The question of priming the CSF collection system is an area that is often neglected at the bedside when the emphasis is placed on the numeric values for ICP management. Unfortunately, priming the system or not can have quite an impact on the amount and speed at which CSF drains from the patient. We must review not only our nursing and medical research, but also the engineering tenets that govern the behavior of fluids and gases and their compressibility in a confined space.

The pressure at which CSF drainage will begin is controlled by positioning the point where the connecting tubing of the EVD empties into a burette, drip chamber, or collection bag relative to the ventricular catheter tip at Monro’s foramen. The external landmarks of Monro’s foramen are the midpoint between the outer canthus of the eye and the tragus of the ear or external auditory canal, and nurses customarily “level” their drainage system to this point. The collection system is usually set at a prescribed height based on the desired upper limit for controlling the ICP. When the ICP exceeds the set level, CSF will drain into the collection system. Leveling works because the ICP must overcome the static fluid column pressure exerted by the weight of the CSF or fluid in the tubing before drainage can occur.

This phenomenon is based on the basic law of hydrostatics. Fluid column pressure is often expressed in height units of a particular fluid such as centimeters of water (cm H₂O).
and can be calculated as, “pressure = \( \rho gh \),” where \( \rho \) (density of fluid), \( g \) (gravitational force), and \( h \) (height of column) refer to the vertical distance between the tip of the ventricular catheter and the point at which the fluid meets atmospheric pressure.

In an unprimed EVD system, the point at which the CSF in the connecting tubing meets the atmospheric pressure will vary as the tube fills with CSF. Because the tubing may be draped off the end of the bed or above the level of the head, there is random gravity pressure exerted on the column in the tubing, which may be greater or less than that of a full fluid column. Translated into practice, this means that the flow of CSF will be faster and in a greater quantity when the unprimed tubing hangs down and will meet greater resistance when traveling upward toward the burette in unprimed tubing.

If the tubing is not primed, we also run the risk of fluid partly filling the tubing and capturing air bubbles, which further alter the flow of fluid to the collection bag.

Liquids such as CSF transmit pressure efficiently because they are much denser than gases such as air. For example, a 10-fold increase in the pressure exerted on a liquid will result in a density change of the liquid of less than 1%. A similar change in pressure exerted on a gas (at constant temperature conditions) can result in a density change of 400%. Therefore, liquids are usually assumed to be incompressible whereas gases are assumed to behave according the “perfect gas law,” \( PV=nRT \), where pressure times volume of a gas equals the number of moles of the gas times the “gas constant” times temperature.

If the clinician is using an external transducer for measuring and recording ICP, air bubbles in the connecting tubing of an EVD system lead to dampened waveforms and inaccurate pressure measurements for the reasons stated above. Manufacturers of drainage systems suggest priming the system, using aseptic technique and preservative free isotonic sodium chloride solution before attaching the system to the ventricular catheter and the patient. Severely brain-injured patients require impeccable attention to detail throughout their hos-
pitalization to optimize their outcomes, and priming the tubing of the drainage system is one small aspect that can make a difference to the management of this fragile population.

References
Ask the Experts
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