



ESRD Network #12 Patient Educational Newsletter

Providing kidney patients and their families information on diet, health and treatment.

Volume 4.

Fall 2004

Issue 2.

Nephron News & You is written and distributed under Centers for Medicare & Medicaid Services Contract #500-00-NW12. For more information, please contact the newsletter editor: Kimberly F. Thompson., R.N., C.N.N. at 1-800-444-9965 Monday – Friday from 8 a.m. – 4:30 p.m. Central standard time.

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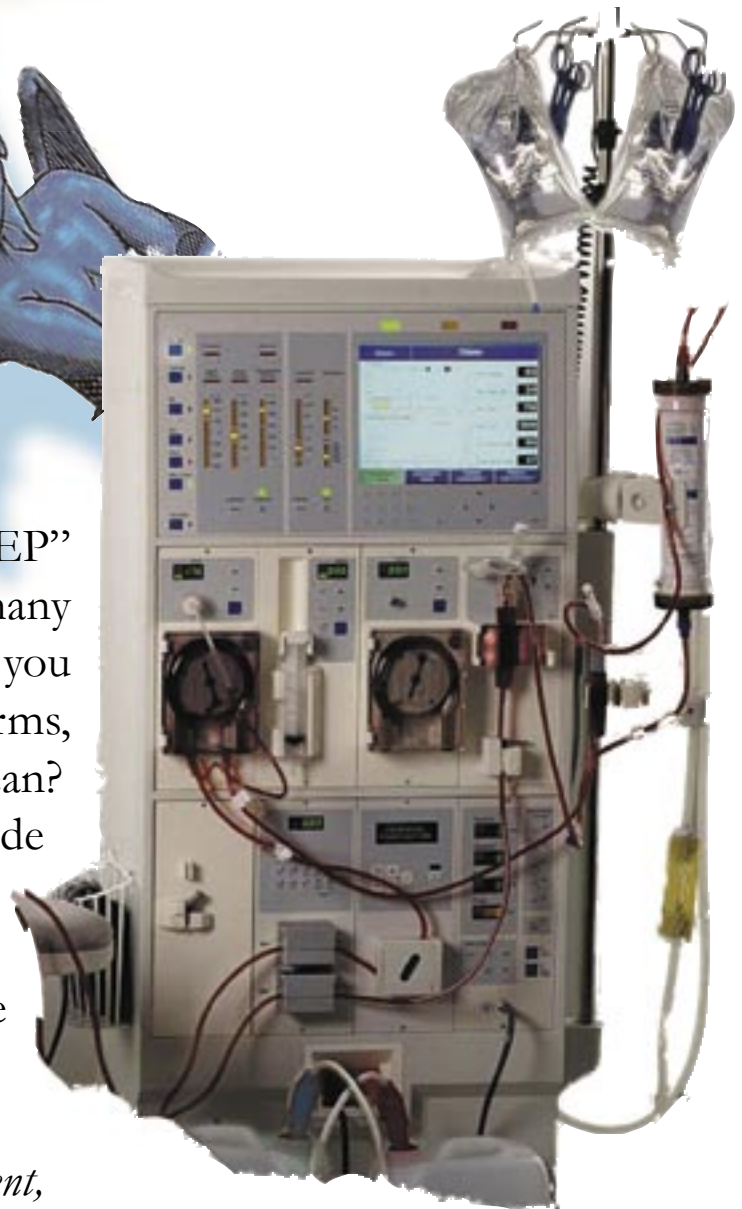
Taking the

MONSTER

out of the MACHINE



“BEEP, BEEP, BEEP BEEP” is a familiar sound to many dialysis patients. Have you wondered what the alarms, flashing lights and noises mean? This newsletter will provide basic information on the principles of dialysis, the alarms and lights and the dialysis machine.

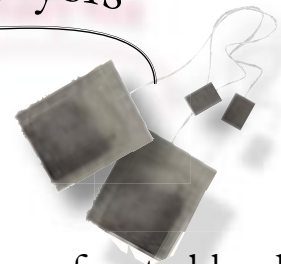


Each dialysis machine is different, please check with your dialysis staff regarding your type of dialysis machine.

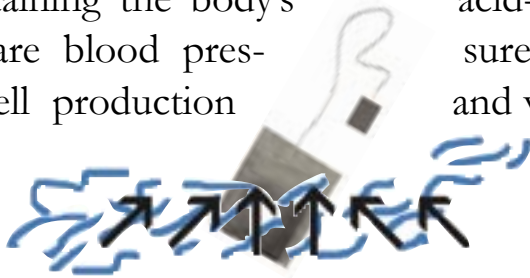




Time for Tea... Principles of Dialysis



Dialysis is originally a Greek word, meaning “to loosen”, and hemo refers to blood. Four processes occur while a patient is on dialysis; osmosis, diffusion, filtration, and ultrafiltration. The artificial kidney or “dialyzer” is only able to mimic the function of normal kidneys in a few ways; 1. balancing fluids and electrolytes, 2. filtering waste, and 3. maintaining the body’s acid-base balance. The other functions of kidneys are blood pressure regulation, vitamin D metabolism and red blood cell production and will not be discussed in this newsletter.



Osmosis

The movement of fluid across a semipermeable membrane from a lower concentration of solutes to a higher concentration of solutes. For example, when making a cup of tea, water (the lower concentrated solute) moves through the teabag (the semipermeable membrane), to the tea (the higher concentration of solutes). The water and the tea never actually touch!

Diffusion

The passage of particles through a semipermeable membrane from an area of higher concentration to an area of lower concentration. For example, when making a cup of tea, tea (the higher concentration of particles) moves through the teabag (the semipermeable membrane) to the water (the lower concentration).

Semipermeable Membrane - The Dialyzer

A porous membrane that allows some particles to pass while not others. For example, blood cells are too large to pass through the dialyzer membrane, while water, electrolytes and glucose can.



Diffusion in Hemodialysis

There are a few additional factors that affect diffusion in dialysis. Your doctor evaluates your lab values, the type of dialyzer you are currently using and can use this information to change your hemodialysis prescription to improve the amount of toxins removed from your blood. Below are several things that can affect diffusion - (solutes - solids - electrolytes like potassium, urea and glucose) in hemodialysis.

How well substances pass through the dialyzer

The surface area of the dialyzer - some dialyzers have larger surface areas

The size of the substance being removed

The difference in concentrations between your blood and the dialysate.

The temperature of the dialysate - (the fluid your blood is bathed against)

(The higher the temperature, the faster the diffusion)

Concepts Of Water Removal During Hemodialysis

Filtration

Filtration is the passage of fluid through the membrane. For example, when making a cup of tea and you lift the tea bag from the cup, the water dripping from the bag is filtered tea.

Ultrafiltration

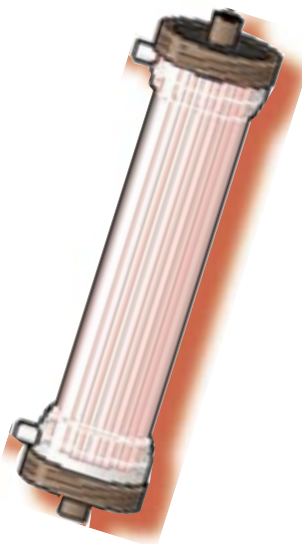
Ultrafiltration provides additional pressure to squeeze extra fluid through the semipermeable membrane. For example, when you are done making a cup of tea, have you ever squeezed the tea bag? Squeezing the tea bag is an example of ultrafiltration!

Concentration Gradients

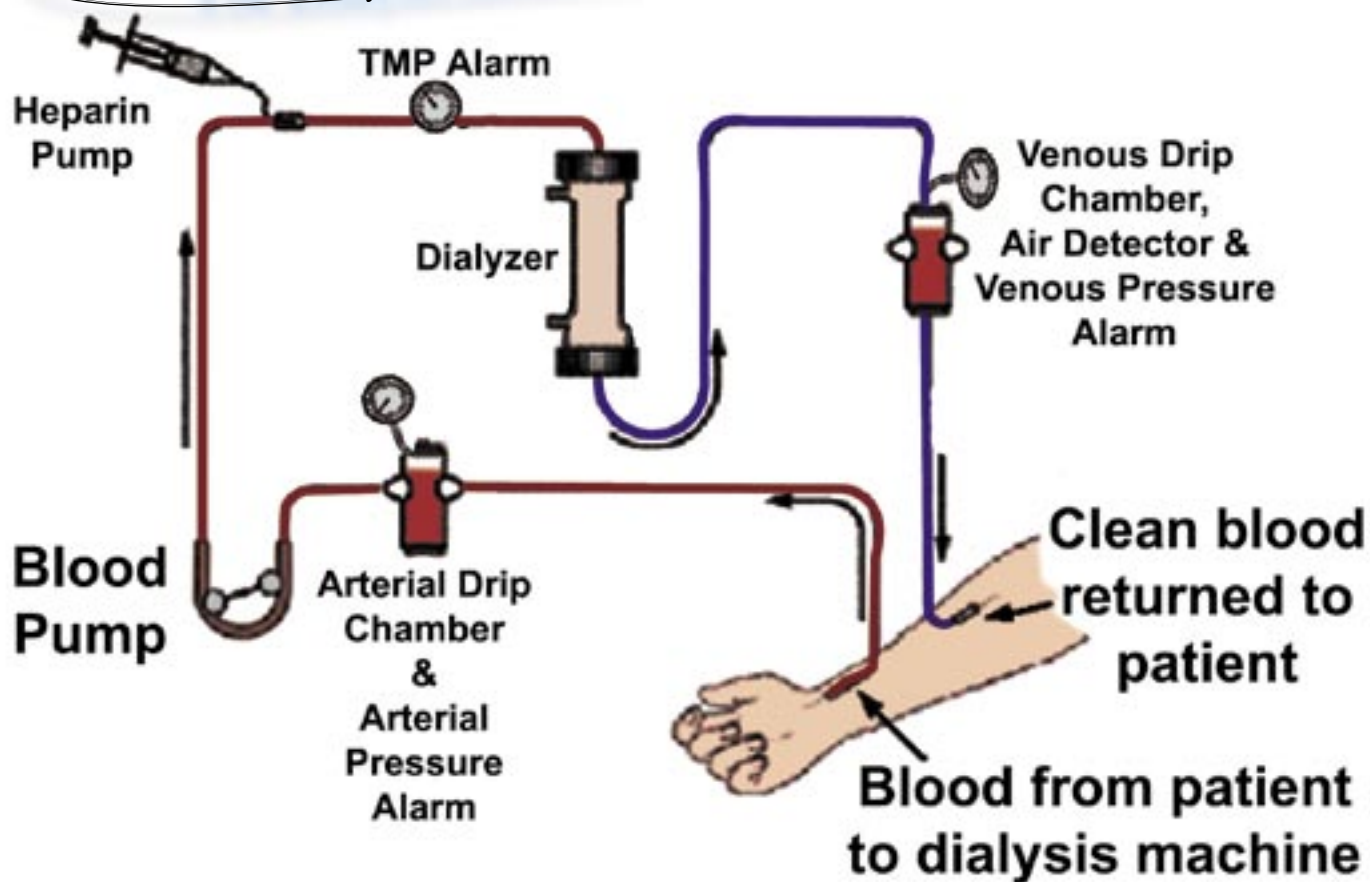
Blood - contains toxins at higher levels than normal before dialysis

Dialysate - A solution similar to normal blood levels.

Gradient - The concentration difference between blood and dialysate



The Dialysis Circuit...It All Begins & Ends With You!

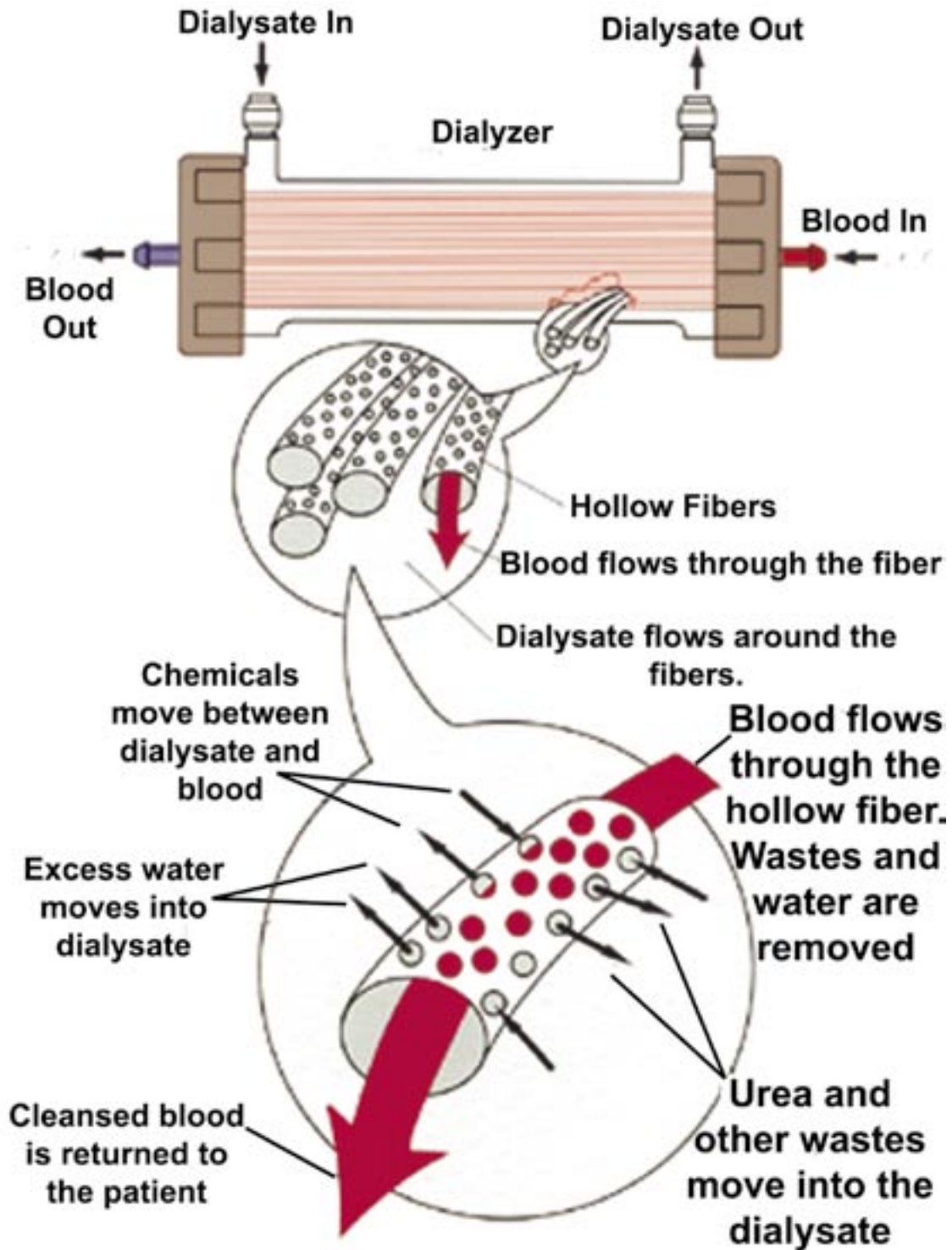


The Extracorporeal Circuit - Your Connection to the Machine

The extracorporeal circuit is a closed sterile system that begins and ends with you, the patient. An arterial needle is placed in your graft or fistula, or tubing is connected to your catheter. This is the beginning of the circuit. Blood is pumped through the dialysis machine by the blood pump. Before reaching the pump, your blood reaches an alarm - the arterial alarm. (All alarms will be discussed further in this newsletter.) After passing the blood pump, your blood moves through the circuit and may be connected to a heparin pump. The heparin pump slowly gives heparin, (a drug that prevents blood from clotting) during the treatment. Your doctor orders the amount of heparin you receive during your treatment. If you experience bleeding after treatment for longer than 30 minutes, consider asking your doctor to decrease the amount of heparin you are given. After receiving heparin, your blood is on its way to the dialyzer, or artificial kidney. On its route, it passes another alarm measuring the transmembrane pressure of the dialyzer. This alarm is referred to as a TMP alarm. Your blood now passes through the dialyzer, where osmosis, diffusion, filtration and ultrafiltration occur. As your blood leaves the dialyzer, it arrives in the venous drip chamber and passes the air detector alarm. The circuit is completed as the blood leaves the chamber and is returned to you through your venous needle or catheter.

There are 2 compartments in a dialyzer, one for blood, the other for dialysate. Blood: Toxins, electrolytes and wastes at higher than normal levels. Dialysate: A solution of PURE water and chemicals closely resembling normal blood.

Your dialyzer, or artificial kidney has thousands of hollow fibers inside. Blood passes through each hollow fiber and dialysate flows around the fiber. Urea, potassium, phosphorus, calcium, sodium and creatinine from the blood cross the fiber membrane into the dialysate . The used dialysate goes down the drain.



What is DIALYSATE?

Three different items make dialysate. The first is PURIFIED WATER, the second is ACID CONCENTRATE, and the third is BICARBONATE CONCENTRATE. We will only discuss Acid and Bicarbonate Concentrates.

ACID CONCENTRATE



Acid concentrate can be delivered to your machine by a jug or a central feed system. The acid concentrate is usually contains sodium, calcium, magnesium, potassium, chloride, dextrose - sugar, and acetic acid. Acids come in a variety of formulas. Depending upon your potassium level, your physician may change the potassium level in the acid concentrate you use.

BICARBONATE CONCENTRATE

Bicarbonate concentrate is the most common type base used in dialysis for maintaining the blood's "acid-base" balance. Bicarbonate is available in powder or liquid forms and must be mixed daily because it can become contaminated from bacteria and lose its effectiveness. All dialysis units are required to have policies to insure safe bicarbonate preparation and storage. Like acid, bicarbonate can be delivered to your machine by jug or a central feed system as well.



The acid and bicarbonate solutions are pulled into the dialysis machine; warmed and mixed with purified water - thus forming DIALYSATE. During the warming process, some small air bubbles may occur and interfere with the conductivity and temperature sensors, as well as the flow of the dialysate, which may cause some alarms to sound temporarily. Dialysate is now pumped through hoses to the dialyzer, or artificial kidney. Most dialysis units have the dialysate flow opposite the blood. This is called "countercurrent" flow. Countercurrent flow between blood and dialysate improve the removal of toxins and wastes from your blood. The dialysate leaving the dialyzer contains the toxins from your blood and is discarded down the drain.

The **MONSTERS...**

...What the ALARMS Really Mean



More than likely you have noticed the alarms on the dialysis machine, either from your own alarming or that of another patient. The alarms can be frightening to some patients, especially when you may not understand what they mean and how they are protecting you. Regardless of reading this information, **RESETTING YOUR MACHINE IS DANGEROUS! IT COULD CAUSE PROBLEMS AND POSSIBLY YOUR DEATH!**

If an alarm is triggered on the blood circuit side, the blood pump will automatically stop.

If the blood pump is stopped, **DO NOT RESET THE MACHINE YOURSELF!**

ARTERIAL PRESSURE ALARM

If this alarm sounds, there is usually a problem with the flow of blood from the patient into the dialysis tubing. These problems could include, poor blood flow from your dialysis access, the dialysis needle could be against the side of the access.

VENOUS PRESSURE ALARM

This alarm sounds if there is a problem getting the blood from the dialysis tubing back to you. For example, if your access has stenosis - a hardening in certain areas, or problems with your catheter.

AIR LEAK DETECTOR ALARM

The air detector alarms if there is air in the blood that is returning to you. Air in your venous tubing can potentially be fatal. In addition to the alarm sounding and the pump stopping, a line clamp is activated to prevent any air from getting to you.

TMP ALARMS

TMP alarms vary by the type of dialysis machine you are using. Usually when this alarm sounds, the dialysate flow and ultrafiltration will stop. Several things can cause this alarm to sound. Some of the causes could be a clotted dialyzer, a bend or kink in the dialysis tubing, mechanical difficulty with the machine or a clogged sensor.

CONDUCTIVITY AND pH ALARMS

Conductivity and pH monitors will alarm and usually stop the flow of the dialysate if they are too high or too low. The machine is programmed for a safe range for you. If the dialysate solution falls outside of this range, dialysate will stop flowing to the machine to prevent harm. These ranges vary by facility and machines.

Parts are Parts...Or are They?

Below is a listing of common dialysis machine parts. They may not be located in the same place on your machine. For further information on your specific machine, please speak with your dialysis facility staff.

