Course Name : Bachelor of Physical Education

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Lecture No. 17

Lecture Title : Examination of Urine : Chemical, Microscopic

Introduction

Hello and welcome to yet another module on physical education. Today we will be discussing about how one can learn more about the state of the body by examination of the urine.

Leukocyte Esterase

Leukocyte esterase is an enzyme present in most white blood cells (WBCs). A few white blood cells are normally present in urine and usually give a negative chemical test result. When the number of WBCs in urine increases significantly, this screening test will become positive. Results of this test will be considered along with a microscopic examination for WBCs in the urine.

When this test is positive and/or the WBC count in urine is high, it may indicate that there is inflammation in the urinary tract or kidneys. The most common cause for WBCs in urine (leukocyturia) is a bacterial urinary tract infection (UTI), such as a bladder or kidney infection. In addition to WBCs, bacteria and RBCs may also be seen in the microscopic examination. If bacteria are present, the chemical test for nitrite may also be positive.

Nitrite

This test detects nitrite and is based upon the fact that many bacteria can convert nitrate (a normal substance in urine) to nitrite. Normally, the urinary tract and urine

are free of bacteria and nitrite. When bacteria enter the urinary tract, they can cause a urinary tract infection. A positive nitrite test result can indicate a UTI. However, since not all bacteria are capable of converting nitrate to nitrite, someone can still have a UTI despite a negative nitrite test. The results of this test will be considered along with the leukocyte esterase (above) with a microscopic examination.

Bilirubin and Urobilinogen

This test screens for bilirubin in the urine. Bilirubin is not present in the urine of normal, healthy individuals. It is a waste product that is produced by the liver from the hemoglobin of RBCs that are broken down and removed from circulation. It becomes a component of bile, a fluid that is released into the intestines to aid in food digestion.

In certain liver diseases, such as biliary obstruction or hepatitis, excess bilirubin can build up in the blood and is eliminated in urine. The presence of bilirubin in urine is an early indicator of liver disease and can occur before clinical symptoms such as jaundice develop.

The results of this test will be considered along with the result of urobilinogen. If positive, the healthcare practitioner will likely follow up with other laboratory tests, such as a liver panel, to help establish a diagnosis.

Urobilinogen

This test screens for urobilinogen in the urine. The results are considered along with those for urine bilirubin.

Urobilinogen is normally present in urine in low concentrations. It is formed in the intestine from bilirubin, and a portion of it is absorbed back into the blood. Positive test results may indicate liver diseases such as viral hepatitis, cirrhosis, liver damage due to drugs or toxic substances, or conditions associated with increased RBC destruction (hemolytic anemia). When urine urobilinogen is low or absent in a person with urine bilirubin and/or signs of liver dysfunction, it can indicate the presence of hepatic or biliary obstruction.

Ascorbic Acid (Vitamin C)

Occasionally, people taking vitamin C or multivitamins may have large amounts of

ascorbic acid in their urine. When this is suspected to be the case, a laboratorian may test the sample for ascorbic acid (vitamin C) because it has been known to interfere with the accuracy of some of the results of the chemical test strip, causing them to be falsely low or falsely negative. Examples of tests that may be affected include the urine dipstick tests for glucose, blood, bilirubin, nitrite, and leukocyte esterase.

The Microscopic Examination

A microscopic examination may or may not be performed as part of a routine urinalysis. It will typically be done when there are abnormal findings on the physical or chemical examination and the results from all will be taken into account for interpretation.

The microscopic exam is performed on urine sediment – urine that has been centrifuged to concentrate the substances in it at the bottom of a tube. The fluid at the top of the tube is then discarded and the drops of fluid remaining are examined under a microscope. Cells, crystals, and other substances are counted and reported either as the number observed "per low power field" (LPF) or "per high power field" (HPF). In addition, some entities, if present, are estimated as "few," "moderate," or "many," such as epithelial cells, bacteria, and crystals. Cells and other substances that may be seen include the following:

Red Blood Cells (RBCs)

White Blood Cells (WBCs)

Epithelial Cells

Bacteria, Yeast and Parasites

Trichomonas

Casts

Crystals

Red Blood Cells (RBCs)

Normally, a few RBCs are present in urine sediment (0-5 RBCs per high power

field, HPF). A positive chemical test for hemoglobin and an increase in the number of RBCs seen under the microscope indicates that there is blood in the urine. However, this test cannot be used to identify where the blood is coming from. For instance, contamination of urine with blood from hemorrhoids or vaginal bleeding cannot be distinguished from a bleed in the urinary tract. This is why it is important to collect a urine specimen correctly and for women to tell their healthcare provider that they are menstruating when asked to collect a urine specimen.

Blood in the urine is not a normal finding, but it is not uncommon and is not necessarily a cause for alarm. Hematuria is a sign or an indicator that prompts a healthcare practitioner to investigate further to try to determine the underlying cause of the blood. As part of the investigation, a healthcare practitioner will evaluate an individual's medical history, physical examination, and accompanying signs and symptoms. Additional urine and blood tests may be done to help determine the source.

Some of the underlying causes of hematuria are benign, temporary states that do no lasting harm and resolve with little or no specific treatment. If there is blood in the urine along with white blood cells and bacteria, it may be caused by a urinary tract infection that can be easily treated with antibiotics. Some causes of hematuria, however, may be critical conditions or represent a chronic condition that requires treatment and monitoring.

White Blood Cells (WBCs)

The number of WBCs in urine sediment is normally low (0-5 WBCs per high power field, HPF). WBCs can be a contaminant, such as those from vaginal secretions.

An increased number of WBCs seen in the urine under a microscope and/or positive test for leukocyte esterase may indicate an infection or inflammation somewhere in the urinary tract. If also seen with bacteria, they indicate a likely urinary tract infection.

Epithelial Cells

Epithelial cells are usually reported as "few," "moderate," or "many" present per

low power field (LPF). Normally, in men and women, a few epithelial cells can be found in the urine sediment. In urinary tract conditions such as infections, inflammation, and malignancies, an increased number of epithelial cells are present. Determining the kinds of cells present may sometimes help to identify certain conditions. For example, epithelial cells containing large amounts of broken-down hemoglobin (called hemosiderin) may indicate that there were red blood cells or hemoglobin in the urine recently, even if there are none now.

Bacteria, Yeast and Parasites

In healthy people, the urinary tract is sterile and, if the urine sample is collected as a "clean-catch" sample, there will be no microbes seen in the urine sediment under the microscope. Special care must be taken during specimen collection, particularly in women, to prevent bacteria that normally live on the skin or in vaginal secretions from contaminating the urine sample.

If microbes are seen, they are usually reported as "few," "moderate," or "many" present per high power field (HPF).

Bacteria from the surrounding skin can enter the urinary tract at the urethra and move up to the bladder, causing a urinary tract infection (UTI). If the infection is not treated, it can eventually move to the kidneys and cause kidney infection (pyelonephritis). If a person has an uncomplicated lower urinary tract infection, then the person may be treated without need for a urine culture. However, if the person has had recurrent UTIs, suspected complicated infection, or is hospitalized, a urine culture and susceptibility testing may be performed to help guide treatment.

In women (and rarely in men), yeast can also be present in urine. They are most often present in women who have a vaginal yeast infection because the urine has been contaminated with vaginal secretions during collection. If yeast are observed in urine, then the person may be treated for a yeast infection.

Trichomonas vaginalis is a parasite that may be found in the urine of women, or rarely, men. As with yeast, T. vaginalis infects the vaginal canal and their presence in urine is due to contamination during sample collection. If these are found during a urinalysis, then Trichomonas testing may be performed to look for a vaginal infection.

Casts and Crystals

Casts are cylindrical particles sometimes found in urine that are formed from coagulated protein released by kidney cells. They are formed in the long, thin, hollow tubes of the kidneys known as tubules and usually take the shape of the tubule (hence the name). Under the microscope, they often look like the shape of a "hot dog" and in healthy people they appear nearly clear. This type of cast is called a "hyaline" cast. Normally, healthy people may have a few (0–5) hyaline casts per low power field (LPF). After strenuous exercise, more hyaline casts may be detected.

Other types of casts are associated with different kidney diseases, and the type of casts found in the urine may give clues as to which disorder is affecting the kidney. Cellular casts, such as red blood cell and white blood cell casts, indicate a kidney disorder. Some other examples of types of casts include granular casts, fatty casts, and waxy casts. When a disease process is present in the kidney, cells or other substances can become trapped in the protein as the cast is formed. When this happens, the cast is identified by the substances inside it, for example, as a red blood cell cast or white blood cell cast.

Crystals

Urine contains many dissolved substances (solutes) – waste chemicals that the body needs to eliminate. These solutes can form crystals, solid forms of a particular substance, in the urine if:

The urine pH is increasingly acidic or basic;

The concentration of dissolved substances is increased; and

The urine temperature promotes their formation.

Crystals are identified by their shape, color, and by urine pH. They may be small, sand-like particles with no specific shape (amorphous) or have specific shapes, such as needle-like. Crystals are considered "normal" if they are from solutes that are typically found in the urine; these usually form as urine cools after collection and were not present in the body. Some examples of crystals that can be found in the urine of healthy individuals include:

Amorphous urates

Crystalline uric acid

Calcium oxalates

Amorphous phosphates

If the crystals are from substances that are not normally in the urine, they are considered "abnormal." Abnormal crystals may indicate an abnormal metabolic process. Some of these include:

Calcium carbonate

Cystine

Tyrosine

Leucine

Normal or abnormal crystals can form within the kidneys as urine is being made and may group together to form kidney "stones" or calculi. These stones can become lodged in the kidney itself or in the ureters, tubes that pass the urine from kidney to the bladder, causing extreme pain.

Medications, drugs, and x-ray dye can also crystallize in urine. Therefore, the laboratorian must be familiar with and trained in the identification of urine crystals.

Conclusion

Leukocyte Esterase

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So in this episode we have done a detailed demonstration of the various chemical properties of urine, the various physical properties of urine and how the various examination techniques can give an insight into the health of a person. I hope the information that was provided in this module was of some use to all of you. Thank you so much for watching.