Evolution of intracranial pressure sensors. Any news ?

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The modern era in intracranial pressure (ICP) monitoring started in the decade between 1950 and 1960. In 1951, Guillaume and Janny reported, even if their work went largely unnoticed, continuous clinical measurement of intracranial pressure with the use of an inductance manometer. In the United States, Ryder and Evans extended their physiologic studies to patients. A milestone in the history of ICP recording was the work done by Nils Lundberg (1965) on the use of bedside strain gauge manometers to record intracranial pressure continuously by ventriculostomy in more than 400 patients. The systematic application of those monitoring systems to the management of acute traumatic brain injury did not take place for almost another decade. By the mid 1970s, monitoring by means of a strain gauge pressure transducer had begun to pervade neurosurgical practice influenced by Becker and Miller good results in 160 traumatic brain injuried patients, using continuous intracranial pressure monitoring with a Statham strain gauge, treated according to defined clinical algorithms over 4-year. In 1981, Flitter wrote that the technique used by Lundberg—the ventricular catheter and strain gauge transducer —for continuous monitoring "continues to serve as a standard against which other devices can be compared". This sentence is still actual. A ventricular catheter connected to an external strain gauge is, nowadays, the most accurate and low-cost method for ICP monitoring. This method has been proven to be reliable and permit for periodic re-zeroing. It also allows the benefit of therapeutic CSF drainage. Nevertheless, the potential risks of difficult positioning and obstruction have lead to different intracranial sites for ICP monitoring. Actually, the more diffuse alternative location for ICP monitoring is the cerebral parenchyma. ICP measurements obtained with intraparenchymal transducers correlate well with the values obtained with an intraventricular catheter. In recent decades, technology of miniaturisation, fiberoptic and piezo-electric ICP measuring devices were introduced. Catheter-tip systems, due to their small diameter, are likely to cause less damage to tissue and are not affected by hydrostatic pressure differences. However, technical complications as well as problems with the accuracy, zero drift, and the robustness of fiberberoptic and piezo-electric ICP probes have been identified in laboratory and in clinical studies. Catheter tip strain gauge utilizes for pressure transduction a Wheatstone bridge, an electrical bridge circuit used to measure the resistance change in a strain gauge. Although these systems are very accurate at the time of placement, they have been reported to possibly produce a drift over time on the ICP readings, which can result in reading errors. The cost of these devices is higher than the cheaper conventional ventricular system. Subdural and epidural monitors (fluid coupled, pneumatic, solid state and fiberoptic) and externally placed anterior fontanel monitors are less accurate. The overall safety of ICP monitoring devices is excellent, with clinically significant complications (e.g., infection and hematoma) occurring infrequently. Future systems, combining ICP with other biochemical parameters, will open new possibilities in the exploration of acute brain damage.