Pain Neuroscience Education "Stories"

Nervous System as an Alarm System:

- **Goal:** introduce basic neuroanatomy and the concept of the "alarm system"
- Let's talk a little bit about what pain is. Your nervous system is made up of 45 miles of nerves, all which carry electricity through them. These nerves go from you skin and muscles and organs to your spinal cord and then up from your spinal cord to the brain. Different stimuli cause electrical activity to happen at the ends of your nerves. When enough electricity enters the nerve, it sends a signal up to your brain about the type of thing that stimulated it.
    - For example, stepping on a nail would elicit a large enough electrical response for your nerves to fire, whereas stepping on a hair is not enough stimulus to cause enough electrical activity for your nerves to fire."
- When you step on a nail, it sends that electrical message up to the spine; the spine can decide to ignore it or decide it's important enough to send to your command center (your brain); the brain receives this info and interprets it; if it believes there's a genuine threat, it sends pain signals back down to foot to alert you there is a threat – this is a good thing. This pain you experience is an alarm system meant to alert you to a threat."

Bus and Nails:

- **Goal:** Introduce pain as an output, rather than an input
- Now imagine you are crossing a busy road and you step on a nail at the same time a bus is speeding towards you. Do you feel the nail? NO. Do you stop and look at your foot while the bus coming right at you? NO. You run out of the way of the bus in order to avoid death. After a few seconds, all of a sudden you start feeling the sharp pain in your foot. What is going on here?
- The brain takes in all the messages (cold/sharp pressure in your foot and giant bus moving towards you); your brain determines the bus is your greatest threat, so it doesn't produce pain so that you pay attention to the bus and sprint out of the way; only once the threat of the bus is gone do you start feeling the pain
    - **This tells us pain is something the brain produces in response to a threat**
- Sometimes you can have an injury and not feel it, but the opposite is true as well, sometimes you can have healthy tissues and still be experiencing pain (e.g., many people in severe pain come back and all their diagnostic tests are negative)
- Your brain is evaluating all of the threats around it (stress, anxiety, emotions, a speeding bus, noxious stimuli) and may produce pain for protection; this can be helpful, or it can be loud and intrusive if not working correctly.

Sensitive Fire alarm:

- **Goal:** Introduce idea of "sensitized" nervous system
- Remember the electricity in your nerves (and how a certain amount of stimulus is needed to send messages)?
- Nerves need enough of an input to send messages
- However, after you get injured, the amount of electricity in your nerves stay high for a while making the area more sensitive
    - Think about a papercut, even after the initial pain has dropped and your skin closes up, the area remains sensitive to the touch; that's because the resting electricity takes a while to decrease; if you have a high level of resting electricity, you need less of a stimulus to reach that "threshold" where the nerve will fire, making it so the nerves fire more easily – this is a good and protective thing because it causes you to pay more attention to this healing tissue so you don't open it right back up)
- In some people, the electricity stays elevated long after the normal tissue healing time (nerves are sensitive while tissue is unharmed)
    - This means it takes less activity for nerves to start firing and send threat messages to the brain, which may result in the brain interpreting danger in the area → pain
    - It's like a fire alarm that has become too sensitive; the fire alarm is meant to detect smoke to indicate a fire – it's a good thing when the fire alarm goes off if there is an actual fire alarm; but when fire alarm starts going off after a candle is lit, that's a highly sensitive alarm
    - Long-lasting pain becomes more about nerve sensitivity than tissue injury; the alarm is firing even without an actual fire

Calming Sensitive Nerves:

- **Goal:** Introduce treatment ideas for de-sensitizing nervous system
- So, you've got a sensitive nervous system, now what? Research shows us that we can calm down the alarm system.
- One way is by teaching people about their pain in order to decrease fear and give the patient a better understanding of what is going on in their body
- in fact, research shows that education alone is as effective as some medications, such as opioids – without the side effects)
- But education alone usually can't get rid of your pain completely. Research also tells us that physical activity is really important
    - Most people think when they're in pain, they should stop moving – but inactivity and rest doesn't help a sensitive nervous system
    - Instead, moving and improving blood flow makes nerves happy and decreases sensitivity; exercise can also cause a release of endogenous opioids, which are natural pain relievers your body produces after exercise).
    - There are also other things you can change about your life that can help calm you down (heat, meditation, etc.)

Stress Response to Pain (Lion in the Room)

- **Goal:** Teach how stress can play a role in pain via fight or flight response
- Imagine that a lion comes storming into this room – what do you do?
    - Your heart starts racing, your blood starts pumping, and you're ready to either run or fight. Are you thinking about your posture or digestion? No, everything in your body is getting you primed to respond. Less resources given to things like sleep, digestion, etc. and the blood is shunted to large muscle groups.
- But if the zookeeper comes and takes the lion away, what happens? You calm down, your heart rate slows, you stop sweating, and you return to a normal, balanced function.
    - It might take a few minutes or hours, but you return to "normal"
- In this example, the lion is a metaphor for the stress associated with your pain, your anxiety, your fears, your failed treatments, your house payment, sick mother, etc.
- If the lion is taken away (your stress is managed) your body calms and returns to typical function. However, if it stays, your system involved in this fight or flight response and stays hyped up.
- The lion follows you around and your system stays stressed. Steady, prolonged stress state leads to a ton of changes in the body (sore muscles, altered posture, mood swings and cognitive changes, changes in appetite and weight, sleep changes, sensitive nerves, irritable bowels, fatigue, depression, etc.).
- So, what do we do about this lion? It's not so easy to totally get rid of it. If you could've easily gotten rid of your pain, you would've done it already.
- However, what you CAN do is change the lion into a cub. If a cute little cub trots in, you don't scream because it's not scary. It is still a lion, but it's not as threatening.
- We can do this same thing by decreasing the threat associated with your pain – through education, engaging in movement that improves blood flow and decreases fears, and using stress coping strategies.
- From what we've talked about, you now know that pain doesn't mean huge dangerous tissue damage – that helps turn the lion of pain into a cub.
- Now when a cub trots into the room (you start to have pain), you no longer react with such intensity. You can calm your system. You can also engage in other ways to calm your system – breathing techniques, progressive relaxation, etc.

Tissue Healing

- **Goal:** Assure patients that tissues heal, and imaging doesn't correlate to pain
- I know you've heard a lot about [insert tissue damage] and how that is causing your pain. However, typical tissues usually heal on the order of weeks to months, so pain 5 years out from an injury doesn't mean tissues haven't healed or something is still broken.
- Even when imaging indicates something like a tear or degeneration, research shows that it doesn't necessarily correlate with the person's pain. People who have positive findings on imaging don't necessarily have pain.

- In one study, they took MRIs of a bunch of people and found that 40% of all the people (who had no pain) had bulging discs! But no pain!
- Another study took images of shoulders after a torn rotator cuff repair and successful rehab and found that over 90% still had things show up on their imaging, even though they didn't have pain. In fact, in patients over 70, they found that 2/3 have asymptomatic rotator cuff tears, meaning a tear doesn't necessarily cause pain.
- For knee pain, a huge research study found that there's only a 50% correlation between pain and arthritis (so if 100 people had arthritis on their imaging, only 50 of them actually had knee pain). In a systematic review of over 5,000 non-painful knees, they found that 43% of those had evidence of arthritis without pain. 35% of collegiate basketball players had significant abnormalities on their MRI scans (meniscus tear, joint narrowing, degeneration, etc.) but didn't have pain.
- The reason I tell you this is to explain that prolonged pain is more about sensitivity than damages. We can think about some of these normal age changes as "wrinkles on the inside"
- Now, what I don't want you to hear is that I'm saying nothing is wrong and it's all in your head. Your pain experience is very real and must be respected. What I am trying to propose is that your pain might not be driven by actual tissue damage but instead a sensitive nervous system (as we've talked about)

Stress/Emotions Impact on Pain

- **Goal:** Explain how emotions and trauma can impact pain
- We know that emotions and trauma can have a big impact of people's pain persisting
- Think about people who get in car accidents vs. people who voluntarily participate in demolition derbys.
- 1 in 3 people who are in an MVA develop chronic pain after their accident. Less than 10% of demolition derby drivers have long lasting pain. Imaging and interviews show they have the same kind of injuries as people in MVAs
- An average derby driver will have an average of 30 events, with 52 collisions per event at 45 miles per hour. Many report some pain after an event, but it goes away because they know the context of the trauma, accept the circumstances, and are able move on
- On the other hand, people who have been in car accidents have just been through a very traumatic event. They have also likely heard many stories of people having car accidents and then living with whiplash forever. They may have started with the same tissue damage as the derby drivers, but their pain persists much longer because there is a lot of fear and trauma involved