Ventriculo-peritoneal Shunting with One Piece Spring Catheter
Technical Note

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ABSTRACT

Shunting of cerebrospinal fluid into the peritoneal cavity is a well established procedure which has, over the years, enjoyed increasing popularity.

A slit valve at the distal end eliminated the insinuation of the omentum into the shunting tube and a spring catheter prevented kinking of the shunt tubing. However, the most common cause of failure of the shunting is from the separation, or pulling apart, of the various components of the shunt system with subsequent infection. A one piece spring catheter is sufficient to the necessity.

Surgical details are illustrated for installing a one piece spring catheter for hydrocephalus. Four basic steps of surgical procedure using a subcutaneous guide, a leader, a cannula and a cuff are described; firstly passing the guide and the one piece shunt from McBurney’s point to the supraclavicular space, secondly passing the guide from the parietal eminence to the supraclavicular space to thread the one piece shunt cephalad. Thirdly, inserting the cannula into the lateral ventricle and threading the ventricular end of the one piece shunt through the cuff into the lateral ventricle and fourthly inserting the peritoneal end into the peritoneal cavity.

INTRODUCTION

After the 1st internal shunt of cerebrospinal fluid was performed in 1893 by Miculicz of Germany, ventriculolubachoid or subdural shunting was attempted who advocated gold or platinum tubes (Andrews, 1911). In 1898 Ferguson ingeniously shunted CSF from the lumbal subarachnoid space to the peritoneal cavity. The 1st ventriculo-peritoneal shunt was performed by Kausch in 1905, using a rubber tube (Andrews, 1911). Following these initial procedures, enthusiasm for shunting procedures waned, in the absence of a suitable shunting tube, until Ingram introduced a plastic shunting tube in 1947. By the late 1950’s silastic ventriculoatrial shunts had proved to be the most effective shunting procedure (Scott, et al., 1955). However, the shunting of ventricular fluid into the blood stream involved many inherent problems (Little, et al., 1964); septicemia, SBE, superior vena cava thrombosis, loss of the distal catheter into the venous system or the heart, pulmonary emboli, renal emboli, and sacrificing the internal jugular vein when
a shunt is performed or revised etc.

Shunting of cerebrospinal fluid into the peritoneal cavity is an established procedure which has, over the years, enjoyed increasing popularity (Ames, 1967; Hammon, 1971; Murtagh and Lehman, 1967). There are still many problems left in ventriculoperitoneal cavity shunting, including obstruction (Harsh, 1934), disconnection, kinking (Raimondi and Matsuno, 1967), infection and subsequently malfunctioning of the shunting etc (Adeloye, 1973; Mosingo and Cauthen, 1974; Patel, et al., 1973). The use of the Spring catheter has diminished the complications secondary to kinking of the shunt tubing (Raimondi and Matsuno, 1967). The slit valve at the distal end has eliminated the insulation and insuination of the omentum into the shunt tubing. However, the most common cause of failure of shunting is from the separation, or pulling apart, of the various components of the shunt system with the subsequent infection (Adeloye, 1973; Patel and Matloub, 1973; Raman, 1974).

The need, therefore, arose for a one piece shunt system since no real advantages, and many unacceptable disadvantages, existed in the multi-unit system.

TECHNIQUE

Local anesthesia and premedication with a lytic cocktail (Demerol 2 mg/kg, Phenergan 1 mg/kg, Thorazine 1 mg/kg) is quite satisfactory to accomplish ventriculoperitoneal shunting for newborns, infants and most children under 2 years of age. General anesthesia with intubation is advocated for the children over 2 years of age, adolescents and adults.

Hair is shaved rather generously, well anterior to the coronal suture, and a radiopaque marker thread is placed over the coronal suture for an adequate positioning of the tip of ventricular catheter. The head is turned fully toward the opposite side, then taped down to keep the A-P plane of the head parallel to the table. Padding is placed under the neck, shoulder girdle and trunk so that the cranium, neck, thorax and abdomen are in a line to eliminate ridges or valleys. The urinary bladder is catheterized and emptied completely to avoid a traumatic tap when a peritoneal trocar is planned to advocate in the processes of the shunting. The skin is marked with a marker from McBurney’s point to the suprACLAVICULAR region and immediately posterior to the parietal eminence, indicating the path along which the shunting tube is placed.

A transverse skin incision is made at the McBurney’s point, then a hockey stick incision or semicircular scalp incision is made immediately posterior to the parietal eminence. After the incisions have been made and clamps put on either the subcutaneous tissue or the galea. Normal saline is injected into the subcutaneous tissue along the path of the shunt tubing so as to create a tract along which the guide may be passed. This facilitates the passing of the guide and minimizes the possibility of damaging the subcutaneous tissue. One must be cautious not to bend the tubing quickly, thereby rendered it impossible to pass the leader and the one piece Uni-shunt. Rather, gentle molding is best accomplished by holding the guide shaft firmly in both hands and curving it to the desired from between the thumbs. The guide is inserted directly into the subcutaneous compartment through the abdominal incision and then passed within the space distended by the injection of saline. It is advanced rostrally beyond the clavicle, directing the tip by trapping it between the thumb and index finger of the left hand. One may hold the guide either along its shaft or
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at the handle. Once the tip of the leader has passed over the clavicle, it is recommended to bring the tip of the guide as rostrally as possible. Then the handle of the guide shaft is rotated 180° until the skin in the supraclavicular space is tented, at which time a tiny skin incision is made against the protruding tip, in the supraclavicular space and deepened, thereby permitting exit the tip and guide shaft itself.

The ventricular tip of the shunting tube is nestled into the leader clasp. The leader tip is drawn from the shaft, bringing the tip of the Uni-shunt out of the shaft. Then the guide shaft is withdrawn caudal through the abdominal opening, allowing the Uni-shunt to rest within the subcutaneous space. The tip of the Uni-shunt is unclasped to lie free. The procedure for a passage of the subcutaneous guide and the leader system from the posterior parietal area down to the supraclavicular space is performed exactly in the same manner as the passage from the abdominal end up to the supraclavicular space. The guide and leader tip are brought through the supraclavicular incision, and the leader is withdrawn entirely. Then the clasp of the leader system is inserted through the cephalic end and proceeds toward the supraclavicular end. Once the clasp exits out of the supraclavicular space, the ventricular end of the shunt tubing is reclasped and pulled up toward the parietal eminence. Then the tube is unclasped and the guide shaft is completely removed, resting the shunt tubing in the subcutaneous space of scalp.

At this time the pericranium over the parietal eminence is cut and stripped away.

A 1/4” twist drill opening is made in the skull. Care must be taken not to penetrate the dura, for the skull in hydrocephalic infants is extremely thin. The dura is coagulated with a bipolar forceps in a cruciate fashion and then opened. The ventricular cannula, with the plastic cuff, is then inserted through the dural opening and into the lateral ventricle, directed toward the inner canthus of the opposite eye. As soon as the needle is in the lateral ventricle it is recommended to turn the obturator to prevent further unnecessary draining of ventricular fluid. The cannula cuff is grasped snugly between the thumb and index finger of one hand as the cannula is slowly withdrawn with the other. An assistant holds the ventricular end of the Uni-shunt in shod Cushing forceps and as the cannula is slowly withdrawn, the ventricularend of the shunt tubing is brought closer to the opening groove in the plastic cuff. The cannula has a fluted tip, larger than the inner diameter and the same as the outer diameter of the plastic cuff, which opens up the cuff as the cannula is withdrawn, thereby providing an adequate space into which the ventricular tip of the Uni-shunt may be inserted as the cannula is withdrawn. The surgeon must be careful to withdraw the cannula very slowly until the fluted end is out of cranium and comes into vision. Then he inserts the ventricular tip of the Uni-shunt into the opening of the cuff quickly, so as to minimize the loss of ventricular fluid. A rapid and complete withdrawal of the cannula will allow ventricular fluid to pour from the ventricular system.

The Uni-shunt is threaded into the lateral ventricle placing the tip at the desired distance (preferably placing the tip at the level of coronal suture on fluoroscopy).

Once there is a free flow of cerebrospinal fluid through the distal end of the Uni-shunt at the abdominal end, both the cuff and the ventricular cannula are removed. The Spring
catheter is anchored into the position by placing it in the plastic clip (or metallic clip), which is then sutured to the pericranium. The peritoneal cannula with a plastic cuff (the same as that of the ventricular cannula without a fluted end) is fixed snugly between thumbs and fingers of both hands and inserted through the abdominal musculature to the peritoneum. Pressure is applied to the peritoneum itself or a Valsalva maneuver is accomplished until proper guarding is obtained, thereby, assuring the surgeon that the peritoneum is rigid, and can be punctured without perforating a viscus or damaging vessels. The puncture of the peritoneum itself should be performed with a quick, snapping and brisk movement which is limited in excursion, so as to assure a clean penetration of the peritoneum. When the cannula and cuff are within the peritoneal cavity, the cannula is removed, leaving the plastic cuff in place. The peritoneal end of the Uni-shunt is then passed into the peritoneal cavity by threading it through the cuff. Once the tubing has been completely inserted, the spring catheter is held snugly in place by a pair of shoed Cushing forceps and the cuff is withdrawn. The abdominal spring catheter is anchored in a plastic clip which is sutured in place to the abdominal musculature. It is recommended to place approximately 15–20 cm of the shunt tubing in the peritoneal cavity, by selecting an adequate length before shunting surgery.

**DISCUSSION**

As experience accumulated with this shunting procedure, a high morbidity came into evidence. Ames in 1967 published his satisfactory experiences, advocating ventriculo-peritoneal shunting with silicone tubing. Ventriculo-peritoneal shunting also presented many complications, with the slit valve at the peritoneal end of the catheter it was noted that the omentum could not insinuate itself into the distal end of the catheter (Raimondi and Matsumoto, 1967). Consequently, obstruction at the distal end diminished considerably as a complicating factor. It had been considered that the length of tubing and the positioning of tubing into the peritoneal cavity affects adversely the efficacy of a shunting system. With time, however, it became clear that the length of tubing or its positioning over the liver had little or nothing to do with the obstruction or with avoiding it (Raimondi and Matsumoto, 1967). The experience at the Children’s Memorial Hospital, Northwestern University, Chicago, through 1968 to 1973 by Robinson and Raimondi with 598 ventriculo-peritoneal shunting procedures for 196 patients emphasized that by far the most ubiquitous and serious complications were ventriculitis and infection related complications comprising 81.7% among all complications. Approximately 31.1% of all patients receiving ventriculo-peritoneal shunt developed ventriculitis at some time during their course of treatment.

In addition to that, complications include disconnection (Adeloye, 1973; Mozingo and Cauthen, 1974; Patel and Matloub, 1973; Ramani, 1974), severance, migration of the shunting tube (Adeloye, 1973; Mozingo and Cauthen, 1974), obstruction of either the ventricular or peritoneal ends by proteinaceous materials or choroid plexus and/or braindebris (Scott, 1955; Weiss and Roshina, 1969), abdominal cyst (Dean and Keller, 1972; Fischer and Shillito, 1969; Keen and Weitzner, 1973), subdural hematomas and the formation of a proteinaceous film over the surface of the distal end of the shunt tubing within the peritoneal
cavity etc.

The main factors determining the obstruction (Harsh, 1954) remained the occlusion of the proximal end by either choroid plexus or the accumulation of brain debris within the shunt tubing and kinking (Patel and Matloub, 1973) of the shunt tubing along its tract. Proper placement of the ventricular shunt tubing at the F. of Monro, as suggested by Becker and Nulsen, 1968, diminished considerably the number of cases of obstruction of the proximal tubing by choroid plexus. The use of the spring catheter (Raimondi and Matsumoto, 1967) diminished the complications secondary to kinking of the shunt tubing. The slit valve at the distal end of shunt tubing eliminated entrance of omentum into the shunt tubing within the peritoneal cavity (Raimondi and Matsumoto, 1967) from: The most common cause for shunt revision is associated with separation of the various components of the shunting system (ventricular catheter, flushing device, right-angle connector, straight connector, distal catheter etc).

The flushing device has been installed under the scalp with the supposition that the device could flush out brain debris from the proximal or distal ends of the shunting system. In addition it has been believed that a good rebound of the flushing device automatically indicates functioning order of the system. However neither of these has been proved as a fact determining the functioning status of the shunting system. Moreover, presently available shunting materials with flushing devices, multiple connectors, double reservoir etc. add to the complexity of shunting system. Our clinical experience with Uni-shunt, at the present time, is limited and not great enough yet for conclusion of any superiority or real advantage over other shunting devices but the authors do believe that the simplicity of the shunting system and of performing the surgery will give proof of real satisfactory results in the near future.

CONCLUSION

The history and literature of ventriculo-peritoneal shunting are reviewed and the surgical technique is discussed. In this presentation, a surgical technique of performing a ventriculo-peritoneal shunting with a one piece spring catheter is described.

Insertion of the ventriculo-peritoneal Uni-shunt using the subcutaneous guide, the leader, the cannula and the cuff consists of four basic steps. The 1st is passage of the guide and Uni-shunt from the McBurney's point to supraclavicular space. The second is passage of the guide from the parietal eminence to the supraclavicular space bringing the ventricular end of the Uni-shunt cephalad. The third step consists of inserting the ventricular end into the lateral ventricle and the fourth consisting of threading the peritoneal end into the peritoneal cavity.

An alternative method may be applied; this consists of first, inserting the ventricular end into the lateral ventricle, second, bringing the peritoneal end to the supraclavicular space, third, pulling the Uni-shunt to McBurney's point and lastly, inserting the peritoneal end into the peritoneal space.

REFERENCES


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