Subgaleal shunt for temporary ventricle decompression and subdural drainage

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The authors describe a closed method for temporary ventricle decompression and drainage of some chronic subdural hematomas and hygromas.

Key Words • intracranial pressure • hydrocephalus • subdural hematoma • subdural effusion • cerebrospinal fluid shunt

The ventriculosubgaleal shunt represents a method of shunting the ventricular fluid from the ventricle into the subgaleal space. It is used to temporarily decompress the ventricular system until a definite corrective surgical procedure can be carried out. This method has been used in 173 patients at the University of Iowa Hospitals since 1967.

It is occasionally expedient or necessary to temporarily reduce the intraventricular pressure, particularly in patients with obstructive lesions involving the ventriculocisternal pathways such as tumors of the third or fourth ventricle, craniopharyngiomas, or multiple tumors in the posterior fossa, as seen with von Recklinghausen's disease. The usual methods are repeated ventricular or spinal puncture, external drainage by simple mechanical reservoirs (condoms, glass bottles, burettes), or more complicated systems in which the intraventricular pressure is controlled by tube-occluding clamps or by adjustable level drainage tubes. Although such systems are designed to be closed and all efforts are directed to maintain them as sterile systems since the drainage is externally directed, the risk of infection and its complications is ever present.

Technique

Ventriculosubgaleal Shunt

Trephines are made in a conventional way in the posterior parietal area. A cannula is introduced into the ventricle, and an estimate made of brain thickness. A shunting tube is then passed into the ventricle and after good flow is established, the tube is fixed with a suture to the pericranium next to the trephine opening. The subgaleal space is then widely dissected laterally and inferiorly and a pocket 8 to 10 cm in diameter is established. The dissection can be facilitated by injection of the subgaleal space with saline, which readily distends this tissue plane so that it can be more easily and cleanly separated from the underlying pericranium. The distal end of the ventricular tube, 5 to 6 cm in length, is then placed into this space which must be free of blood. The wound must be meticulously closed in two layers.

The procedure can conveniently be performed at the time of air ventriculography. When this is the case, it is important to transport the patient from the operating theatre to the x-ray unit with head high, as air from the ventricle can be lost into the subgaleal space (Fig. 1).
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Volumes of ventricular fluid of over 100 cc have been recovered from the subgaleal space, indicating good drainage and decompression. The subgaleal space has remained functional with apparent fluid-absorbing surfaces for 3 or more weeks. One of our shunts has remained patent and functioning for 20 months. When the ventricular pressure becomes normal, or normal cerebrospinal fluid circulation has been restored, or when a permanent shunting procedure has been employed, the subgaleal space remains empty and rapidly becomes obliterated. The shunt tubes (commonly Silastic) have usually been left in place, but are removed, however, if convenient. The tubing in the subgaleal space can also be connected to the Holter valve system, and a permanent vascular or peritoneal shunt made should this be needed. This avoids the necessity of performing another trephination in the posterior temporal region.

Subdural-Subgaleal Shunt

A trephine opening is made over the hematoma (hygroma) usually in the parietal region, the dura is opened, and the shunt tubing is placed in the subdural space. The tube is fixed by suture to the pericranium and its distal end led to the subgaleal space, prepared as previously described for the ventriculosubgaleal shunt. The scalp wound is meticulously approximated with galeal and skin sutures.

Case Reports

Ventriculosubgaleal Shunts

The practical value of the ventriculosubgaleal shunt may best be illustrated by the following two cases:

Case 1. This 10-year-old girl was admitted in May, 1967, complaining of headaches, vomiting, and intermittent diplopia. She had bilateral high-grade papilledema with retinal hemorrhages, and right sixth nerve paresis. Skull films showed midline suprasellar calcifications. Ventriculography was performed with the patient under general anesthesia in the sitting position. Bilateral posterior parietal trephinations revealed a ventricular fluid pressure of 330 mm H2O; 100 cc of cerebrospinal fluid (CSF) was removed. It was believed that the ventricles apparently communicated, and a silicone rubber catheter was inserted into each lateral ventricle for a distance of 10 cm. The tubes were sutured to the pericranium at the burr-hole sites, and placed...
into a large cavity previously dissected between the pericranium and galea.

Ventriculograms showed symmetrical hydrocephalus with the third ventricle displaced posteriorly and superiorly. There was no filling of the aqueduct or fourth ventricle. A diagnosis of craniopharyngioma was established. After ventriculostubgaleal shunting she became free of headaches and was able to feed well; diplopia disappeared with the recession of papilledema.

Eleven days later, the patient underwent right frontal craniotomy and transcortical approach to the lateral ventricle. The tumor was found bulging through the foramen of Monro, the cystic contents were aspirated and the tumor wall partially removed. Full recovery followed a course of cobalt irradiation; the patient is asymptomatic at the present time.

Case 2. This 6-year-old boy was admitted in May, 1968. He had a history of progressive ataxic gait, awkwardness, and visual complaints. There was bilateral high-grade papilledema, nystagmus, and ataxic stance and gait. Skull films showed spreading of the cranial sutures.

Ventriculography was performed with the patient under general anesthesia in the sitting position. Bilateral posterior parietal trephinations revealed a ventricular fluid pressure of 600 mm H₂O; 160 cc of CSF was removed. A silicone rubber catheter was inserted into the right lateral ventricle for a distance of 10 cm, and sutured to the periosteum at the burr-hole site. The tube was placed into a space dissected between the pericranium and galea in the right parietooccipital area.

Ventriculograms showed symmetrical hydrocephalus; the aqueduct was dilated and kinked, and only the superior portion of the fourth ventricle could be seen, being displaced superiorly and to the left of the midline. The patient was alert, comfortable, and neurologically unchanged.

Four days later, a posterior fossa craniectomy exposed a medulloblastoma protruding from the lower fourth ventricle; the tumor was partially removed. The right posterior trephine wound was reopened; the subgaleal tube was exposed and passed between dura and bone to the posterior fossa. Here it was connected with a longer piece of silicone tubing, and inserted into the cervical subarachnoid space to the C-3 vertebral level.

The patient received a course of cobalt irradiation and recovered fully; he is asymptomatic at the present time.

Subdural-Subgaleal Shunts

The subdural-subgaleal shunt has been used in 26 patients to drain recurrent subdural hematomas after initial surgical evacuation of fluid hematomas or symptomatic hygromas. In most cases this type of shunt is as effective as the more complicated subdural-peritoneal shunt. The following case illustrates its successful application.

Case 3. This 7-month-old girl was admitted in December, 1969, for care of bilateral chronic subdural hematomas. She had been treated elsewhere with multiple trephinations and subdural taps, but subdural fluid reaccumulated.

With the patient under general anesthesia bilateral posterior parietal trephinations were performed, with bilateral dissection of the subgaleal space over the occipital and parietal regions extending almost to the coronal suture. Incision of the dura disclosed a large accumulation of subdural fluid; the brain was depressed 1 ½ cm below the bone. Silicone rubber tubes with multiple holes were inserted into each subdural space, sutured to the pericranium at the site of the burr holes, and placed into the subgaleal spaces.

Large collections of fluid accumulated in the subgaleal spaces. Three days postoperatively, 80 cc bloody fluid were aspirated from the subgaleal space, leaving 30 to 40 cc of fluid in the space. The next day, 65 cc, 2 days later 78 cc, and 2 days after that 80 cc of bloody fluid were aspirated from the subgaleal space. Eleven days postoperatively, 55 cc of xanthochromic fluid were aspirated from the subgaleal space. Only a small amount of fluid reaccumulated into the subgaleal space not necessitating further taps. At the time of discharge, the anterior fontanel and burr holes were sunken, and only a minimal collection of fluid remained in the subgaleal space.

On follow-up examination on February 27, 1970, the subgaleal spaces were obliterated. The patient had made a full recovery.

Discussion

The greatest value of the ventriculostubgaleal shunt lies in the immediate decom-
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Fig 2. Computerized tomography (CT) scans of a 9-year-old girl with a left cystic cerebellar astrocytoma. Left: Preoperative scan showing dilated ventricles. Right: Scan done 2 days after ventriculography and introduction of right ventriculosubgaleal shunt. Note decrease in size of the ventricles, and the tube in the right lateral ventricle.

pression it produces following ventriculography, especially in the presence of a tumor obstructing the third or fourth ventricle, since air as well as CSF escapes into the subgaleal space (Fig. 2). The symptoms of increased intracranial pressure improve; the patient's headaches subside, vomiting stops, and immediate operation is no longer necessary. The control of increased intracranial pressure with a risk of infection no greater than for simple trephines, gives the surgeon leisure to plan the best possible permanent corrective procedure for a time when the patient's general condition is more favorable.

The indications for the ventriculosubgaleal shunt are as follows: 1) when an enlarged ventricular system is demonstrated by ventriculography or computerized tomography (CT) scan, usually with raised intracranial pressure; 2) when decompression is required preparatory to a definitive surgical procedure, such as craniotomy for tumor, placement of a Torkildsen shunt; 3) after ventriculography indicating that a palliative shunting procedure (ventriculoperitoneal or ventriculocaval) may be made; 4) when temporary decompression is required during radiation treatment for certain brain tumors; and 5) for the control of increased intracranial pressure and hydrocephalus secondary to subarachnoid hemorrhage. An analysis of the cases in which the ventriculosubgaleal and subdural-subgaleal shunt was employed is shown in Table 1.

Contraindications for ventriculosubgaleal shunting are small lateral ventricles in which case adequate long-term drainage usually fails.

Complications are few. As with other types of shunt, there may be failure of function. With the subgaleal shunt this is due to obstruction of the shunt tubing or obliteration of the subgaleal pocket by blood or scarring. Distal occlusion of the shunt tube by a blood clot may allow drainage of ventricular fluid around the tubing into the subdural space and produce an accumulation of fluid over the cerebral cortex to compress the hemisphere. In our experience such a subdural collection of fluid has necessitated a subdural-subgaleal shunt in four instances. In three of these four patients a contralateral hemiparesis developed 1 or 2 days after the shunt was placed. It is important to recognize this complication as such, rather than being
the result of intrinsic damage to the brain from the passage of the ventricle cannula or shunt tube. The absorption of CSF is enhanced by a clean dissection of the subgaleal space and careful control of local bleeding, which is necessary to obviate obstruction of the shunt tube. We have found it necessary to revise the shunt only once. This was in the case of a hypothalamic tumor. The subgaleal end of the tube was occluded by clot. A ventriculospinal subgaleal shunt was then placed on the opposite side. There have been no infections in this series of patients attributable to the shunting procedure or to the presence of the shunt.

The ventriculospinal subgaleal shunt requires little postoperative care. Leakage of ventricular fluid does not occur if an accurate, careful galeal and skin closure is made at the site of the trephine opening. The subgaleal space rarely requires tapping. In unusual circumstances, for example, during the course of radiation/steroid therapy in patients with inoperable tumor, where such treatment has not become as rapidly effective as desired, the subgaleal space in 2 to 3 weeks may become tense. This indicates that the absorbing surface is becoming less functional. Tapping of the space with removal of fluid can readily be made in order to control rising intracranial pressure. Under the usual conditions for which the shunt is placed, namely, temporary ventricle decompression before operation, no particular care other than that for any scalp wound is necessary.

**Summary and Conclusions**

Since 1967, 180 ventriculospinal subgaleal shunts have been created in 173 patients for a variety of conditions that produce increased intracranial pressure and a dilated ventricular system. We believe that temporary ventricle decompression improves the patient’s general condition, relieves the symptoms of raised intracranial pressure, and provides time during which fluid, electrolyte, and nutritional deficiency often incident to repeated vomiting can be corrected and stabilized before operation. From the technical standpoint, especially with tumors of the posterior fossa, the decompression produces a slack cerebellum making the opening of the posterior fossa and the handling of its contents easier for the surgeon. The method has proved to be helpful in the management of patients with increased intracranial pressure and large ventricles, and has the distinct advantage of being a truly closed system as op-
posed to those where drainage is externally directed with the attendant risk of infection.

Thirty subdural-subgaleal shunts have been made upon 26 patients with chronic subdural hematoma or hygroma. We feel that the procedure avoids the risk of infection of the subdural space from repeated subdural puncture. The operation is simpler to perform than the subdural-peritoneal shunt and is as effective in draining the subdural space. It avoids the risk of opening the abdominal cavity and the possible complications of a tube within it. In bilateral hematomas in children, a single rather than bilateral shunt is adequate for drainage, when communication between the hematomas (hygromas) is demonstrated by injection of air into the subdural (hematoma) space.

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