

## Hemodialysis: Why More is Better

All dialysis centers are not alike—some are better than others. And all forms of dialysis are not equal—some treatments are better than others, too. The more you know about how dialysis works, the better equipped you'll be to find high quality care that will allow you to live the best life you can.

More dialysis is better for your health. If you get more treatment, you'll feel better, have fewer diet and fluid limits, your heart will stay healthier, and you may live longer. Why? Read on.

### Removing Water

Healthy kidneys remove excess water as urine. Once they fail, one of the main tasks of dialysis is to remove excess water from your blood and tissues. This is not as easy as it may sound.

Your body is mostly—60%—water, which can be found in three “spaces:”

- **Intracellular space** - inside your cells
- **Interstitial space** - between your cells
- **Intravascular space** - in your bloodstream

Dialysis can only remove water that is in your bloodstream. As water is removed from your blood, water from between your cells starts to move into your bloodstream to make up for what has been lost. This takes time. If a hemodialysis (HD) treatment is too short, the water between your cells won't have enough time to move into your bloodstream. This problem will show itself as swelling or trouble breathing.

Inside your dialyzer are thousands of hair-like hollow fibers. Each fiber is a *semipermeable* membrane: small wastes can pass through it, but large substances, like proteins, can't. During a treatment, blood flows through the insides of the fibers. Dialysate, a precise mix of purified water and salts, flows around the outside of the fibers. Excess water is forced out of the blood and into the dialysate, using a pump. This way to remove water is called *ultrafiltration*.

### The Importance of Time

Most in-center HD treatments have about 3 hours to remove all the water you gained since your last treatment—45 to 69 hours ago. In the short term, gaining a lot of water and then pulling it off in 3 hours can be hard on you. Only so much water can be removed without making you sick. This is why you need strict salt and fluid limits, though dealing with thirst can be one of your biggest challenges. If your blood pressure drops during HD, you may have severe muscle cramps, headaches, feel dizzy, throw up, or pass out.<sup>1</sup> For the rest of the day, you may feel washed out or like a truck hit you.

In the long term, standard in-center HD is hard on your heart. Studies have found that 911 calls for CPR,<sup>2</sup> cardiac arrests,<sup>3</sup> and sudden cardiac deaths<sup>4</sup> were highest after the 2-day break. Having your fluid levels “yo-yo” up and down three times a week may cause high blood pressure or make it worse. Blood pressure pills may not control it well. High blood pressure can damage your heart and raise your risk of a heart attack, stroke, or blindness.

Two other types of HD let you drink more fluid *and* are better for your heart:

- With **short daily HD** (2-3 hour treatments 5-7 days per week), you have just 22 hours between treatments on most days. Since you haven't had time to gain as much, you take off less water at each treatment. This is easier on your heart, and means your salt and fluid limits need not be as strict. A study of 192 patients on short daily hemo found significantly better survival than on standard in-center HD.<sup>5</sup> A second study of 405 patients found that 68% (+/- 4%) survived for 5-years on short daily HD, vs. 31% of age-matched in-center HD patients\*.<sup>6</sup> In most places, short daily HD is a home treatment only.
- **Long nocturnal HD** (8 hour treatments 3-6 nights per week) gives you twice as much treatment each week—or more—as you'd get with standard in-center HD. It's more like having healthy kidneys. Treatments are slow and gentle, and remove water with less strain on your heart. This may help reduce inflammation that causes heart damage.<sup>7</sup> Done 6 nights per week, nocturnal treatments make blood vessels more flexible, which lowers blood pressure.<sup>8</sup> Most patients need no blood pressure pills. You may not even need salt or fluid limits. Nocturnal HD may be done at home or in some centers.

\* These studies are still small, and not random. A large, national, multi-year study is starting soon to look at survival in short daily and long nocturnal patients to see if it is truly better.

## Removing Wastes

The other key task of dialysis is to remove wastes that form in your body each day. Most wastes are removed by *diffusion*, a chemical principle. Particles dissolved in a fluid (in this case your blood) pass through the semipermeable membrane of your dialyzer. Since there are no wastes in dialysate, wastes in your blood diffuse into the dialysate and out of your body. This goes on until the concentration of particles on both sides of the membrane are equal.

Wastes vary in size (molecular weight). Small wastes pass more readily through the dialyzer membrane than so-called “middle molecules,” which are larger. Proteins and blood cells are too large to fit through the membrane.

We'll focus on three wastes, below: urea, phosphorus, and beta-2 microglobulin:

- **Urea** is a protein waste. It is removed by healthy kidneys, and measured as *blood urea nitrogen* (BUN). Most urea is removed in the first hour or two of HD. So, short daily treatments are better than standard in-center HD because you get more “first hours” of treatment. Long nocturnal HD is better because it has more time to remove larger wastes.
- **Phosphorus** is a mineral that is present in most foods. With calcium, it forms the bulk of your bones and teeth. In the short term, if your blood phosphorus levels are too high, you may itch all over. In the long term, high phosphorus levels can damage your bones, heart, and blood vessels. Standard in-center HD removes up to 70% of your excess phosphorus.<sup>9</sup> To remove more, you need phosphate binders. But, calcium-based binders can add to *calcification* of your soft tissues, blood vessels, and heart valves<sup>10</sup>—they literally turn to stone. During the 2-day treatment gap, blood levels of calcium and

phosphorus rise in people who take calcium-based binders, which may make calcification worse.<sup>11</sup> Non-calcium binders work better, but are costly. Nocturnal HD removes much more phosphorus than standard treatment—so much more that most people who use it don't need binders, and some even need phosphorus *supplements*.<sup>12</sup> In one patient, large calcium deposits melted away after 9 months on daily nocturnal HD.<sup>13</sup> Since both short daily or long nocturnal HD remove more wastes, they have fewer diet limits than standard in-center hemo, too.

- **Beta-2 microglobulin (B2M)** is part of a form of *amyloid*, a waxy protein. In time, it can build up in the blood of people on dialysis and deposit anywhere in the body, causing *amyloidosis*. Often, B2M deposits in the joints, leading to pain and trouble moving (such as carpal tunnel syndrome) or walking. Deposits can also form in blood vessels, on internal organs, or even in the eyes or skin. B2M is a “middle molecule;” one that takes a long time to be removed. The 3-4 hours of a standard treatment is most often not long enough to remove B2M well. Long nocturnal treatments do a better job of removing B2M.<sup>14</sup>

### **It's Common Sense**

When your kidneys were healthy, they worked 24 hours a day, 7 days a week (168 hours a week). Your heart and lungs don't work for only a few hours 3 days a week; why should your dialysis? Longer and/or more frequent treatments do a better job of removing both water and wastes.

People who do longer or more frequent treatments say they:

- Feel better, have more energy, and are less tired
- Have more good days with few ups-and-downs
- Eat better, including more fruits and vegetables
- Return to a normal skin color
- Have more free time for work or play and more control over their lives
- Sleep better at night and have better sexual function

### **The Time-Life Trade-off**

You are the only one who can say whether the benefits of longer or more frequent treatment are worth the costs in training time and extra responsibility. Even if one of these options won't fit your life right now, keep them in mind for the future. You can always change your mind about the type of treatment you do.

The goal of dialysis is to make you feel as well as you can so you can keep doing what you value. If, at any time, that's not true, revisit your options. You may be able to feel better.

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