



# CSF LEAK ASSOCIATION FACTSHEET

## *CSF Leak Terminology*

This factsheet has been produced by the CSF Leak Association, a Scottish Charitable Incorporated Organisation working to raise the profile, promote awareness and support sufferers of Cerebrospinal Fluid (CSF) Leaks. The factsheet is provided in good faith, however cannot be guaranteed error free and is not a substitute for professional healthcare advice. The content of this factsheet is checked regularly to ensure it remains current; it was last updated on **7 February 2016**. If it is some time since you obtained this factsheet, please visit our website to check if a newer version is available for download: [www.csfleak.info](http://www.csfleak.info)

### Quick Reference Guide to CSF Leak Terminology

Health-related terminology can be confusing at times, particularly to those without a medical background, with limited experience dealing with doctors or hospitals or who are new to a particular condition or illness.

We have prepared an alphabetical list of some of the most commonly used CSF leak terminology. The list is published in good faith and is intended to guide, but cannot be guaranteed error-free.

You should always consult with your doctor to ensure that you understand what is being discussed in, and is relevant to, your case. A variety of medical and encyclopaedic sources have been used to provide these definitions.

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#### Anterior

Anterior refers to the 'front' of the subject and is synonymous with ventral, other than in the head. When referring to the body as a whole, the term 'ventral' is used infrequently in human anatomy.

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#### Arachnoid Mater

The arachnoid mater is one of the three meninges, the protective membranes that cover the brain and spinal cord. It is interposed between the two other meninges, the more superficial and much thicker dura mater and the deeper pia mater, from which it is separated by the subarachnoid space. Cerebrospinal fluid (CSF) flows under the arachnoid mater in the subarachnoid space. The arachnoid mater makes arachnoid villi, small protrusions through the dura mater into the venous sinuses of the brain, which allow CSF to exit the subarachnoid space and enter the blood stream.

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## Autologous Blood

Autologous blood is blood drawn from a patient's body and then injected back into another area of the body for the purposes of healing. It is used in a blood patch.

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## Blind Blood Patch

A blind blood patch is a blood patch where the placement of the epidural needle is carried out by hand without the guidance of fluoroscopy. This is the standard procedure for high and low volume patches in the lumbar spine. A directed blood patch, using fluoroscopy, is more common for patches in the thoracic and cervical regions of the spine, where incorrect needle placement could have a significant adverse effect.

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## Blood Patch

An epidural blood patch is a surgical procedure that uses autologous blood in order to close one or more holes in the dura, usually as a result of a previous lumbar puncture or epidural anaesthesia, although hole may also occur follow trauma or spontaneously. It is the most common treatment for a CSF leak that does not respond to conservative treatment, such as bed rest.

### *Low-Volume Patch*

In a low-volume blood patch, where the site of a cerebrospinal leak is known, an epidural needle is inserted into the epidural space at the leak site and a small amount of the patient's own blood is injected (approximately 4-5ml) in order to 'patch' the meninges. The procedure carries the typical risks of any epidural puncture. However, even though it is often effective, further intervention is sometimes necessary.

### *High-Volume Patch*

In a high-volume blood patch, where the precise location of a cerebrospinal fluid leak is not known, an epidural needle is inserted into the epidural space around L3/L4 in the lumbar region. A relatively large amount of the patient's own blood is injected (approximately 20ml). The high volume means that the blood can travel around the epidural space in order to 'patch' the meninges. It is thought that this procedure can be successful up to 8 vertebrae from the injection site. The procedure carries the typical risks of any epidural puncture, however due to the additional volume of blood injected, the risks tends to be higher than a low volume patch. Success rates are thought to be in the region of 40%, however even where it is effective, further intervention is sometimes necessary.

One school of thought is that blood patches work by way of the clotting factors of the blood, which close the hole in the dura. Another is that the blood, acting as an irritant, encourages the body to scar and heal. It is also postulated that symptom relief immediately after an epidural blood patch may be due to more of a compression effect than sealing the leak itself.

Epidural blood patches are rarely successful for cranial leaks. Patches used to treat anterior spinal leaks or spinal leaks in the cervical region may be less effective.

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## Cauda Equina

The cauda equina (Latin for "horse's tail") is a bundle of spinal nerves and spinal nerve roots.

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## Cerebrospinal Fluid / CSF

Cerebrospinal fluid (CSF) is a clear colourless bodily fluid found in the brain and spine. It is produced in the choroid plexus of the brain. It acts as a cushion or buffer for the brain's cortex, providing a basic mechanical and immunological protection to the brain inside the skull, and it serves a vital function in cerebral auto regulation of cerebral blood flow.

The CSF occupies the subarachnoid space (the space between the arachnoid mater and the pia mater) and the ventricular system around and inside the brain and spinal cord. It constitutes the content of the ventricles, cisterns, and sulci of the brain, as well as the central canal of the spinal cord.

When a hole or tear forms in the dura, CSF leaks out. This is known as a CSF leak and can lead to Intracranial Hypotension. A CSF leak in the head can substantially raise a patient's susceptibility to meningitis, whereas a spinal leak discharges CSF into the surrounding tissue and a patient's risk of developing meningitis is no higher than the average person.

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## Cerebrospinal Fluid / CSF Fistula

A CSF fistula is a term generally interchangeable with 'CSF leak'.

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## Cerebrospinal Fluid / CSF Leak

A cerebrospinal fluid leak syndrome (CSF leak) is a medical condition in which the cerebrospinal fluid (CSF) held in and around a brain and spinal cord leaks out of the surrounding protective sac, the dura. It may occur through trauma, following surgery, due to atypical bone growth and other skeletal anomalies or for no apparent reason.

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## Cerebellar Tonsils

The cerebellar tonsil is analogous to a rounded lobule on the under surface of each cerebellar hemisphere. It is located close to the Fourth Ventricle, towards the rear and bottom of the brain, where it meets the spinal cord.

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## Cervical

The cervical section of the spine comprises seven bony vertebrae, typically referred to as C-1 to C-7, with cartilaginous discs between. The neck supports the weight of the head and protects the nerves that carry sensory and motor information from the brain down to the rest of the body. In addition, the neck is highly flexible and allows the head to turn and flex in all directions.

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From top to bottom the cervical spine is gently curved in convex-forward fashion. It is the least marked of all the curves of the column. CSF leaks are commonly found at or around the junction of the cervical and thoracic spine.

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### **Chiari Malformation / Arnold–Chiari malformation**

Chiari malformation, also known as Arnold–Chiari malformation, is a malformation of the brain. It consists of a downward displacement of the cerebellar tonsils through the foramen magnum (the opening at the base of the skull), sometimes causing non-communicating hydrocephalus[1] as a result of obstruction of cerebrospinal fluid (CSF) outflow.

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### **Choroid Plexus**

The choroid plexus is a plexus in the ventricles of the brain where cerebrospinal fluid (CSF) is produced. The choroid plexus consists of modified ependymal cells. CSF is recycled (flushed) 4 times per day in order to clean out metabolites and toxins. The choroid plexus must produce about 500ml of CSF per day (or 21ml per hour).

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### **Coccyx**

The coccyx, commonly referred to as the tailbone, is the final segment of the vertebral column in tailless primates. Comprising three to five separate or fused vertebrae (below the sacrum, it is attached to the sacrum by a fibrocartilaginous joint, the sacrococcygeal symphysis, which permits limited movement between the sacrum and the coccyx.

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### **Computed Tomography / CT**

Computed Tomography (CT) is a medical imaging technique that uses computer-processed x-rays (ionising radiation) to produce tomographic images (virtual 'slices') of specific areas of the head and spine, allowing doctors to see what is inside it without performing surgery. CT imaging is sometimes used in combination with intrathecal contrast.

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### **Digital Subtraction Myelography / DSM**

Digital Subtraction Myelography (DSM) is an imaging technique, normally used to locate brain aneurysms, which also used to locate CSF leaks. This imaging technique normally uses intrathecal contrast and is often performed under general anaesthetic. It is not common in the UK at this time, but is considered by some to be the most sensitive and accurate imaging technique for detecting smaller CSF leaks.

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## Directed Blood Patch

A directed blood patch is a blood patch where fluoroscopy is used to guide the placement of the epidural needle. This ensures that the needle is accurately placed and avoids puncturing the dura or damage to the patient's nerves and spinal cord. A directed patch usually involves the injection of a small amount of autologous blood and is more common for patches in the thoracic and cervical regions of the spine, where incorrect needle placement could have a significant adverse effect.

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## Dura Mater

Dura mater, or simply the dura, is a thick membrane that is the outermost of the three layers of the meninges that surround the brain and spinal cord. The other two meningeal layers are the pia mater and the arachnoid mater. The dura surrounds the brain and the spinal cord and is responsible for keeping in the cerebrospinal fluid. A hole or tear in the dura allows cerebrospinal fluid to leak out and is known as a CSF leak.

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## Elliotts B

Elliotts B is a sterile, non-pyrogenic, isotonic solution containing no bacteriostatic preservatives. Elliotts B solution is often used as a diluent for intrathecal administration of methotrexate sodium and cytarabine. It is also used alongside intrathecal contrast in order to raise intracranial pressure and maximise the chances of the location a CSF leak being disclosed by CT and MRI imaging.

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## Epidural

The term 'epidural' is a simplified and all-inclusive term used to refer to techniques such as epidural analgesia, epidural anaesthesia and epidural blood patch. These techniques involve a needle or catheter being placed into the anatomic space between the outermost part of the spinal canal and the dura. Epidural techniques frequently involve injection of blood or medication into the epidural space.

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## Epidural Blood Patch

See 'Blood Patch'.

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## Epidural Space

The epidural space is an anatomic space that is the outermost part of the spinal canal. It is the space within the canal (formed by the surrounding vertebrae) lying outwith the dura mater (which encloses the arachnoid mater, subarachnoid space, the

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cerebrospinal fluid and the spinal cord). The epidural space contains lymphatics, spinal nerve roots, loose fatty tissue, small arteries and a network of large, thin-walled blood vessels called the epidural venous plexus.

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## Extra-dural Fluid Collection

See 'Pseudomeningocele'.

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## Fibrin Glue

Fibrin glue (also called fibrin sealant) is a formulation used to create a fibrin clot. It is made up of fibrinogen (lyophilised pooled human concentrate) and thrombin (bovine, which is reconstituted with calcium chloride) and is applied to tissue sites to glue them together. It is commonly used to seal CSF leaks where blood patches have failed, or in combination with autologous blood. It is also used during neurosurgery.

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## Fluoroscopy

Fluoroscopy is an imaging technique that uses x-rays to obtain real-time moving images of the internal structures of a patient through the use of a fluoroscope. In its simplest form, a fluoroscope consists of an x-ray source and fluorescent screen between which a patient is placed. However, modern fluoroscopes couple the screen to an x-ray image intensifier and video camera allowing the images to be recorded and played on a monitor.

The use of x-rays, a form of ionizing radiation, requires the potential risks from a procedure to be carefully balanced with the benefits of the procedure to the patient. While physicians always try to use low dose rates during fluoroscopic procedures, the length of a typical procedure often results in a relatively high absorbed dose to the patient. Recent advances have reduced the radiation dose to the patient.

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## Gadolinium

Gadolinium is a chemical element with symbol Gd and atomic number 64. It is commonly used as a contrast alongside MRI imaging. Once injected into the blood stream or CSF, gadolinium-based contrast agents accumulate in abnormal tissues of the brain and body. This accumulation provides a greater contrast between normal and abnormal tissues, allowing doctors to better locate uncommon tissue formations or, when administered intrathecally, CSF outwith the thecal sack.

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## High Intracranial Pressure / IH / HP

Intracranial hypertension (sometimes abbreviated to IH or HP) is high pressure inside the skull, which may happen suddenly or build up gradually over time. It is often caused by an over-production or under-absorption of cerebrospinal fluid.

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## **Intracranial Hypotension**

A loss of CSF (normally through a tear or absorption) greater than its rate of production leads to a decreased volume and/or pressure inside the skull. This is known as intracranial hypotension.

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## **Intrathecal**

Intrathecal refers to something occurring in or introduced into the anatomic space or potential space inside the arachnoid membrane of the brain or spinal cord (under which is the subarachnoid space).

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## **Intrathecal Contrast**

A contrast agent injected into the cerebrospinal fluid to better visualise the spinal canal and nerve roots in the spine. Where it leaks outwith the dura, it may indicated the location of a CSF leak.

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## **Low Intracranial Pressure**

See 'Intracranial Hypotension'.

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## **Lumbar**

The lumbar region, sometimes referred to as the lower spine, comprises the five vertebrae in the lumbar region of the back (L1-L5) that are the largest and strongest in the movable part of the spinal column. The lumbar region of the spine curves outward.

The lumbar portion of the spine bears the most body weight and also provides the most flexibility, a combination that makes it susceptible to injury and wear and tear over time.

The spinal cord does not descend far into the lumbar region; for this reason, and in order to reduce risk, it is the normal location for lumbar punctures and high volume epidural blood patches.

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## **Lumbar Puncture**

A lumbar puncture is a diagnostic medical procedure. It is used to collect and measure the pressure of cerebrospinal fluid (CSF) and to confirm or exclude conditions such as meningitis and subarachnoid haemorrhage.

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The procedure is typically performed under local anaesthetic and aseptic technique. A needle is used to access the subarachnoid space and fluid collected. Fluid may also be sent for biochemical, microbiological and cytological analysis.

A lumbar puncture is generally regarded as a safe procedure, but is not without risk. Risks can include additional CSF leaks, nerve damage, infection and epidural haemorrhage.

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## Magnetic Resonance Imaging / MRI

Magnetic resonance imaging (MRI) is a medical imaging technique used to investigate the anatomy and physiology of the body. MRI scanners use strong magnetic fields and radio waves to form images of the body. The technique is widely used in hospitals for medical diagnosis, staging of disease and for follow-up without exposure to ionising radiation. MRI imaging is sometimes used in combination with IV or intrathecal contrast, such as gadolinium.

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## Meninges

The meninges are the membranes that envelop the central nervous system. They consist of three layers: the dura mater, the arachnoid mater, and the pia mater.

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## Nerve Root

Nerve roots are bundles of nerve fibres, the initial segment of a nerve leaving the central nervous system. Types include:

- A cranial nerve root, the beginning of one of the twelve pairs leaving the central nervous system from the brain stem or the highest levels of the spinal cord;
- A spinal nerve root, the beginning of one of the thirty-one pairs leaving the central nervous system from the spinal cord. Each spinal nerve root consists of the union of a sensory dorsal root and a motor ventral root. At the height of each intervertebral space of the spinal roots go four - two roots ventral and two dorsal roots, one pair of right and left side of the core.

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## Orthostatic Intolerance

Generally means an inability to tolerate sitting or standing. See 'Postural Orthostatic Tachycardia Syndrome'.

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## Pia Mater

The pia mater, often referred to as simply the pia, is the delicate innermost layer of the meninges, the membranes surrounding the brain and spinal cord. The other two meningeal membranes are the dura mater and the arachnoid mater. Pia mater is a thin

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fibrous tissue that is impermeable to fluid. This allows the pia mater to enclose cerebrospinal fluid. By containing this fluid, the pia mater works with the other meningeal layers to protect and cushion the brain and spinal cord.

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## **Pituitary Gland**

The pituitary gland, or hypophysis, is an endocrine gland about the size of a pea. It is a protrusion off the bottom of the hypothalamus at the base of the brain, and rests in a small, bony cavity covered by a dural fold.

The posterior pituitary (is a lobe of the gland that is functionally connected to the hypothalamus by the median eminence via a small tube called the pituitary stalk. The anterior pituitary is a lobe of the gland that regulates several physiological processes (including stress, growth, reproduction, and lactation).

The pituitary gland is an important part of human anatomy and can be impacted upon by intracranial hypotension. In suffers who experience significant sagging of the brain, the pituitary gland may appear misshapen or compressed.

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## **Pledgets**

Small wads of absorbent cotton or other soft material, which are inserted into the nose or ears to establish if CSF is leaking from those orifices.

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## **Posterior**

Posterior refers to the 'back' of the subject and is synonymous with dorsal, other than in the head. When referring to the body as a whole, the term 'dorsal' is used infrequently in human anatomy.

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## **Postural Orthostatic Tachycardia Syndrome / POTS**

Postural Orthostatic Tachycardia Syndrome (POTS) is a condition of orthostatic intolerance in which a change from the supine/lying position to an upright position causes an abnormally large increase in heart rate, called tachycardia.

People with POTS have problems maintaining homeostasis when changing position, for example moving from one chair to another or reaching above their heads. Many also experience symptoms when stationary or even while lying down.

Symptoms present in various degrees of severity depending on the individual. POTS can be severely debilitating. Some afflicted individuals are unable to attend school or work and for especially severe cases, may be completely incapacitated. POTS symptoms can be very similar to those of Intracranial Hypotension and, accordingly, misdiagnosis can occur. Additionally, some CSF leak sufferers can develop POTS or a POTS-like condition, perhaps in part due body deconditioning stemming from the inability to stand for anything more than a short period of time.

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## **Pseudomeningocele**

A pseudomeningocele is a collection of cerebrospinal fluid (CSF), normally located outwith the dura mater, which communicates with the CSF space around the brain or spinal cord. A pseudomeningocele normally has no surrounding membrane, but is contained in the space between the dura mater and surrounding soft tissues. Pseudomeningocele are commonly found alongside a CSF leak, particularly high-flow leaks and those found on the anterior side of the spinal cord. Diagnosis of CSF leak may be possible where a pseudomeningocele is present, even if no specific leak site is found.

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## **Radionuclide Cisternography**

Radionuclide cisternography is an imaging technique which involves injecting a radionuclide by lumbar puncture into a patient's cerebral spinal fluid (CSF). It is used to determine if there is abnormal CSF flow within the brain and spinal canal and may also evaluate a suspected leak (also known as a CSF fistula).

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## **Sacrum**

The sacrum is a large, triangular bone at the base of the spine and at the upper, back part of the pelvic cavity, where it is inserted like a wedge between the two hip bones. Its upper part connects with the last lumbar vertebra, and its lower part with the coccyx.

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## **Spinal Canal**

The spinal canal (or vertebral canal or spinal cavity) is the space in vertebrae through which the spinal cord passes.

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## **Spinal Cord**

The spinal cord is a long, thin, tubular bundle of nervous tissue and support cells that extends from the brain. The brain and spinal cord together make up the central nervous system. The spinal cord begins at the occipital bone and extends down to the space between the first and second lumbar vertebrae; it does not extend the entire length of the vertebral column, normally terminating around the top of the lumbar spine. The spinal cord is housed within the meninges and is bathed by the cerebrospinal fluid.

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## **Spinal Tap**

See 'lumbar puncture'.

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## Subarachnoid Space

The subarachnoid space (sometimes known as the subarachnoid cavity) is the anatomic space between the arachnoid membrane and pia mater. It is occupied by spongy tissue consisting and intercommunicating channels in which the cerebrospinal fluid is contained and circulates.

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## Thecal Sack

The thecal sac is a membrane of the dura mater that surrounds the spinal cord and the cauda equina. This thecal sac is filled with cerebrospinal fluid.

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## Thoracic

The thoracic vertebrae comprise the middle segment of the spine, between the cervical vertebrae and the lumbar vertebrae. There are twelve thoracic vertebrae and they are intermediate in size between the cervical and lumbar vertebrae; they increase in size going towards the lumbar vertebrae, with the lower ones being a lot larger than the upper.

By convention, the human thoracic vertebrae are numbered T1-T12, with the first one (T1) located closest to the skull and the others going down the spine towards the lumbar region. The thoracic region is thought to be the most common area in the spine for the occurrence of CSF leaks.

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## Ventricles / Ventricular System

The ventricular system is a set of four structures, the ventricles, containing cerebrospinal fluid (CSF) in the brain. It is continuous with the central canal of spinal cord. The ventricles are interconnected, allowing the flow of cerebrospinal fluid. CSF is produced by the ependymal cells in the choroid plexus, a network of these cells within each of the ventricles.

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