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Who was Hakim?

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Letter to Editor

Many radiologists frequently interpret skull radiographs in patients with hydrocephalus, the purpose of which is to assess the pressure setting of a Cerebrospinal Fluid (CSF) shunt catheter. One of the most commonly used types of CSF shunter catheters is the Codman Hakim programmable valve [1]. The name is one that radiologists have included in reports many times, but few know the fascinating story of the inventor of the valve, Salomon, Hakim, MD PhD, one of the most famous physicians ever to emerge from the nation of Colombia.

Hydrocephalus afflicts approximately 1 to 2% of the US population, accounting for 70,000 hospital admissions and the placement of between 18,000 and 33,000 CSF shunts each in the United States [2,3]. Shunt malfunction is a common clinical concern, and many patients undergo multiple radiographic evaluations over the course of their lives. CSF shunt catheters consist of three components: A ventricular catheter, a valve, and a distal catheter, which are impregnated with radiopaque material to facilitate visualization. Programmable valves eliminate the need for reoperation to change pressure settings [4].

Salomon Hakim, MD PhD was born in Colombia in 1922 of a Lebanese immigrant family [5]. In Arabic, the name Hakim means "physician." He demonstrated great avidity for science and technology at a young age, disassembling devices as a child and spending his school breaks working in the physics laboratory building radios. In 1944, he began studies at the National University of Colombia, where he earned his medical degree with honors. He continued his training in neurosurgery at Harvard University, where he also earned a PhD in neuropathology.

As a fellow in neurosurgery, Hakim discovered that many patients with enlarged cerebral ventricles demonstrated no evidence of cortical injury. Back in Colombia, he hit upon the idea of "normal-pressure hydrocephalus" also sometimes referred to as "Hakim syndrome" [6]. He knew that the force exerted

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on the wall of a ventricle equaled the product of pressure and surface area. Therefore, he reasoned, a given pressure exerts a larger force on enlarged ventricles than it does on normal-sized ones. He also showed in some patients that lowering CSF pressure could improve symptoms.

The classic symptoms of normal-pressure hydrocephalus are impaired gait, urinary incontinence, and dementia. Because the disorder is associated with advanced age, the number of cases is expected to increase dramatically with the aging of the US population. The diagnosis of the condition can be challenging, but the gold standard is a favorable response to CSF shunting. It is thought that many patients with normal-pressure hydrocephalus-perhaps as many as 5% with dementia-go undiagnosed, resulting in unnecessary disability and suffering [7].

Hakim's interest in CSF pressure naturally led him to explore the valves used for its regulation. The first such valve had been developed by Eugene Spitz, who treated Charles Holter, a child who had been born in 1955 with hydrocephalus [8]. The patient's father, John Holter, a hydraulics technician, suspected that the valves used in intravenous lines to prevent leakage could do the same for CSF. He suggested as much to Spitz, who provided specifications. Holter developed a CSF shunt valve, which he began manufacturing by hand, eventually producing over 500 per year.

However, there was a problem with the Holter-Spitz valve, which was the fact that it did not drain physiologically in all body positions. To surmount the problems of Holter's ball-valve design, Hakim developed a spring-loaded, ball-in-cone design [9]. This design permitted CSF to flow in only one direction, while adding the ability to regulate CSF pressure through the use of the spring. Introduced in Colombia in 1966, Hakim's ball-in-cone design is now the basis for many subsequent valves. It also makes it possible to adjust the pressure setting non-invasively after implantation.

Hakim died in Bogota, Colombia in 2011 from a hemorrhagic stroke. One of his four children, Carlos, inherited his father's passion for tinkering and became a biomedical engineer, and two other sons, Fernando and Rodolfo, became neurosurgeons. Today Hakim is remembered primarily for the identification of normal-pressure hydrocephalus and for his unparalleled contributions to CNS shunting, which included the development of ball, adjustable, gravitational, and auto-regulating valve designs. Radiologists who report CSF shunt pressure settings may wish to remember his important legacy.

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