Initial Experience with the Hakim Valve for Ventriculovenous Shunt

Technical Note

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IN 1964, Hakim described 7 years' experience with a new valve he had developed for ventriculovenous shunting in patients with hydrocephalus.[8,10] He reported the following advantages of this valve: 1) it could be sterilized by autoclaving immediately before use; 2) the incidence of obstruction of the valve mechanisms was greatly reduced; 3) the operating characteristics of the valve were immune to the effects of use, heat, and age; and 4) the differential between opening and closing pressures of the valve was small.

The purpose of this report is to summarize the initial experiences of the senior staff at the Massachusetts General Hospital with this valve* in the treatment of hydrocephalus of all types over an 18-month period.

Description of the Valve

The system consists of two stainless-steel ball check valves connected by a 45-mm length of silicone rubber tubing (Fig. 1). One valve functions as an inlet valve when the cerebrospinal fluid pressure rises above the calibrated level, while the other serves as an outlet. When the silicone rubber tubing is compressed to pump the valve, flow occurs only through the outlet twin-valve.

Each valve is a solid cylinder 11 mm long. One end is cut obliquely at a 23° angle with respect to the axis. In the basal part of this new surface is a conical perforation that connects with a small, circular channel 1 mm in diameter coming from the flat, unbeveled end of the cylinder. This conical perforation is formed so that a 1.5 mm polished, synthetic sapphire ball will operate in the hard, highly-polished stainless steel valve seat, with the two surfaces touching each other only along the perimeter of a circle. The sapphire ball is held in place against the valve seat by a stainless steel calibrated spring, which determines the pressure.

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* The Hakim valve is manufactured by the Cordis Company, Miami, Florida.

Surgical Procedure

The method of shunt insertion is modified from previously described operative procedures[12,16,19,20] and will not be described in detail. One useful modification has been the use of one of the plastic skin drapes in such a way that it is solidly adherent to the skin surrounding the areas of incision. This prevents direct contact between the tubing and the skin.

The ventricular catheter is constructed so that the ventricular end forms a semicircle (shepherd's crook) with three holes on the inner surface of the circle (Fig. 2). During insertion, this curve is straightened by a small metal stylet. If the catheter has to be removed, it is carefully withdrawn, and as the tip comes in contact with the ventricular wall the curve is straightened and remains so as the catheter moves through cerebral tissue. The ventricular catheter is sutured to tissue near the burr hole. A silicone rubber antechamber which allows the shunt system to be punctured by a fine needle through the skin for pressure measurement or irrigation may be attached to the ventricular catheter. The valve is then attached to the antechamber, and the entire mechanism is placed in a subgaleal tunnel so that the distal end is at the mastoid incision and all of the valve and antechamber are under intact skin.

The cardiac catheter is introduced into the internal jugular vein through the common facial vein when possible, or through a purse string suture in the internal jugular vein itself. The position of the catheter is checked by filling the tubing with a radiopaque contrast medium. An attempt is made to place the tip of the catheter at the level of the sixth thoracic vertebral body, which Nulsen[15] considers the ideal level for avoiding infection.

Prophylactic antibiotics have not been used in this series. At the time of operation, all wounds are irrigated with a bacitracin solution.

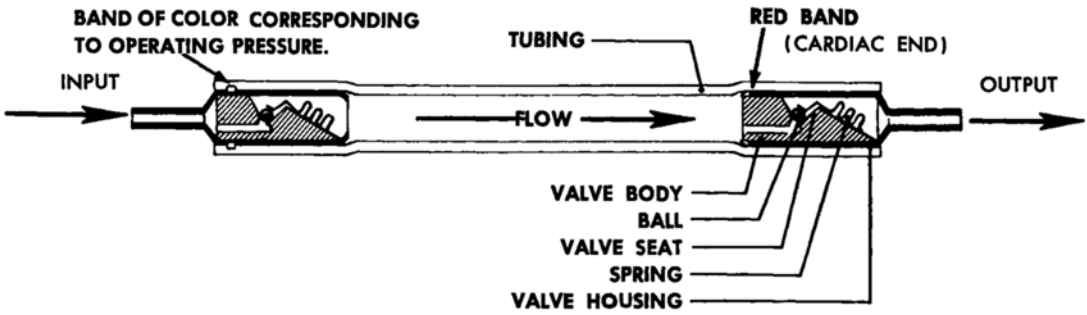

FIG. 1. Schematic drawing of valve mechanism.

Results

During a period of 18 months, we have used the Hakim valve in 33 consecutive patients requiring ventriculovenous shunt for hydrocephalus. Table 1 summarizes these cases. The group included 23 adults ranging in age from 23 to 77 years and 10 children ranging from 1 month to 10 years with six children under 1 year.

In eight patients some type of shunting procedure had been used prior to insertion of the Hakim valve. In three cases of aqueduct stenosis, a Torkildsen procedure had been performed. Inadequate relief of increased intracranial pressure in two cases and infection in the third necessitated removal of the Torkildsen tube and insertion of a ventriculovenous shunt. In one adult with a pinealoma, a ventriculocisternostomy failed to produce a satisfactory reduction of intraventricular pressure. The other four cases were revisions of ventriculovenous shunts because of occlusion or malfunction of another type of valve.

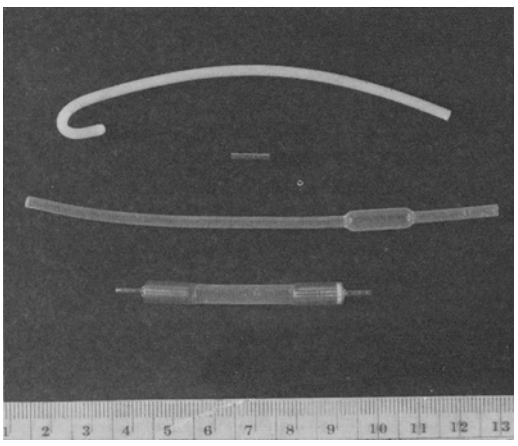

FIG. 2. Components of shunt system which includes "shepherd's crook" ventricular catheter, metal connector, reservoir and valve.

Complications of the Shunt System. Ten patients (30%) had a total of 14 complications (Table 1). There was one postoperative infection in a patient whose shunt had been first placed at the age of 1 month. The child was well until 9 months of age when signs of recurrent hydrocephalus developed. Three days after revision of the shunt, *Staphylococcus albus septicemia* developed and proved fatal. During subsequent treatment with penicillin, she died following an attack of status epilepticus.

Obstruction of the ventricular catheter was the major cause of postoperative complication, occurring in nine cases. In five patients, this problem developed in the immediate postoperative period. In two, occlusion was noted approximately 3 months after insertion, with migration into brain tissue in one and occlusion with choroid plexus in the other. In two others, obstruction occurred more than 6 months after operation, apparently because the catheter had migrated with growth.

During the first portion of the study, a No. 8 French rubber tube with extra holes near the end was used as the ventricular catheter. This was passed through an occipital burr hole in the longitudinal axis of the ventricle. Eight of the nine problems with obstruction were encountered with this catheter.

Subsequently, Hakim developed the ventricular catheter (Fig. 2) described above. This catheter has been used in 11 cases; in seven it was placed through a frontal burr hole. Only one instance of obstruction of this new catheter has been encountered. In one case, revision was required when the ventricular tubing became disconnected from the valve following a fall.

Over the period of this study, the Hakim