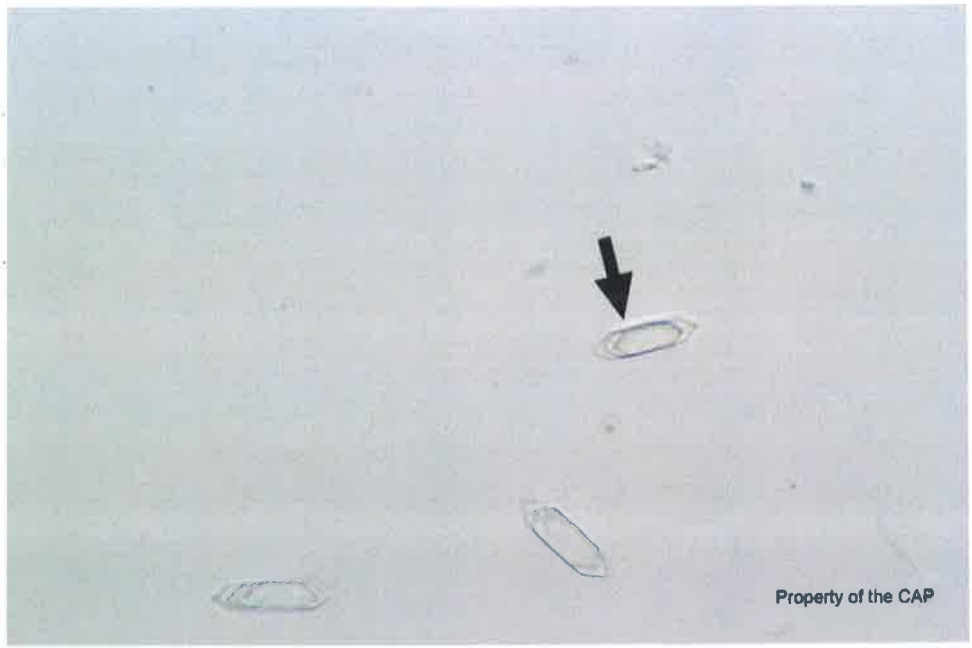
Urine Sediment Photographs

Case History CMP-04 through CMP-06

This urine sample is obtained from a 15-year-old boy suspected of being a "glue sniffer." Laboratory data include specific gravity = 1.007; pH = 5.0; blood and leukocyte esterase = positive; glucose, ketones, protein, nitrite, bilirubin, and urobilinogen = negative. **Crystals are insoluble in acetic acid.**

CMP-04



(URINE, UNSTAINED, 40X OR HIGHER POWER)

Identification	CMP Referees No.	CMP Referees %	CMP Participants No.	CMP Participants %	Performance Evaluation
Hippuric acid crystal	44	74.6	4736	76.3	Non-consensus
Uric acid crystal	6	10.2	590	9.5	
Calcium oxalate crystal	4	6.8	546	8.8	
Ammonium magnesium (triple) phosphate crystal	4	6.8	287	4.6	

The arrowed object(s) is a hippuric acid crystal, as correctly identified by 76.3% of participants. Hippuric acid forms hexagonal crystals found in acid urine. The crystals are longer than they are wide. Very rarely, needles and rhombic plates are formed. Hippuric acid crystals are soluble in alcohol, hot water, alkali, and ether. These solubility characteristics separate hippuric acid crystals from cysteine, primidone, pyridoxalate and occasionally, uric acid, the other hexagonal crystals found in acid urine. Hippuric acid may be found in the urine of patients with fever, liver disease and those who "huff" or sniff glue. Consumption of very large amounts of foods containing natural benzoic acid (berries, prunes, tea, and cinnamon) may also result in formation of hippuric acid crystals.

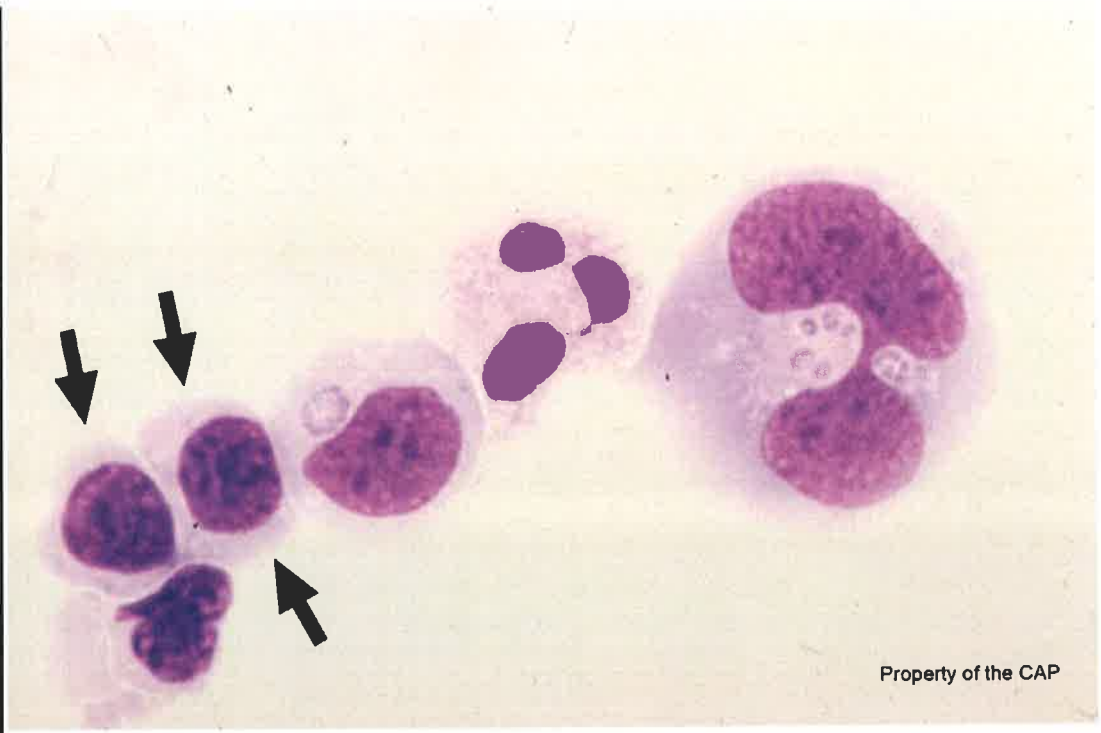
Please note that there was a discrepancy in the Urine Glossary regarding the solubility of hippuric acid crystals. The *Color Atlas of Urinary Sediment* also incorrectly states that hippuric acid crystals are soluble in acetic acid. Hippuric acid crystals are insoluble in acetic acid, and soluble in alcohol, hot water, alkali and ether. Hippuric acid crystals can be differentiated from uric acid and triple phosphate crystals based on solubility. Uric acid crystals (found in acid urine) are insoluble in ether and soluble in 10% sodium hydroxide and (sparingly) in water. Triple phosphate crystals (found in alkaline to neutral urine) are soluble in acetic acid. Calcium oxalate crystals can be differentiated from hippuric acid by their typical square "envelope" morphology seen in the former.

Body Fluid Photographs

Case History CMP-07 through CMP-09

This patient is a 42-year-old man admitted through the emergency department with a fever of 104°F, intense headaches, and body aches. Patient reported to physician that he had been camping recently and had been bitten by a deer tick. Cerebrospinal fluid data shows: Total nucleated cells (TNC) = 300 cells/µL (0.300 x 10E3/µL) and RBC = 2 cells/µL (0.002 x 10E3/µL).

CMP-07



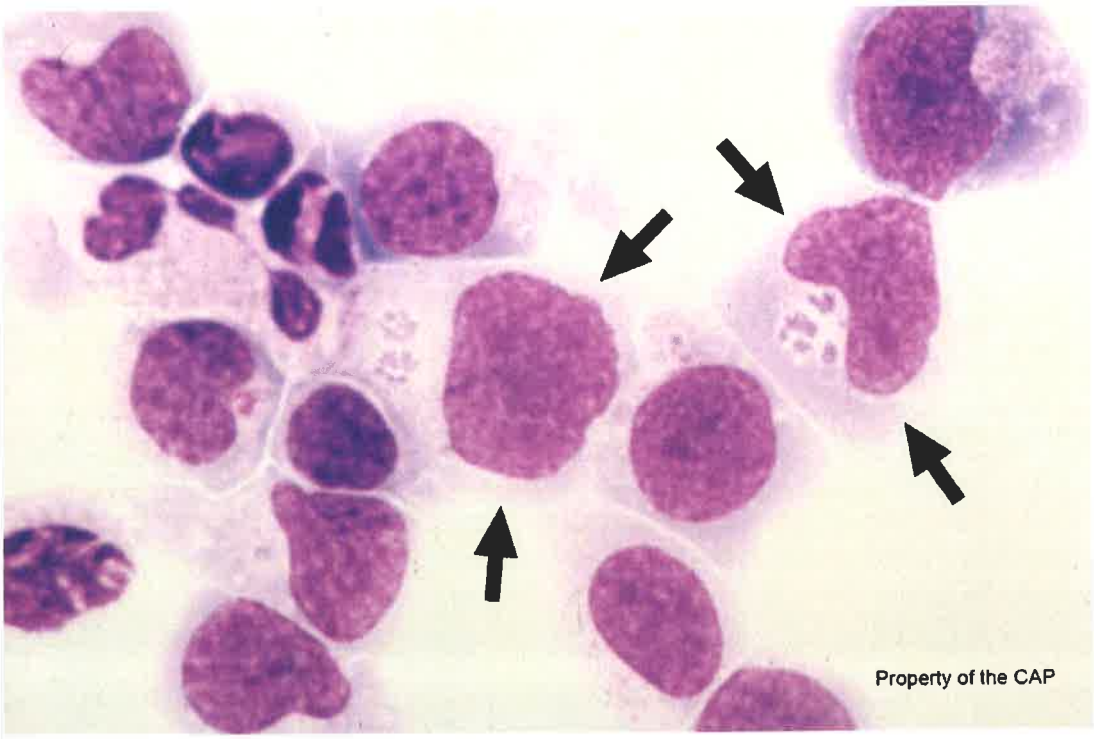
(CSF, CYTOCENTRIFUGE, WRIGHT-GIEMSA, 100X)

Identification	CMP Participants No.	CMP Participants %	Performance Evaluation
Lymphocyte	3628	93.9	Good

The arrowed object(s) are lymphocytes, as correctly identified by 93.9% of participants. Owing to the process of cytocentrifugation, mature/quiescent lymphocytes such as these seen in CSF preparations may appear slightly larger than their blood smear counterparts, potentially with cytoplasmic spreading, nuclear convolutions and more prominent nucleoli. In contrast to mature/quiescent lymphocytes, moreover, reactive lymphocytes tend to be larger, with even greater increases in volume of both nucleus and cytoplasm.

Body Fluid Photographs

CMP-08



(CSF, CYTOCENTRIFUGE, WRIGHT-GIEMSA, 100X)

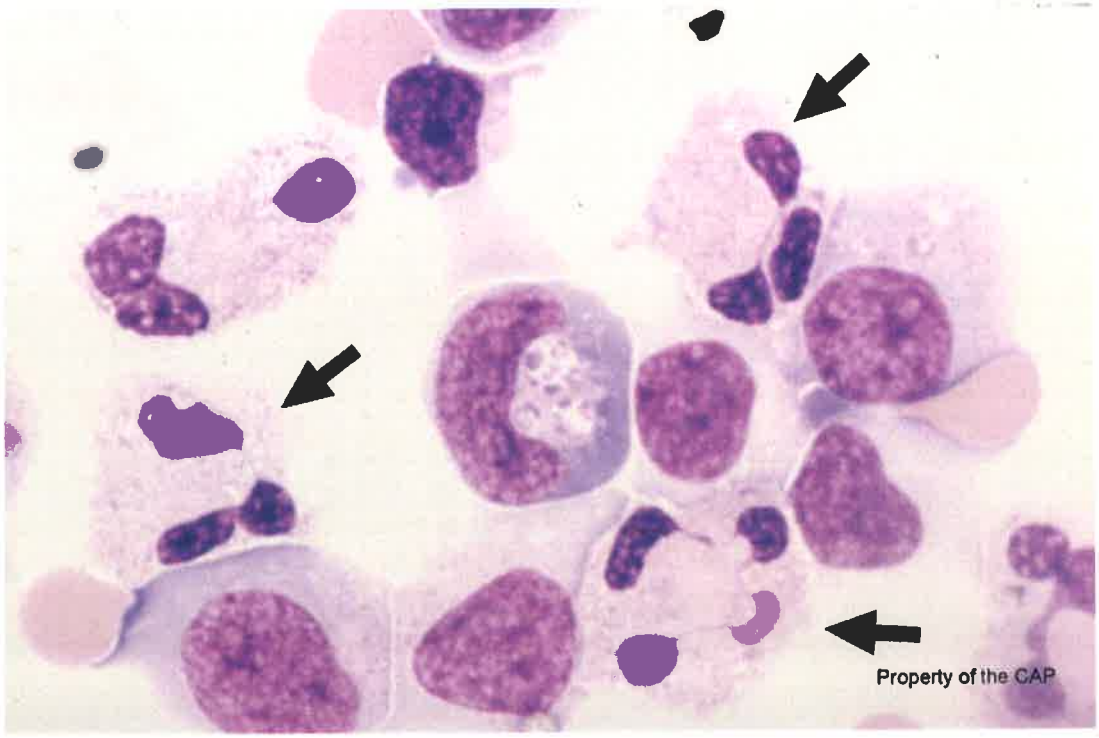
Identification	CMP Referees No.	CMP Referees %	CMP Participants No.	CMP Participants %	Performance Evaluation
Neutrophil/macrophage containing bacteria	27	45.8	1814	47.0	Non-consensus
Monocyte/macrophage	9	15.3	883	22.9	
Ehrlichia/Anaplasma	16	27.1	763	19.8	

The arrowed object(s) are leukocytes containing *Ehrlichia/Anaplasma* organisms; as such, either identification as *Ehrlichia/Anaplasma* (19.8% of participants) or Neutrophil/Macrophage Containing Bacteria (47.0% of participants) are accepted as correct responses. On Wright-stained preparations, *Anaplasma* species appear as round, dark purple-stained dots or clusters of dots (morulae) in the cytoplasm of either neutrophils (*A. phagocytophilia*) or monocytes and macrophages (*A. chafeensis*). Bacteria within a neutrophil or macrophage are notable for their uniform appearance, round or rod-shaped, single, diploid, or in small chains depending upon the species present. It is important to distinguish bacteria from the normal cytoplasmic granules or debris.

22.9% of participants identified the arrowed objects as Monocyte/macrophage. The kit instructions state that the most specific identification is considered the correct response. Monocyte/macrophage is not the most specific response for this challenge and would be considered an incorrect response.

Body Fluid Photographs

CMP-09



(CSF, CYTOCENTRIFUGE, WRIGHT-GIEMSA, 100X)

Identification	CMP Participants No.	%	Performance Evaluation
Neutrophil, segmented or band	3767	97.4	Good

The arrowed object(s) are neutrophils, as correctly identified by 97.4% of participants. Usually the segmented or band neutrophil is easily recognized. Often, the nuclear lobes appear eccentric in cytocentrifuge preparations. In contrast to the monocytes of this photomicrograph, the arrowed neutrophils do not demonstrate intracytoplasmic microorganisms.

Case Presentation:

This patient is a 42-year-old man admitted through the emergency department with a fever of 104°F, intense headaches, and body aches. Patient reported to physician that he had been camping recently and had been bitten by a deer tick. Cerebrospinal fluid data shows: Total nucleated cells (TNC) = 300 cells/µL (0.300 x 10E3/µL) and RBC = 2 cells/µL (0.002 x 10E3/µL).

(CSF, CYTOCENTRIFUGE, WRIGHT-GIEMSA, 100X)

Case Discussion: Ehrlichiosis/Anaplasmosis

Ehrlichiosis and Anaplasmosis are a group of febrile tick-borne illnesses causes by members of the *Ehrlichia* and *Anaplasma* genera.[1,2] *Ehrlichia* and *Anaplasma* species are obligate intracellular gram-negative bacteria that replicate within host cell vacuoles, therein forming microcolonies (morulae).[1,2] Human Ehrlichiosis can be identified on peripheral smears or in fluid preparations by way of granulocyte (typically neutrophil) inclusion bodies, whereas Anaplasmosis is monocyte-specific.[1,2] The intracytoplasmic inclusion bodies, which may be numerous, can be visualized on Wright-Giemsa preparations as dark purple stained globular inclusions.

Ehrlichiosis and Anaplasmosis are transmitted between hosts during the blood meal of an infected tick. The primary reservoir species for *Ehrlichia* species is the white-tailed deer, transmitted by the Lone Star tick (*Amblyomma americanum*), whereas the *Anaplasma* reservoirs are mainly small rodents such as the white-footed mouse transmitted by *Ixodes* species of ticks.[1,2] Trends in disease incidence in humans tend to overlap with areas of showing the highest distribution of reservoir and vector; Ehrlichiosis incidence is highest in states such as Mississippi, Oklahoma, Tennessee, Arkansas, and Maryland whereas Anaplasmosis is most common in New England and the North Central United States.[2]

Ehrlichiosis and Anaplasmosis typically present with fever following a tick bite; other symptoms such as headaches, myalgias (muscle aches) and arthralgias (joint pain) are also common.[1,2] Ehrlichiosis is regarded as a more severe illness relative to other tick-borne illnesses, with a significant rate of required hospitalization and a relatively high case fatality rate.[2] Meningitis (as in this case) or meningoencephalitis manifest in 20% of cases of Ehrlichiosis, whereas central nervous system disease is much more infrequent in cases of Anaplasmosis.[2] Given these potential complications and the potential severity of disease, active surveillance is practiced in a number of states with endemic disease.[2]

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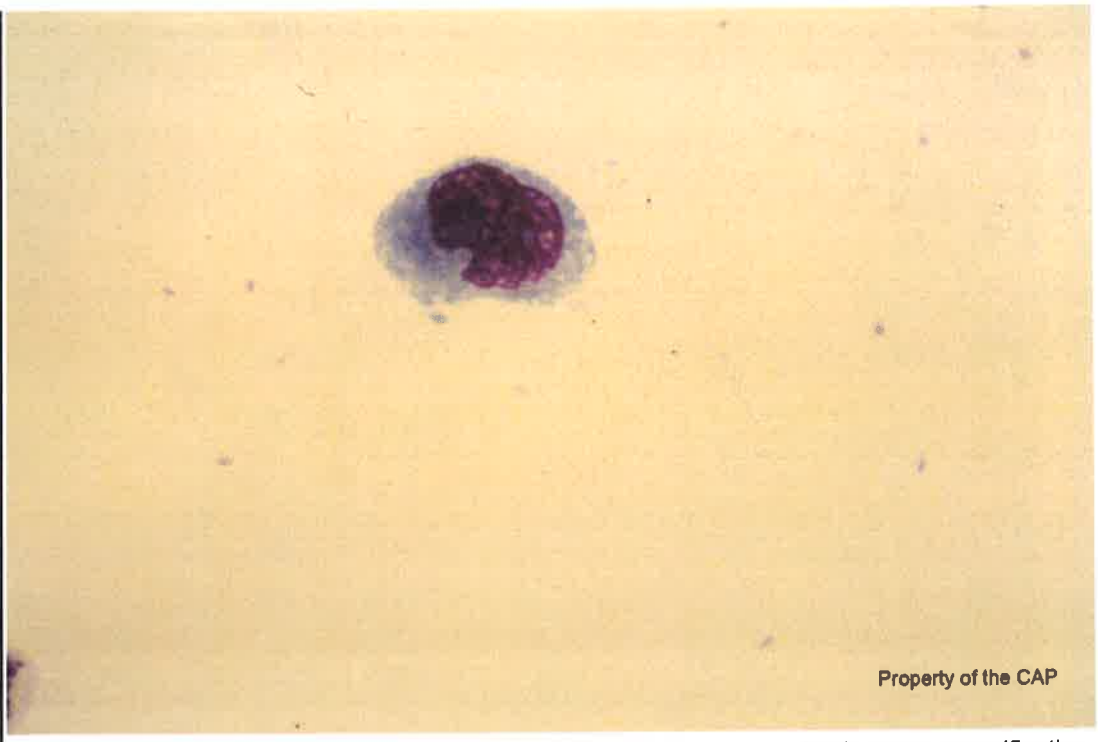
Hematology and Clinical Microscopy Committee

References:

1. Dumler JS, Choi K-S, Garcia-Garcia JC, et al. Human Granulocytic Anaplasmosis and *Anaplasma phagocytophilum*. *Emerg Infect Dis.* 2005;11:1828-1834. doi:10.3201/eid1112.050898
2. Ismail N, Bloch KC, McBride JW. Human ehrlichiosis and anaplasmosis. *Clin Lab Med.* 2010;30:261-292. doi:10.1016/j.cll.2009.10.004

CMMP – Clinical Microscopy Miscellaneous Photographs

CMMP-22



(NASAL, WRIGHT-GIEMSA) High power magnification

Identification	CMMP Participants No.	%	Performance Evaluation
Eosinophils are absent	1913	96.6	Good

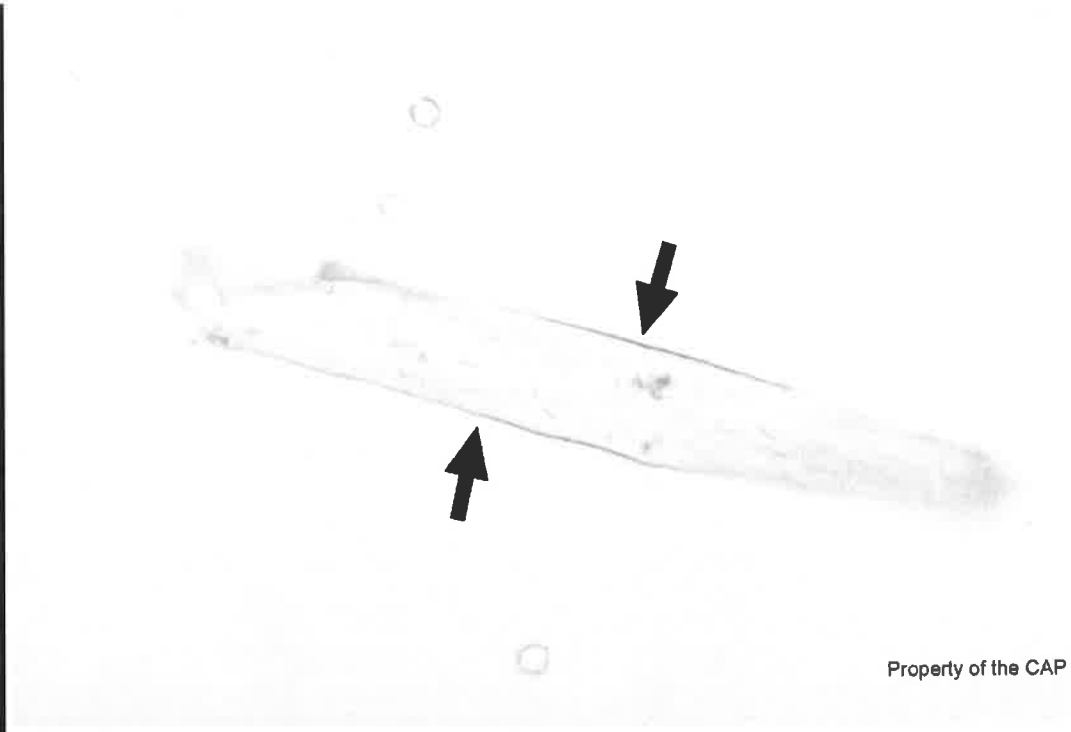
This Wright-Giemsa stained nasal smear is negative for eosinophils. Eosinophils are granulocytes named because their granules stain intensely with eosin. In addition to the many bright orange-red granules in their cytoplasm, eosinophils typically have a bilobed nucleus. The granules contain mediators that are toxic to many organisms, particularly parasites, and also to tissues as in asthma. Nasal smears for eosinophils are an aid to distinguishing allergic rhinitis, where eosinophils are present, from non-allergic rhinitis.

CMMP – Urine Sediment Color Photographs

Case History USP-01 through USP-03

This urine sample is from a 71-year-old man. Laboratory data include specific gravity = 1.015; pH = 8.0; ketones, glucose, protein, blood = negative; nitrite and leukocyte esterase = positive.

USP-01



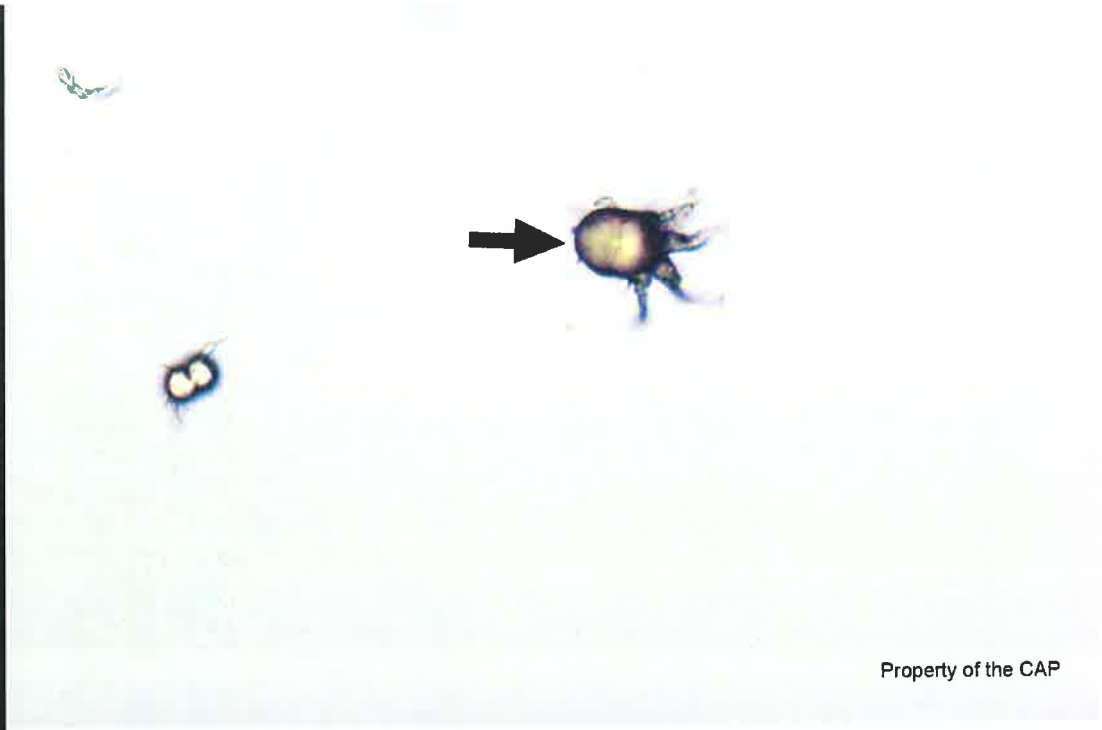
(URINE, UNSTAINED, 40X OR HIGHER POWER)

Identification	CMMP Participants No.	%	Performance Evaluation
Fiber (exogenous)/fecal contamination	3380	81.6	Good

The arrowed object(s) is a fiber, as correctly identified by 81.6% of participants. Fibers are exogenous contaminants and may be hairs, clothing fibers, gauze dressing fibers or diaper fibers. Fibers vary in size, shape and usually elongated and refractile. They may be frayed, twisted and pitted. Diaper fibers may resemble waxy casts but are birefringent. Waxy casts are found in urines positive for protein. Fibers are not clinically significant.

CMMP – Urine Sediment Color Photographs

USP-02



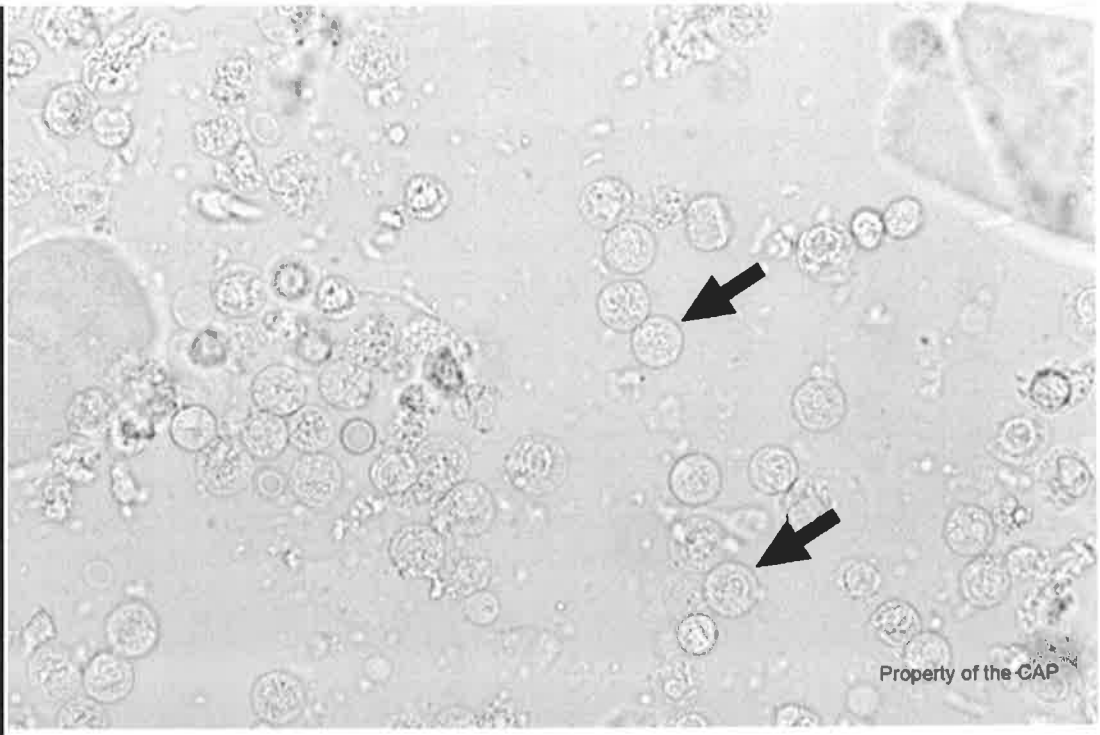
(URINE, UNSTAINED, 40X OR HIGHER POWER)

Identification	CMMP Participants No.	%	Performance Evaluation
Ammonium biurate crystal	4034	97.4	Good

The arrowed object(s) is an ammonium biurate crystal, as correctly identified by 97.4% of participants. Ammonium biurate crystals are rare and found in alkaline urine. Ammonium biurate crystals are generated from uric acid as urine specimens age for prolonged periods in the refrigerator. Ammonium biurate crystals are usually yellow-brown spiculated spheres, sometimes with radial striations. Ammonium biurate crystals are not clinically significant. They are not seen in freshly voided specimens.

CMMP – Urine Sediment Color Photographs

USP-03



(URINE, UNSTAINED, 40X OR HIGHER POWER)

Identification	CMMP Participants No.	%	Performance Evaluation
Leukocyte (neutrophil, eosinophil, lymphocyte)	4078	98.5	Good

The arrowed object(s) is a leukocyte, as correctly identified by 98.5% of participants. Neutrophils are the most common white blood cell found in urine. Leukocytes are approximately twice as large as red cells and round or oval with a segmented or lobular nucleus. The cytoplasm is finely granular. Degeneration of leukocytes may occur in only 2 - 3 hours at room temperature, so urines should be examined when fresh. Up to five leukocytes per high power field may be seen in normal urine. Leukocytes are increased in inflammation. The inflammation may be due to bacterial infection, non-infectious inflammation, vigorous physical activity or bladder/kidney stones.

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