Sagittal Sinus Venous Pressure in Hydrocephalus*

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Previous workers have demonstrated a gradient of pressure between cerebrospinal-fluid pressure as measured either in the cisterna magna or ventricle and the venous pressure in the superior sagittal sinus. Data obtained in our laboratory have confirmed this difference in pressure in dogs with mean cerebrospinal-fluid pressure equal to 147 mm. H₂O and venous pressure in the superior sagittal sinus equal to 90 mm. H₂O. Acute elevations of cerebrospinal-fluid pressure in the normal dog did not cause a rise in the venous pressure in the superior sagittal sinus, but in the type of hydrocephalus induced by Kaolin, all rises of cerebrospinal-fluid pressure were accompanied by an increase in venous pressure in the superior sagittal sinus.

In an attempt to define the gradient of pressure available for shunting cerebrospinal fluid from the lateral ventricle to the superior sagittal sinus in infants with hydrocephalus, simultaneous recordings of pressure in the sagittal sinus and lateral ventricle have been accomplished in 15 infants. In 5 of these children simultaneous jugular venous pressure was measured. Three children had sinograms to visualize the dural venous system.

Materials and Methods

A. Methods of Recording Pressure. Hydrocephalic infants were studied at the time of ventriculojugular or ventriculocephalus shunting. With the infants under general endotracheal anesthesia (Fluothane) and in the supine position with the head turned to the left, a burr hole was placed in the right occipital area. The dura mater was opened minimally in a cruciate fashion and after coagulation of the arachnoid and pia mater, a ventricular needle was passed into the lateral ventricle. This was withdrawn and a polyethylene catheter with an outside diameter of 1.7 mm. was introduced into the ventricle and held in place by a purse-string suture around the dural edges. This catheter was connected to a Statham P23 AA transducer and set at the level of the heart. A 1.5-cm. coronal incision was made over the posterior third of the anterior fontanelle straddling the midline, and the sagittal sinus was exposed. A purse-string 6-0 suture was placed in the wall of the sinus and a small opening was made, just large enough to admit a polyethylene catheter of similar size. The tip of the catheter was directed caudally for 2–3 cms. in the direction of the flow of blood, and sutured in place with the previously placed silk. A pledget of Gelfoam was fashioned around the catheter to control any bleeding. This venous catheter was continually irrigated with saline to maintain its patency, and its position was checked by aspirating blood. Recordings were done on an Electronics for Medicine PR-7 polygraph which allows full-screen deflection at low pressures (10 mm. Hg). In a number of infants after stable base-line pressures were recorded, fluid was allowed to escape from the ventricle to observe the effect of the lowered cerebrospinal-fluid pressure on the venous pressure in the superior sagittal sinus. In 5 infants undergoing shunting into the right atrium via the jugular vein, pressure in this structure at the level of the common facial vein was recorded by introducing a catheter via this side branch into the center of the internal jugular vein. This catheter was led off to a Statham P23 AA transducer.

B. Sinography. These studies were performed under local anesthesia usually prior to operation. A #20-gauge Cournard needle was introduced into the sinus in the direction of the flow of blood. Injection of 50 per cent Hypaque was done by hand and seriograms were taken. No complications occurred in the infants studied.

Results

Simultaneously obtained data on pressure in the equilibrium state are presented in
Table 1. The mean pressure of the ventricular cerebrospinal fluid was 206±95 mm. H₂O, while the venous pressure in the superior sagittal sinus was 222±94 mm. H₂O. In 11 of 15 instances, the venous pressure in the superior sagittal sinus equalled or exceeded the ventricular cerebrospinal-fluid pressure. The ratio of mean venous pressure in the superior sagittal sinus to mean cerebrospinal-fluid pressure was 1.08. If the venous pressure in the superior sagittal sinus is plotted as a variable of the ventricular cerebrospinal-fluid pressure, the equation of the least squares straight line is

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SSVP = (0.95) \times \text{CSFP}_{\text{vent}} + 27.5 \text{ mm. H}_2\text{O}
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Such a plot is shown in Fig. 1. The regression coefficient, b, of SSVP as a function of CSFP_{vent} is 0.95 with a standard error of 0.08. This regression is highly significant and shows that in different individuals high values of SSVP and CSFP_{vent} go together, and low values of SSVP and CSFP_{vent} go together. This also suggests that changes in SSVP are causally related to changes in CSFP_{vent}. Indeed this observation is substantiated in Fig. 2, a graph obtained in patient J.S., where, by allowing the cerebrospinal fluid to escape, both the ventricular cerebrospinal-fluid pressure and the venous pressure in the superior sagittal sinus were lowered along a curve whose regression slope is 1. This line and that of the least squares obtained on all the children do not pass through the origin, but bisect the y axis at approximately 30 mm.