Intracranial compliance

Intracranial compliance refers to the ability of the brain and cerebrospinal fluid (CSF) within the skull to change volume in response to changes in pressure. It is affected by factors such as the amount of CSF within the skull, the elasticity of brain tissue, and the degree of brain swelling. Low intracranial compliance can occur in conditions such as brain tumors, hydrocephalus (excess fluid within the skull), and traumatic brain injury, and can lead to increased pressure within the skull, which can cause brain damage. High intracranial compliance, on the other hand, can lead to decreased pressure within the skull, which can also cause brain damage.

The brain is enclosed in a rigid container, and any transfer of pulsatility from the arterial walls into the surrounding tissue is felt almost instantaneously everywhere throughout the cranium. This leads to the observation that intraparenchymal and CSF pressure waveforms tend to be similar and independent of location. This is sometimes over generalized to suggest that pressures are everywhere equal intracranially, but this obviously does not apply to the very important arterial and venous compartments. Secondly, this leads to the interesting and potentially important phenomenon of measurable flow pulsatility in the microvasculature [1] and in the venous system. In the brain, the substitute for tissue compliance, which dissipates arterial pulsations in non-cranial tissues, is the overall intracranial compliance. This compliance, is comprised of four main components: actual brain tissue compliance (which is small), arterial compliance, venous compliance (veins have highly compliant walls) and compliance of the spinal thecal sac (which communicates with the brain via the cerebrospinal fluid spaces). Traditionally, intracranial compliance is assumed to decrease primarily with increased ICP, due to the exponential pressure-volume relationship [2].

Decreased compliance with elevated ICP leads to increased pressure pulsatility. However, an additional factor which must be considered is the transfer of pulsations out of the cranium through either venous or CSF outflow pathways; while usually not considered as a factor which affects intracranial compliance, this is another way in which pulsatility is modified in the brain. Thus, intracranial pulsatility can also be affected by restriction of these flow pathways (which can manifest itself as a change in either pressure or flow pulsatility), such as with venous hypertension or a blockage in the outflow CSF pathways at the craniocervical junction (e.g., in Chiari malformation or Dandy-Walker variant) [3].

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see Application of non-invasive intracranial pressure waveform analysis in acute brain injury: Intracranial Compliance Scale [4].

1)
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