Lab Report: Urinalysis

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Introduction

Urine, along with carbon dioxide, is one of the most wasteful products. Along with the circulatory and digestive systems, the urinary system is one of the most important ones in the human body. The body is capable of filtering “150-180 liters of blood plasma,”(Meisenberg & Simmons) which contains metabolic wastes, excess ions, water, and other harmful contaminants. In other words, its principal purpose is to eliminate waste such as ammonia, creatine, uric acid, urea, and much more from the body. It does, however, control blood volume/pressure, electrolyte levels, and pH in order to maintain the body’s homeostatic environment.

The urinary system, also known as the renal system or urinary tract, is mainly composed of the kidneys, ureters, bladder, and urethra. The kidney, on the other hand, is composed of around a million filtering units known as nephrons, which serve as the kidney's functional unit. What makes it so special is that each kidney has around 1 million tiny structural nephrons, each with a glomerulus in command for filtering blood and renal tubules which are in charge of reabsorbing required ions and nutrients back to the circulation and secreting wasteful products.

Only the kidneys and ureters are confined within the retroperitoneum, i.e. the upper urinary system. The bladder is a dint organ that has a pyriform shape and is located in the lower abdomen. Ligaments connect the bladder to other organs and the pelvic bones, allowing it to stay in position. After the nephron has processed and filtered the urine, the bladder's walls relax and expand to store it, then contract and flatten to expel it via the urethra.

Because urine comprises the majority of the waste products that the body secretes, it may reveal a lot about the body's health. Urinalyses or also known as a simple “urine test” are evaluated in clinical settings to discover substances or cells in the urine that indicate various illnesses, including infections or mostly kidney problems. Its “a popular screening test used across a wide range of inpatient and outpatient clinical settings, due to ease of accessibility, rapidity of results, and low cost.” (Weber, Talbot, & Mayhall,) The purpose of a urinalysis lab that was taken in this experiment was to comprehend the many forms of abnormalities in organic components such as an excess of protein, blood, bilirubin, glucose, and so on through a set of three distinct urine samples ranging from normal to abnormal.

Materials and Methods

The experiment was subdivided into two parts, Physical Characteristics, and Organic Components. Throughout the course of the lab experiment, three artificial urine samples were employed. Sample #1 was classified as normal urine, whereas samples #2 and 3 were classified as abnormal urine. Assessments that could be evaluated with the naked sight and olfactory senses were used to evaluate the urine's odor, color, and transparency. Exams requiring specialized equipment, such as a "Chemstrip or a Muiltistix," included up to ten distinct chemical pads that changed color when dipped in urine to determine the varying levels of concentration on urine content in organic components and to assess the pH. After dipping, the test can usually be read after 30 seconds to 2 minutes, depending on each organic compound. To determine a urine-specific gravity a Urinometer is needed however, for this lab a “Muiltistix” was used by also inserting the strip into the samples.

Results

Activity 1: Urinalysis Results on Physical Characteristics

Observation Or Test	Normal Values	Normal Urine	Abnormal 1 Urine	Abnormal 2 Urine
Color	Yellow (light/pale to dark/deep amber)	Pale yellow	Pale deep amber	Light pale amber
Transparency	Clear or cloudy	Clear	Cloudy	Somewhat cloudy
Odor	Varies with composition	Aromatic	Aromatic	Aromatic
pH	4.5-8	6.5	6	8.5
Specific Gravity	1.003-1.030	1.025	1.030	1.005

Continuation on Activity 1: Urinalysis Results on Organic Components

Type of Urine Sample	Glucose	Bilirubin	Ketone	Blood	Protein	Urobilinogen	Nitrate	Leukocyte
Normal	Negative	Negative	Trace 5 mg/dL	Negative	Negative	Normal 0.2	Negative	Negative
Abnormal 1	Positive 2,000 mg/dL or more	Negative	Small 15mg/dL	Trace	Positive 2000 or more +++	Normal 0.2	Negative	Negative
Abnormal 2	Positive 1,000 mg/dL	Negative	Trace 5 mg/dL	Large +++	Positive 2000 or more +++	Normal 0.2	Negative	Negative

Discussion/Conclusion

All three synthetic urine samples examined had varied findings for both physical characteristics and organic components. These outcomes were able to reveal the state of the person's health or kidney health. Unfortunately, a restraint in this lab was the lack of "in person," which hindered obtaining hands-on experience with the lab. The lab was virtually processed due to covid restrictions, that had precluded further evaluations such as for "Odor" in urine, therefore it was classified as "Aromatic" for each sample. Although urine is commonly recognized to have a somewhat strong ammonia smell, this is not necessarily the case for all people; nor in all three samples used in this experiment, it can also be related to dehydration, particular meals consumed, or diseases.

Urinalysis research results based on the physical properties of normal urine revealed that the patient was healthy. The hue suggested a pale yellow with a specific gravity of 1.025, indicating that the urine’s solute concentration was neither excessively concentrated nor too diluted and that the urine volume was at a proper weight volume. “The normal yellow color is due to urochrome, a pigment metabolite that arises from the body’s destruction of hemoglobin and travels to the kidneys as bilirubin or bile pigments.” (Marieb, 2015) The pH was also good, with a neutral level of 6.5, indicating that it was slightly acidic; diet may have a big impact here, such as eating too much dairy or poultry products or ingesting too much protein. The clarity or transparency was clear, which is a favorable indicator of sufficient hydration and a healthy urinary system.

The results of abnormal urine-1 suggested that the patient’s renal health was not optimal. The hue was a faint deep amber with a specific gravity of 1.030, which doesn't necessarily suggest the individual's kidneys aren't working properly, but it might indicate that the person is dehydrated, which causes the urine to be execrated with a somewhat deeper color. This may also imply that the solute's volume is more concentrated since it is less diluted. The pH results were an average of 6.0, which can be mildly acidic but is still considered a good level, with transparency of cloudiness that can indicate a variety of medical conditions ranging from relatively mild to severe, such as water loss, sexually transmitted infections, a urinary tract infection, and so on.

Lastly, two physical characteristics for abnormal urine-2, suggested that the patient was overhydrated, with a specific gravity of 1.005 with a light pale amber appearance. The lower the specific gravity, the more water intake the person had consumed, this can also suggest that the patient's solute concentration is low, which explains why the urine's color execration was a light pale amber. The urine had a pH of 8.5, which is very alkaline, and transparency of fairly hazy. This indicates that the person's kidneys are most likely not sufficiently eliminating acids, which can lead to a condition known as renal tubular acidosis, which occurs in the renal tubules of the nephron.

Moving on to organic compound data, a Muiltistix strip was dipped for 30 seconds into the urine samples and glucose was the first to be evaluated. A normal urine sample yielded a negative result, demonstrating a light turquoise hue, showing that blood sugar levels are not increased and insulin levels were functioning normally. However, the Abnormal Urine-1 sample resulted in a Positive 2,000 mg/dL or more, and the Abnormal Urine-2 sample resulted in a 1,000 mg/dL, indicating that there are extreme levels of abnormally sugar levels in the blood for both abnormal urine samples and that the body could be deficient in insulin levels. Both abnormal urine samples included glucose, indicating that the kidneys had exceeded their renal glucose threshold, also known as RTG. When the blood glucose level reaches 160–180 mg/dL, the proximal tubules situated around the glomerulus capsule in the nephrons get overloaded reabsorbing extra glucose, leading the urinary system to begin secreting sugar through urine to lower blood concentration. If not treated, this can potentially lead to a “pathological uncontrolled diabetes” (Marieb, 2015) a health condition, or a non-pathological “excessive carbohydrate intake.” (Marieb, 2015)

For the following organic chemical, bilirubin, a Muiltistix was dipped into all three samples for 30 seconds. Fortunately, all three urine samples revealed a light yellow hue, indicating that the patients had a healthy liver that is adequately functioning. Bilirubin is a byproduct of hemoglobin breakdown; and it circulates in the blood and then goes into the liver, where it is extracted and incorporated into bile. If bilirubin was found in one of the urine samples and was tested positive, this could've been an indication that there is a possibility of liver injury or illness in the patient’s health.

Following that, the ketone was tested, and a Muiltisitx was dipped for 40 seconds into each of the three samples. Normal urine and abnormal-2 urine samples resulted in a trace 5 mg/dL, which does not necessarily mean that the patients may have "diabetic ketoacidosis," also known as DKA, because the ketone levels results here were not abnormally high, but it may possibly mean that the patients could be lacking food or other nutrients that it requires, in other words, this can be starvation or just being hungry, which can explain the very low levels of ketone bodies present in urine. One of the causes for this is that not enough food is consumed to give sugar or glucose levels for the body to create energy, thus the body begins to burn fat for energy and fat are well known to provide an abundant amount of ATP than glucose. The findings for abnormal-1 urine samples, on the other hand, resulted in a small 15mg/dL, indicating a much higher quantity of ketone detected in the urine than the other two samples. This makes sense due to the high glucose readings which was Positive 2,000 mg/dL or more from the dipstick test in the case of the abnormal-1 urine sample. There could be a chance this patient may have DKA along with being diabetic.

In addition, the next organic substance examined was blood, in which a Muiltstix was immersed for 1 minute this time on each sample. Urine should not include blood, yet each sample yielded a different result. The normal urine sample came out negative, with a light orange tint, indicating the absence of "hematuria." Hematuria is a urinary tract organ irritation that causes blood excretion when urine is passed. It can be caused by kidney stones, damage, or inflammation of the urinary tract organs. Hematuria can also be caused by filtration damage to the glomerulus membrane, which is known as "glomerulonephritis." In the case of the normal urine sample, the hemoglobin molecule had successfully bound to the haptoglobin and bypassed the kidney filtration mechanism, resulting in no blood in the urine. However, in the abnormal-1 urine sample, there was evidence of non-hemolyzed blood with a considerably deeper orange tinge, indicating a modest presence of intact red blood cells, revealing a source of probable blood loss in the lower urinary tract. The abnormal-2 urine sample, on the other hand, revealed a Positive Large +++ with a very dark green tint, indicating that a number of red cells in the urine had ruptured apart. The reagent on the dipstick interacted with the hemoglobin produced when red blood cells were lysed, resulting in hemolyzed blood, also known as "Hemoglobinuria."

Possible “fragmentations of erythrocytes, resulting in the release of hemoglobin into the plasma and subsequently into the filtrate.” (Marieb, 2015) can be concerning.

Protein was the next to be examined. For 60 seconds, a Muiltistix was immersed in each of the three samples. A normal urine sample produced a negative with a light green color, indicating that no protein was detected and hence the patient is healthy. Positive 2000 or more +++ was obtained for both abnormal-1 and abnormal-2 urine samples, which is alarming for the patients. Protein should never be discovered in urine because its molecules are considered too big to pass through the glomerular filtration barrier and so should not be eliminated in the urine. Proteinuria, also known as "Albuminuria," is characterized by an increased permeability in the glomerular filtration membrane of the nephron, which functions as an open door for protein to be filtered. This can potentially result in kidney damage for both patients.

In addition, the next samples were tested for urobilinogen, by submerging a Muiltistix for 1 minute. After analysis, all three samples yielded a normal 0.2. Urobilinogen is generally present in little amounts in urine and should not be a cause for concern until there are excessive levels of it observed, in which case it should be. High levels of urobilinogen may suggest a dysfunction with the liver, damage to the liver can cause disorders including hepatitis and cirrhosis.

Nitrate and leukocytes were the last organic components analyzed; a dipstick was submerged in all three urine samples, yielding all negative results! Leukocytes were tested for 2 minutes and nitrate for 60 seconds. This is regarded as normal; in healthy people. A nitrate and leukocyte test should normally be negative, indicating that the urine is devoid of germs and, in particular, no urinary tract infections (UTI). As a result, there is no presence of "Pyuria" or "Nitrituria" in any of the three samples.

A positive leucocyte test is somewhat concerning because it should generally be negative. This might be a symptom of Pyuria, a disorder caused by a UTI. When a urinalysis reveals the presence of white blood cells or, in some circumstances, pus cells in the urine, the patient is most likely suffering from Pyuria. Women, unlike males, are at a considerably higher risk of being diagnosed with pyuria due to having a shorter urethra than males which allows germs to move quicker and infect a woman's bladder and other urinary organs more easily. This is sometimes caused by germs from feces entering the urinary tract during toilet breaks; however, the most prevalent cause of pyuria is sexually transmitted infections (STIs), such as gonorrhea or other viral infections. Some pyuria symptoms include a burning feeling when urinating, which can be quite unpleasant, fever, a foul odor in the urine, and continuous pelvic discomfort can also be symptoms of pyuria. Physical signs of pyuria include transparency of cloudiness, evidence of pus, and maybe accompanied with greater specific gravity, which might lead to more acidic pH urine. Pyuria can be treated with antibiotic medication administered by a trained medical practitioner, such as oral trimethoprim-sulfamethoxazole or nitrofurantoin most commonly. These medicines can help to halt and kill the bacteria, alleviating the patient's symptoms over time. Wiping front to back in females to prevent bacteria from being wiped to the vaginal area, cleaning up before intercourse and urinating afterwards, and avoiding irritant feminine cosmetics that might potentially disturb the vaginal pH and safe sex are all simple measures to prevent pyuria.

Dipstick tests such as the Muiltistick one used for this lab report are not always reliable, but it’s one of the best tools in clinical settings for detecting any abnormalities or illnesses at an early stage rather than not knowing at all. Dipsticks, such as the Muiltistick in this example, were quite effective for testing numerous things at once. The goal of this lab was to learn how various amounts of organic components in urine may frequently alter not only how the urinary system and its organs work, but also how it might potentially lead to other disorders that can impair the patient's overall health.

References

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