

Neurons and Motor Units 101

by Annie

Ever find yourself wondering what exactly happens in Post Polio? Here's a short version (well, I tried!) of what happens in our bodies.

Disclaimer: The names have been changed to protect the innocent. And—this is an old article that I have decided to repost due to recent questions!

Meet Bob, the Neuron-or nerve cell. A handsome guy, very tall and thin he is. Bob is a simple fellow, really, but he has a lot of responsibility. He has just a few body parts; The first one is a cell body, with a nucleus inside... (if you can picture a little octopus with tentacles going everywhere and a single eye in the middle, that's sort of what he looks like.) Handsome, huh? These tentacles are called dendrites.

Now, attached to that, he has what's called an Axon, which looks sort of like a long string of skinny hot dogs, end to end. (Well, sort of.) Bob's Axon is very thin, but really, really long—it *can* be almost three feet long—and the other end of his Axon is attached to the Nerve Junction.

The junctions have what look like more tiny little tentacles, and at the end of each of them, is a little bulb. This bulb puts out messages and makes phone calls. Now, on the next Neuron in line, the tentacles have little indentations called 'receptors', where the bulbs fit. They don't actually touch, but they send across chemicals to the receiving end. The space in between is called the synaptic cleft. The chemicals that the Neurons send across are called "Neurotransmitters". That's how they talk to each other.

Something like:

Neuron Maxine: "Hey, Mack! You there?"

Neuron Billy Bob: "Mack's busy. Whaddaya want? You're disturbing my lunch."

Maxine: "I want you to tell the legs to step up high enough to clear this curb before we trip over it and fall on our face!"

Billy Bob: "YyyyyyOK. Will do."

So, Billy Bob passes the message along to the next Neuron in line, who passes it along to the next, and the next, and eventually the message gets to the muscle fibers. And Voila! Another crisis averted.

A Motor Unit, on the other hand, is made up of the Neuron, plus all the muscle fibers that are attached to it.

And this is where we Polio survivors were affected. When the initial Polio struck, it killed a percentage of the Neurons in the Brainstem, and the Anterior Horn cells of the spinal column. In addition to that, there was a percentage of Neurons who were stunned. The Neurons that died would never return, but the Neurons who were just stunned would eventually awaken. (And when they did, boy, would they *work hard!*)

Poor little fellas, those muscle fibers—they were suddenly sent to the orphanage. They no longer had a “brain” or “Neuron” to tell them what to do. Hence, the paralysis. So they sat there, twiddling their thumbs and thinking.’

“Well, well, Wanda..... You never call, you never write....” (nobody told them that Wanda, their Neuron, died, and would never write again....) So sad—but! Another neuron would, in time, step up and begin regular correspondence!

This went on for quite some time after the Poliovirus hit.

After the initial period of illness (six months, or even a year (or longer for some of us), the Neurons that were stunned but still left, came back to life a bit.

But there weren’t so many of them now- and they were very weak. So these Neurons (ingenious little buggers) made a plan; They sprouted more and more terminals at the ends of their axons in order to plug into more Muscle fibers, and then decided to go recruiting! They sent out signals (remember the Neurotransmitters?) to the orphaned fibers.

Neuron Wendy: “Hey, Joe!”

Muscle fiber Joe: ““Wendy! Where’ve you been? I thought you’d at least write once in a while.”

Wendy: “Oh, quit with the complaining, already. I’ve been sick.”

Joe: “Sheesh. Somebody coulda told me. My receptors are empty. Have been for months.”

Wendy: “Well, I can fill them now. I’m the ‘happening thing’, didn’t you know? My neurotransmitters will knock your socks off, buddy!”

Joe: “No kidding?”

Wendy: “No kidding. Be right there soon as I put on some make-up and fix my dendrites. ”

Joe: “Well, sure, ok. *I’m* not doing anything..”

So now Joe checks his receptors, and pretty soon, Wendy plugs in. But not to just Joe; lots and lots of his buddies who have been sitting, bored out of their skulls, have lined up. A ‘happening thing’ sounds pretty good to them.

So, in perspective:

A “normal” (before Polio) thigh muscle might have a thousand muscle fibers attached to one Neuron. Each eye might have ten. (The more precise the movement, the less muscle fibers (and the smaller the Motor Unit .)

Each case of Polio was different, but:

When Polio hit –let’s say that perhaps it destroyed as many as 60% (or possibly more?) of the Neurons we had, and stunned around 30%. That would only leave 10% that were working. So there were many, many orphaned muscle fibers affecting large muscle groups. And as a result, we became paralyzed. The 10% that were left were probably just enough to maintain breathing (perhaps, perhaps not. Many of us ended up in an Iron Lung), swallowing, and basic body functions, but not much more than that.

Or maybe there were less neurons affected, and we were only paralyzed on one side. It didn’t matter whether we thought we had a ‘mild case’ or a ‘severe case’, we still lost a significant amount of neurons.

And, since there were far fewer Neurons left, each one would eventually have to adopt lots and LOTS of muscle fibers—way more than the original thousand it was supposed to have adopted. These adoptions were occurring when we were doing our intense Physical Therapy.

And when this happens, the Motor Units are no longer small; they’ve gotten really “Large” because of the large number of muscle fibers attached to each

Neuron. When your Physician does an EMG and says “It shows Large Motor Units” that’s what he means. One neuron, lots of muscle fibers.

But, back to the beginning phase of the PT:

Now, the Muscle Fibers and the Neurons begin learning how to do this “slow dance”. It’s a bit awkward at first, because the Neurons are still stressed and weakened, and the fibers have been sitting for so long with nothing to tell them what to do, they have forgotten how to interpret signals very well.

And so it begins..

Ralph and Joe—both muscle fibers—along with thousands of their buddies, are trying to ‘line dance’ to the tune that Wendy the Neuron is singing.

Ralph: “Hey! You guys—Get off my FEET!!”

Joe: “Sorry, Ralph. It’s Wendy’s fault. She’s singing off key and it distracted me.”

Wendy: “Am not. Just because you have two left feet—“

Rest of the muscle fibers: “Grumble, grumble. We’re doing the best we can. Just ‘stuff a sock in it!’”

It goes like this for some time.

But Polio survivors don’t give up easily, and Wendy the Neuron and the Muscle fibers refuse to give in. Eventually, the more P.T. we took as survivors, the more rhythmic and smooth the dance became, and over time, things began to work better—for some of us, almost normally. (Notice I said *almost!*)

..for maybe 30 years? 40?

It seems that most of us seem to be Type A personalities who worked very hard to gain our abilities back. We tried extremely hard to be able to pass as “normal”. We heard the “no pain, no *gain*” mantra over and over again, until we said it in our sleep. But once we regained our strength and led semi-normal lives again, did we give these weakened Neurons a break and say, “Well, buddy, I know you’re weak and tired. I’ll go easy on you now, and cut you some slack”?

Nope. Not on your life. We stayed in “full-tilt boogie” mode for as long as we possibly could. No breaks for the weak and no rest for the weary.

But then:

Enter Post Polio Syndrome. The Old Dragon that tried to defeat us has been awaiting his chance. Sitting patiently on the sidelines, he just watched. And waited. And now he makes his entrance.

The little Neurons have trudged on, year after year in a weakened state, sending impulses to many, many more muscle fibers than they were meant to. The metabolic stress on each Neuron has become tremendous. And now? Poor little things, they just begin to wear out and give it up.

When PPS hits, and the stressed Neurons begin to die—they don't just abandon the normal amount of muscle fibers they were supposed to have had. Now, a Neuron attached to a thigh muscle abandons not a thousand, but the fifty or sixty thousand fibers it had adopted. Each time we lose a Neuron, there is a big significance to it—and a noticeable effect (and the more we lose, the more noticeable it is).

Of course, we're talking about bulbar and the Spinal cord neurons here, so...

Breathing also begins to be more ragged,..

The swallowing mechanism may forget the right sequence for swallowing. The epiglottis – the little flap that closes off the lungs when we swallow food or saliva- may not close at the right time. And we may aspirate easily,..

Legs and arms don't work so well anymore,...

Gait may become unsteady, we begin to fall more, and we begin to need assistive devices to get around. (Of course, being typical PPS'ers, we put off having to use those as long as possible and stress our Neurons even more.)

New weaknesses, new fatigue, sometimes new pain begins to affect us,..

Sleep disorders and disturbances such as Restless Leg Syndrome may cause us to be unable to get in down to the Delta or REM (Rapid Eye Movement) stage—the stage which gives us the most beneficial and the most recuperative sleep,..

And on top of these things, the muscles in the diaphragms are no longer working well, so we do not get enough oxygen to our brains and bodies when we sleep. The Dr. may prescribe a Bi-Pap for us.

There is something else which we may not be prepared for, so I will mention it here as well. That is *grief*.

It is not unusual for us, the survivors, who have worked our way back from the initial polio with such intensity, to again go through stages of grief each time we realize we have new losses in function. We may experience things like:

Shock: “This isn’t happening to me! I don’t believe it!!”

Denial: “I must have just been having a few off days (or months-or years) I can still do anything I want.”

Anger: Why would this happen! It’s not right! I worked so hard to be able to get back to a normal existence! How could this happen to *me!*?”

Bargaining: “If only I can have my normal life back, I’ll do anything!”

Depression: “I’m so, so sad.... Life will never be worthwhile again if I have to live like this.”

Or Guilt: “This is all my fault. I did it to myself. I’m worthless.”

And finally,

Acceptance: “OK, sooo, this is what I still have to work with. How can I get through this and have the best life possible? So what if I have to wear braces-at least I can walk.. Or so what if I have to use my power chair-it gets me wherever I want to go! There is still so much I can do!” This is where we begin to smile again, and look forward to each new day.

Grief is a continual process, I have found. Every ten years or so, I seem to manage to have a significant crash, whether or not I take care of myself. And I must be honest enough to say that each time I have a loss of function, I go through the grieving process all over again. I think everyone does. Sometimes we may get through grief in a few moments; other times it may last a month. And sometimes it catches us quite by surprise, when we least expect it.

Memories may trigger experiences we thought we had forgotten; Further losses may throw us for a loop; Fatigue may be debilitating at times, but we are survivors. We can still, with our strong and stubborn determination, manage to find ways to be able to do things many “normal” people would just give up on. We still manage to smile, even to laugh at ourselves.

If I had one word of advice to give to a Polio survivor, it would be “Support groups” (ok, so that’s two). We at the Branson group meet every year for a fantastic Reunion, where we support each other, encourage each other, and share ideas on how to cope with challenges of living. We spend hours telling funny stories and laughing at ourselves and our experiences, until we fall asleep at night with smiles on our faces. I cannot think of time more splendidly spent than with friends who share what *we* do. As my dearest ‘Polio friend’ says,

“These are *my* people!”

Yes. We are survivors. And we are unique and wonderful ones at that!