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Medicine for Managers

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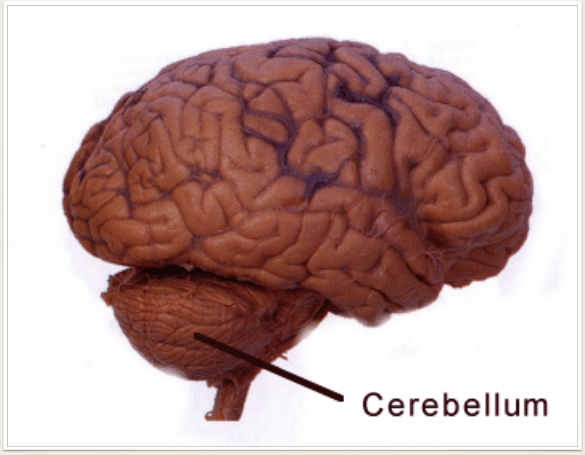
What is the Cerebellum?

The cerebellum, which means 'little brain', is one of those parts of the body of which almost everyone has heard but about which few have any significant knowledge. It is located towards the back of the brain and it plays an essential role in virtually all physical movement. It is immensely complex and parts of its function are still to be elucidated.

The cerebellum is located at the back of the brain beneath the lobes of the cerebral cortex.
It accounts for about 10% of the brain's volume but contains about 50% of the neurones (nerve cells).



The earliest anatomists identified the cerebellum by its distinctive appearance shown and labelled in the diagram. Aristotle named it the parenkephalis. Galen, in the first century AD, provided a comprehensive description and suggested in was the source of motor nerves.

Although there were some studies of cerebellar function in the eighteenth century, Jean Flourens, in the first half of the nineteenth century, discovered that animals with cerebellar damage could still move but lost co-ordination.

By the early 1900s it was becoming clear that the cerebellum was essential for control of movement.

The cerebellum helps a person's co-ordination when any definitive action is taken, e.g. driving or playing chess. Nerve impulses that cause movement are not initiated in the cerebellum but it modifies movements to make them more adaptive and accurate.

Functions of the Cerebellum

The cerebellum is an influencer and moderator of a number of functions which include:

- ***Maintenance of balance and posture***. It controls nerves which stimulate muscles to correct for changes in body position.

Cerebellar damage causes balance disorders

- ***Motor Learning***. The cerebellum adapts and adjusts motor activity to make it more accurate, e.g. learning to ride a bicycle.
- ***Co-ordination of voluntary movements***. The cerebellum co-ordinates timing and strength of movements when groups of muscles act together to achieve movement.
- ***Cognitive functions***. The cerebellum is involved with language and thought and with other cognitive functions but this is not understood.
- ***Vision***. The cerebellum co-ordinates eye movements.

Because the cerebellum is so central to the fine tuning of key movements, any disorder of the cerebellum will have effects, often profound, as a result of disturbance of motor control. The features will take the form of disruption of the functions listed above and include:

- Loss of balance
- Lack of general muscle control and co-ordination
- Difficulties with movements such as walking or climbing stairs
- Disturbances with cognitive activities such as speech, which may be slurred, slow and difficult, sometimes with confusion.
- The development of abnormal eye movements
- Difficulty swallowing
- Mood changes

For success, movements overall require the co-ordinated activity of many muscle groups and different joints to achieve a smooth trajectory of the body part.

Cerebellar disorders may be seen as an intention tremor (involuntary tremor) where, for example, someone taking a cup from saucer to mouth will develop an increasing tremor as it approaches the lips.

Using perhaps the most difficult word ever encountered in medicine, the patient may develop ***dysdiadochokinesia*** (dis-dye-a-doe-coe-ki-knee-zee-ah) which is the inability to perform rapid alternating movements, such as touching the nose and a finger alternately and repeatedly.

[*The word comes from the Greek 'dys'-bad, 'dia'-across, 'docho'-receive, 'kinesia'-movement*]

Disorders of the cerebellum

These include:

- Cerebellar stroke, where a vessel either becomes blocked (thrombosis) or bleeds (hemorrhagic stroke)
- Infection with virus
- Cancers
- Drugs and toxins
- Genetic causes.

The principal symptom is ***ataxia***, which is a loss of co-ordination and control. Speech difficulties are often the first sign.

The other features subsequently develop. Ataxia may either be the result of a ***degenerative condition*** or a ***genetic disorder***.

The most common type of genetic disorder, ***Friedreich's ataxia***, is estimated to affect 1 in 50,000 people. It commonly starts between ages 5 and 15, but 15% of people develop symptoms after age 25. Generally the person is confined to a wheelchair within 10 to 20 years of onset.

It is usually diagnosed when other causes have been ruled out and can be diagnosed by genetic testing. Other genetic causes are extremely rare.

Another group of conditions is called ***sporadic ataxia***. This conditions are not believed to be inherited. Features of ataxia occur together with other symptoms such as fainting, cardiac anomalies and incontinence. They gradually progress over time.

Toxins can damage cerebellar nerves leading to ataxia and they include alcohol in excess, heavy metals such as mercury and lead, some industrial chemicals such as paint thinners and some drugs. Treatment may be effective at reducing the ataxic symptoms depending on how quickly treatment is started and how extensive the cerebellar damage actually is.

Viruses can cause ataxia and it is generally of acute onset. Implicated viruses are:

- ***Varicella-zoster Virus*** which causes chicken pox.
- ***Coxsackie Virus*** which causes such illnesses as hand, foot and mouth disease
- ***Epstein-Barr Virus*** which causes glandular fever
- ***HIV***

There is no treatment for this type of viral illness but it usually resolves spontaneously with resolution of the virus.

Tumours of the cerebellum are very uncommon and result in ataxic symptoms often with headache, vomiting and progressive difficulties in co-ordination.

The treatment of such tumours depends on the precise location, size, nature and age and general health of the patient.

In summary, the cerebellum is an amazing structure and vital for the co-ordinated activity which we undertake.

If the cerebellum is dysfunctional, the individual experiences a range of basic neurological deficits including inco-ordination of muscles limbs and joints, loss of ability to judge distances (dysmetria) resulting in undershooting or overshooting in grasping movements and loss of ability to make repetitive movements requiring muscle groups to be switched on and off repeatedly.

All aspects of waking life become a challenge as all activity is disrupted. Treatment is often disappointing but there may be some success with:

- Implantable electric devices
- The drug buspirone for mild to moderate ataxia
- Behavioural training with strategies to help speech and some movement.

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