus aureus</i>	9	11.3
<i>Enterococcus faecalis</i>	2	2.5
<i>Staph. Epidermidis</i>	2	2.5
<i>Streptococcus agalactia</i>	1	1.3
<i>Micrococcus luteus</i>	2	2.5
<i>Listeria monocytogenes</i>	1	1.3
<i>Candida</i> spp.		
<i>C. albicans</i>	18	22.5

<i>C. glabrata</i>	9	11.3
<i>C. krusei</i>	5	6.3
<i>C. tropicalis</i>	3	3.8
Total	80	100

4 DISCUSSION

The present study showed that 80 (66.7%) of the 120 vaginal swab specimens were positive for *Trichomonas vaginalis*, whereas 40 (33.3%) were negative. The present finding differs from that reported in an Iraqi study conducted in Duhok, where *T. vaginalis* was detected in 2.4% of vaginal swabs by wet-mount microscopy. The lower prevalence reported in that study may be partly related to differences in the study population and, importantly, the diagnostic method used [11].

More recently, a study conducted among married women in Duhok examined 400 vaginal swabs and detected *T. vaginalis* in 24 samples by direct smear examination, demonstrating that the parasite continues to be detected among women with vaginal infections in the Iraqi population [12].

These results came close to what the researchers [13] in Mousel City who found 14.4% from 250 cultivated swab were mixed growth between Candida and bacteria, and 5.2% were mixed bacterial growth, also researcher [6] found that there were (35) mixed bacterial growth of a total (130) samples of pregnant and non-pregnant women with vaginitis. In females, the vagina plays an important key role in the pathogenesis of UTIs and the intestinal normal flora is the ultimate source of bacterial strains causing pyelonephritis or cystitis in the majority of cases. The pathogenesis of UTI is a colonization of the vaginal area and periurethra with uropathogens, and ascension of uropathogens via the urethra to the bladder or kidneys to cause infection [14]. A study by [15] were showed that the prevalence of infection among of women, is due to a decrease of normal vaginal flora (*Lactobacilli*), less acidic pH of vaginal surface, short and wide urethra and proximity of the urethra to anus.

The results of the current study showed that the percentages of infection with yeast were 28.2%, while the mixed infections between bacteria and yeast were 14.7%. The current results agree with the study carried out by [15], who referred that the patients that have positive culture for opportunistic microorganisms were (74%), which is composed of (29.7%) of *S. aureus*, (17.6%) of *E. coli*, (4.0%) of *Strep. fecalis*, (23%) mixed infections, and (25.7%) of *C. albicans*.

The study included the presence of mixed microbial isolates. Mixed vaginitis is defined as the simultaneous presence of at least two different vaginal pathogens, both contributing to an abnormal vaginal milieu leading to signs and symptoms. In coinfection, although two pathogens are identified, a potential pathogen may be present but may not be a cause of existing vaginal symptoms. Approximately 20–30% of women with bacterial vaginosis are coinfecting by the *Candida* species [16].

5 CONCLUSION

The findings indicate a considerable occurrence of microbial agents among women with clinical symptoms of female genital tract infections. Bacterial-associated infections were more frequently detected than yeast-associated infections, while mixed bacterial–yeast infections represented an important proportion of positive vaginal specimens. The predominance of mixed infections, particularly combinations involving *E. coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Candida* spp., highlights the diversity of microorganisms associated with female genital tract infections and supports the importance of laboratory-based identification of the causative agents for appropriate clinical management.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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