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BIO 2312- Section OL23

Tuesday-Thursday 2:30-5:00PM

Urinalysis

Introduction

The urinary system functions to get rid of the metabolic wastes generated by the body's cells (Martini et al., 2018). The organs of the urinary systems are the kidneys, ureters, urinary bladder, and urethra. The kidney is the organ that removes the metabolic waste from the circulation to produce urine (Martini et al., 2018). The body forms three important metabolic wastes which are urea, creatinine, and uric acid. These metabolic wastes get dissolved in the bloodstream and can only be removed through urination.

The paired kidneys of the urinary system have excretory functions (Martini et al., 2018). It produces urine that flows through the urinary tract. The urinary tract contains the urinary bladder, urethra, and paired tubes that are termed ureters. When the urinary bladder becomes full urination occurs. During urination, the urinary bladder contracts and forces urine through the urethra which brings urine to the outside.

As we eat the body absorbs nutrients needed for the maintenance of bodily fluids, energy, and self-repair (Kidney & Urology, 2020). When the body decides that it has absorbed enough nutrients the rest becomes waste left behind in the blood and the bowel. According to Kidney and Urology, the urinary system works to keep the chemical and water in the body balanced by removing the waste called urea from the blood. Urea gets produced through meat, vegetables, poultry, etc. Urea is carried from the bloodstream to the kidneys. Kidneys remove urea through filtering units called nephrons. Each of the nephrons comprises a ball that is made of small blood capillaries called a glomerulus and a small tube termed a renal tubule. Urea, water, and other waste substances(creatinine, uric acid) form the urine as it transports through nephrons and down the renal tubules.

Passing from the kidney the urine goes down two thin tubes (ureters) to the bladder. Muscles found in the walls of the ureter constantly work back and forth to tighten and relax so urine can appear down from the kidney(Kidney & Urology, 2020). If the urine stays back up without coming down it can cause a kidney infection. Problems such as kidney infections and other problems in the urinary system can be detected through urinalysis.

Urinalysis is a test studying the content of urine for abnormal substances such as protein etc or any signs of infection (Kidney & Urology, 2020). According to the textbook, urinalysis is the chemical and physical analysis of a urine sample (Martini et al., 2018). To take the test you urinate into a special container and the sample gets studied. In this lab, the Multistix urine test strip/ dipstick was used to show the pathological changes in the patient's urine in standard urinalysis. The objective of this lab is to use prepared dipsticks to perform chemical and physical tests to determine the characteristics of normal urine and to identify abnormal urinary components (Marieb et al., 2019).

Materials and methods

To analyze various urine samples in the lab disposable gloves, wide-range pH paper, dipsticks, urinometer, test tubes, test rack, test tube holders and 10-ml graduated cylinder were used. Prior to the start of the experiment students were reminded and required to wear disposable gloves throughout the laboratory session (Marieb et al.,2019). Set up for the lab then began. Students determined the color, transparency and odor of the urine. These observations were recorded in the chart.

After this, a fresh piece of pH paper was used to test the pH of the normal and abnormal artificial urine sample. A strip of pH paper was dipped into the urine and tested two to three times. The results were then recorded in the chart. Students proceeded to take the samples of the urine and mix it well. After mixing, the urinometer cylinder was filled with $\frac{2}{3}$ (two-thirds) of the urine. A urinometer float was lowered into the urine. Readings for the specific gravity was then taken.

To determine the chemical analysis of the urine samples a 10 ml graduated cylinder, test reagents for sulfates, hot plate, 500-ml beaker, test reagents for phosphate, glass stirring rod, test reagents for chloride, clean microscope slide and coverslip, test reagents for urea, test reagents for glucose, medicine droppers and timer were used. We determined the inorganic and organic constituents of the urine. We first checked for the inorganic constituents (nitrites) in the urine. A timer of 60 seconds was placed. To check for nitrite a combination dipstick was used. After the 60 seconds results for the tests were then recorded.

Students then checked for the organic constituents in the urine (glucose, protein, ketone, blood/ hemoglobin, bilirubin and leukocytes). To check for glucose a timer of 30 seconds was set in place. 5 drops of urine was then placed into a test tube using a medicine dropper. After the dropper was rinsed and 10 drops of water was added to the tube. A clinitest tablet was then added. After 15 seconds the color was compared to the color chart and results were recorded. To check for the protein, ketone and leukocytes presence combination dipsticks were used. Results were then recorded.

The timer was set for 90 seconds to determine the presence of blood/ hemoglobin, bilirubin and urobilinogen . To test the urine sample for hemoglobin and bilirubin a combination dipstick was used.

Results

Table 1 Urinalysis Results on Normal and Abnormal Urine Samples

Observation/ Test	Normal values	Normal Urine Artificial	Abnormal Urine- 1 Artificial	Abnormal Urine- 2 Artificial
Color	Pale yellow	Pale yellow	Transparent Yellow	Dark Yellow
Transparency	Clear	Clear	Bubbles	Clear
Odor	Aromatic	Aromatic	Mild	Mild
pH	4.5-8.0	6.5	6.0	8.0
Specific gravity	1.001- 1.030	1.025	1.030	1.005
Leukocytes	Absent	Negative	Negative	Negative
Nitrite	Absent	Negative	Negative	Negative
Urobilinogen	Present	0.2 mg/dL	0.2 mg/dL	0.2 mg/dL
Protein	Negative	Negative	300+++ mg/dL	2,000 or more +++ mg/dL
Blood	Negative	Negative	Negative	Large +++
Ketone	Negative	Trace 5 mg/dL	Negative	Trace 5 mg/dL
Bilirubin	Negative	Negative	Negative	Negative
Glucose	Negative	Negative	2,000 mg/dL or more	1000 mg/dL

Discussion and Conclusion

The results from the three samples differed. Based on the three samples provided we had one from normal urine and the other two from patients (Niloufar et al., 2020). The table indicates the physical analysis and chemical components of the urine sample (Table 1).

Tests for the determination of leukocytes, nitrite, protein, blood, bilirubin, and glucose were negative (Table 1) for the normal urine patient. Going in order from the test taken we can confirm that the person does not have a sign of infection because their leukocytes and nitrite were negative. When white blood cells (leukocytes) increase in urine this may produce a positive test. A positive test may indicate inflammation in the kidney or urinary tract (American Association, 2020). According to the American Association, the most common cause for leukocytes in the urine is a UTI (urinary tract infection), like a bladder or kidney infection. A positive nitrite test may also indicate a UTI so from the normal urine sample the patient does not indicate a UTI. A negative protein test means there was no protein detected in this patient's urine but if there was it could have been due to an infection, stress, exercise. A negative blood test in this patient does not raise an alarm for a doctor because this means there was no presence of blood in the urine. The same logic goes for the negative bilirubin and glucose test. Bilirubin and glucose are not present in the urine of normal individuals (American Association, 2020).

The patient with the normal urine has urine with a pH of 6.5 which is considered within the normal so does not have to be monitored. The specific gravity is also 1.025 (Table 1) which is in the normal range for urine specific gravity. According to MedlinePlus urobilinogen occurs from the reduction of bilirubin. Normal urine contains urobilinogen but if there is little or none this may be an indication that the liver is not functioning properly. Urobilinogen is present in urine at concentrations that can reach up to 1.0 mg/dL. A concentration of 2.0 mg/dL may mean the person has hemolytic or hepatitis disease. They will have to be evaluated further. Lastly, the ketone presence for the patient for the normal urine appeared to be a Trace 5 mg/dL. This may not be concerning as of yet but this may mean that buildup of the ketone is occurring. This

patient will be encouraged to drink more fluids and check their blood sugar levels (American Diabetes Association).

Some results from the abnormal urine- 1 patient mimicked the normal urine patient in some tests that they observed. The leukocytes, nitrite, urobilinogen, blood, ketone, and bilirubin tests indicated the same results. For this patient, the protein and glucose results were a bit concerning. The glucose test indicated a result of 2,000 mg/dL or more. Glucose does not normally appear in urine, but when it is this condition is termed glucosuria (American Association, 2020). Glucosuria can result from high glucose levels in the blood (diabetic patients) or a reduction in the renal threshold. The renal threshold means that the blood glucose level has reached a maximum concentration. This will cause the kidney to begin to eliminate glucose into the urine. This will then decrease blood concentrations (American Association, 2020). Lastly, glycosuria can also result from liver disease, hormonal disorder, and pregnancy. The abnormal urine 1- patient may be diabetic, have a liver disease, etc that has to be watched out for. The protein level for this patient was extremely alarming also. The patient has a result of 300 (+++) mg/dL. Proteins are normally found in the body. But if a problem occurs with the kidney it can leak protein into the urine. This may indicate kidney disease in the abnormal urine- 1 patient. It was noticed that the transparency of urine also wasn't clear and had bubbles on top of it. It has been noted that when kidney damage worsens and an excessive amount of proteins is displayed in the urine one of the symptoms is foamy or bubbly looking urine (American Kidney Fund, 2020).

Results from the abnormal urine- 2 patients indicated more problems. The pH level was 8.0 for this patient (Table 1). This is an issue to watch out for because this may signal a medical

condition. This patient may be suffering from conditions such as kidney stones, kidney-related disorders, or possibly a Urinary tract infection. Like the abnormal urine- 1 patient, this patient also had high levels of proteins in their urine. Like explained before, high levels of proteins found in the urine can indicate liver disease. This patient has a protein resulting in 2, 000 or more (+++) mg/dL (Table 1). In this patient, there were also large amounts of blood found in the urine. Blood in the urine is known as hematuria (American Association, 2020). In hematuria, the kidneys or various parts of the urinary tract can allow blood to leak into the urine. This can be caused by urinary tract infection, kidney infection, bladder or kidney stones, cancer, enlarged prostate, or even medication (Mayo Clinic, 1998). Lastly, the results of the patient showed high levels of glucose in the urine. This can show signs of diabetes, kidney, or liver disease like explained before in abnormal patient 1. In conclusion, this patient may be suffering from a UTI infection, diabetes, or liver disease after reviewing the results of their tests.

With some difference between the normal and abnormal urine samples, the abnormal patients should be encouraged to lead a healthier lifestyle through exercising, eating enough vegetables and fruits. They should also be guided to drink water. According to the National Kidney Foundation, water helps keep the kidney healthy. Water can help the kidney remove waste from the blood in the form of urine. Water can also keep the blood vessels open so blood travels freely to the kidneys. When a person becomes dehydrated it becomes more difficult for the urinary system to function. Mild dehydration can make one feel tired and impair normal body functions (National Kidney Foundation, 2020). Patients should also limit smoking and use the bathroom often when needed to avoid infections/ disorders.

The objective of this lab was to use dipsticks to analyze the physical and chemical components of the urine. This helped us diagnose the various patients based on the dipstick results and also learn more about the characteristics of normal and abnormal urine. Urinalysis is an examination of the urine for certain properties, organisms, matter, and most importantly medical diagnosis. It can help show doctors' problems that occur in the body. According to Mayo Clinic, a urinalysis involves checking the contents, appearance, and concentration of urine. This can help discover certain disorders such as UTI, diabetes, kidney disease, etc. Tests such as the dipstick urinalysis can be easily done at home. Like the professor did with artificial urine we can use our urine to check for various conditions.

References

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