

Physiology of the Brain and Stress

Triune Brain Theory

In 1950's neurologist Dr. Paul MacLean proposed we had three brains instead of one which operate like three interconnected biological computers. These parts are called our Reptilian Brain made up of the brainstem and the cerebellum, the Limbic System which is the emotional control centre located deep in the center of the brain and the Neocortex which is the upper, thinking part of the brain. Since the Neocortex is the highest evolved and largest part of the brain, it was thought to dominate the other two more primitive brain regions. However, our two lower, primitive parts of the brain which are responsible for our survival are the ones in charge when we feel threatened. They react automatically 7/10th of a second before conscious thought is triggered.

The reptilian brain, our most primitive part of the brain, begins to develop in utero within the first several weeks of life. This oldest brain part is the seat of our instincts and is programmed with all of our primitive reflexes which stimulate us to move and develop. It also controls automatically important body functions such as our heart rate, respiration, circulation, digestion, muscle movement and balance. The Autonomic Nervous System within the primitive brain triggers the fight, flight or freeze mechanism to help us survive. When triggered this system causes a person to become hyper aroused, aggressive and defensive or hypo aroused, passive, numb and/or withdrawn. Since the primitive brain is not a thinking part of the brain, it registers what the body is sensing but may not be able to connect these sensations to cognitive thought or verbal expression.

The mammalian part of the brain which is often referred to as the Limbic System is primarily our emotional center of functioning. This system also regulates our body temperature, appetite, sexual desires and attachments. This non-thinking part of the brain is wired based on our experiences and the quality of our attachment relationships. Within the Limbic System is a small, almond shaped cluster of neurons called the amygdale. This alarm center of the brain is constantly monitoring for danger and will activate the fight, flight or freeze response in the primitive brain when triggered. Many times the reptilian brain and the Limbic System work together like a team to help you survive.

The Neocortex which is the outer region of the brain consists of highly folded layers of neuronal clusters making up over 70% of our brain mass. It is the highest evolved, superior, thinking part of the brain. The Frontal Cortex at the forehead is what makes us human and is capable of complex reasoning, problem solving, creativity and change. Developing from four years of age on it is divided into two hemispheres which are connected by a bundle of nerves called the Corpus Callosum. The left hemisphere which is the language center of the brain, processes in a linear, logical, detailed step-by-step kind of way. The right hemisphere thinks more holistically, is more spatial, abstract, intuitive, creative and directly connected to our feelings. The left hemisphere registers our conscious thought process and the right hemisphere is where our more hidden, subconscious thought processes occur.

Under stress the reptilian brain and the emotional Limbic System hijack higher mental functioning in order to help you survive. Energy which normally flows up to the thinking part of the brain is reserved for the primitive brain areas and the brain reverts to a bottom up processing. The Fight, Flight or Freeze mechanism is activated, draining the blood flow from the Frontal Cortex (forehead) down into the core of the brain/body. Sub-conscious, primitive reactions of the lower brain systems are activated emotionally overwhelming the coping strategies of the person

If this person is not able to calm themselves and reprocess the trauma, it can lead to ongoing problems with dysregulation of arousal and emotional reactivity. Hyper-arousal which is the sympathetic nervous system response results in aggression, outburst, mobilization, impulsive behaviors, and hyperactivity. Hypoarousal which is the opposite response of the parasympathetic nervous system can also be triggered when the dorsal vagal system is activated. This is a low arousal state resulting in social withdrawal, passivity, compliance, lack of motivation, “spacing out” and daydreaming. If the person experienced trauma and attachment disruptions during early, critical developmental periods, then it would be wise to start reprocessing from the subcortical areas of the brain first.

Other Stress Responses

Brain cells which typically have a higher rate of metabolism than other cell types, consume more oxygen than any other organ. Normally our brain utilizes over twenty percent of the body’s oxygen even though it weighs less than two percent of the whole body. Under stress our oxygen usage is compromised as we revert to a shallow, upper chest breathing pattern. Since most of our oxygen rich blood cells reside in the bottom third of our lungs, it becomes much harder to get oxygen rich blood up to the brain, compromising our thinking abilities.

Another body reaction to stress is to produce high levels of adrenaline and cortisol. These chemical messengers trigger the Tendon Guard Reflex so that muscles and tendons are shortened as the body prepares to fight or flee. If the stress response stays for an extended time, physical pain in the calf muscles, lower back or neck and shoulders can result from these over-contracted muscles and tendons. When muscles in the lower back are over contracted, this reduces the flow of cerebrospinal fluid up the spine and throughout the brain, blocking the flow of information throughout the brain and whole nervous system. This can make it harder to focus and learn in school.

Breathing exercises are especially important for reestablishing oxygen flow, reducing heart rate and lowering anxiety for anyone who is experiencing a stress response. Consciously taking deep breaths from your diaphragm helps interrupt any involuntary breathing responses and restores your body’s normal breathing patterns. Gentle movement and stretches can also help to switch off the stress response. When the muscles which have become contracted and painful are gently stretched, the spindle cells reset allowing the muscle to release the blocked energy (pain) and return to their normal length.