The Absence of Pain

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As soon as he stuck the needle into the newborn baby's heel, Dr. Yashuhiro Indo knew something was wrong. "I was thinking out loud, 'why does this baby not cry?'" said Dr. Indo, a pediatrician and molecular geneticist from Kumamoto University. There exists a small group of people who, like this baby, have never felt the unpleasantness of a shot, the sharp pain of a paper cut, or a sudden burn from a hot surface. These people are insensitive to pain and are said to have hereditary sensory and autonomic neuropathy (HSAN). One version of this disorder, called congenital insensitivity to pain with anhidrosis (CIPA), is an extremely rare disorder of the nervous system in which the body is insensitive to pain and temperature. The repercussions of this disease are devastating.

Consequences of a pain-free lifestyle

To those of us who feel pain every day, the notion of a painless existence is perhaps initially appealing. Scrapes, bruises, and burns would still be present on our bodies, but would not feel any differently from the rest of our body. While a pain-free life might seem like a pleasant way to live, it is actually extremely dangerous. Because it is congenital, children with CIPA cannot be taught that harming the body is a bad thing since they never feel the consequences. Normal children learn to associate negative consequences with "bad" actions through experience, most often involving pain. The child then knows that taking that action again would cause them further pain, and so they do not repeat it. For instance, if a child jumps off of a tree, a painful landing will reinforce a hesitancy to do so in the future.

Children with CIPA can never learn these lessons. These children will jump out of the tree, experience no pain, and are more likely to repeat that action. They can even sustain multiple-fracture bone injuries. Children with CIPA often gnaw on their fingers to the point where it can endanger their life because they don't understand that damaging the fingers is harmful. The lips and tongue are other common targets for children with CIPA.

Most people afflicted with the disorder do not live past age 3, though not all deaths are due to the lack of pain. In fact, half of CIPA deaths are due to overheating because of the person's inability to produce sweat. This causes hyperthermia, or extremely elevated body temperature, which then leads to death. Excessive self-mutilation can also lead to death in some cases. There have been an extremely small number of CIPA patients who have lived past age 25.

Figure 1. Destruction of right distal tibial epiphysis as a result of generalized absence of deep pain sensation and joint sensation. Taken from http://hkoa.org/hkjos/1997-1/045_049.htm.

Developing CIPA

CIPA is caused by a genetic mutation in the gene that codes for the neurotrophic tyrosine kinase receptor. Though this mutation is known to cause CIPA, the exact mechanism is not yet completely understood. Dr. Wen-Chin Weng, a pediatric neurologist at National Taiwan University, explained that "animal studies are needed in the future to understand the mechanism about how [receptor] mutations lead to CIPA." This receptor spans the membrane of

pain-detecting cells and is expressed during development. Pain-detecting cells can only survive development if a particular protein binds to the receptor. However, in CIPA patients, the protein that normally binds to the receptor on the pain cells cannot bind because the receptor is not produced. Since the protein is not bound, it is not able to affect the cell, and the pain-detecting cells eventually die. People with CIPA are therefore born without the ability to sense pain.

CIPA is an extremely rare disorder. Only 17 people live with the disease in the United States. Dr. Weng also noted the rarity of CIPA in her country: "We have only one case report. This is the youngest and second reported patient in our country, as this a very rare disease in Taiwan."

Therapies and research

Despite the odds, scientists have developed a few treatments for CIPA. The most commonly used treatment is a drug called Naloxone, which is currently used to treat opioid overdoses. It aims to counteract severe, life-threatening depression of the nervous system. Opioids block the sensation of pain and Naloxone stops this blockage. This treatment only works in some CIPA patients and its mechanisms are not entirely known.

One of the harsher, but effective treatments of CIPA is to remove all of the patient's baby teeth when they first come in. Sometimes children with CIPA can completely chew their tongues off for lack of feeling. This can cause the child to bleed to death if the behavior or disease is not diagnosed. This removal saves the fingers, lips, and tongue of children who are unable to stop before damage is done. By the time the patient's adult teeth begin to grow in, he or she will likely have developed an understanding of healthy behavior.

Most of the studies on CIPA have focused more on its mechanism in development more than on creating possible treatments for the disorder. Dr. Felicia Axelrod, a pediatric neurologist at New York University who studies CIPA, highlighted the importance of this research. "Understanding mechanisms of autonomic control and pain perception in CIPA and FD is very special, as these are genetic models that help us understand function and maintenance of the autonomic and sensory nervous systems," she said. Scientists have begun to identify pathways absent in CIPA patients that may be essential for developing the entire nervous system, not just pain neurons. "Right now we are still trying to understand the mechanisms, but the goal of course will be how to use this knowledge to help the patients," Dr. Axelrod said.

Why we need pain

Pain is as essential to our lives as breathing and walking. It is part of who we are and is among the most essential things we need to survive. CIPA serves as important model for how pain works in our bodies. As noted by Dr. Indo, "CIPA can serve as a useful model to determine mechanisms of development and maintenance of neurons in autonomic, sensory and central nervous systems." By using this model, scientists can more fully understand the mechanisms of the nervous system while taking one step closer to treating patients with CIPA.

Further Reading

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