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What is hydrocephalus?

Hydrocephalus is a condition in which cerebrospinal fluid (CSF) builds up within the brain. CSF is needed to provide protection for the brain, much like the fluid in the womb protects a growing baby. The brain makes CSF in special fluid-spaces called ventricles and any excess CSF is usually channelled back into the blood-stream. Hydrocephalus occurs when there is a blockage which prevents excess CSF from draining away.

Diagram of the brain showing the normal CSF fluid pathways
What causes hydrocephalus?

There are two main causes of hydrocephalus:

- Non communicating hydrocephalus - the fluid pathways may be blocked or narrowed so that fluid cannot flow properly. The main causes of this are either scarring of the fluid pathways or blockage by a tumour.
- Communicating hydrocephalus - sometimes the fluid collection channels can become blocked and stop working - in a similar manner to how leaves can block a drain. This commonly happens after infection or a haemorrhage (bleed). It also appears to happen in older adults where problems with absorption lead to a condition known as 'normal pressure hydrocephalus'.

What are the symptoms?

Typical symptoms include headaches, nausea and vomiting. Older patients may experience problems with balance, walking difficulties, short-term memory difficulties and urinary incontinence.

There is a final group of patients who do not fit into the patterns described above. These patients have Idiopathic Intracranial Hypertension. The root cause is not fully understood. The typical symptoms are headaches and problems with vision.

What investigations are required?

CT brain scan

Normally a CT brain scan will be performed. This is a special X-ray based scan that will help determine the best treatment to offer. A CT brain scan may also be done if there are concerns about the functioning of the shunt in the future.
**MRI brain scan**

If more information is required an MRI scan can be done. This is a more detailed scan of the brain that involves an extremely strong magnet and does not involve X-rays. It is a noisy scan which requires you to lie very still whilst it is being performed.

**What are the treatment options?**

The doctors will recommend the best treatment based on the cause of the hydrocephalus and other factors such as the scan findings. All treatments aim to restore normal CSF flow either by removing CSF from the brain or by diverting it.

The two main treatment methods are:

- Insertion of a 'shunt'
- Neuro-endoscopic third ventriculostomy

**Treatment option 1 - Insertion of a 'shunt'

A shunt is a thin tube that is permanently implanted to allow excess fluid to drain away to another part of the body, where it can be absorbed. Depending upon the cause of the hydrocephalus, fluid can either be drained away from the ventricles of the brain (ventricular shunt) or from around the spinal cord in the lower back (lumbar shunt).

**Ventricular Shunts**

There are 3 main types of ventricular shunt used:

- Ventriculo-Peritoneal (VP) Shunt - CSF is drained into the abdominal cavity where it is taken back into the blood stream.
- Ventriculo-Atrial (VA) Shunt - CSF is drained directly into one of the blood vessels going to the heart.
- Ventriculo-Pleural (V-Pleural) Shunt - CSF is drained into the space beside the lung where it is taken back into the blood stream.
The ventricular shunts include a valve that regulates the flow of CSF along it. Two types of valve can be used: one with a fixed pressure setting, or a programmable valve. The programmable valve allows the setting to be adjusted after surgery (using a special magnet) to change the amount of CSF being drained.

Diagrammatic illustration of ventriculo-atrial (VA) shunt, ventriculo-peritoneal (VP) shunt and ventriculo-pleural shunt.

**How is the shunt inserted?**

Inserting a ventricular shunt involves an operation under general anaesthetic and will include the following stages:

- Usually two cuts to the skin - one in the head, usually above and behind the ear. The second cut is either made in the abdomen (VP shunt), the side of the neck (VA shunt) or the side of the chest (V-pleural shunt).
- A hole is made through the skull and a tube is inserted into the ventricle.
The shunt is tunnelled under the skin between the two cuts and connected to the tube in the ventricle. The flow of CSF is confirmed before both wounds are closed.

**Lumbar Shunts**

A lumbar shunt involves a tube draining CSF away from around the spinal cord in the lower back. It can drain the fluid to either the abdominal cavity (most common) or beside the lung.

- Lumbo-Peritoneal (or LP) Shunt - CSF is drained into the abdominal cavity where it is taken back into the blood stream.
- Lumbo-Pleural (or L-Pleural) Shunt - CSF is drained into the space beside the lung where it is taken back into the blood stream.

This type of shunt tends to drain more fluid when you are sitting or standing and less when you lie down. The shunt tube may have a slit or mechanical valve to control the flow of CSF.

For some patients additional valves are used to help regulate flow.

**How is the shunt inserted?**

Inserting a shunt involves an operation under general anaesthetic. It involves the following stages:

- Two cuts to the skin - one in the lower back over the spine, and the second in either the abdomen (LP shunt), or the side of the chest (L-pleural shunt).
- A lumbar puncture (spinal tap) is performed through the cut in the back.
- The shunt tube is then passed down through the needle into the fluid space around the spine.
- The shunt is then tunnelled under the skin to the other cut, and the flow of CSF along it is confirmed before the other end is inserted and both wounds are then closed.
Treatment option 2 - Neuro-endoscopic third ventriculostomy

In some cases of hydrocephalus the brain’s internal fluid channels can get blocked. If this is the case it may be possible to make a ventriculostomy for CSF to flow through. The operation is called a 'neuro-endoscopic third ventriculostomy'. It is done with a special fine telescope-tube that enables the neurosurgeon to look inside the ventricles.

Diagram illustrating third ventriculostomy with the neuro-endoscope in place and the ventriculostomy also demonstrated.
What are the advantages of this operation?

The advantage of this operation over a shunt is that it can provide a permanent cure. Shunts can fail over time and need to be replaced. The decision as to whether or not this operation is possible is made by the neurosurgeon with careful examination of your scans. It is important to be clear, however, that even with a scan that shows this operation may be possible or should work, we cannot guarantee that it will be successful and a shunt may still be required.

What does the operation involve?

The operation is carried out under general anaesthetic and involves the following steps:

- A 2-3cm cut is made, usually at the top of the head towards the front, behind the hair line. This is most often on the right-hand-side, but may be made on the left depending on the scan findings.
- A 1-1.5cm hole is made through the skull.
- The neuro-endoscope is inserted and the ventriculostomy is made.
- Finally, the neurosurgeon checks that the ventriculostomy is fully open before removing the neuro-endoscope and finishing the operation.

Follow-up after third ventriculostomy

Some patients who have undergone a third ventriculostomy experience a re-occurrence of their pre-surgery symptoms and an MRI scan shows that the ventriculostomy has closed. If this is the case, the neurosurgeons will consider whether it is possible to re-do a third ventriculostomy or whether to implant a shunt.
What are the risks of treatment?

The risks of treatment are the same for any neurosurgical operation. What varies is the level of that risk. With this surgery the risks are as follows:

**Infection** - Due to the skin being cut, there is a risk of infection. This may be a superficial wound infection. However, it may spread deeper and the shunt itself can get infected. This is discussed below.

**Bleeding / bruising** - Some bruising may occur around the surgical wounds but may also occur along the tract of the shunt. There is always some risk of bleeding inside the brain from the operation as well. This risk is small but a blood-clot such as this could be potentially serious.

**Pain** - Some pain may be present along the shunt tract or from the surgical wounds. This is usually controlled by simple painkillers such as Paracetamol. The operations themselves are not particularly painful procedures. Some people may experience headache after a shunt because of a change in the pressure inside their head. This usually settles with fluids, rest and simple painkillers.

**Brain injury** - The risk of this is extremely small, but nevertheless important to understand. It could be seen in the form of a weakness or paralysis like a stroke and could be temporary or permanent. If something like this were to occur the neurosurgeon would investigate to find out why it has happened and explain this to you.

**Fits / epilepsy** - With any neurosurgical operation these can occur, simply because an operation has been done. Fits are, however, uncommon after shunts or third ventriculostomy surgery. Long-term treatment may or may not be required depending on the circumstances.

**Risk to life** - With any neurosurgery or procedure under general anaesthetic there is always a risk to life. This is usually extremely small but is partially dependent on your age, weight and general health.
Consent

We must seek your consent for any procedure or treatment beforehand. Staff will explain the risks, benefits and alternatives where relevant before they ask for your consent. If you are unsure about any aspect of the procedure or treatment proposed, please do not hesitate to ask for more information.

What should I look out for when I go home?

How do I know if the shunt has blocked?
The signs and symptoms of shunt block may vary depending on the reason for the shunt and how suddenly the shunt blocks. If blockage is slow the symptoms may be gradual. Symptoms may include:

- Headaches
- Nausea and vomiting
- Drowsiness, sleepiness, hard-to-wake
- Bulging around the shunt valve
- Restriction in upgaze / looking downwards constantly (mainly children)
- If you have epilepsy, there may be a change in the number or pattern of seizures
- Return of pre-shunt problems
- Balance problems or unsteadiness on feet
- Worsening memory

What should I do if I think my shunt is blocked?
If you have concerns about possible shunt block, contact your GP and ask for immediate referral to the on-call neurosurgical registrar at the Royal Hallamshire Hospital. If you cannot contact your GP or you are not in Sheffield, go to the A&E Department of the nearest hospital. Explain you have a shunt and your concerns over possible shunt block.
If you are becoming drowsy, call an ambulance or ensure someone takes you to the nearest A&E department. The doctors there will be able to assess you and contact us as necessary.

**Is it normal to hear the programmable valve mechanism?**
Yes the valve mechanism adjusts when you move. Over time this should become less audible.

**What happens if the shunt becomes infected?**
Symptoms of a shunt infection include:

- feeling unwell
- high temperature
- neck stiffness
- painful eyes
- the surgical wound may look swollen and/or broken down and part of the shunt may be visible.

The risk of infection is highest during the first 30 days after surgery. If the shunt is found to be infected the system will have to be removed through an operation. During this operation an external drainage system is often inserted, called an external ventricular drain. This allows the CSF to continue to be drained and also allows antibiotics to be given through it if required. Once the infection has been cleared, a new shunt is inserted.

**Frequently asked questions**

**How long is the hospital stay?**
You will usually be discharged within 1-3 days of surgery.

**Will the shunt be visible after the operation?**
A bump can be felt under the skin surface behind the ear. This is due to the valve which is an essential part of the shunt system. It is approximately 0.5cm in height, 2-3cm long and 1cm wide. However, it is not usually visible due to the overlying hair.
Does a shunt last forever?
As a man-made device, a shunt will not last forever. It can last from a few days or weeks to many years. In adults we have seen them last for as long as 35 years. Over time the plastic tube can corrode and disintegrate, requiring a new shunt to be inserted. The valve itself can also block and so can the tube that is in the ventricle of the brain, peritoneum, atrium and pleura.

Will it affect me at work?
The shunt is fully under the skin and as such there is usually only minimal external evidence that it is there. The shunt itself will not affect academic performance or achievement.

Can I drive after having the operation?
No, the current DVLA guidance is that you must not drive after a revision or insertion of a ventricular shunt, extraventricular drain and third ventriculostomy. You must inform them that you have been in hospital and had your operation. They will then contact us for details and inform you when you can drive again. The usual time period is 6-months suspension from the date of surgery provided you do not suffer any epileptic fits.

Can I fly?
There are no reasons why you should not fly after treatment for hydrocephalus. There are no cases that we know of where this has been harmful.

However, if a shunt has been inserted that has a programmable valve, we usually recommend avoiding electromagnetic scanning devices such as handheld security scanners because they may change the shunt valve setting.

Are there any limitations on sports?
The only sport we absolutely ban is boxing due to the deliberate repetitive head injury. We also urge caution over scuba diving. This is
because of the risk of serious harm should there be a problem whilst deep underwater.

Otherwise, there are no reasons why you can't participate in all other sports including swimming and football. However, care is advised to avoid repetitive head injury.

**Are antibiotics needed for dental treatment?**
We do not usually recommend or require this.

**What if I have a head injury?**
Normal post-head-injury procedures should be followed and you should go to the local A&E department if you have concerns. It would be important to mention to the doctors that you have a shunt, however, as this will help them assess and treat you.

**Who should I contact if I have any queries?**

For general enquiries you can contact the Department of Neurosurgery at the Royal Hallamshire Hospital on: **0114 271 1900**.

If you think the problem is more serious, please contact your GP or go to your nearest A&E department.

If you are becoming drowsy, call an ambulance or ensure someone takes you to the nearest A&E department.

The doctors there will be able to assess you and contact us as necessary.
The above named person has a right / left Ventriculo-Peritoneal / Ventriculo-Atrial / Ventriculo-Pleural / Lumbo-Peritoneal / Lumbo-Pleural shunt for:

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Shunt insertion date: ....................................................................................................................................................................................

Valve manufacturer & Serial No: ................................................................................................................................................................................

Valve pressure setting: .......................................................................................................................................................................................

Fixed / Programmable: ....................................................................................................................................................................................

If you have concerns, please contact us through the Royal Hallamshire Hospital switchboard on **0114 271 1900**.

Please do not leave a message on an answering machine in case your message is not found soon enough.

If the patient is drowsy, please take them to the nearest A&E department and the doctors there will be able to assess them and contact us as necessary.