Head Drains:

A Guide to Ventriculostomy Therapy for Patients and Families in the Neurosurgery Intensive Care Unit

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Introduction

A team of doctors and nurses at The University of Michigan Neuro Intensive Care Unit (Neuro ICU) wrote this booklet for patients with head drains (ventriculostomies) and for the family members and friends who care about them. The purpose of this booklet is to give answers to questions about ventriculostomy (v*en-**trik**-u-los-tomy)* therapy and about what you can expect during your stay in the Neuro ICU.

If you have any additional questions, please ask a Neurosurgery team member.

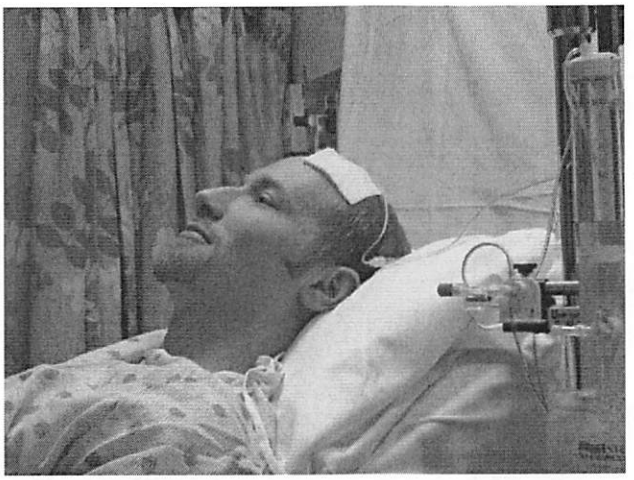
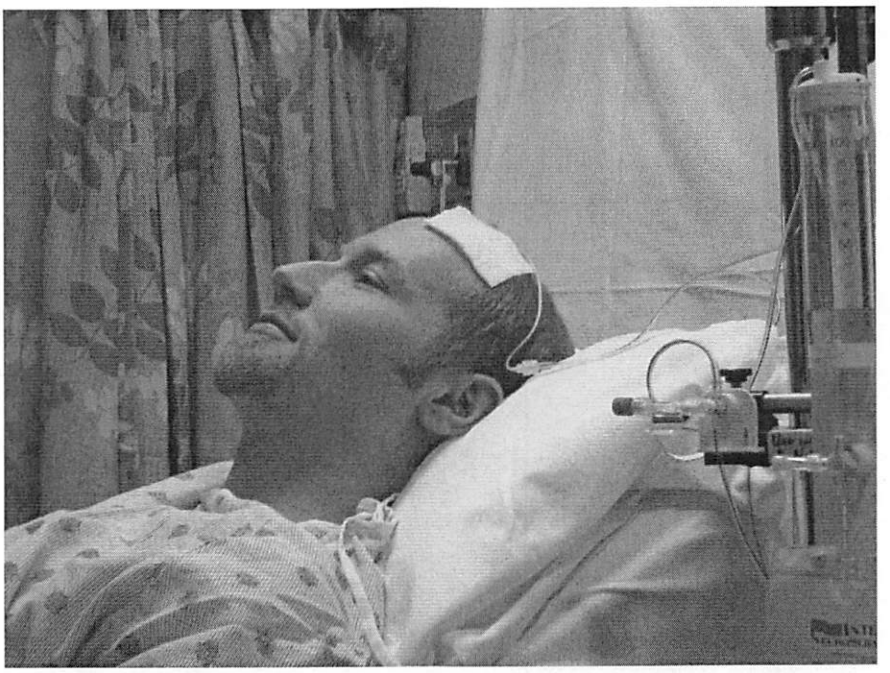


Table of Contents:



What is Hydrocephalus?

Normally flowing blood is not the only fluid essential for brain health. Another very important fluid circulating within the skull is Cerebral Spinal Fluid (CSF). CSF provides important support and protection for the brain. As it surrounds and flows around the brain, CSF delivers nutrients, carries away waste, and cushions the brain from sudden impacts against the skull.

The snug space within the skull contains three elements: brain tissue, blood in blood vessels, and CSF. These three elements share limited space and must maintain a careful balance since the skull does not have the ability to expand or stretch. If the amount of blood, CSF, or brain tissue increases to take up more than its share of space, the others become crowded. This crowding increases the pressure within the skull (called intracranial pressure), and this increased pressure may interfere with brain function.

When there is an abnormal accumulation of CSF within the skull, the condition is called hydrocephalus (*hi-dro-sef-uh-luss).*

This booklet looks at an important therapy used to treat hydrocephalus, one that helps to decrease intracranial pressure (ICP) and reduce the stress on delicate brain tissue.

What is Ventriculostomy Therapy?

Briefly: Ventriculostomy therapy allows fluid trapped within the brain to escape into a drainage system. The system also lets us monitor pressures within the skull.

In Detail: A ventriculostomy drainage system allows removal of cerebrospinal fluid from the brain in order to maintain a critical balance of fluid and pressure within the skull. The neurosurgeon places a small, soft silicone tube (ventriculostomy catheter) into the brain, creating a pathway for CSF to leave it in carefully controlled amounts. This prevents dangerous shifts in brain position and maintains optimal blood flow within the arteries and veins. It is also possible to use the ventriculostomy system to measure pressure within the skull.

Why is a Ventriculostomy necessary?

Briefly: The amount of Cerebral Spinal Fluid (CSF) in a healthy brain is always the same: this fluid is produced and absorbed at rates that keep its total amount constant. An obstruction in CSF circulation or a problem with re-absorption of CSF causes a dangerous brain fluid overload called Hydrocephalus. Without treatment, this condition may cause loss of consciousness, massive strokes, and even death.

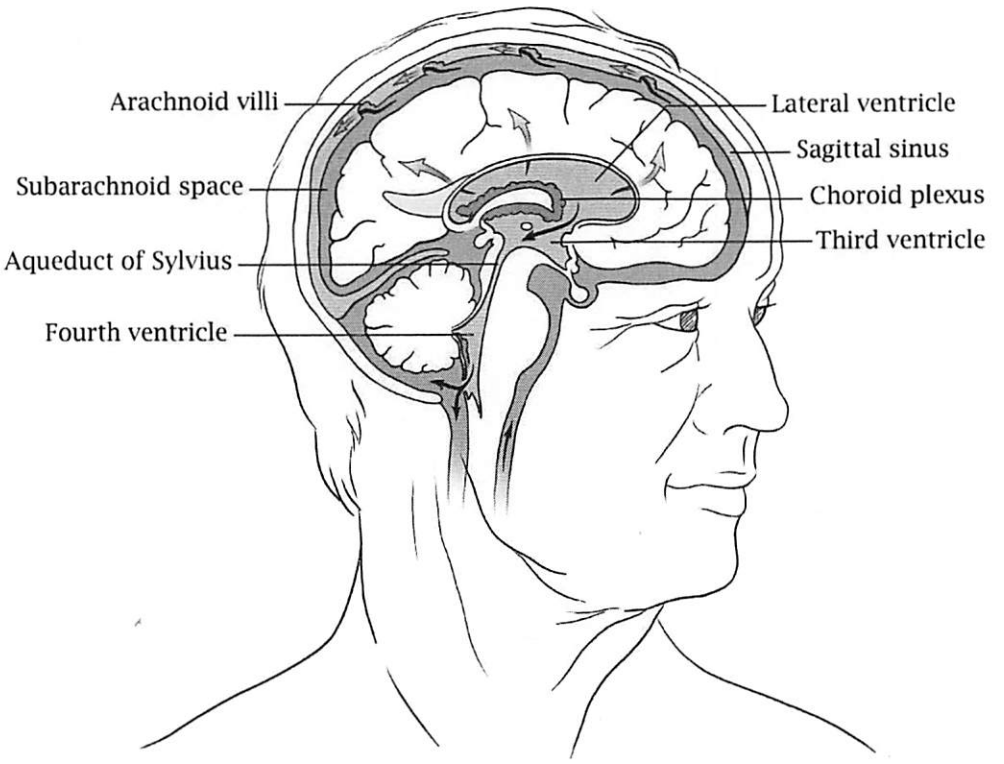


Illustration © Lynne Larson 1986-2011

In Detail: CSF is essential for support and protection of the brain. It is often called the brain's second circulation. Tucked under the brain's hemispheres are a series of chambers connected in sequence, called ventricles that contain the CSF (see illustration, above). All ventricles contain specialized cells that produce CSF, and 95% of this fluid is produced in the lateral ventricles, a pair of sacs tucked highest up and deeply within the brain. The CSF circulates from ventricle to ventricle, passing through a series of very narrow passages, eventually flowing out into the spaces surrounding the brain and spine. When the CSF circulates into the subarachnoid space (the area between skull and brain), it is absorbed by specialized cells called the arachnoid villi. The brain produces approximately 4 teaspoons of CSF per hour, and the amounts of CSF production and absorption must remain equivalent for the system to maintain a healthy balance.

In the Neuro Intensive Care Unit setting, the most frequent reasons for placing a ventriculostomy are bleeding into or around the brain and swelling of the brain. Bleeding into any one of the ventricles can cause blood cells to settle into the narrow connecting passages and clog them. Large deposits of blood in the subarachnoid space might limit CSF flow and impair absorption. Also, swelling in the lower structures of the brain might squeeze shut the outflow passages, trapping the CSF.

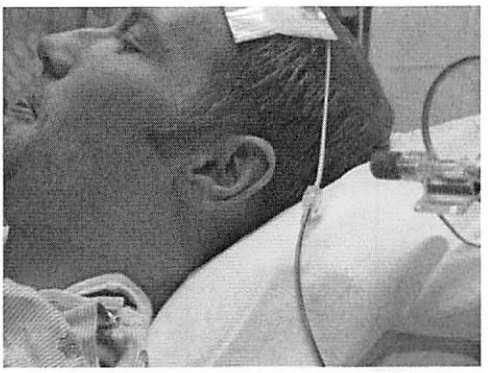
In each of these cases of obstruction, the crucial detail is that the brain never stops producing CSF. So any restriction of outflow or failure to remove accumulating fluid means the ventricles grow steadily larger, like a balloon being inflated inside a jar. Because the skull (i.e., the jar) is rigid, brain cells get compressed between the growing ventricles and the stiff bone. As the ventricles continue to enlarge, the pressure on those trapped brain cells grows more and more intense. It can even reach a point where the cells can be seriously damaged. One way to stop this damaging CSF buildup is to create a new pathway out of the skull by placing a drain called a ventriculostomy.

There can be other therapeutic reasons for ventriculostomy placement. Sometimes CSF pressure within the skull needs to be reduced to allow a CSF leak to heal. Or when intracranial pressures (ICP's) are high for reasons other than hydrocephalus (for example, bleeding or swelling within brain tissue itself), removing CSF can still help reduce ICP's. Also, by measuring ICP's, a ventriculostomy can guide ICP- reducing drug therapy.

What are the potential side effects?

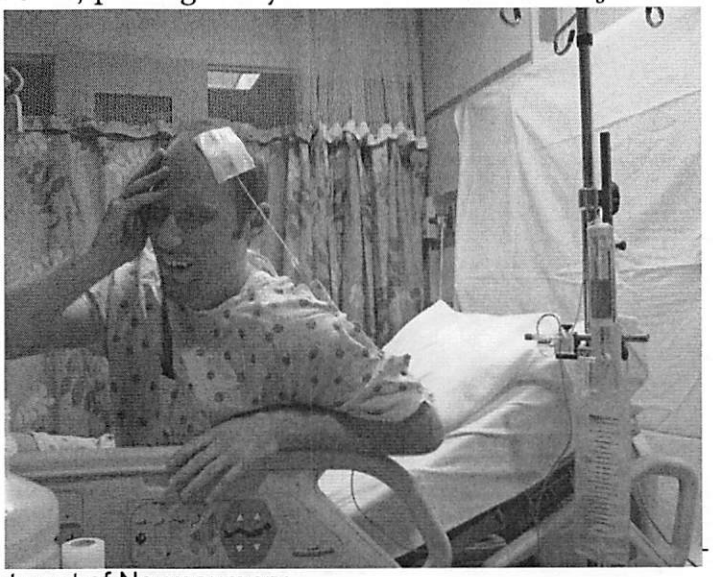
A ventriculostomy system is an effective therapy for hydrocephalus, but its presence does present some risk for complications.

Briefly: If the ventriculostomy drainage system is not kept at the appropriate level, the patient may have new bleeding within the skull or the system may not drain out enough CSF to be effective.



This image shows a properly leveled ventriculostomy. Note that the transducer (with the red cap) is lined up with the notched part of the ear (the Tragus).

In Detail: Because the brain is fragile, any sudden changes in brain size or position can tear the blood vessels between the brain and skull. This is similar to a balloon filled with water and positioned within a jar. As the liquid is drawn out, the balloon shrinks in size, pulling away from the wall of the jar. The faster the fluid leaves, the quicker the size changes. If the patient's head rises significantly above the level of the drainage system (for example, the patient sits up or stands abruptly), the speed of the CSF outflow increases and the size of the ventricle may shrink drastically.



This shrinkage may tug the brain downward, tearing the blood vessels surrounding it. The leaking blood from these torn vessels can quickly build up between skull and brain. This bleeding may itself become a source of increased pressure within the skull and increase the risk for brain damage.

Another problem may occur if the patient slides down in bed, settling lower than the drainage system. If the CSF has to flow further uphill, the amount of effective drainage may be reduced; and reduced drainage means the therapy will be far less effective.

How long will I need the ventriculostomy?

Briefly: The duration of therapy is different for each patient because the reasons for needing a ventriculostomy vary from case to case. We will closely monitor the ventriculostomy output and pressures so we can wean the system off at the earliest signs of readiness.

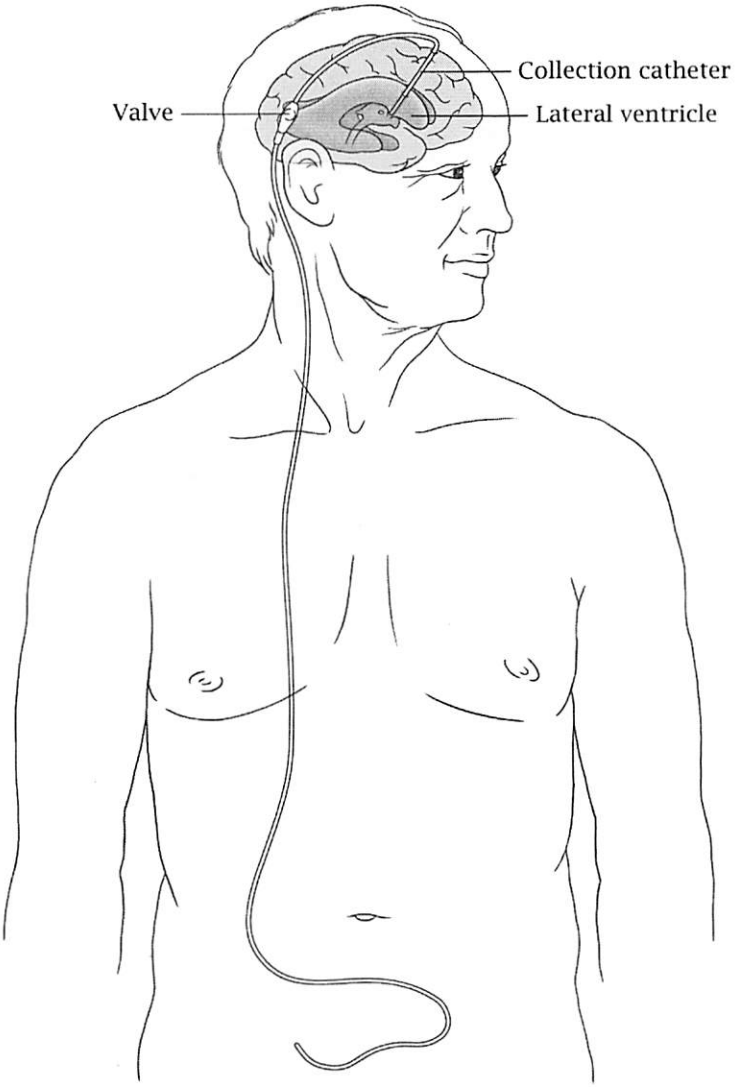
In Detail: Hydrocephalus may be caused by different reasons. Different causes require different lengths of therapy, and some causes might not resolve during the hospital stay at all (see the next page). We evaluate each patient daily, and based on the head pressure readings and the amounts of drainage, we make adjustments. Our goal is to wean the system off as soon as possible.

To test whether the CSF flow is normalizing, we raise the height of the drain point (increasing the size of the hill the fluid must climb) step-by-step over several days. If the drainage stops, the head pressures stay normal, and the patient's condition is unchanged, we can clamp the drain system for a final 24 hour evaluation period. If everything stays stable during this final stage, we can remove the ventriculostomy.

What happens if the Hydrocephalus continues? Can it become permanent?

Sometimes the brain changes that created the need for a ventriculostomy continue, even after the original problem has been resolved.

Briefly: Sometimes the disruption of normal CSF flow does not go away, and the hydrocephalus becomes chronic. In these cases it's possible to place an internal version of the ventriculostomy drainage system with a simple operation. This internal head drain is called a Shunt.



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In Detail: When the CSF needs a permanent diversion, doctors place an internal drainage system called a shunt. The principles of managing the CSF remain the same as in the acute phase; but instead of draining the fluid into an outside collection system, the catheter sends it to places where it can be absorbed within the body. In most cases the CSF is delivered into a cavity within the abdomen (see illustration), but sometimes the system directs the CSF to an upper chamber of the heart. In both cases an adjustable, one way valve maintains a therapeutic flow rate, and the system can be monitored and regulated with minimal care. The shunt is likely to stay in place for the duration of the patient's life.

If I go home with a shunt in place, what symptoms should I report?

If you have a shunt, be sure to notify your healthcare provider if any of the following symptoms appear:

- Redness, tenderness, pain, or swelling of the skin along the length of the tube or incision
- Irritability
- Drowsiness
- Nausea
- Vomiting
- Headache
- Double vision
- Fever
- Abdominal (belly) pain
- Return of symptoms you had before you received the shunt

Resources for people living with a shunt.

The following sites offer valuable information, education and resources for people living with a shunt.

- Hydrocephalus Association - http://www.hydroassoc.org
- Hydrocephalus Foundation, Inc. http://www.hydrocephalus.org
- Hydrocephalus Action (UK) http://www.shinecharity.org.uk/hydrocephalus

In closing....the idea is not to close

We hope that this booklet has provided you with some useful answers, but please feel free to ask us additional questions as they come up. We pride ourselves in being a place that provides knowledge as well as care.

Feel free to use the lines that follow for noting anything you might want to ask about later.

Disclaimer: This document is not intended to take the place of the care and attention of your personal physician or other professional medical services. Questions about individual health concerns or specific treatment options should be discussed with your physician.

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