Microorganisms in Urine Sediment: A review

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Abstract

In health, the urinary tract is sterile, i.e., no microorganisms are present. Consequently, the presence of Bacteria like Escherichia coli, yeast like Candida, Trichoonads like Trichomonas vaginalis, or other parasites in urine indicates an infection or that contamination occurred during the collection process.

Keywords: urinary tract, Bacteria, parasites, wroms

1. Bacteria

Observing bacteria in the urine sediment requires high-power magnification Figure (1),Table (1) The most commonly encountered bacteria in urine are rod shaped (bacilli), but coccoid forms can also be present. These microorganisms can vary in size from long, thin rods to short, plump rods. They may appear singly or in chains, depending on the species present. In wet preparations, their motility often distinguishes bacteria from amorphous substances that may be present. Because the skin, vagina, and gastrointestinal tract normally contain bacteria, the presence of bacteria in urine often reflects contamination from these sources.

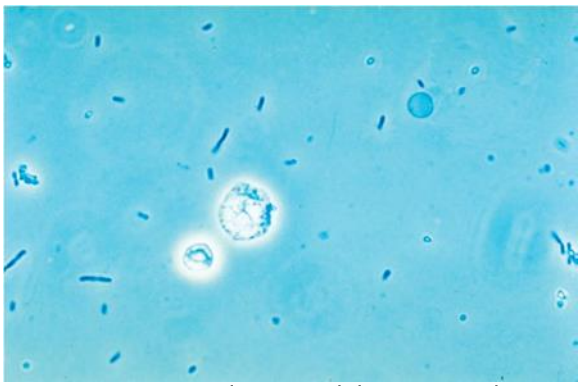

Figure: 1: Urine sediment with bacteria (rods), two erythrocytes, and a leukocyte, Phase contrast, 400X.

Table 1	Microorganisms in Urine Sediment	
Organism	**Characteristic Features**	**UA Correlations**
Bacteria	Bacilli (rods) or cocci (spheres) Single organisms, in chains, or in groups (e.g., diplococci, tetrads)	WBCs increased; WBC clumps and macrophages with severe infection LE +/− Nitrite +/−
Yeast	Ovoid, colorless, refractile cells No nucleus Characteristic budding forms Pseudohyphae may be present	WBCs increased LE +/−
Trichomonads	Pear-shaped organisms Average length ≈15 µm 4 anterior flagella, 1 posterior axostyle, undulating membrane Identify based on characteristic flitting or jerky motion	WBCs increased, WBC clumps present LE +/−
Other (parasites)	Enterobius vermicularis (pinworm) Football-shaped or ovoid eggs 50-60 µm long by 20-30 µm wide Transparent cell wall, larva visible inside	None; fecal contaminant
	Giardia lamblia Ovoid eggs 8-12 µm long Smooth, well-defined cell wall	None; fecal contaminant
	Schistosoma haematobium Football-shaped or ovoid eggs with a spike at one end Thick, transparent cell wall; larva visible inside	Blood positive RBCs increased

Bacteria are reported as few, moderate, or many per high-power field. Because urine from normal healthy individuals is sterile, the presence of bacteria in the urine sediment implies a UTI or urine contamination. Bacteria most often ascend the urethra to cause a UTI. They can also be present because of a fistula "a narrow pathway" between the urinary tract and the bowel. In addition, contaminating bacteria multiply rapidly in improperly stored urine. Therefore the presence of bacteria has clinical significance only if the urine specimen has been properly collected and stored.

For urine sediment in which identification of bacteria is difficult, a cytospin preparation followed by Gram

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staining could be performed. During UTI, bacteriuria usually is accompanied by leukocytes in the urine sediment. When significant bacteriuria is present without leukocytes, the specimen collection and handling should be investigated.

2. Yeast

Yeasts are ovoid, colorless cells that can closely resemble RBCs **(Figure: 2)**. More refractile than erythrocytes, yeasts often have characteristic budding forms and pseudohyphae **(Figure: 3)**. Yeasts can vary in size, and some species are very large (10 to 12 µm). Yeasts do not dissolve in acid and usually do not stain with supravital stains; these two characteristics can aid in differentiating them from erythrocytes.

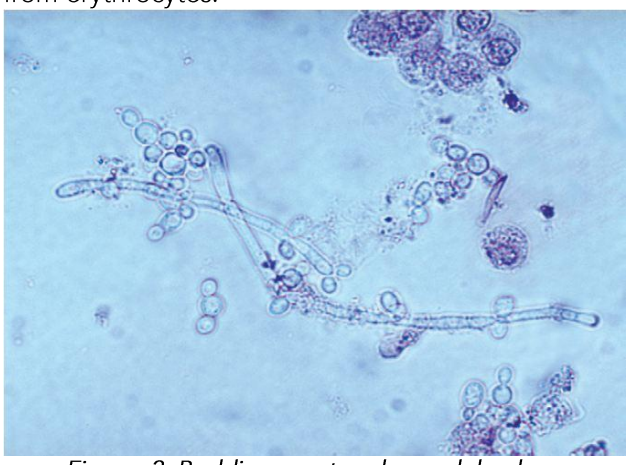

Figure: 2: Budding yeast and pseudohyphae, Leukocytes are also present singly and as a clump. Brightfield, Sedi Stain, 400X

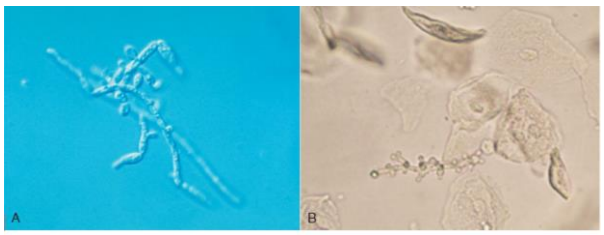

Figure: 3: Pseudohyphae development by yeast. A. Interference contrast, 400x. B. Brightfield, 400X.

In women, yeast in the urine sediment most often indicates contamination of the urine with vaginal secretions. However, because yeasts are ubiquitous "present in the air and on skin" their presence could indicate contamination from these sources. Although infrequent, primary UTIs resulting from yeasts are possible, hence health care providers must correlate the finding of yeast with the patient's clinical picture to determine whether an actual infection, vaginal or urethral, is present. Certain situations such as pregnancy, use of oral contraceptives, and diabetes mellitus promote the development of vaginal yeast infection.

The most commonly encountered yeast in urine sediment is Candida albicans. The characteristic budding and the development of pseudohyphae make C. albicans readily identifiable as yeast. Another species found less frequently is C. glabrata, formerly called Torulopsis glabrata. This species does not form pseudohyphae, and these yeast cells may be found phagocytized within white blood cells (Figure: 4). In immunosuppressed patients, systemic Candida infections are common; for some unknown reason, yeasts have a predilection for the kidneys. During the microscopic examination, only the presence of yeast can be determined; identification of the species present requires fungal culture.

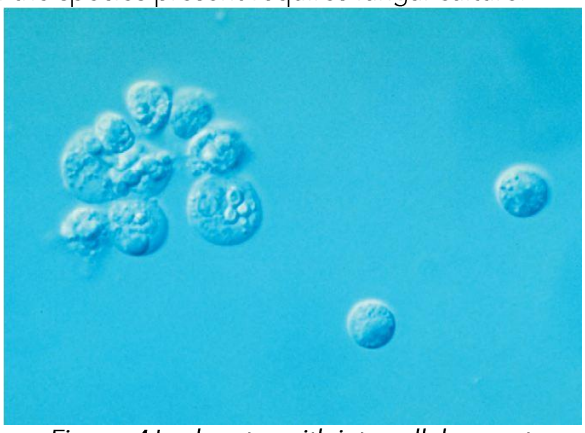

Figure: 4 Leukocytes with intracellular yeast, Interference contrast, 400X.

A KOH preparation is often used to detect yeast, hyphae, and other fungal cells in vaginal secretions.

Trichomonas Vaginalis

Trichomonads, protozoan flagellates, can be observed in the urine sediment. Trichomonads appear as turnip-shaped flagellates whose unicellular bodies average 15 µm in length, although organisms as small as 5 µm and as large as 30 µm are possible. They have four anterior flagella, a single posterior axostyle, and an undulating membrane that extends halfway down the body of the organism. The beating flagella propel the organism while the undulating membrane rotates it. The result is a characteristic flitting or jerky motility in wet preparations. Because of their similarity in size to both leukocytes and renal tubular cells, this motility is critical for their identification (Figure: 5).

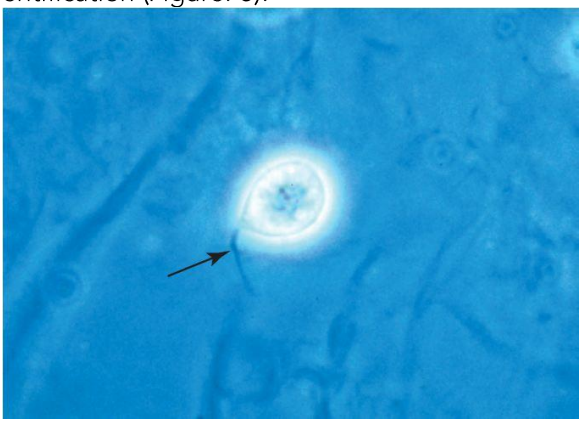

Figure: 5 A trichomonad in urine sediment, Because of their rapid flitting motion, only one of the flagella is visible in this view (arrow). Mucus, white blood cells, and other trichomonads are present but are not in focus at this focal plane, Phase contrast, 400X.

Trichomonas vaginalis is the most common cause of parasitic gynecologic infection in female patients. Transmitted sexually, trichomonads most frequently

represent an infection of the vagina and/or urethra, and their presence in the urine often indicates contamination with vaginal secretions. In male patients, trichomonad infections of the urethra are usually asymptomatic. In either case, when observed in urine sediment, trichomonads are not quantitated but are simply reported as present.

Urine is not an optimal medium for trichomonads. Because their characteristic motility provides the best means of positively identifying them, a fresh urine specimen is needed. Once in urine, trichomonads proceed to die, first losing their motility; later, their undulating membrane ceases, and eventually they ball up to resemble white blood cells or renal tubular epithelial cells. With loss of motility or movement of the undulating membrane, differentiation from other cells in the sediment can be impossible. Supravital stains do not enhance trichomonad identification, whether they are dead or alive. Whereas phase-contrast microscopy and interference contrast microscopy permit enhanced imaging and visualization of the flagella and undulating membranes of trichomonads, these techniques depend on movement to identify the organisms specifically.

3. Parasites

Several parasites, in addition to trichomonads and yeast, can be observed in the urine sediment. The eggs or ova of Enterobius vermicularis (pinworm) can be found in urine from school-aged children; however, individuals of any age can be infected. The adult female pinworm lays eggs in the area around the rectum; this causes itching. Consequently, the eggs can be present in urine sediment if the specimen is contaminated during collection. Pinworm eggs are characteristically American football–shaped, with one side appearing flatter. They are large, transparent cells (50 to 60 µm long; 20 to 30 µm wide), and the developing larva can be seen inside (Figure: 7).

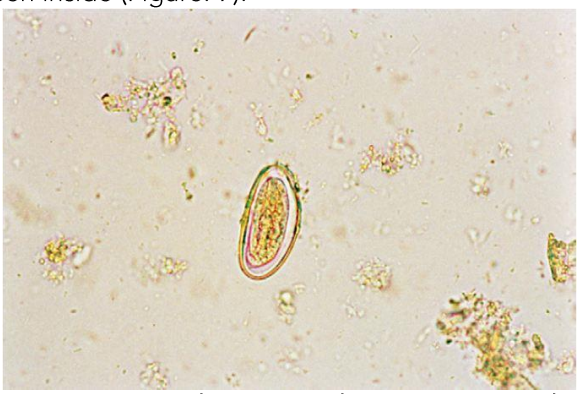

Figure: 7 An Enterobius vermicularis egg, unstained wet mount, Note its oval shape with a slightly flattened side and the developing larva within.

Cysts of Giardia lamblia may be observed in urine sediment as the result of fecal contamination of infected individuals. Giardiasis is most often acquired by drinking contaminated water. It can occur from inadequate sanitation of city water supplies or from contamination of fresh water lakes and streams. Giardia organisms have contaminated recreational water sources such as swimming pools and water parks. The cysts are small; ovoid cells about 8 to 12 µm in length, with smooth, welldefined cell walls (Figure: 8). When viewing using brightfield microscopy and high power (400X) magnification, the cytoplasm appears to be filled with nuclear material, but distinct nuclei (up to four) usually are not apparent without specific staining.

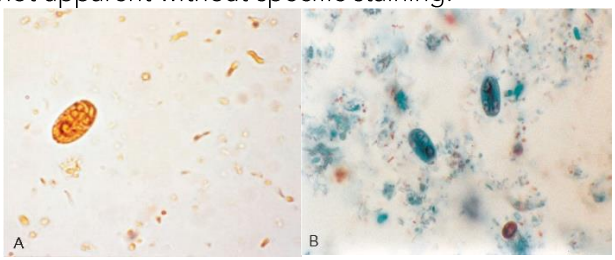

Figure: 8 Cysts of Giarda lamblia. A. A single Giardia lamblia cyst, unstained. B. Two Giardia lamblia cysts, trichrome stained.

Finally, the eggs of the blood fluke Schistosoma haematobium can be present in urine sediment. Schistosomiasis is endemic in Africa and the Middle East and is acquired upon exposure to water where infected snails live (e.g., fishermen, swimmers, workers in irrigation canals). Infections are most often diagnosed when the eggs are found in urine sediment or in biopsies of the bladder, rectum, or vaginal wall. Schistosoma eggs are distinctively large (100 to 170 µm long and 40 to 70 µm wide) and shaped like an American football with a spike at one end (Figure: 9). Their cell walls are thick but transparent, revealing the larva that fills its interior. Hematuria is often present as well.

Figure: 9 A Schistosoma haematobium egg, unstained wet mount Note the terminal spine on this large, American football shaped egg.

4. Conclusion

it is important to note that urine analysis is a vital tool for disease surveillance and still remains an accepted and well-established component of many screening programmes. However, the need for additional laboratory analysis for proper patient evaluation cannot be over-emphasised

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