

Kidney Disease

Diabetes Mellitus

- When the control of insulin is not working properly, the levels of glucose in the blood can spike after a carbohydrate rich meal or plunge when glucose is not immediately available.
- The distal tubule of the nephrons is designed to be able to maintain 0.1% blood glucose levels. If there is a higher concentration due to lack of insulin to convert glucose to glycogen, the excess is released in the urine.
- This excess can be detected through urine analysis. Another clue to this disease is the release of copious amounts of urine.
- As glucose is a solute, water is released along with it following the osmotic pressure gradient. The individual is often left thirsty because of the large amount of water loss.

There are three main types of diabetes mellitus (DM).

- Type 1 DM results from the body's failure to produce insulin, and currently requires the person to inject insulin or wear an insulin pump. This form was previously referred to as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes".
- Type 2 DM results from insulin resistance, a condition in which cells fail to use insulin properly, sometimes combined with an absolute insulin deficiency. This form was previously referred to as non insulin-dependent diabetes mellitus (NIDDM) or "adult-onset diabetes".
- The third main form, gestational diabetes, occurs when pregnant women without a previous diagnosis of diabetes develop a high blood glucose level. It may precede development of type 2 DM.

Diabetes Insipidus

- This form is caused by the destruction of the ADH-producing cells or the pathways that signal its release.
- If ADH is not present to regulate water reabsorption, much of the filtered water is not recovered and lost as urine.
- An affected individual may produce 10-20 L of urine per day creating a strong thirst response.
- Large quantities of water have to be ingested to maintain proper fluid levels.

Bright's Disease

- This disease is also known as nephritis which is not one single disease but many causes that are characterized by inflammation of the nephrons.
- If the nephron is damaged, it alters the permeability of the membrane allowing larger solutes to pass through.
- Since there is no mechanism in place to reabsorb these larger solutes, they cannot be recovered and are lost in the urine. Again, because of the higher solute concentration in the waste, more water is lost as well.

Kidney Stones

- Kidney stones are caused by the hardening of mineral solutes from the blood.
- They can be alkaline or acidic in nature.
- The stones can become lodged in the ureter, blocking the path of the urine to the bladder and it can also get caught in the urethra.
- The delicate tissues of the tube can be damaged as pressure pushes the stone down the passageway.
- In many cases, the stone is left to pass through on its own, which can cause great pain. Some have likened the pain to the pain of childbirth.
- If the stone is too large, it may have to be removed surgically.
- Newer methods are using high energy shock waves to break up the stone so the pieces can be passed.
- Use of this method depends on the location of the stone and its composition but it does provide an alternative to surgery.

Disease Technology

Kidney Dialysis

- When the kidney is damaged for whatever reason and cannot filter the wastes out of the blood, dialysis can accomplish the task.
- Dialysis uses the principles of diffusion and blood pressure to exchange substances across a semi-permeable membrane.
- It can remove the waste products but it cannot perform active transport to move the wanted solutes back into the bloodstream.

- In hemodialysis, a machine is connected to the circulatory system through a vein.
 - Blood is pumped through a series of tubes that are submerged in a bath of various solutes.
 - Because urea is not present it will diffuse into the solution.
 - The chemical substances that a functional kidney would normally produce can be added into the solution and they will diffuse back
 - Having their blood filtered three times a week, six hours per session.
- Recently, a second form of dialysis has been developed called continuous ambulatory peritoneal dialysis (CAPD).
 - Using this method, 2 L of dialysis fluid is pumped into the abdominal cavity and the membranes in the body selectively filter wastes from the blood.
 - Urea and other wastes enter the fluid by diffusion.
 - The waste filled fluid can be drained off and replaced several times a day.
 - This allows patients to continue with moderate activity over the day and provides them with independence as they can learn to perform the procedure themselves in their own home rather than having to go to the hospital for treatment.

Kidney Transplant

- Kidney transplants are 85% successful.
- If the transplant works, proper kidney function is restored including its blood filtering abilities and the formation of the chemical substances that the kidney produces that help with normal body functioning.
- The main disadvantage is the possibility of rejection of the kidney as foreign tissue by the immune system.
- Immune suppression drugs have to be taken to prevent this from happening.
- The kidney is placed in the lower abdomen near the groin and connected to the blood vessels.
- After a few days, the kidney should be fully functional and the patient should no longer need dialysis.