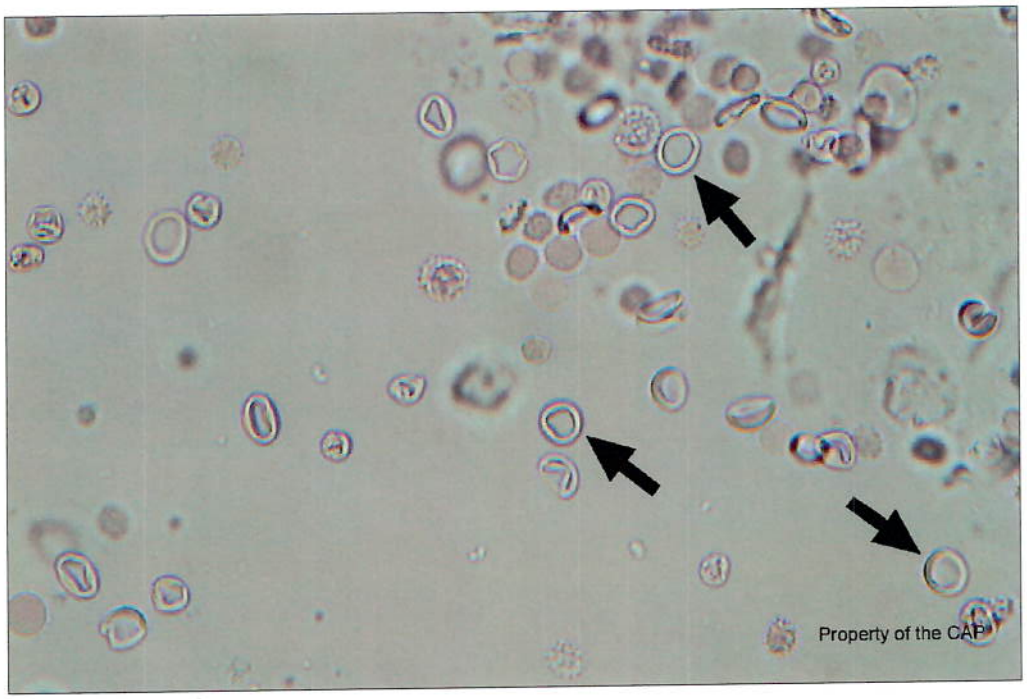
Urine Sediment Photographs

Case History CMP-13 through CMP-15

This urine sample is obtained from a 17-year-old girl presenting with glomerulonephritis. Laboratory data include: specific gravity = 1.012; pH = 6.5; protein, blood, and leukocyte esterase = positive; glucose, ketone, bilirubin, nitrite, and urobilinogen = negative. Identify the arrowed object(s) on each image.

(URINE, UNSTAINED, HIGH POWER)

CMP-13



Identification	Participants Freq	%	Evaluation
Erythrocyte	5766	96.3	Good

The arrowed cells are erythrocytes, as correctly identified by 96.3% of participants. The red blood cells (RBC) in this unstained wet preparation are identified by their non-nucleated size and shape. The area of central pallor seen in these erythrocytes is a feature of the red cell biconcave shape. Red blood cells are often seen in patients with a urinary tract infection (UTI).

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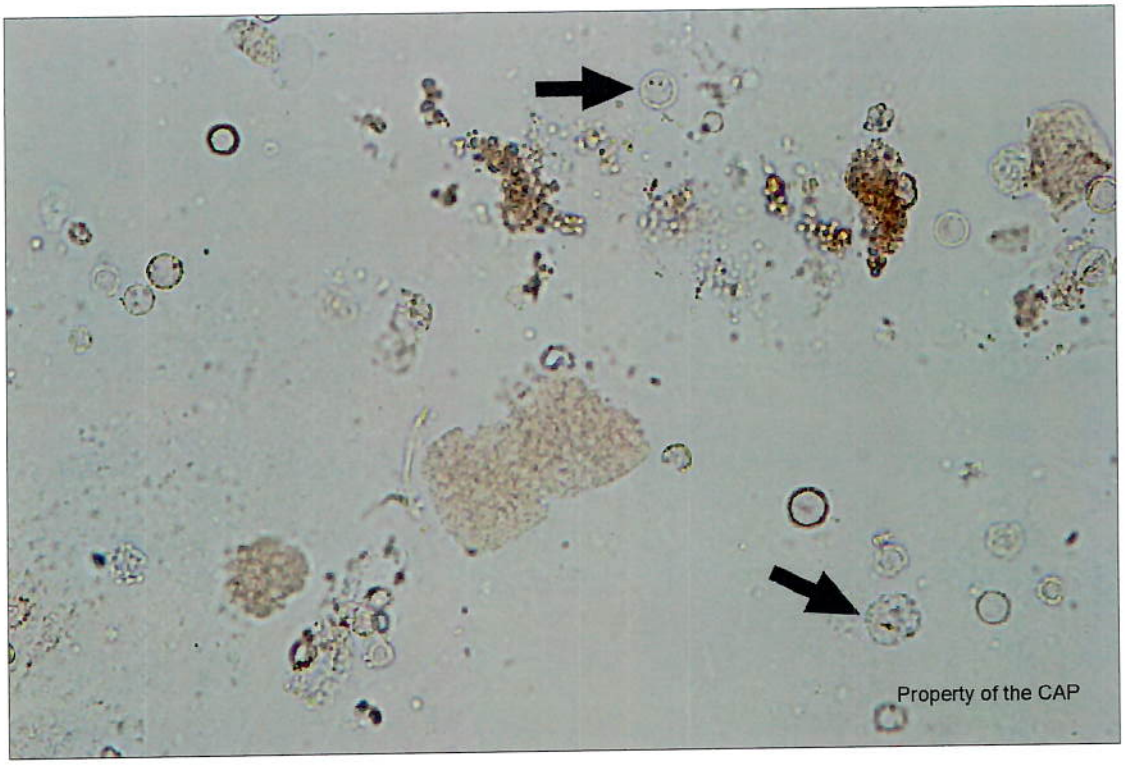
Urine Sediment Photographs

CMP-14



Identification	Participants Freq	%	Evaluation
Leukocyte (neutrophil, eosinophil, lymphocyte)	5790	96.8	Good

The arrowed cells are leukocytes, as correctly identified by 96.8% of participants. The white blood cells in this unstained wet preparation are identified as nucleated round cells with the nucleus clearly demarcated in one of the cells. These leukocytes appear shrunken and smaller than expected due to dehydration in hypertonic urine. Many of the leukocytes are shrunken to a degree than obscures nuclear detail, a feature often observed in urine with high specific gravity. Increased numbers of leukocytes in the urine greater than five per high power field are a characteristic feature of urinary tract infections (UTI). Reflex urine cultures are often used to distinguish between infections and other causes of increased urinary white blood cells.

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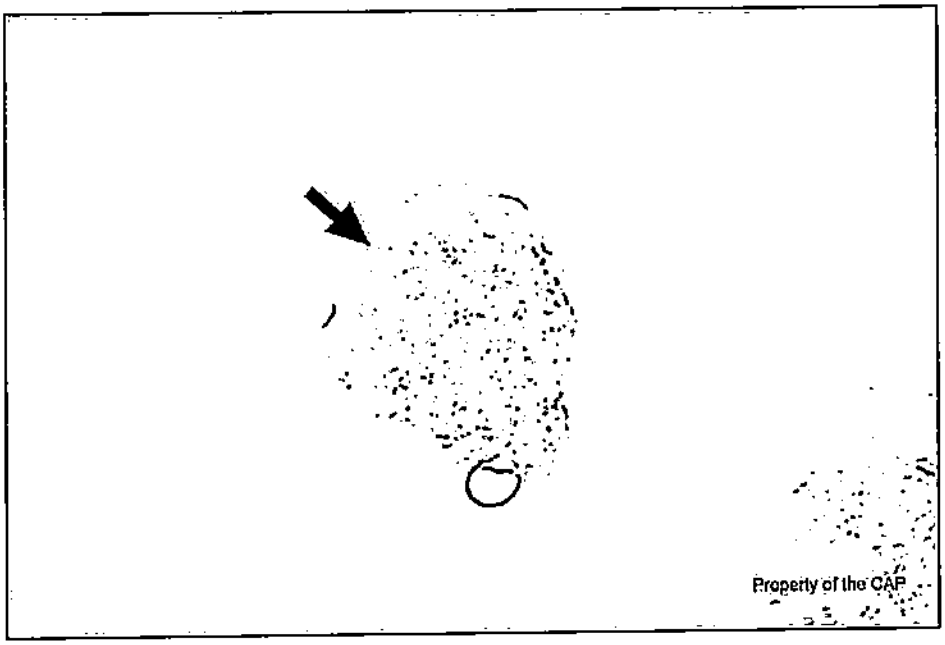
Urine Sediment Photographs

CMP-15



Identification	Participants Freq	%	Evaluation
Squamous epithelial cell	5910	98.7	Good

The arrowed cell is a squamous epithelial cell, as correctly identified by 98.7% of participants. It is recognizable by its large size relative to the leukocyte in the image, as well as its polyhedral shape with folded cytoplasmic borders and low nucleus:cytoplasm ratio. The nucleus in this image is small and slightly oblong and the much larger cytoplasm is granular. This is the typical appearance of a squamous cell sloughed from the superficial layers of the epidermis. Large numbers of squamous cells can be a clue to an improperly collected urine sample that is associated with mixed flora contamination on urine culture. A properly collected mid-stream clean catch can prevent this type of contamination.

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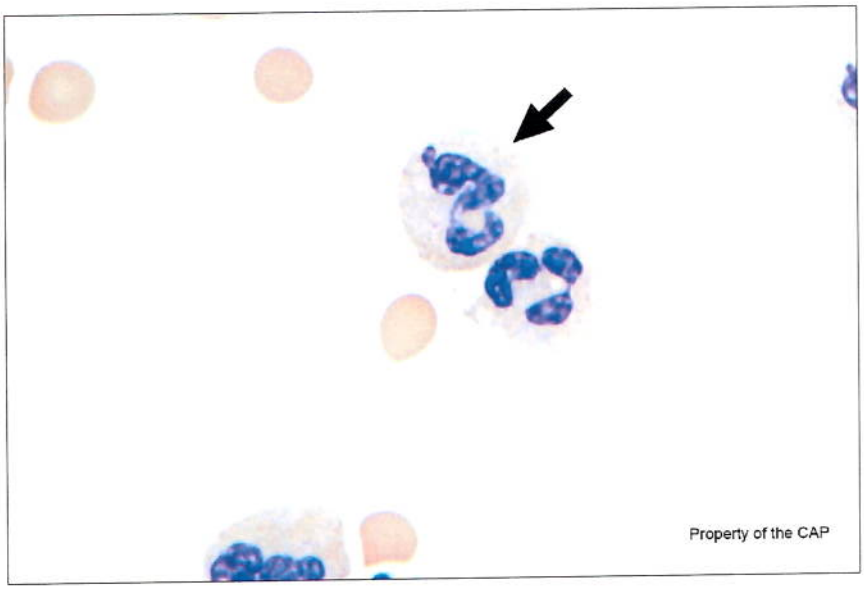
Body Fluid Photographs

Case History CMP-16 through CMP-18

This patient is a 59-year-old man who has been coughing for the past 20 days and experiencing fevers. Pleural fluid sample laboratory findings include: WBC = 15724/µL (15.724× 10E3/µL); RBC = 40063/µL (40.063 × 10E3/µL). Identify the arrowed object(s) on each image.

(PLEURAL FLUID, CYTOCENTRIFUGE, WRIGHT-GIEMSA, 100X)

CMP-16



Identification	Participants Freq	%	Evaluation
Neutrophil, segmented or band	3556	97.0	Good

The arrowed cell is a neutrophil, segmented or band, as correctly identified by 97.0% of participants. The segmented or band neutrophil is usually easily recognized. Segmented neutrophils and bands have pale pink cytoplasm with fine cytoplasmic granules. They generally have 3-5 nuclear lobes. Neutrophils in body fluids can show morphologic change due to autolysis, including nuclear pyknosis and fragmentation.

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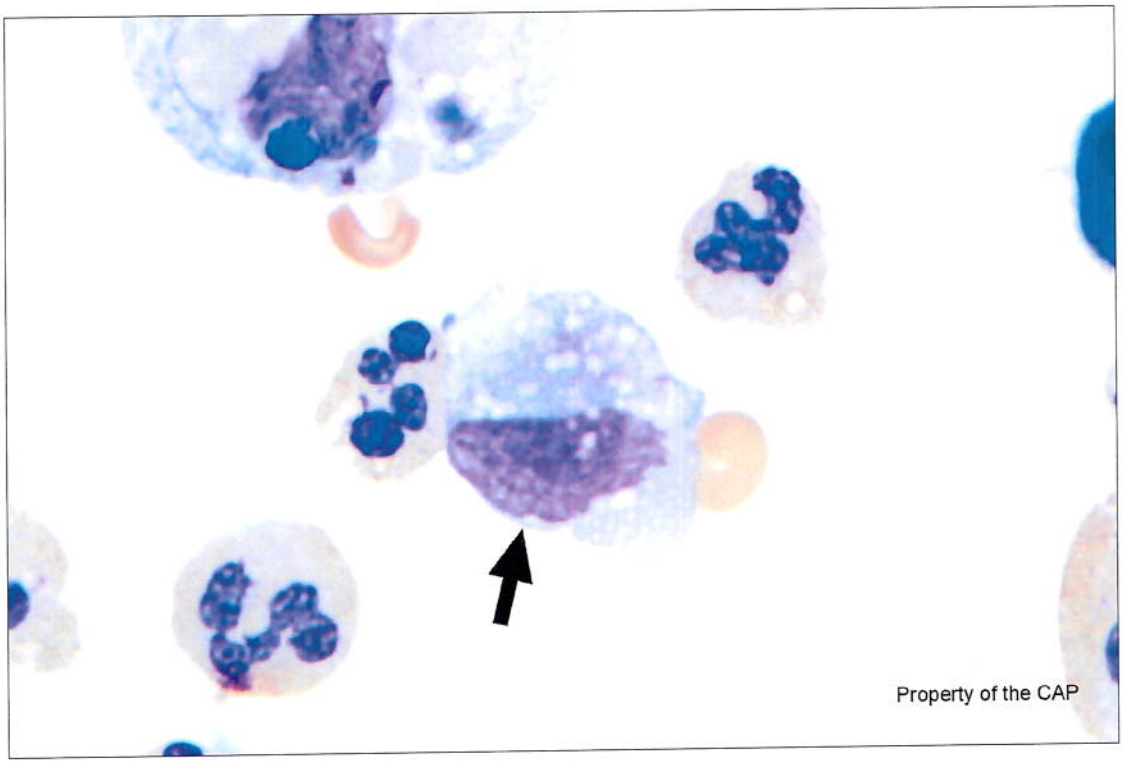
Body Fluid Photographs

CMP-17



Identification	Participants Freq	%	Evaluation
Macrophage/monocyte, including macrophage containing abundant uniform small lipid vacuoles/droplets ie, lipophage	3547	96.9	Good

The arrowed cell is a macrophage/monocyte, including macrophage containing abundant uniform small lipid vacuoles/droplets ie, lipophage, as correctly identified by 96.9% of participants. Monocytes arise from bone-marrow derived cells and circulate in peripheral blood. Macrophages evolve from monocytes after migration into tissues and body fluids. Monocyte/macrophage morphology in fluids is quite variable, ranging from the typical monocyte of the peripheral blood to a vacuolated, activated stage with the morphology of a typical macrophage. Monocytes are usually large (12 to 20 µm) with abundant blue-gray cytoplasm and often containing sparse azurophilic granules. The nucleus is round to oval and may show indentation, giving it a kidney bean or horseshoe shape. The chromatin is lacy, and small nucleoli may be apparent. Macrophages are larger cells (15 to 80 µm) with abundant cytoplasm showing evidence of active phagocytosis. This includes ingested material such as other blood cells or bacteria, hemosiderin, fungi, and remnants of digested materials as well as cytoplasmic vacuoles. One or more round to oval nuclei are present and occasionally prominent nucleoli may be seen. Macrophages can at times be difficult to differentiate from mesothelial cells. Mesothelial cells are usually larger than monocytes/macrophages and usually show a biphasic staining cytoplasm and surface microvilli.

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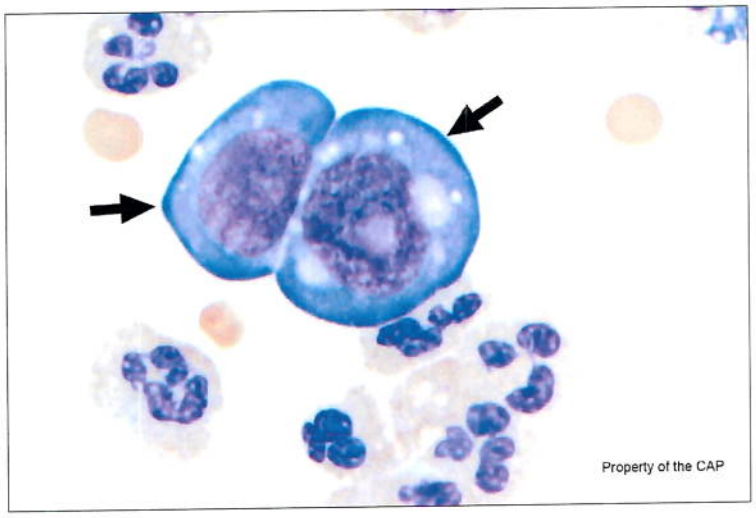
Body Fluid Photographs

CMP-18



Identification	Referees Freq	Referees %	Participants Freq	Participants %	Evaluation
Malignant cell, non-hematopoietic	30	50.8	1371	38.0	Non-consensus
Mesothelial cell (pleural fluid)	21	35.6	1606	44.5	Non-consensus

The arrowed cells are malignant cells, non-hematopoietic, as correctly identified by 50.8% of referees and 38.0% of participants. A variety of neoplastic cells may be found in body fluids. Their morphology is dependent on that of the primary underlying malignancy. Malignant cells may be numerous and clustered or appear as rare single cells. Cytologic features of malignant cells on cytocentrifuge preparations include high nuclear-to-cytoplasmic ratio, increased cell and nuclear size, irregularly shaped nuclei, atypical nuclear chromatin patterns, large nucleoli, and a tendency to form large clusters, frequently with nuclear molding. Occasionally, a cell cluster may recapitulate an organoid structure, such as gland formation which would represent an adenocarcinoma.

The arrowed cells were incorrectly identified by 35.6% of referees and 44.5% of participants as mesothelial cells. The mesothelial cell (20 to 50 µm) normally lines pleural, pericardial, and peritoneal surfaces. These cells can be shed individually or in clusters. When found in pairs or clusters, mesothelial cells have articulated or coupled cell borders with a discontinuous outer border (clear spaces or windows) between many of the cells. Unlike the malignant cells in the image, the nuclear-to-cytoplasmic ratio of mesothelial cells is low (less than 1:1). The nucleus is round to oval in shape with a well-defined nuclear membrane and regular contour. Nuclei are usually single and centrally located.

The cytoplasm is light to dark blue and may have a grainy texture or a crystalline/ground glass appearance particularly in the perinuclear area, similar to the malignant cells in the image. Cytoplasmic vacuoles, blebs, and/or fragmentation may occur with cellular degeneration, however, in the image the cells are preserved and the presence of large vacuoles is abnormal. In summary, the malignant morphologic features include: absence of windows between two cells, high nuclear-to-cytoplasmic ratio, variability between the cells' appearance, deep basophilic cytoplasm with large vacuoles.

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Clinical Presentation:
This patient is a 59-year-old man who has been coughing for the past 20 days and experiencing fevers. Pleural fluid sample laboratory findings include: WBC = 15724/µL (15.724 × 10E3/µL); RBC = 40063/µL (40.063 × 10E3/µL).

(PLEURAL FLUID, CYTOCENTRIFUGE, WRIGHT-GIEMSA, 100X)

CASE DISCUSSION: Non-Small Cell Lung Carcinoma (NSCLC)

Non-Small Cell Lung Carcinoma (NSCLC) represents approximately 85% of all new lung cancers and includes a diverse group of epithelial malignancies that arise from bronchial and alveolar cells.[1] The most common risk factor is smoking, while in some cases environmental exposure (including exposure to metals, mineral dust, and radioactive gases) may play a role. Clinical features at presentation may include persistent cough, shortness of breath, chest pain, hemoptysis, loss of appetite, and weight loss.[1] Initial evaluation of suspected NSCLC begins with imaging, typically a chest X-ray followed by a contrast-enhanced CT scan to assess tumor size, lymph node involvement, and pleural or mediastinal invasion. PET-CT scans are also routinely employed for staging and to detect distant metastases. Tissue diagnosis is established via bronchoscopic biopsy, CT-guided transthoracic needle aspiration, endobronchial ultrasound-guided biopsy (EBUS), or surgical approaches like video-assisted thoracoscopic surgery (VATS). If a pleural effusion is present, thoracentesis is performed, and the pleural fluid is sent for cytology to evaluate for the presence of malignant cells. Additionally, a cell block preparation can be made for immunohistochemical evaluation as necessary.

Three main histologic subtypes of NSCLC include adenocarcinoma (the most common subtype), squamous cell carcinoma, and large cell carcinoma.[2] Adenocarcinoma demonstrates glandular formation with or without mucin production and is cytologically characterized by enlarged nuclei, prominent nucleoli, and occasionally vacuolated cytoplasm. The cells are typically positive for TTF-1 by immunohistochemistry. Squamous cell carcinoma usually arises centrally within the lungs and shows histologic features including keratinization or intercellular bridges. Cytologically, the cells have dense cytoplasm and 'tadpole' or polygonal cells. Immunohistochemistry is typically for p40, p63, and CK5/6. Large cell carcinoma lacks the features of adenocarcinoma or squamous carcinoma.[2] Other more rare variants include adenosquamous carcinoma and sarcomatoid carcinoma. Accurate subtyping is crucial for guiding treatment. Molecular analysis is also a critical component of NSCLC diagnosis and guides personalized therapy. The most common genes evaluated include *EGFR, ALK, ROS1, BRAF, KRAS, RET, NTRK* and *MET*.[3] PD-L1 immunohistochemistry is also routinely assessed to guide immunotherapy use, particularly checkpoint inhibitors like pembrolizumab.[4]

The overall survival for NSCLC depends on the stage of the disease with 65% 5-year survival in early stage localized disease, while only < 10% survive at 5 years in advanced metastatic NSCLC.[4] Treatment options include surgery, chemotherapy, targeted ("personalized") therapy, radiation, and immunotherapy.[5]

Aishwarya Ravindran, MD, FCAP
Olga Pozdnyakova MD, PhD, FCAP, Chair
Hematology and Clinical Microscopy Committee

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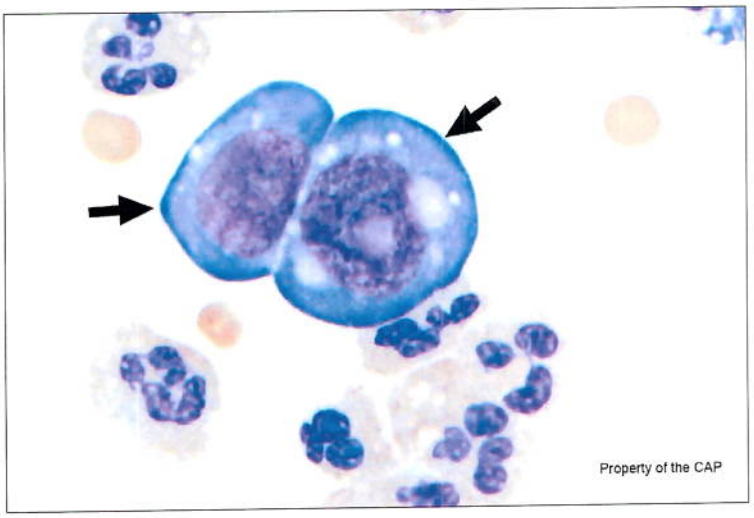
Body Fluid Photographs

CMP-18



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Olga Pozdnyakova MD, PhD, FCAP, Chair
Hematology and Clinical Microscopy Committee

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References:

1. Gridelli C, Rossi A, Carbone DP, et al. Non-small-cell lung cancer. *Nat Rev Dis Primers.* 2015;1:15009.
2. Han Y, Ma Y, Wu Z, et al. Histologic subtype classification of non-small cell lung cancer using PET/CT images. *Eur J Nucl Med Mol Imaging.* 2021;48(2):350-360.
3. Sathiyapalan A, Ellis PM. Molecular Testing in Non-Small-Cell Lung Cancer: A Call to Action. *JCO Oncol Pract.* 2024;20(1):7-9.
4. The American Cancer Society medical and editorial content team. Lung Cancer Survival Rates. American Cancer Society. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/survival-rates.html. Accessed June 3, 2025.
5. Pawelczyk K, Piotrowska A, Ciesielska U, et al. Role of PD-L1 Expression in Non-Small Cell Lung Cancer and Their Prognostic Significance according to Clinicopathological Factors and Diagnostic Markers. *Int J Mol Sci.* 2019;20(4).

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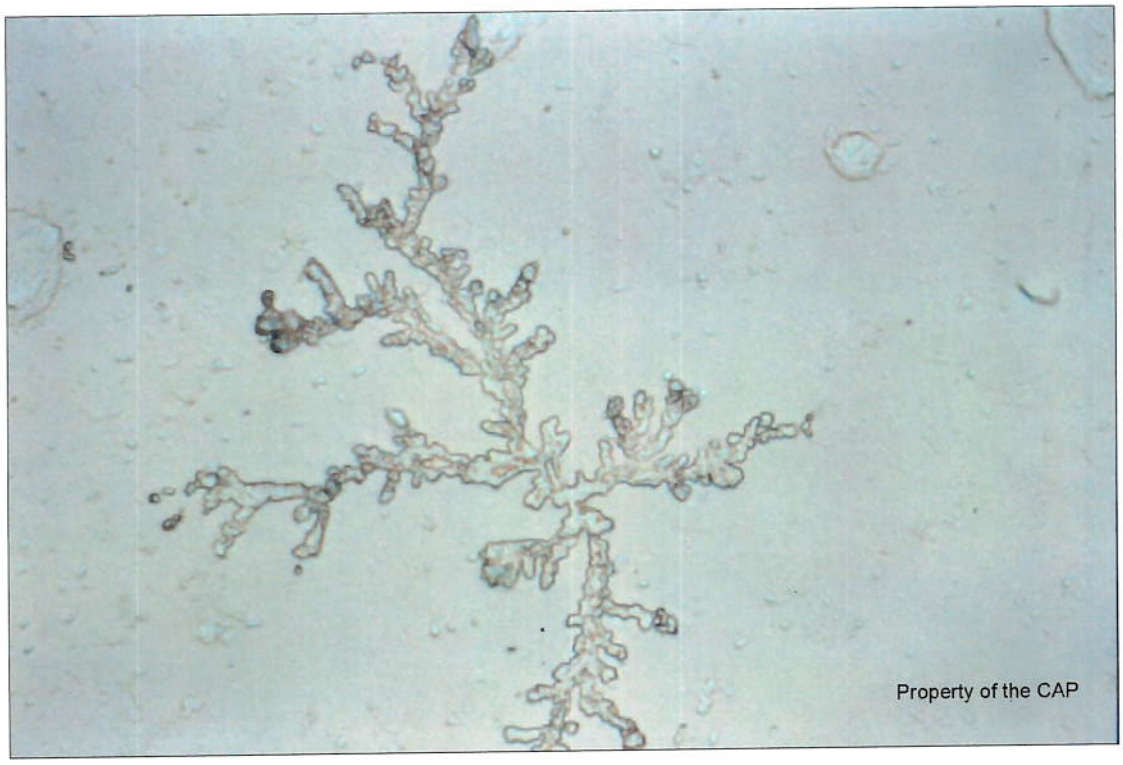
CMMP – Clinical Microscopy Miscellaneous Photographs

(VAGINAL, UNSTAINED)

CMMP-30



Identification	Participants Freq	%	Evaluation
Ferning is present	1505	92.2	Good

This vaginal wet preparation exhibits ferning. The fern test is used to detect ruptured amniotic membranes and the early onset of labor. A vaginal pool sample is collected, and the fluid is allowed to air dry on a glass slide. The slide is examined using a microscope to detect ferning, an elaborate arborized crystallization pattern. Ferning, in conjunction with the nitrazine test and the medical history, is highly sensitive for the detection of ruptured membranes.

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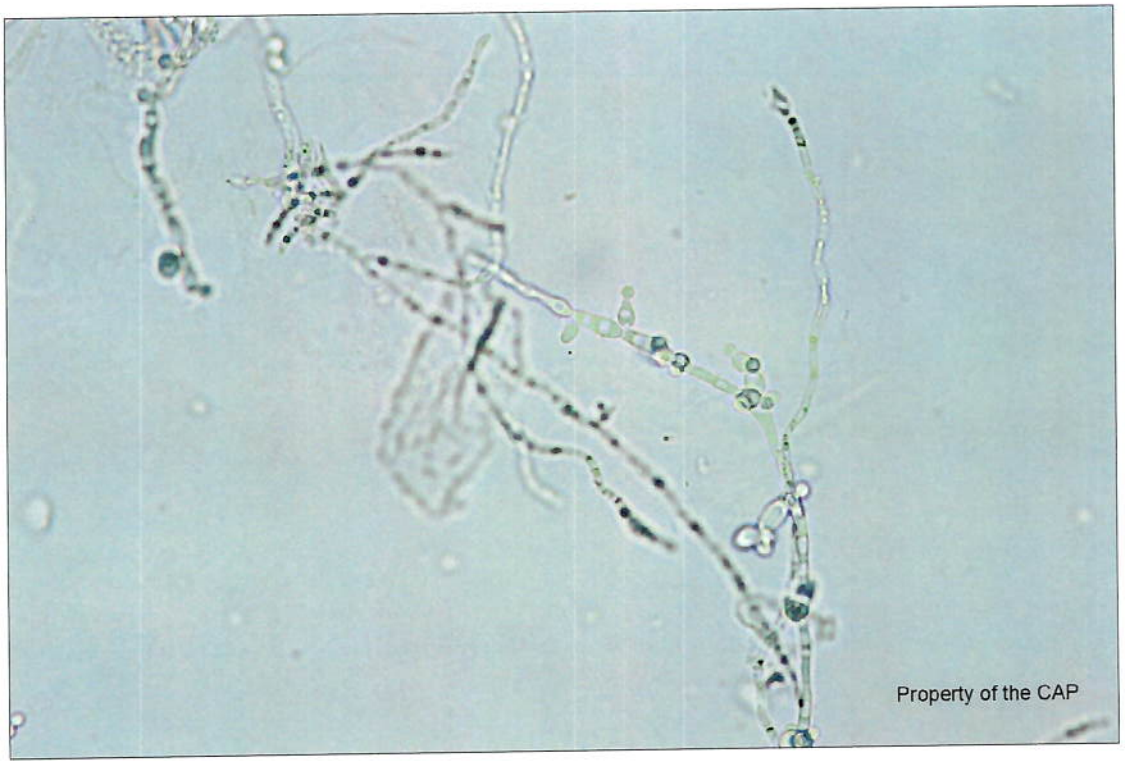
CMMP-31

(VAGINAL, KOH)



Identification	Participants Freq	%	Evaluation
Yeast/fungi are present	2631	99.8	Good

This KOH wet preparation is positive for pseudohyphae, consistent with *Candida* species. Candidiasis accounts for approximately one third of vases of vulvovaginitis and usually is caused by *Candida albicans* (less frequently by *Candida glabrata*). While small numbers of *Candida* sp. can be identified in normal samples, overgrowth can occur, leading to symptoms of vulvovaginitis including pruritis, burning, and irritation. Risk factors for symptomatic infections include antibiotic use, increased estrogen levels, and immunosuppression.

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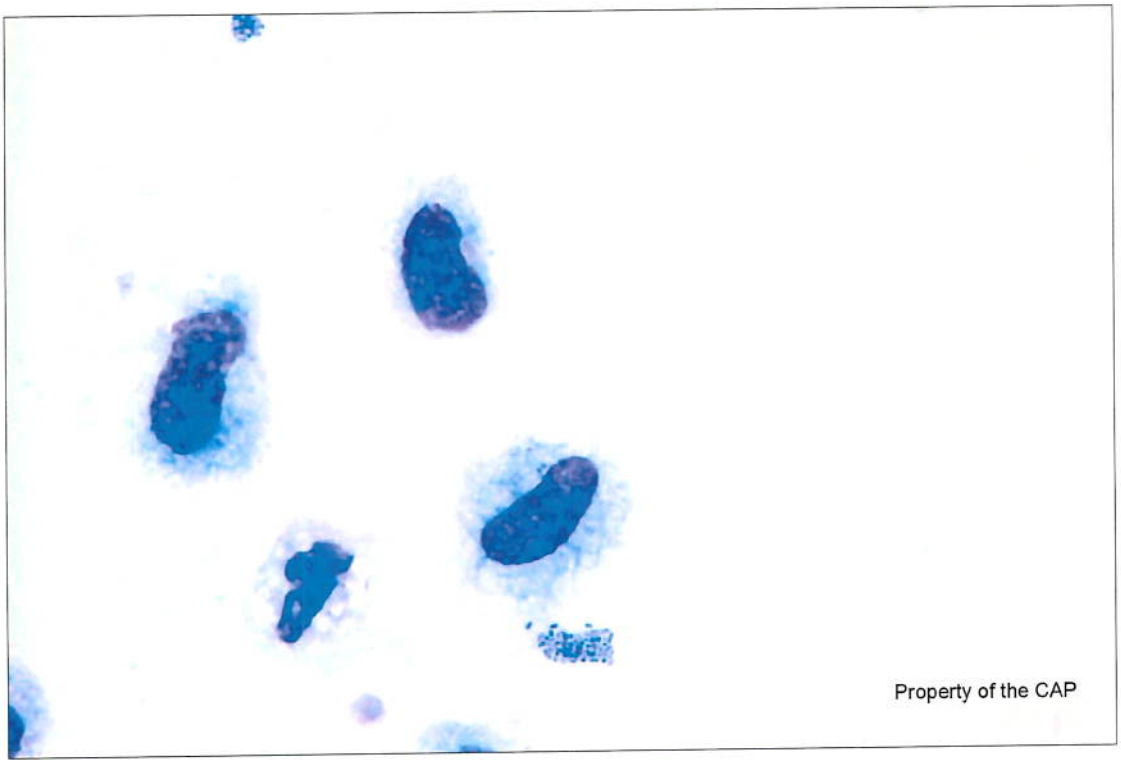
CMMP – Clinical Microscopy Miscellaneous Photographs

(NASAL, WRIGHT-GIEMSA)

CMMP-32



Identification	Participants Freq	%	Evaluation
Eosinophils are absent	1562	98.6	Good

This nasal smear is negative for eosinophils. Nasal eosinophils correlate with clinical allergic rhinitis. In patients with nonallergic causes of nasal discharge either acellular mucus or neutrophils will be present on the nasal smear.

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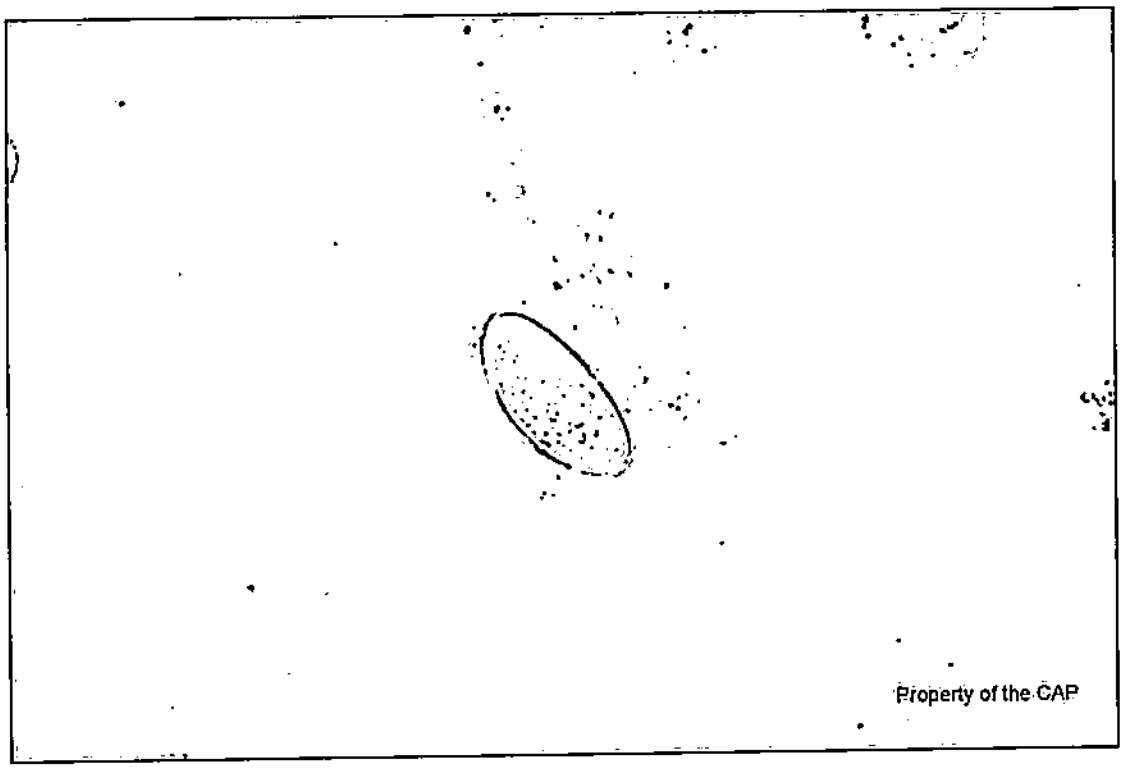
CMMP – Clinical Microscopy Miscellaneous Photographs

(PINWORM PREP, UNSTAINED, 66X)

CMMP-33



Identification	Participants Freq	%	Evaluation
Pinworm/pinworm eggs are present	1731	99.8	Good

This unstained preparation demonstrates an *Enterobius vermicularis* egg which is known colloquially as pinworm. Humans are considered to be the only hosts of *Enterobius vermicularis*. Transmission occurs by transferring infected eggs to the mouth with hands that scratch the perianal region. Person to person transmission can occur through handling of infected bed linens or clothes.

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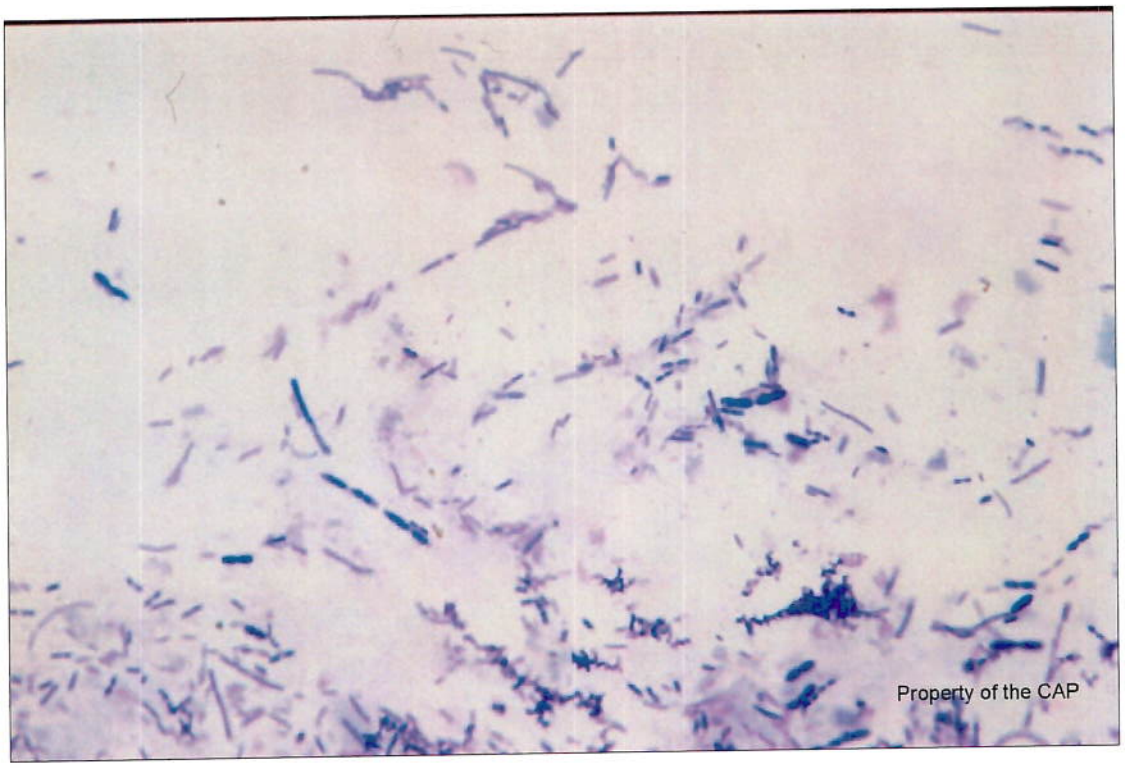
CMMP – Clinical Microscopy Miscellaneous Photographs

(STOOL, WRIGHT-GIEMSA)

CMMP-34



Identification	Participants Freq	%	Evaluation
Leukocytes are absent	1741	99.8	Good

This stool specimen is negative for neutrophils. Assessment of stool specimens for neutrophils is a test that can be used in conjunction with a bacterial culture in the evaluation of enteritis/colitis. While the presence of neutrophils is consistent with a bacterial infection, the findings are not specific. Stool cultures are more sensitive and specific for the evaluation of enteric pathogens.

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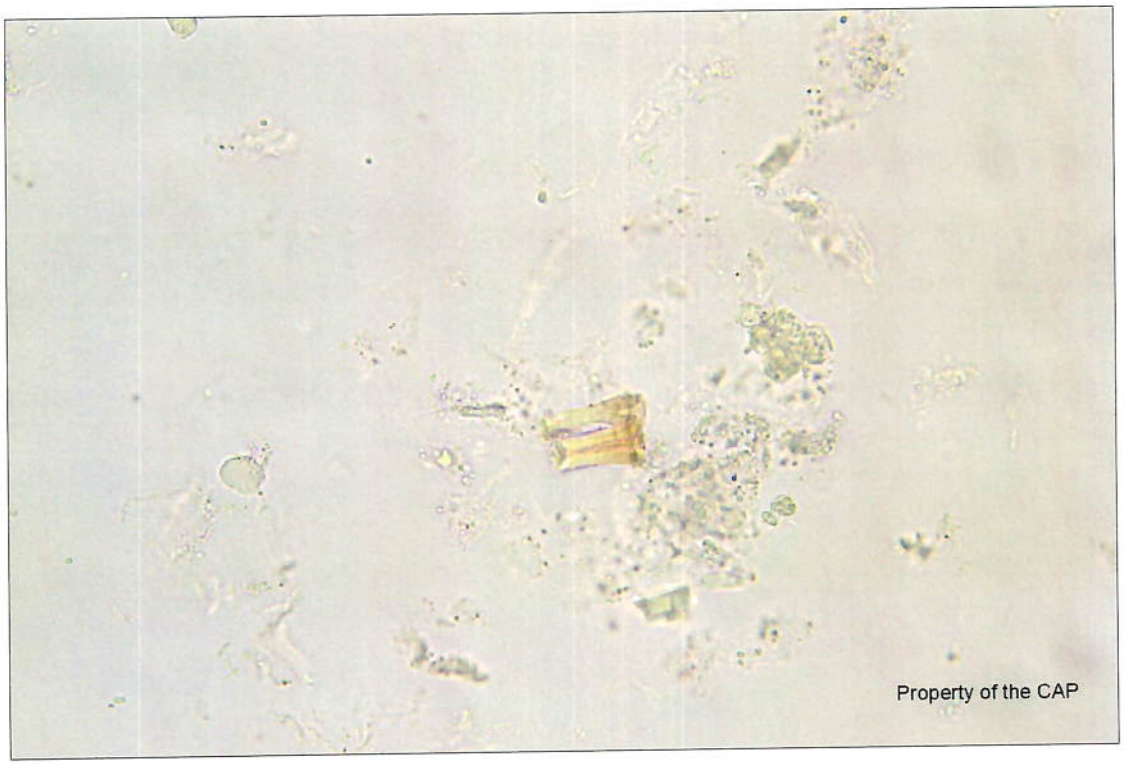
CMMP – Clinical Microscopy Miscellaneous Photographs

(VAGINAL, UNSTAINED)

CMMP-35



Identification	Participants Freq	%	Evaluation
Spermatozoa are absent	2153	99.8	Good

Spermatozoa are not present in this image. In wet preparations, the sperm head is about 4 to 6 µm long, usually tapering anteriorly. The head is smaller and narrower than red blood cells. Slender tails are about 40 to 60 µm long.

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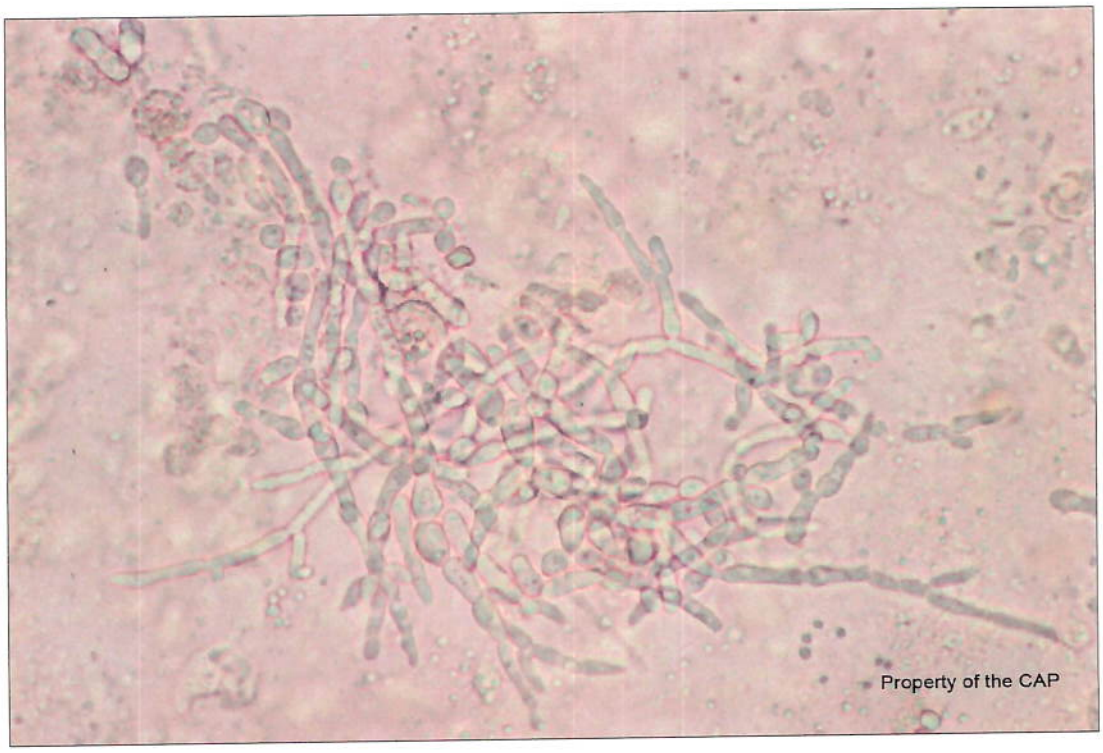
CMMP – Clinical Microscopy Miscellaneous Photographs

(VAGINAL, UNSTAINED)

CMMP-36



Identification	Participants Freq	%	Evaluation
Yeast/fungi are present	3245	99.7	Good

This KOH wet preparation demonstrates pseudohyphae to be present, consistent with *Candida* species. Vulvovaginal candidiasis is a common fungal infection that occurs when there is overgrowth of *Candida* species. While small numbers of *Candida* are normally present, when the vaginal fluid pH changes or when hormonal changes occur, *Candida* can multiply.

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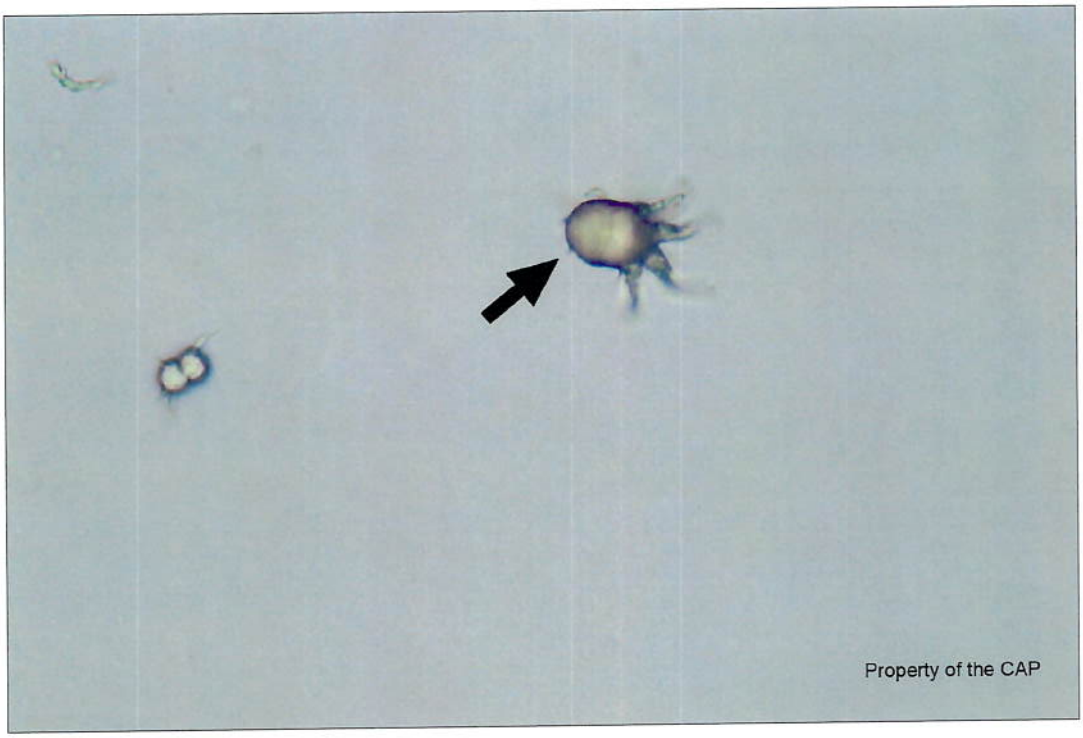
Urine Sediment Color Photographs

Case History USP-04 through USP-06

This urine sample is obtained from a 45-year-old woman. Laboratory data include: specific gravity = 1.010; pH = 8.5; protein and blood = positive; glucose, ketone, bilirubin, leukocyte esterase, nitrite, and urobilinogen = negative. Identify the arrowed object(s) on each image.

(URINE, UNSTAINED, HIGH POWER)

USP-04



Identification	Participants Freq	%	Evaluation
Ammonium biurate crystal	3610	98.7	Good

The arrowed object is an ammonium biurate crystal, as correctly identified by 98.7% of participants. Ammonium biurate crystals may be associated with phosphate crystals generally in aged/stored alkaline urine. Biurates appear as crystalline yellow-brown smooth spheres with radial or concentric striations. The "thorn apple" variety has projecting horns. These crystals should not be confused with sulfonamide crystals.

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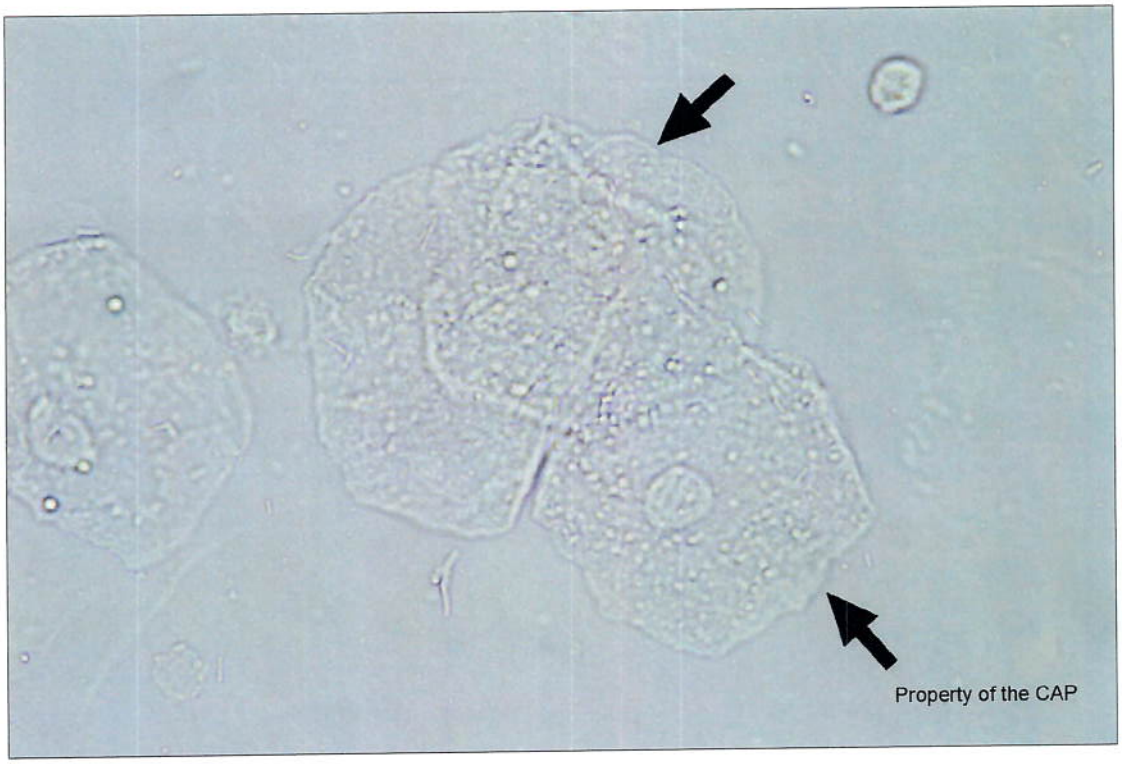
Urine Sediment Photographs

USP-05



Identification	Participants Freq	%	Evaluation
Squamous epithelial cell	3637	99.4	Good

The arrowed cell is a squamous epithelial cell, as correctly identified by 99.4% of participants. It is recognizable by its large size relative to the leukocyte in the image, as well as its polyhedral shape with folded cytoplasmic borders and low nucleus:cytoplasm ratio. The nucleus in this image is small and slightly oblong and the much larger cytoplasm is granular. This is the typical appearance of a squamous cell sloughed from the superficial layers of the epidermis. Large numbers of squamous cells can be a clue to an improperly collected urine sample that is associated with mixed flora contamination on urine culture. A properly collected mid-stream clean catch can prevent this type of contamination.

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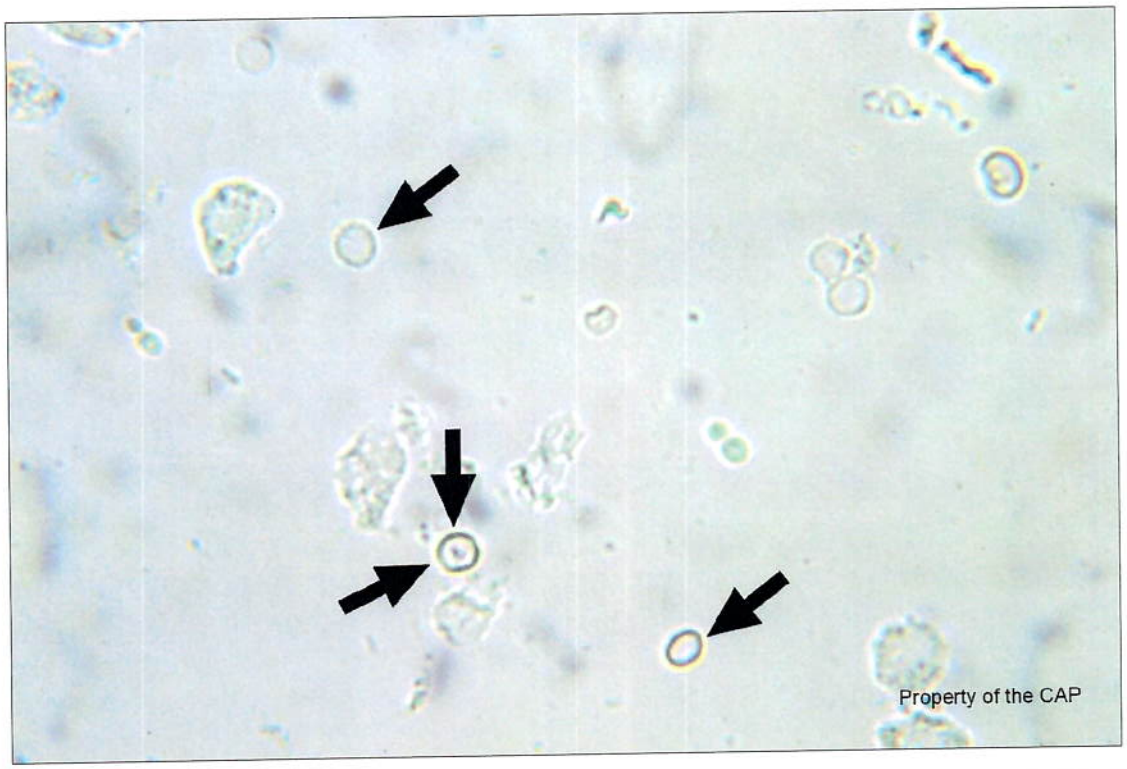
Urine Sediment Photographs

USP-06



Identification	Participants Freq	%	Evaluation
Erythrocyte	3600	98.4	Good

The arrowed cells are erythrocytes, as correctly identified by 98.4% of participants. The red blood cells (RBC) in this unstained wet preparation are identified by their non-nucleated size and shape. The area of central pallor seen in these erythrocytes is a feature of the red cell biconcave shape. The central pallor of the red cells in this image is larger than is typical and may be the result of relative dehydration due to the high specific gravity of 1.031 of a hypertonic urine. Red blood cells are often seen in patients with a urinary tract infection (UTI).

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