

Preliminary Report

Ventriculo-Subgaleal Shunt: Step-by-Step Technical Note

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Ventriculo-subgaleal (VSG) shunt placement is an option for temporary CSF diversion in neonate suffering from hydrocephalus. The authors describe step-by-step technique of VSG shunt assembly and insertion by using previously-cut shunt tubes and connector. It is simple and inexpensive. The authors also present a short review of the literature of the VSG shunt.

Keywords: Ventriculo-subgaleal, Shunt, Premature infant, IVH, Technical note

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Hydrocephalus is a common neurological problem in neonates. Ventriculo-peritoneal (VP) shunt placement is the widely-accepted choice of treatment for cerebrospinal fluid (CSF) diversion. Other definitive surgeries include Ventriculo-pleural (VPI) shunt, Ventriculo-atrial (VA) shunt, and Endoscopic third ventriculostomy (ETV)⁽¹⁻³⁾. However, sometime, patients may not be suitable for these procedures. Premature neonates, for whom intraventricular hemorrhage (IVH) is common, represent a large portion of this group of patients. They are frequently too small with debris-filled CSF. Some are suffering from necrotizing enterocolitis (NEC). Therefore, definitive CSF diversion procedures for hydrocephalus can occasionally be inappropriate for this particular group of patients.

Lumbar puncture, percutaneous intermittent ventricular tap, ventricular access device and external ventricular drainage are among common temporary CSF drainage procedures⁽²⁻⁴⁾. Each has its own advantages and disadvantages. In addition, Ventriculo-subgaleal (VSG) shunt has been used as temporary CSF diversion. A few series reported results of VSG shunt⁽⁵⁻¹⁰⁾. It is the intention of the authors to describe and illustrate step-by-step technical note of VSG shunt assembly and insertion. Readers will find that it is simple to do. The materials are at little or no cost since previously cut shunt tubes and a connector are used. A short

review of the literature is provided to enable readers to appreciate the use of the VSG shunt as a viable alternative for temporary CSF drainage.

Material and Method

Materials needed for VSG shunt assembly are two silastic shunt tubes (3 to 4 centimeters in length) and a plastic (or metal) straight shunt connector (Fig. 1). The authors used sterile shunt tubes that were cut from previous shunt surgeries.

Step I: Assembly of VSG shunt- A VSG shunt is assembled by connecting shunt tubes, each with three to four centimeter length, to a connector as shown in Fig. 2. The long sutures are left intact for securing the VSG shunt to periosteum at the end of its placement. The subgaleal (or distal) end is closed by tying its exit while two, one centimeter long, cuts are made along its length to create slit valves (Fig. 3). This allows one-way direction for CSF flow into, but not out of, the subgaleal space.

Step II: Creation of the subgaleal pocket- Once the VSG shunt is assembled, a curvilinear skin incision is made over the frontal region (Fig. 4). A large pocket is created with blunt dissection under the galea. It is important to reach as far as possible posteriorly to create a generous subgaleal pocket (Fig. 5). This will act as a reservoir for CSF drained out of ventricles. One should avoid creating a pocket in the frontal area for cosmetic reasons (Fig. 6).

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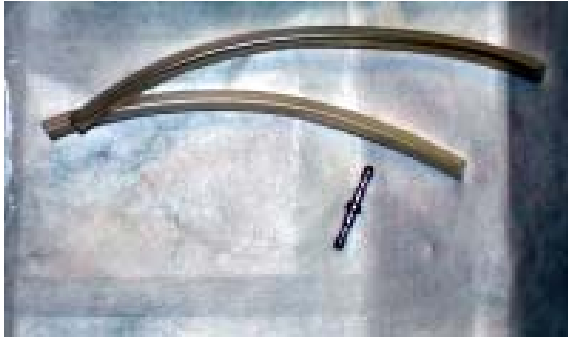


Fig. 1 Two silastic shunt tubes and a metal connector



Fig. 2 Two shunt tubes are tied to the straight connector

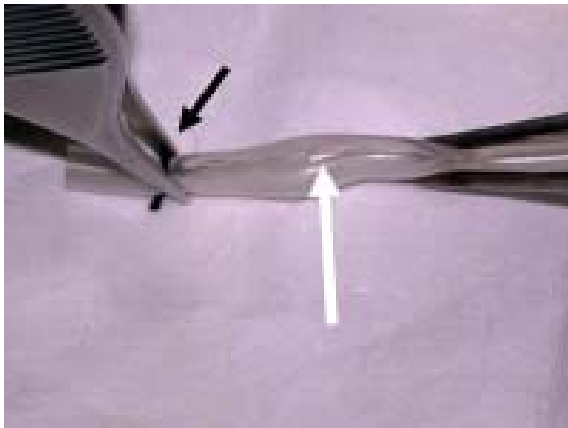


Fig. 3 At its distal end, the shunt tube is closed by a silk suture (dark arrow)
Two, one-centimeter longitudinal slits are made (white arrow)

Step III: Insertion of VSG shunt- A small hole in the skull is made. The dura is coagulated and incised (Fig. 7). A brain cannular is inserted until CSF is obtained (Fig. 8). The VSG shunt is then inserted into the brain (Fig. 9). It is important to ensure that spontaneous CSF flow via the distal part is obtained (Fig. 10). The subgaleal end of the VSG shunt is then placed into the subgaleal pocket (Fig. 11, 12). While securing the connector to the periosteum, it is important to check



Fig. 4 A curvilinear incision is made over the frontal area



Fig. 5 By using a blunt instrument, subgaleal pocket is created



Fig. 6 Reach posteriorly and avoid the region of the forehead (F) for cosmetic



Fig. 7 Dura is coagulated and opened after a hole is made in the skull

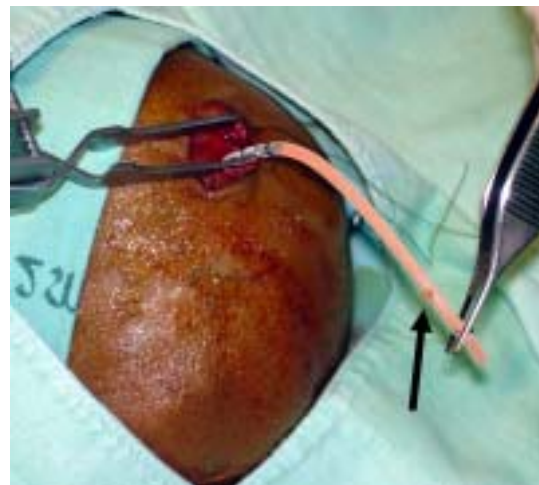


Fig. 10 CSF flow via the distal slits is noted (arrow)



Fig. 8 A brain cannula is inserted until CSF flow is seen



Fig. 11 Securing the VSG shunt to the periosteum with suture
Do not tie the knot at this step

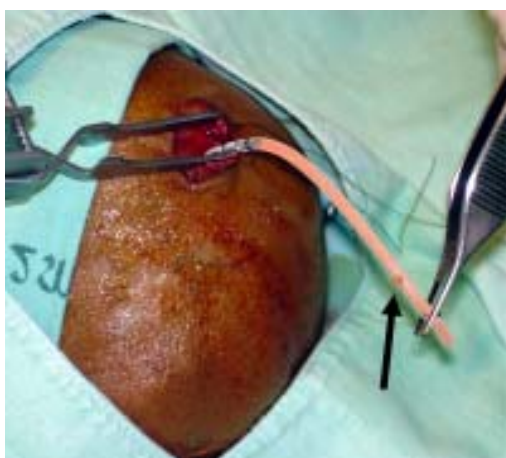


Fig. 9 Insertion of the VSG shunt



Fig. 12 The distal end of the VSG shunt is inserted into the subgaleal cavity

that the VSG shunt tube is not kinked (Fig. 13). Closure of the skin is done in one layer (Fig. 14).

Step IV: Postoperative care- A dry dressing is loosely applied to the wound. Any maneuver that prevents expansion of the subgaleal pocket is discouraged. This includes a pressure dressing over the incision and the pocket. In addition, it must be emphasized to a caretaker to avoid placing the baby on the side of surgery (Fig. 15). Not being attentive to these small details can result in failure of the VSG shunt.

The VSG shunt drains CSF from ventricles into the subgaleal pocket where it is absorbed. The pocket will enlarge as it acts as a CSF reservoir. Once the amount of the CSF outflow exceeds the ability of its absorption, the head circumference will start to grow and the fontanel will become tense. It usually takes, in average, three weeks to reach this point after surgery. When the VSG shunt fails, another VSG shunt can be placed on the other side of the cranium if certain conditions of the baby prohibit definitive procedures.

The authors have placed more than ten VSG shunts in premature infants. Most of them suffered from post-hemorrhagic hydrocephalus of prematurity. The average time-to-failure of these VSG shunts was three to four weeks. One VSG shunt lasted 6 weeks. Common complications include CSF leakage at the suture site and premature failure of VSG shunt (within five days after surgery). CSF leakage can be avoided by insertion of the VSG shunt away from the skin incision. Generous subgaleal pocket creation resulted in increased longevity of the VSG shunt. After a definitive CSF diversion, such as VP shunt placement, was performed; the VSG shunt pocket slowly disappeared⁽¹¹⁾.

Discussion and review of literature

In premature infants with hydrocephalus, a definitive CSF diversion surgery, i.e. VP shunt, can occasionally not be performed. Common reasons are small size of the baby, risk of infection in the abdominal cavity from NEC, or fear of VP shunt occlusion by cell debris in CSF. In these situations, a temporary CSF diversion becomes necessary. Treatment options include lumbar puncture (LP), percutaneous intermittent ventricular tapping, ventricular catheter with ventricular access device (VAD), or external ventricular drainage (EVD)⁽¹⁻⁴⁾.

LP is utilized by neonatologists until it becomes ineffective after several taps. LP carries a risk of infection such as spinal osteomyelitis or abscess⁽¹²⁾. The LP and ventricular tap are both more labor-inten-

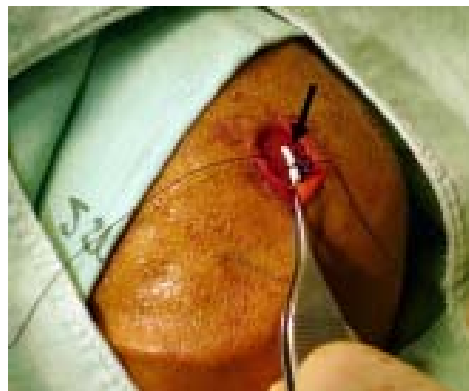


Fig. 13 After the distal end is placed inside the subgaleal pocket
Before tying the VSG shunt to the periosteum, recheck that the connector is not too close to the hole in the skull to prevent kinking of the shunt (arrow)



Fig. 14 After skin closure



Fig. 15 Loose dressing applied to the incision
Avoid any pressure over the area of the subgaleal pocket (dotted line)

sive than other procedures. With repetitive percutaneous ventricular punctures, there is an increased risk of porencephaly and infection. VAD, in spite of a lower incidence of porencephaly, has a similar risk of infection. The thin skin of premature infants easily breaks upon repeated tapping for CSF release via reservoir. Skin breakage usually associates with infection of soft tissue, or even CSF, infections^(4,13,14). Moreover, VAD costs over 2,000 baht. Although EVD is not as labor-intensive, it carries a risk for infection when prolonged use is necessary⁽¹⁵⁻¹⁸⁾.

Few articles reported VSG shunt's efficacy in temporary CSF diversion.⁽⁵⁻¹¹⁾ The VSG shunt provides a sustained and relatively controlled CSF drainage into the subgaleal pocket. The CSF is slowly absorbed until it exceeds the pocket's capacity. It is, by contrast, much less labor-intensive. Porencephaly is significantly lowered because of no repetitive brain cannulation. In addition, the risk of infection is not higher than those of the above-mentioned procedures. By using previously-cut shunt tubes and connector, it is inexpensive. Known complications of the VSG shunt include catheter dislodged, CSF leakage, and acute ventricular decompression^(5,6,8-10).

From the authors' experience, common pitfalls of VSG shunt assembly and insertion are as follows. First, one must make sure that the distal end is tied off and slits are made. Failure to do this step will allow two-way CSF flow into and out of the subgaleal pocket. Lack of fluid in the pocket will hinder its expansion and will result in premature failure of the VSG shunt. Second, it cannot be over-emphasized that the subgaleal pocket must be ample to accommodate CSF. The eventual size of the pocket is always significantly smaller than its originally created size. A large subgaleal pocket can prolong the time-to-failure of the VSG shunt as much as possible. Third, one must check before skin closure that the VSG shunt is still patent. The tube can be occluded by tying a tight suture or placing the connector too close to the hole in the skull, causing kinking of the VSG shunt. These little details can easily be overlooked. Fourth, proper caring for the VSG-shunted baby is also important. One must avoid any pressure against the subgaleal pocket either by positioning or tight wound dressing. Full expansion of the subgaleal pocket is necessary for the success of the VSG shunt.

The authors hope that, by illustrating the VSG shunt assembly and insertion, readers can fully appreciate its principles and pitfalls. Because it is inexpensive, quick, and easy to do, one should consider

VSG shunt when dealing with hydrocephalus if a definitive procedure cannot be performed.

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ขั้นตอนการประกอบและการผ่าตัดเพื่อใส่ท่อระบายน้ำจากโพรงสมองสู่ใต้ชั้นเกลีย

เอก หังสสุต, อัครพร บุญเกิด

การรักษาผู้ป่วยเด็กโดยการใส่ท่อระบายน้ำจากโพรงสมองสู่ใต้ชั้นเกลียเป็นการผ่าตัดทางเลือกหนึ่งที่ได้ผลชั่วคราวสำหรับผู้ป่วยเด็กที่มีภาวะโพรงสมองคั่งน้ำ ผู้นิพนธ์บรรยายการประกอบและการผ่าตัดใส่ท่อระบายน้ำ เป็นขั้นตอนที่เข้าใจได้ง่ายโดยใช้วัสดุที่ใช้แล้วมาประกอบกัน ผู้นิพนธ์ได้รวบรวมข้อมูลเกี่ยวกับการใส่ท่อระบายน้ำชนิดนี้จากรายงานทางการแพทย์เพื่อให้เข้าใจในข้อบ่งชี้ ผลดีและผลแทรกซ้อนที่เกิดจากการใช้วิธีผ่าตัดวิธีนี้