NASCIC
SCI RESEARCH
ADVOCACY COURSE

Module 5 – SCI Biology Part II: Secondary Complications

Examples of Secondary Complications Caused by Autonomic Dysfunction

Autonomic Dysfunction can cause many symptoms that greatly affect people living with an SCI. Here we will discuss common examples and symptoms of autonomic dysfunction that may result in secondary complications.

The complexity and variety of secondary complications that are caused by autonomic dysfunction are too many to list in this course. Our selections are meant to exemplify autonomic dysfunction's role in the occurrence and severity of some secondary complications. Two of the factors which have the most influence on the effects of the SCI are the location and severity of the damage to the spinal cord.

For example, after a *complete* SCI at the cervical or high thoracic levels, sympathetic nerves in the thoracic and lumbar segments of the spine may lose the ability to send and receive signals between the brain and body.

In contrast, an incomplete SCI above the T6 level can sometimes maintain sympathetic activity if certain nerves are spared.

If sympathetic activity is impaired in someone with a high thoracic or cervical injury, they may have reduced function of the lungs, airways, heart, and circulatory system because parasympathetic signaling becomes dominant, leading to constriction of the airways and increased secretion of mucus and reduced output of the heart and circulatory system.

When the airways are constricted and there is an increased secretion of mucus it is harder to breathe and increases the risk of respiratory infection (and if the person also has muscle weakness in torso that makes it difficult to cough, the risk of infection is compounded).

When there is Impaired efficiency of the heart and circulatory system it may lead to dangerously low blood pressure and possible fainting and physical exertion.

However, even in these individuals, it is still possible for blocked signaling between the lower parts of the body and the brain to cause a sudden and life-threatening *increase* in blood pressure called "autonomic dysreflexia."

People with an injury at or above T6 are at the highest risk of autonomic dysreflexia. It is triggered by something that is irritating the body below the level of injury, such as an infection or pain, which sends a signal up the spinal cord. These signals are blocked at the level of injury, which causes an uncontrolled reflex response from the sympathetic nervous system that

stimulates the blood vessels to narrow, or "constrict," causing a rapid and large spike in blood pressure. Increased pressure in the circulatory system then sends a signal to the brain stem, which responds with a signal back to the circulatory system to reduce heart rate and open the vessels. The opening of blood vessels above the level of injury leads to sweating and headache, two of the signs of autonomic dysreflexia. However, below the level of injury, blood vessels are still constricted, so blood pressure remains uncontrolled.

Another example of how the level of injury influences the effect on autonomic control can be seen in the different types of bladder dysfunction that can stem from an SCI. People with an SCI above the sacral level commonly have hyperreflexic (overactive) bladder, in which the bladder spasms or contracts involuntarily, on its own. Injury in the sacral section of the cord is more likely to cause areflexic (flaccid) bladder, in which the bladder loses its ability to contract, causing it to overfill and leak.

Similarly, different types of sexual dysfunction are associated with different levels of injury, for example:

- Erection and vaginal lubrication are controlled by the autonomic nervous system, but the signals that activate them can be transmitted either through sensory nerves in response to physical stimulation such as touch, or through arousal signals from the brain in response to hearing, seeing, feeling, or thought.

- Men and women with a complete injury *above* T11 are likely to experience erection or vaginal lubrication in response to physical stimulation, but not in response to arousal in the brain.

- People with a complete injury *between T11 and L2* are likely to experience erection or vaginal lubrication in both physical stimulation and arousal in the brain.

- People with an injury to the *sacral spine* are likely to experience erection or vaginal lubrication in response to arousal in the brain but not physical stimulation.

Bowel dysfunction can be caused by damage to the parts of the nervous system that govern sensation and voluntary movement and/or to the autonomic nervous system; there are two main types depending on which nerves are affected:

- SCI *above* the T-12 level is associated with "upper motor neuron" or "reflexic" bowel, when the loss of ability to voluntarily relax the anal sphincter causes stool to build up until an involuntary bowel movement happens. The reflex that triggers a bowel movement still works, but one may not feel it coming.

- *Below* the T-12 level, "flaccid bowel" is common, in which there is reduced movement in the colon, the defecation reflex is damaged, and the anal sphincter muscle is more relaxed than normal. This can lead to constipation with frequent leaking of stool.

Researchers are testing many ways to correct autonomic dysfunction in SCI to treat secondary complications. Some of the most advanced research involves a type of therapy called "neuromodulation." Neuromodulation is the electrical stimulation of peripheral nerves using electrodes that are implanted into the body, or electrodes or magnets placed on the skin.

Researchers are studying which nerves to stimulate and how to stimulate them. Clinical trials are testing neuromodulation to treat bladder, bowel, and sexual dysfunction.

We will discuss neuromodulation research in Module 9: Retraining (Neuroplasticity).

In the next video we'll look at secondary complications that are not caused directly by SCI, but rather by the indirect effects of loss of movement or weight-bearing activity.