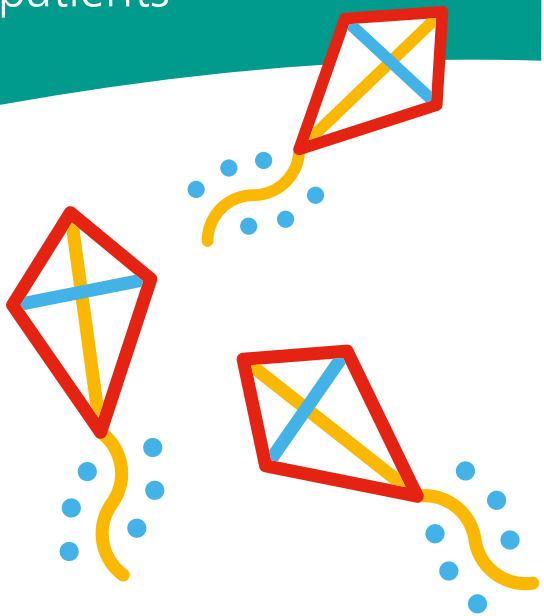
The Leeds Teaching Hospitals
NHS Trust

Department of Paediatric Neurosurgery, Leeds

Hydrocephalus and Shunts

Information for patients



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What is hydrocephalus?

The brain is surrounded by fluid called CSF - cerebrospinal fluid. The CSF provides protection for the brain, much like the fluid in a womb protects the growing baby. The brain makes CSF in special fluid spaces inside it called ventricles. The ventricles link to each other by a system of channels through which the CSF flows and eventually, leaves to surround the whole brain and spinal cord. The CSF is then taken back into the bloodstream by special channels beside the major veins on the inside of the skull. These are called arachnoid granulations.

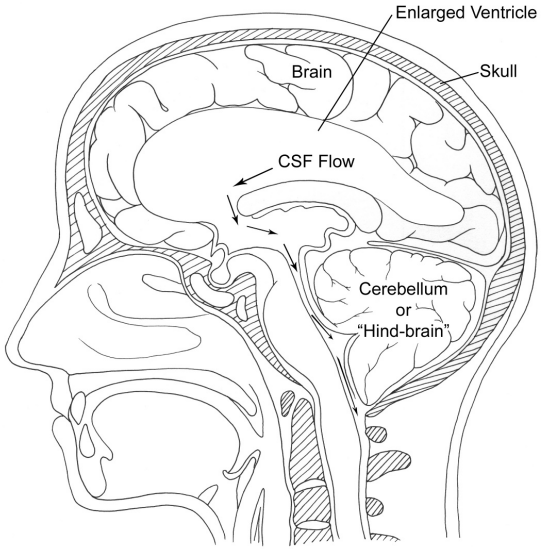

Figure 1

Diagram of the brain showing the normal CSF fluid pathways.

Hydrocephalus is a condition in which fluid builds up within the brain. There are two causes of this.

1. The fluid pathways may be blocked or narrowed so that fluid cannot flow adequately. The causes of this blockage or narrowing can include scarring or a variation in the development of the fluid pathways (as the baby grows in the womb), or sometimes, by tumours blocking CSF flow.
2. Sometimes, the arachnoid granulations (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).
3. As a result of this block in fluid flow, CSF builds up inside the brain. In babies, this is seen by the head growing larger and larger, crossing the normal growth lines. The fontanelle (soft spot at the top of the head) may be noticed to become firm as well. The build-up of pressure may affect development of the brain tissue itself, which is still growing and developing in the early years of life.

In older children, the signs are often less distinct as the skull bones have fused together. Headaches, nausea or vomiting are the commonest sign but balance and short term memory problems have also been reported.

What investigations are required?

Ultrasound

In babies with a patent fontanelle, an ultrasound can be done to initially examine the size of the ventricles; however, once the skull bones have closed over the fontanelle, this cannot be done as ultrasound cannot go through bone.

CT brain scan

Normally, a CT brain scan will be performed before shunt insertion. This is a special x-ray based scan that shows us the anatomy of the ventricles and helps us to decide what the best treatment to offer is. A CT brain scan may also be done if there is a question mark over the shunt function in the future.

MRI brain scan

This provides more detailed information about the anatomy of the brain. It involves an extremely strong magnet and does not involve x-rays. It is a noisy scan and the patient has to lie very still during it; therefore, in younger children, this is usually done under a general anaesthetic. In older children, general anaesthetic is usually not necessary.

How is hydrocephalus treated?

The doctors treating your child will determine the best treatment according to a number of factors such as their age and weight, and whether or not there are any concerns about infections. All treatments aim to remove CSF from the brain in a controlled manner to relieve pressure on the brain. The methods that are used are:

1. Ventricular Tap;
2. Ventricular Reservoir;
3. Shunt; and
4. Endoscopic Third Ventriculostomy.

1 - Direct sampling of CSF - 'Ventricular Tap'

In very young babies, the CSF may be directly sampled by passing a needle through the fontanelle into the ventricle. This would be required especially when a baby is premature or if there are concerns about possible infection. This procedure can be performed on the ward where your baby is being cared for.

If continued, CSF drainage is required. The options are to insert either a 'reservoir' or a 'shunt'. A 'shunt' provides a semi-permanent solution with continuous CSF drainage but babies need to be a certain size and weight for this to be safe; therefore, a baby is too small for a shunt, the safest option is to insert a 'reservoir'. This is a small plastic button that is under the skin and connected to a tube that goes into the ventricle. This allows CSF to be removed as often as required by using a needle to access the reservoir. This is safer than performing repeated ventricular taps.

2 - Inserting a 'Ventricular Reservoir'

This procedure involves an operation under anaesthetic in the operating theatres of the Leeds Children's Hospital at Leeds General infirmary. It involves the following stages:

1. A semi-circular cut in the skin at the top of the head near the fontanelle;
2. A hole is made through the skull;
3. Through this hole, a special cannula is passed into the ventricle; and
4. A plastic tube with the reservoir is then passed along the same track as the needle. The reservoir is buried under the skin so the whole system is under the skin.

A bump remains visible under the skin surface due to the reservoir. This enables us to remove CSF on the ward as often as is required, by inserting a needle through the skin into the reservoir.

3 - Insertion of a 'shunt'

This provides a continuous drainage of CSF away from the brain. The CSF is usually drained into the abdominal cavity, where it is taken back into the blood stream (Ventriculoperitoneal shunt or VP shunt). Other alternatives are to drain the CSF directly into one of the blood vessels going to the heart (ventriculo-atrial shunt or VA shunt), or into the space beside the lung (ventriculo-pleural shunt or V-pleural shunt). We usually prefer to put in a VP shunt in the first instance but the choice will be made specifically for your child.

The shunt system incorporates a valve that regulates the flow of CSF along it. Two types of valve can be used and the choice depends on our expectation about the shunt function. They can either be set at a fixed pressure setting or be special variable valves that means the setting can be adjusted after surgery (using a special magnet against the skin over the valve) to change the amount of CSF drainage.

Again, this procedure involves an operation under anaesthetic in the operating theatres of the Leeds Children's Hospital at Leeds General Infirmary. It involves the following stages:

1. Usually, two cuts to the skin - one in the head, usually above and behind the ear. The second cut is made in abdomen for a VP shunt, the side of the neck for a VA shunt or the side of the chest for a V-pleural shunt;
2. A hole is made through the skull;
3. The shunt is then tunnelled under the skin between the two cuts; and
4. The shunt is then inserted into the ventricle and flow of CSF along it is confirmed, before the other end is inserted and both wounds then closed.

A bump remains visible 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 0.5 cm in height, 2 - 3 cm long and 1 cm wide. Initially, this bump can seem large due to the baby's head being small and not having much hair. With time; however, it becomes less visible as the hair grows.

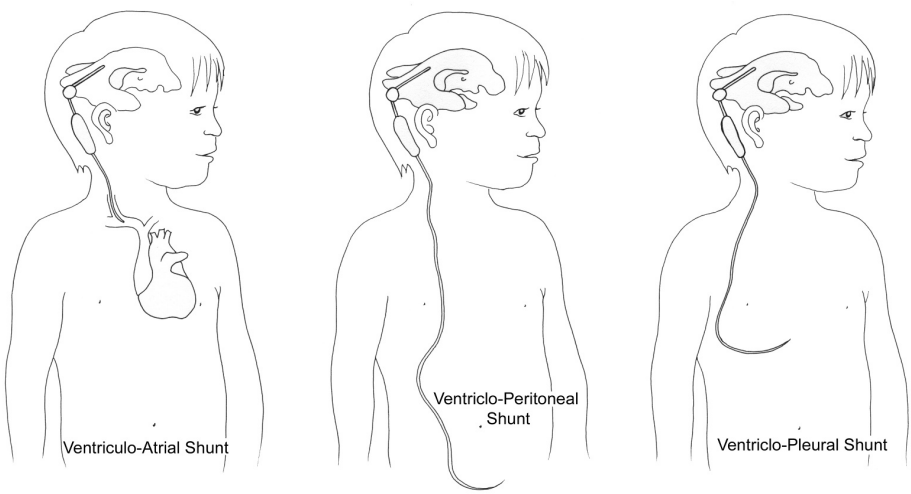

Figure 2

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

4 - Endoscopic Third Ventriculostomy (ETV)

In some cases of hydrocephalus, the brain's internal fluid channels can get blocked. In these circumstances, it may be possible to make a new exit hole (ventriculostomy) for the CSF to flow out from. The operation is called an endoscopic third ventriculostomy and is done with a special fine telescope tube that enables the neurosurgeon to look inside the ventricles.

The advantage of this operation over a shunt is that it can provide a permanent cure, whereas shunts 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 child's 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.

The operation involves the following:

1. Under general anaesthetic, a 2 - 3 cm 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;
2. A hole, 1 - 1.5 cm is made through the skull and then the endoscope is inserted;
3. The internal anatomy of the ventricles is now seen by the neurosurgeon and the endoscope is advanced to where the ventriculostomy (hole) is made under direct vision; and
4. Finally, the neurosurgeon checks that the ventriculostomy is fully open before removing the endoscope and finishing the operation.

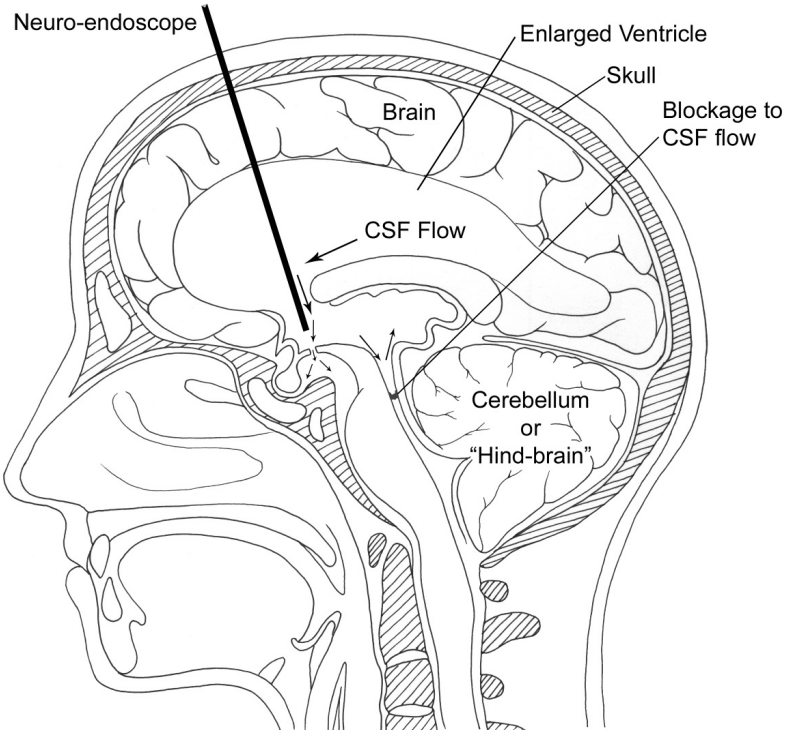

Figure 3

Diagram illustrating third ventriculostomy with the neuro-endoscope in place and the hole (ventriculostomy) also demonstrated.

Does a shunt last forever?

As a man-made device, a shunt will not last forever. A shunt can last from a few days or weeks to many years. Indeed, in adults, we have seen them last for even as long as 50 years; however, in a child, we would normally expect a more realistic lifespan for a shunt to be 5 - 10 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 itself. When a VP shunt is inserted, the tube into the abdomen is deliberately left long to allow the system to 'grow' with your child; however, your child can outgrow the tube and this would also need a new shunt to be inserted.

How do I know if the shunt has blocked?

The symptoms and signs of shunt block may vary depending on the age of your child and how suddenly the shunt blocks. If blockage is slow, the symptoms may be seen as slowly progressive.

Below is an outline of what your child may complain of or what may be seen:

Baby	
Bulging fontanelle (soft spot)	Floppier than normal
Vomiting	Crying a bit different - more high-pitched
Drowsy, sleepy, hard to wake	Irritable
	Restriction in upgaze / child looking downwards constantly

Older child	
Headaches	Worsening memory
Nausea and vomitting	Balance problems or unsteady on feet
Drowsy, sleepy, hard to wake	School problems such as worsening concentration or handwriting
	If epileptic, there may be a change in the number of or pattern of seizures
	Return of pre-shunt complaints

If you have concerns, please contact Ward L52 on: **0113 3927452** and ask to speak to the nurse in charge. Tell them your child has a shunt and explain your concerns.

Ward L52 is the Children's Neuroscience Ward of Leeds Children's Hospital in Clarendon Wing at Leeds General Infirmary. Staff are available 24 hours per day, 365 days per year to receive phone calls and give advice. We will usually request that you bring your child to Ward L52 for review.

What are the risks of treatment?

Before surgery, the neurosurgeon will go through all the risks with you in detail. In outline, these are the risks of surgery and they are similar to any neurosurgical operation. What varies is the level of that risk. With this surgery, the risks are as follows:

Infection

Because a cut is made through the skin, infection can get in. 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 path 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 path of the shunt or from the surgical wounds. This is usually easily controlled by simple painkillers such as Paracetamol. The operations themselves are usually not particularly painful procedures. Some children 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; however, fits are uncommon after shunts or third ventriculostomy surgery. Long-term treatment may or may not be required depending on the circumstances.

Risk to Life

This is usually extremely small but is partially dependent on your child's age, weight and general health. The risk is there because this is neurosurgery and also, because it involves a general anaesthetic.

Treatment of shunt infection

The main risk for infection is in the first 30 days after surgery and can present in different ways. If the shunt is found to be infected, the system will have to be removed through an operation. At 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.

Other questions:

Are antibiotics needed for dental treatment?

We do not usually recommend or require this.

Can my child fly?

There are no reasons why a child with treated hydrocephalus could not fly on an aeroplane. There are no cases that we know of where this has been harmful; however, if a shunt has been inserted that has an adjustable 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?

We are keen that children with shunts lead lives that are as normal as possible. AII activities and sports pose some risks and so, in theory, nothing is completely safe; therefore, we cannot say that anything is completely safe. A child with a shunt who receives a head injury is potentially more at risk of harm than a child without a shunt. Disconnection of the shunt tubing is a small possibility during activities which involve vigorous movements of the head or neck. Parents should be aware of these slight risks but balance them with benefits of allowing their child to be involved.

It is clear that boxing should not be undertaken due to deliberate repetitive head injury. Other activities where the head may be hit deliberately should also be avoided or controlled; for example, we would advise against heading a football and against competitive rugby due to an increased risk of bleeding in / over the brain. We also urge caution with scuba diving due to the risk of harm, whilst in deep water.

Martial arts may be undertaken if head blows are avoided. Swimming should be supervised. An exhaustive list is not possible but we hope this gives some useful guidance.

Will it affect my child at school?

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 - this is dependent on the brain structure and function itself.

What if my child has a head injury?

Normal post head injury procedures should be followed and you should take your child to the local Emergency department if you have concerns; however, it would be important to mention to the doctors that your child has a shunt, as this will help them assess and treat your child.

We hope you find this information book helpful and instructive.

If you have concerns, please contact Ward L52 on: **0113 3927452** and ask to speak to the nurse in charge. Tell them your child has a shunt and explain your concerns.

Louise Higgins, Hydrocephalus Specialist Nurse
email: **louisea.higgins@nhs.net**
Work Mobile (office hours only): **07881 328283**

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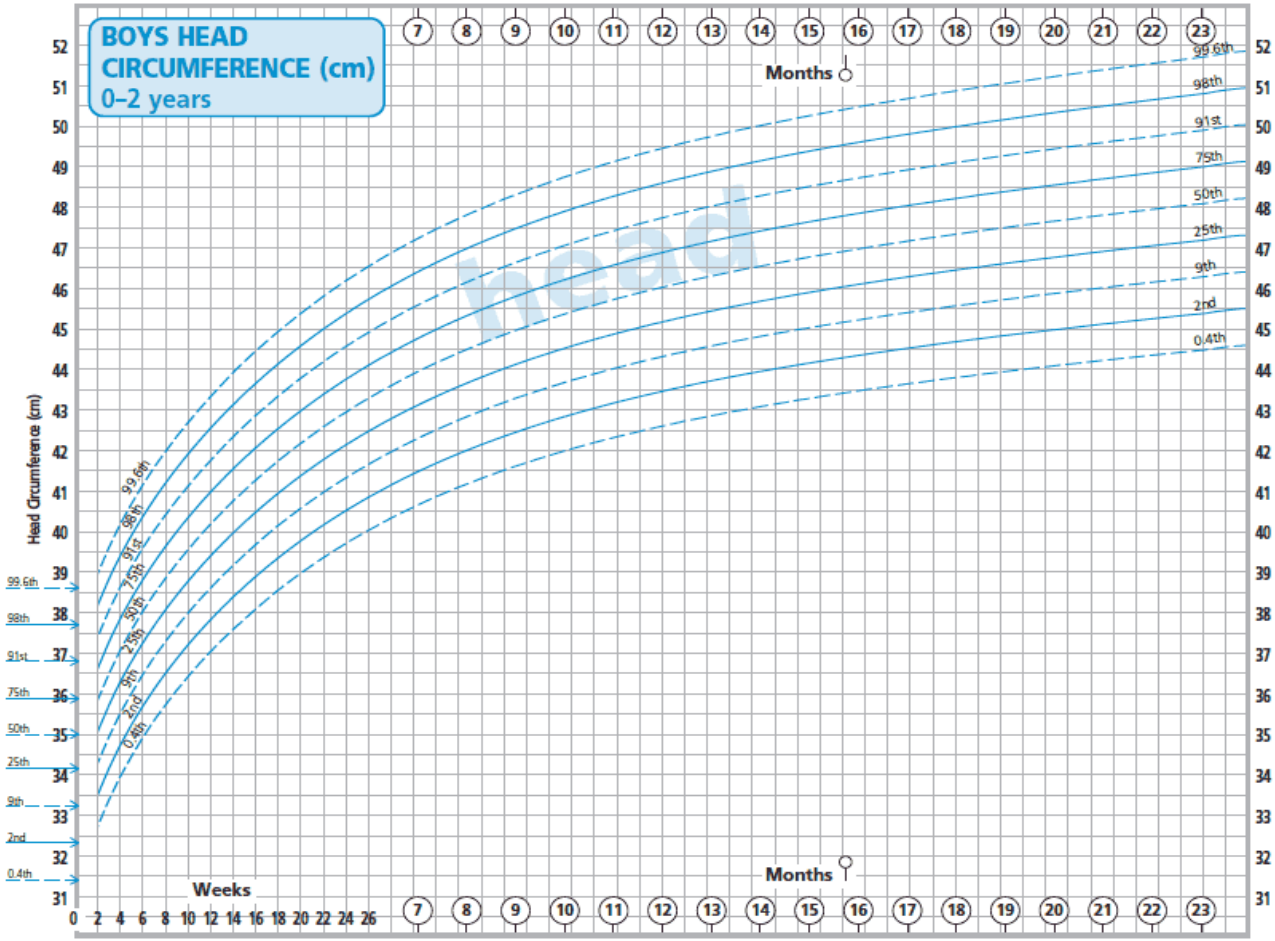
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Months
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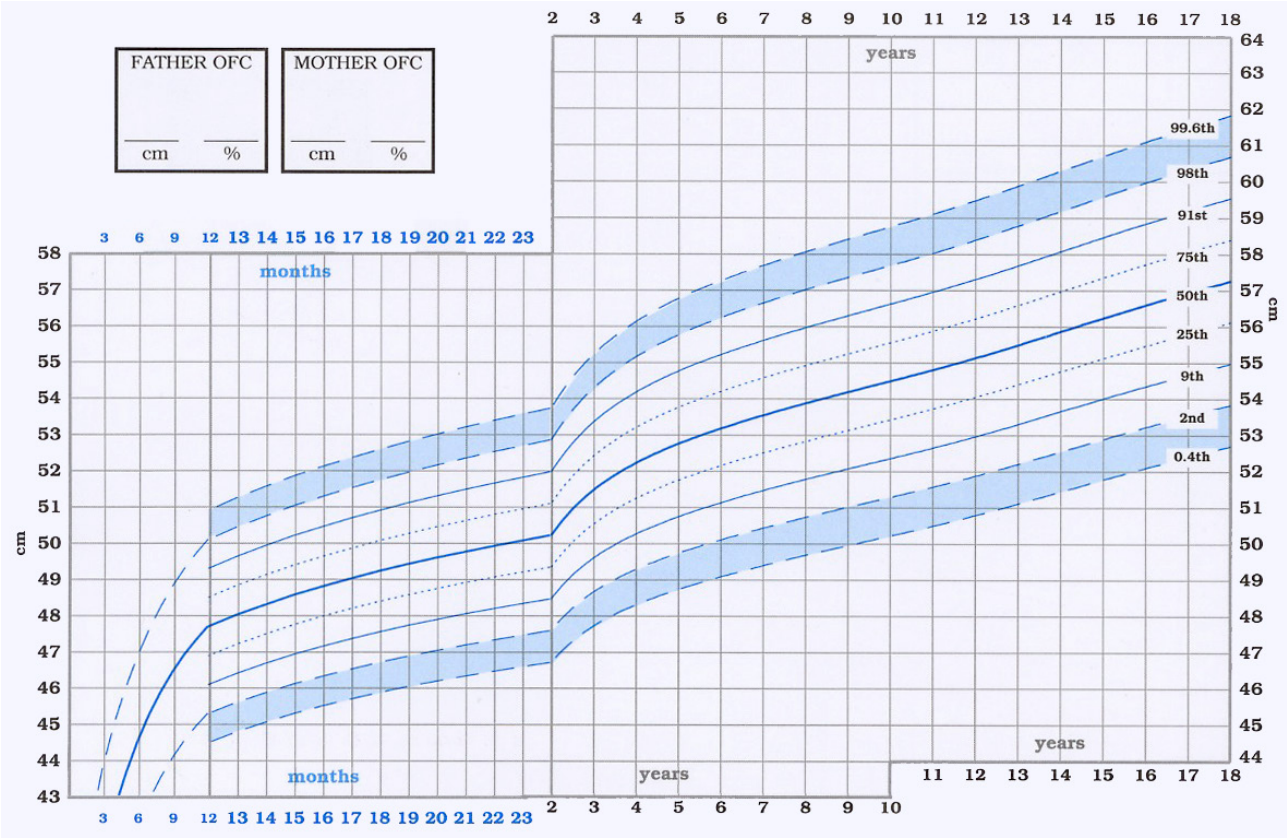
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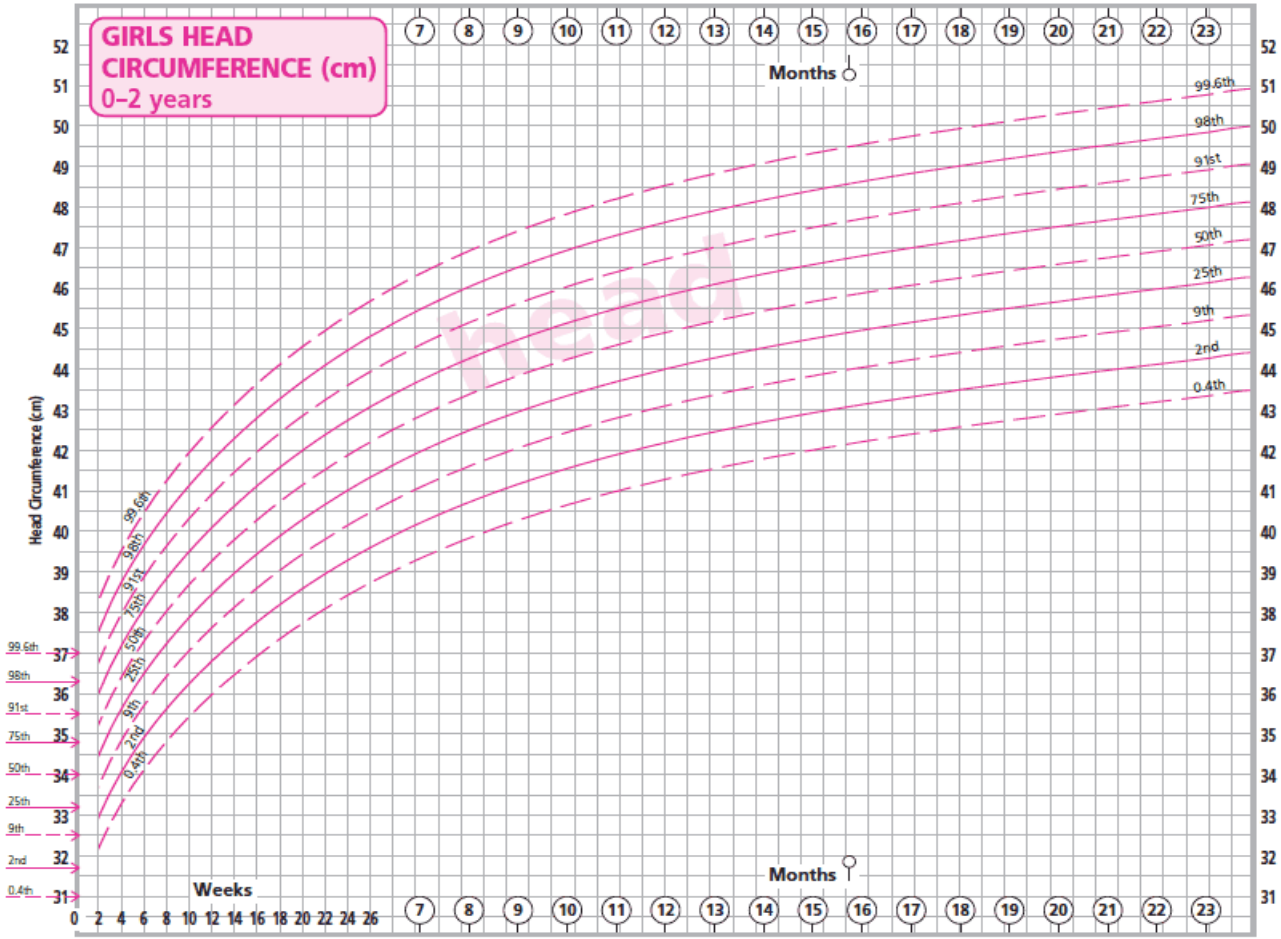
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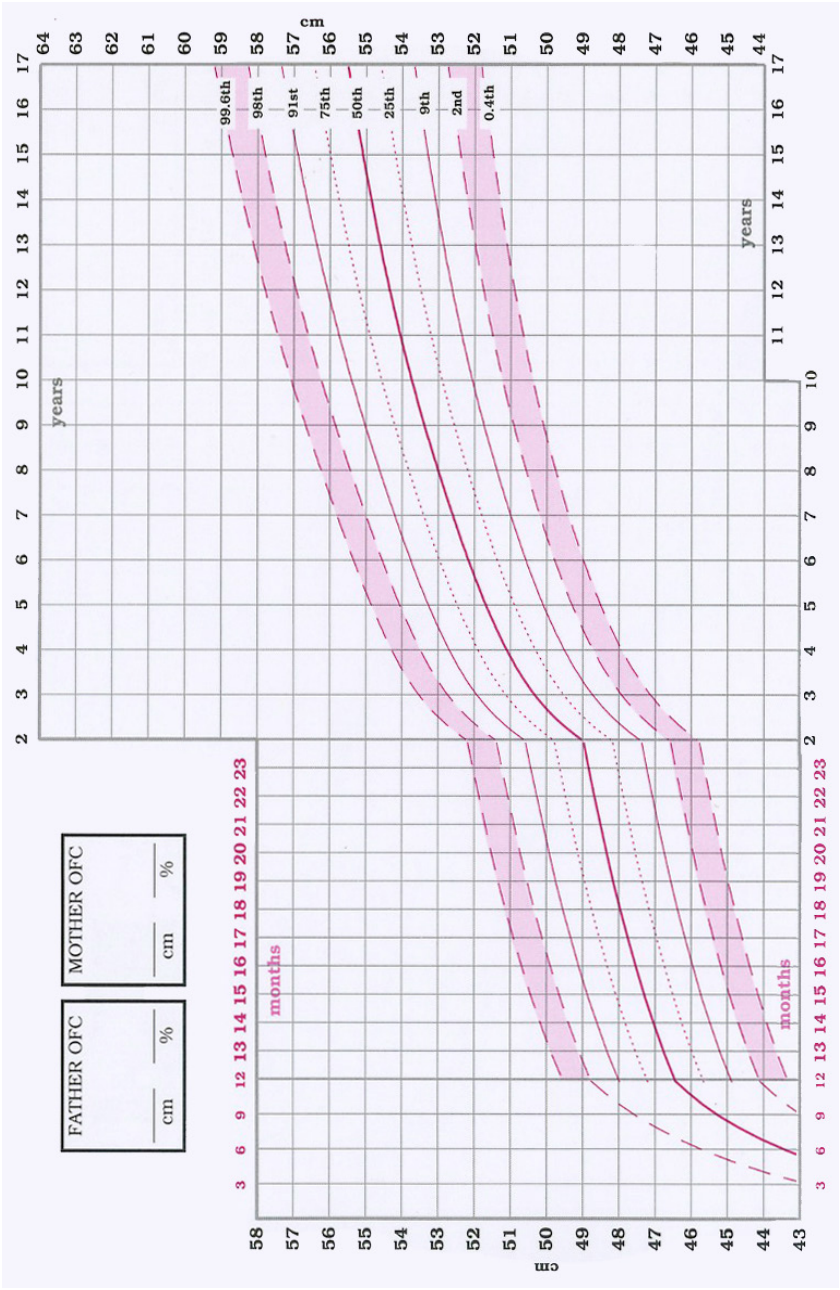
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Department of Neurological Surgery
Ward L52
Leeds General Infirmary
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Tel: (0113) 3927452

AFFIX PATIENT LABEL

This patient has a shunt for ..... Hydrocephalus.

Surgery Date	Shunt Type VP / VA / V-Pleural	Valve Details

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For further advice, contact:

Louise Higgins, Hydrocephalus Specialist Nurse
Email: **louisea.higgins@nhs.net**

Work Mobile (office hours only):
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The Children's Neuroscience Ward (Ward 52):
0113 3927452

Leeds General Infirmary (switchboard number):
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