Annalea Cullen

BIO 2312 – D057

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Urinalysis Lab Report

**Introduction**

The urinary system is composed of four major organs: the kidneys, which produce urine; the ureters, which transport urine from the kidneys to the urinary bladder; the urinary bladder, which stores urine before it is expelled from the body via urination; and the urethra, which transports the urine from the bladder to outside the body during urination (Martini, Nath & Bartholomew 2018).

The urinary system performs several important functions. It works to regulate blood volume, blood pressure and plasma concentrations of certain ions. It also helps to stabilize blood pH and expel metabolic wastes and toxins while filtering out valuable nutrients that are then reabsorbed by the body (Martini, Nath & Bartholomew 2018).

The kidneys are a vital part of these processes, and the functional units of the kidney are called nephrons. Each nephron is composed of a renal corpuscle, which is the site of blood filtration, and a renal tubule, which directs filtrate into the collecting system of the kidney. The renal corpuscle is composed of a capillary network called the glomerulus, as well as the glomerular capsule (or Bowman’s capsule), which surrounds the glomerulus. The renal tubule is composed of three segments: the proximal convoluted tubule (PCT), the nephron loop (or Loop of Henle), and the distal convoluted tubule (DCT). As filtrate from the renal corpuscle travels through the renal tubule, its composition is altered via reabsorption and secretion. In the PCT, water, critical ions and organic nutrients are reabsorbed. As the filtrate fluid passes into the nephron loop, further reabsorption of water (in the descending portion) and sodium and chloride ions (in the ascending portion) occurs. Finally, in the DCT, acids, drugs, toxins and certain ions are secreted, while water and selected ions are reabsorbed (Martini, Nath & Bartholomew 2018).

Once the fluid passes from the DCT into the collecting system, it is drained into collecting ducts, which empty into structures called minor calyces, and then ultimately into the ureters. Before leaving the collecting system, the fluid undergoes further changes in concentration that are regulated by hormones such as aldosterone and antidiuretic hormone (ADH). Sodium ions, bicarbonate ions and urea are reabsorbed in the collecting system, while hydrogen or bicarbonate ions are secreted in response to changes in pH (Martini, Nath & Bartholomew 2018).

Once the urine has left the collecting system it enters the ureters – muscular tubes that undergo peristaltic contractions to push the urine from the kidneys to the bladder while preventing backflow. Once in the bladder, the urine collects until the detrusor muscle of the bladder contracts to compress the bladder and expel the urine into the urethra, which opens to the exterior of the body to expel the urine (Martini, Nath & Bartholomew 2018).

As with all bodily systems, the urinary system is susceptible to infection and disease. The primary method of testing for problems within the urinary system is a urinalysis, which “involves checking the appearance, concentration and content of urine” (Mayo Clinic 2019). For the purposes of this lab, a urinalysis was conducted using a dipstick. A dipstick is a plastic stick containing strips of different chemicals that will change color once inserted into a urine sample. The color changes on the stick represent the presence and levels of certain substances within the urine, including protein, glucose, ketones, bilirubin, leukocytes and blood. The dipstick also measures the pH of the urine sample (Mayo Clinic 2019).

The purpose of this lab was to compare three artificial urine samples via urinalysis using a dipstick.

**Materials & Methods**

To complete this experiment, three dipsticks called Multistix were used (one for each urine sample). Each Multistix contained 10 chemical strips. Each strip tested for the presence and/or concentration of one of the following: leukocytes, nitrate, urobilinogen, protein, pH, blood, specific gravity, ketone, bilirubin and glucose. All three of the urine samples contained artificial urine. The first sample contained normal urine, while the other two samples were abnormal. To perform this experiment, one Multistix was inserted into each of the three urine samples for a duration of 60 seconds. After the 60 seconds, the test strips were removed from the urine samples for analysis.

**Results**

**Table 1. Urinalysis Results from Multistix Test Strips**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Normal Urine (Artificial)** | **Abnormal Urine 1 (Artificial)** | **Abnormal Urine 2 (Artificial)** |
| **Leukocytes** | Negative | Negative | Negative |
| **Nitrate** | Negative | Negative | Negative |
| **Urobilinogen** | 0.2 mg/dL  (normal) | 0.2 mg/dL  (normal) | 0.2 mg/dL  (normal) |
| **Protein** | Negative | 2000 mg/dL or more  (++++) | 2000 mg/dL or more  (++++) |
| **pH** | 6.5 | 6.0 | 8.5 |
| **Blood** | Negative | Hemolyzed trace | Large (+++) |
| **Specific Gravity** | 1.020 | 1.030 | 1.005 |
| **Ketone** | Trace 5 mg/dL | Negative | Trace 5 mg/dL |
| **Bilirubin** | Negative | Negative | Negative |
| **Glucose** | Negative | 2000 mg/dL or more | 1000 mg/dL |

**Discussion & Conclusion**

The urinalysis results for the normal artificial urine sample came back mostly as expected. The test was negative for leukocytes, which is characteristic of a healthy urine sample, as the presence of leukocytes in urine can indicate infection (Khatri 2019). There was also no presence of nitrates in the sample, which is a healthy result given that the presence of nitrates can indicate a urinary tract infection (MedlinePlus 2020). As shown in the results table above, the urobilinogen levels were reported as normal. There were no traces of protein found in the sample, which is an optimal result because high levels of proteins (i.e., proteinuria) can be an early sign of kidney disease (American Kidney Fund 2020). The pH of the sample was 6.5, which falls within the normal range (Bono & Reygaert 2019). There was no blood found in the sample, which is optimal as the presence of blood signifies underlying disease or infection (Mayo Clinic 2017). The specific gravity for this sample was 1.020, which falls within the normal range (1.002 – 1.030 is indicative of normal kidney function) but could indicate that the patient is slightly dehydrated. According to Healthline, “specific gravity results above 1.010 can indicate mild dehydration. The higher the number, the more dehydrated you may be” (Nall & Gotter 2018). The test indicated trace amounts of ketone in the urine; ideally there would be no ketones present, as high ketone levels can be indicative of ketoacidosis – a common complication of diabetes. However, trace amounts of ketone can be attributed to non-illness-related factors such as very low carbohydrate intake, strenuous exercise or even pregnancy (MedlinePlus 2020). The test for bilirubin came back negative, which is good because the presence of bilirubin in urine can indicate liver damage (Mayo Clinic 2019). Finally, there was no glucose found in the sample, which is a normal result as the presence of glucose in urine is indicative of diabetes (Mayo Clinic 2019).

For the first abnormal urine sample, the test results for protein, blood, specific gravity and glucose were abnormal (the other indicators were normal). The most striking of these abnormal results was the very high level of glucose found in the sample (2000 mg/dL or more), as this would point to diabetes. Using this hypothesis as a starting point, the trace amounts of hemolyzed blood could be due to glomerulonephritis, an inflammation of the kidneys' filtering system that can stem from diabetes (Mayo Clinic 2017). The specific gravity reading of 1.030 is the high end of the normal range, which can indicate dehydration as well as the presence of extra substances in the urine, such as glucose (Nall & Gotter 2018). The very high level of protein found in the sample (2000 mg/dL or more) is also a sign of both diabetes and glomerulonephritis (American Kidney Fund 2020). As such, this sample indicates that the subject may have diabetes that has caused damage to the kidneys resulting in glomerulonephritis.

For the second abnormal urine sample, the test results for protein, pH, blood, specific gravity and glucose were abnormal (the other indicators were normal, aside from trace amounts of ketone, which, while by itself is not necessarily problematic, could aid in diagnosis when analyzed alongside the other abnormal indicators). The most striking of these indicators was the high pH (8.5) and the large presence of blood in the urine. A pH of 8.5 and above is generally indicative of either a urinary tract infection (UTI) or kidney stones (Bono & Reygaert 2019). Blood in the urine can also indicate either of these conditions (Mayo Clinic 2017). However, with a UTI, generally there would be elevated levels of nitrates and leukocytes as well (Bono & Reygaert 2019). Since neither of these are present in this sample, it can be concluded that a UTI is likely not the cause of the abnormality. The low specific gravity reported in this sample (1.005) could indicate simply that the subject is very well hydrated, or it could mean that the kidney tubules are not functioning correctly (Nall & Gotter 2018). Proteinuria, which is present in this sample, can lead to kidney stones (WebMD 2020). Analyzing these factors together, kidney stones are a probable diagnosis for this abnormal urine sample. However, given the moderate levels of glucose and trace amounts of ketone present, there is also a possibility that the subject may be diabetic.

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