

# **GLOSSARY OF BRAIN INJURY TERMS**

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## **AUTHORS**

The authors of the original version of the Glossary in 1989 and a revision in 1991 were Dr Neil Brooks and Bill McKinlay. A further revision was made in 1999 by Dr McKinlay who has also prepared the present revision in 2003.

## **NOTE ON USING THE GLOSSARY**

Some items in the Glossary include further terms in capital letters followed by “qv”. Where you see this, you are advised also to look up this further term.

**C M S**



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## **A- and DYS-**

Many terms begin with the prefixes 'a-' or 'dys-'. 'A-' means, literally, a complete inability to perform while 'dys-' means an impaired ability. For example, 'amnesia' should mean total loss of memory while 'dysmnnesia' should mean partial loss of memory. However, the terms tend to be used somewhat loosely to the extent that the prefix 'a-' is often used to indicate impaired ability as well as complete inability.

## **ACTIVITIES OF DAILY LIVING (ADLs)**

ADL is a term used to mean various basic day-to-day activities, which we tend to take for granted, but which may pose problems after brain injury. These include feeding, washing, toileting, dressing, grooming, etc. Advanced ADLs are activities which require a higher level of integration of plans and actions, such as planning activities, budgeting, time management, etc. (See also OCCUPATIONAL THERAPY.)

## **AFFECT (a'fect)**

Emotional disposition. Thus 'appropriate affect' means the individual shows emotional reactions appropriate to the circumstances, 'flattened affect' means that little emotional response is made (which is common after frontal lobe injury).

## **AGNOSIA**

An inability (or impaired ability) to recognise objects or other events via the senses when that sense is unimpaired. Visual agnosia means an inability to recognise objects by sight, despite preserved vision. Similarly, auditory agnosia is an inability to recognise sounds, and tactile agnosia is an inability to recognise objects by touch.

## **AKINESIA**

An inability to start movement or slowness in movement.

## **AMNESIA**

Loss of MEMORY (qv). Associated with head injury are RETROGRADE AMNESIA (qv) and POST-TRAUMATIC AMNESIA (qv). Amnesic patients may remember events long past perfectly well but are unable to remember recent events.

## **ANAESTHESIA**

An inability to feel touch. 'Glove and stocking anaesthesia': loss of feeling in the area covered by glove or stocking does not correspond to the anatomical distribution of nerves and is regarded as an instance of HYSTERIA (qv).

## **ANARTHRIA**

An inability to pronounce words (to be distinguished from 'aphasia').

## **ANOSMIA**

Loss of the sense of smell. In head injury, it is not uncommon for Cranial Nerve I to be severed resulting in anosmia. Its importance includes the danger of being unable to smell gas and other dangerous vapours.

## **ANOXIA**

Failure of oxygen supply. Anoxic damage to the brain may occur directly as a result of injury to the head or because other injuries, especially to the chest, cause interruption of the oxygen supply.

## **ANTI-CONVULSANTS**

These are drugs which are taken to control epilepsy. Sometimes they are prescribed prophylactically (to prevent fits) where the risk of epilepsy is calculated to be high. In general, dosage is critical to achieve proper control yet avoid undue side-effects such as diminished powers of concentration. Alcohol intake should be minimal for patients on these and many other drugs. Medical advice should be sought in the individual case before taking alcohol along with anti-convulsants and before changing/stopping treatment.

## **ANXIETY**

Anxiety is a natural reaction to doubts about one's future health and prosperity. Patients with impairments and disabilities, and their relatives, may well suffer from some degree of anxiety. Very high levels of anxiety are found in POST TRAUMATIC STRESS DISORDER (qv).

## **APHASIA**

An inability to use and/or understand language. This is not simply an inability to articulate words but is an inability to find the appropriate words and/or to decode the meaning of words. There are many forms, including: expressive aphasia in which the ability to find and utter words is damaged and which is usually associated with damage to part of the left\* frontal brain area - BROCA'S AREA (qv); receptive aphasia in which the ability to understand words and also to monitor one's own speech is damaged resulting in 'fluent' or 'jargon' aphasia. This kind of aphasia is usually associated with damage to more posterior areas, especially WERNICKE'S AREA (qv).

*\*NOTE: IT IS USUALLY THE LEFT HEMISPHERE WHICH MAINLY CONTROLS LANGUAGE IN BOTH LEFT AND RIGHT HANDERS, CONTRARY TO POPULAR BELIEF.*

## **APHONIA**

An inability or impaired ability to make vocal sounds.

### **APRAXIA**

An inability to carry out actions such as dressing or copying a shape. Basically, this represents a failure of the 'programmes' in the brain which execute motor sequences, and - as with aphasia - various forms may be distinguished.

### **'ARITHMETIC' SUBTEST**

A subtest of the WECHSLER (qv) Intelligence Scales comprising mental arithmetic problems. Successful performance requires ability to do fairly simple arithmetic but also concentration and problem-solving ability.

### **ARTICULATION**

The mechanical production of speech (as opposed to the capacity to find the correct word).

### **ATAXIA**

Unsteadiness of gait resulting from defective control of muscles.

### **ATTENTION**

Attention is a wide term in psychology denoting the capacity to sustain concentration on a single task, to remain vigilant for a signal, or to cope with more than one task simultaneously.

Disorders of attention are very common indeed after head injury (and many other forms of brain damage), and alongside disorders of memory, are a major reason for inability to resume and maintain employment.

### **AURA**

The warning that an epileptic seizure is imminent. This may take the form of experiencing a smell or a visual or auditory distortion, etc. An aura is not present in every individual and need not occur before every fit.

### **'BLOCK DESIGN' SUBTEST**

A subtest of the WECHSLER (qv) Intelligence Scales in which the subject has to reproduce a series of designs, within time limits, using red and white blocks. This is a good test of non-verbal (or 'performance') IQ.

### **BRAIN**

See Appendix 1 for diagrams.

### **BROCA'S AREA**

The part of the brain (see Appendix 1) responsible for the production of speech.

### **BURR HOLE**

A hole drilled in the skull. This is usually to suck out a collection of blood or to insert a gauge for monitoring INTRACRANIAL PRESSURE (qv). Before the advent of the CT SCAN (qv), burr holes were drilled in some circumstances as an exploratory procedure.

### **CASE MANAGER (Brain Injury Case Manager)**

A Brain Injury Case Manager's remit includes identifying local sources of help/support, finding/training/supporting carers, exploring activities that may be available, and helping the person with brain injury structure his/her time and live as independently as possible in the community. The Case Manager (CM) will have the background of a suitable health or related profession. A CM is needed where the person with brain injury has difficulty obtaining the support they need. Specifically, the CM's role may be expected to include, as necessary:

- Co-ordinate placement, care, rehabilitation, and training
- Liaise between hospitals, clinics, day centres, education, social work, etc involved
- Liaise between such agencies and the person with brain injury and family members, care workers, etc
- Arrange further assessment, placement, etc
- Recruit, train, and supervise care workers

### **CEREBRAL HEMISPHERES**

The upper and main part of the brain, which is the seat of higher mental ability and is essential to the regulation of the emotions.

### **CEREBRO-SPINAL FLUID (CSF)**

The CSF bathes the brain and spinal cord. It is produced within the brain and where structural damage or blood clotting block its passage out of the brain, HYDROCEPHALUS (qv) results.

### **CLOSED HEAD INJURY**

The great majority of civilian head injuries are 'closed'. These are injuries in which the head has undergone a rapid change in velocity and has therefore been severely 'shaken about'. It should be distinguished from PENETRATING HEAD INJURY (qv) in which the skull is penetrated by a missile (eg bullet, shrapnel, other flying object).

### **COMA**

Deep unconsciousness. To make the definition more precise, Jennett & Teasdale have offered the definition: "*not obeying commands, not uttering words, and not opening the eyes.*" This is now generally used. In the GLASGOW COMA SCALE (GCS) (qv) scores range from 3 (least responsive) to 15 (most responsive). No point absolutely discriminates patients in coma from those not in coma. However, 90% of observations totalling 8 or less were within the definition of

coma and none of those whose scores totalled 9 or more; so that 8/9 is usually taken as the dividing line in terms of GCS.

#### **COMMUNITY-BASED REHABILITATION**

Brain Injury Rehabilitation in the community may be the approach of choice in some cases, and is a key component of the overall rehabilitation in others. The key long-term problems after brain injury (memory/cognitive deficits; emotional-behavioural problems) often lead to the major long-term problems of social isolation, loss of employment, and family breakdown. Given the nature of these problems, rehabilitation in the community often offers the advantage of making social reintegration faster and easier.

#### **COMPUTERISED TOMOGRAPHY**

See CT SCAN

#### **CORTEX**

The surface layer of the brain in which there is a dense concentration of neural matter.

#### **CRANIOTOMY**

An operation in which the skull is opened to make the brain accessible for surgery.

#### **CSF**

See CEREBRO-SPINAL FLUID

#### **CT SCAN**

The CT scan (computerised tomography) is a key investigation in the head injured. If there is reason to suspect intracranial complications, particularly the formation of a HAEMATOMA (qv) then a CT scan of the head (a "brain scan") should be carried out. This provides a 3 dimensional picture by means of a succession of 2 dimensional 'slices' and indicates the position and extent of any haematoma. The early detection of haematoma, and if appropriate its urgent removal by operation, are key elements in reducing mortality and morbidity following head injury.

*However:* the value of the CT scan must not be overestimated. For example, it cannot detect the diffuse microscopic damage which is characteristic of closed head injury. A 'normal' CT scan does not guarantee a normal brain.

#### **DEMENTIA**

A deterioration in higher mental ability. In the context of head injury, the term is used to mean a major reduction in reasoning capacity rather than impairment of such skills as MEMORY (qv) and ATTENTION (qv)

#### **DEPRESSED MOOD**

A persistent feeling of gloom. In such a state, individuals may take little pleasure in life and participate in few activities. It can be a persistent

state although it is less severe than a full-blown DEPRESSION (qv).

#### **DEPRESSION**

In a full-blown depression or depressive illness there is a feeling of gloom, hopelessness, and a lack of conviction that one can act effectively. The presence of some or all of the following is characteristic: loss of appetite, loss of libido, DIURNAL VARIATION (qv), feelings of worthlessness, feelings of guilt, suicidal intent.

#### **DIABETES INSIPIDUS**

A metabolic disorder in which there is deficient production of antidiuretic hormone caused by damage to the HYPOTHALAMUS (qv) or PITUITARY (qv). The patient passes a lot of water, and has a voracious appetite, but is weak and emaciated.

#### **DIFFUSE AXONAL INJURY**

Widespread and patchy shearing of the axons (nerve cells) which interconnect areas of the brain. Such damage is characteristic of severe CLOSED HEAD INJURY (qv).

#### **'DIGIT SPAN' SUBTEST**

A subtest of the WECHSLER (qv) Intelligence Scales in which the subject has to repeat from immediate memory progressively longer series of numbers. There are two parts: Forwards digit span, which is usually relatively normal after head injury; and Backwards digit span, which is often much reduced indicating limited concentration.

#### **'DIGIT SYMBOL' SUBTEST**

A subtest of the WECHSLER (qv) Intelligence Scales in which the subject writes the designated symbol beside a series of up to 90 numbers. This subtest requires mental speed, speed of writing, and reasonably good concentration.

#### **DIPLOPIA**

Seeing double. This is one of the more common sensory problems after head injury. It may result from dislocation of the eye or damage to the ocular muscles or the nerves.

#### **DISINHIBITION**

Behaviour which is socially inappropriate involving anger, boastfulness, possibly swearing, possibly inappropriate sexual advances, etc.

#### **DISORIENTATION**

1. Not being fully aware of one's location in time and place. Following head injury, disorientation in time and place is an indication that new information is not being properly registered, and means that the patient is still in the state of POST- TRAUMATIC AMNESIA (qv).

2. Left- right disorientation is a confusion between left and right.

#### **DIURNAL VARIATION**

A regular swing in mood, usually starting the day in deep depression but feeling less gloomy as the day progresses. This is one characteristic sign of DEPRESSION (qv).

#### **DOMINANT HEMISPHERE**

The side of the brain which controls language. In virtually all right handers this is the left hemisphere; in about 70% of non-right handers (ie in left handed and ambidextrous people) the left hemisphere is again dominant while the remainder are of right hemisphere or mixed dominance.

#### **DORSOLATERAL FRONTAL CORTEX**

See Appendix 1 and entries for FRONTAL LOBE and FRONTAL LOBE SYNDROME..

#### **DYS-**

See 'A- and DYS-'

#### **DYSARTHRIA**

An impairment of the ability to pronounce words (to be distinguished from DYSPHASIA (qv)).

#### **DYSMNESIA**

Impairment of MEMORY (qv). Dysmnestic patients may remember events long past perfectly well but have difficulty in remembering recent events.

#### **DYSPHASIA**

An impairment of the ability to use and/or understand language. Strictly, a lesser impairment than APHASIA (qv), but otherwise the same description applies.

#### **DYSPRAXIA**

An impairment of the ability to carry out actions such as dressing or copying a shape. Strictly, a less severe form of APRAXIA (qv).

#### **DYSTROPHY**

Degeneration with loss of function (usually applied to muscles).

#### **EEG (ELECTRO- ENCEPHALO- GRAM)**

A machine for measuring the electrical activity of the brain. Depending on level of alertness, the brain emits characteristic waveforms. Where there is damage to brain tissue there may be associated abnormalities on the EEG. There are also abnormal patterns characteristic of epilepsy.

#### **ENABLER**

See HOME SUPPORT WORKER (HSW).

#### **ENCEPHALITIS**

Inflammation of the brain.

#### **ENCEPHALOPATHY**

A general term for a disorder of brain function.

#### **EPILEPSY**

Abnormal electrical activity in the brain giving rise to fits or absences. The main forms are Grand Mal characterized by loss of consciousness and convulsions, and Petit Mal which takes the form of a momentary absence. Other forms are JACKSONIAN (qv) and STATUS EPILEPTICUS (qv). (See also PSYCHOMOTOR SEIZURES).

#### **EXTENSOR RESPONSE/POSTURING**

Extension of the muscles in response to a pain stimulus is a sign of serious brain injury. The extensor response is neurologically more primitive than the flexor or localizing responses. (See GLASGOW COMA SCALE).

#### **FIELD DEFICITS**

See VISUAL FIELDS

#### **FITS**

See EPILEPSY.

#### **FLEXOR RESPONSE**

Flexion of the muscles in response to a pain stimulus is a less serious sign than the EXTENSOR RESPONSE (qv). (See GLASGOW COMA SCALE).

#### **FOCAL**

A deficit is 'focal' if it implies local rather than generalized underlying brain damage. Thus, the focal neurological deficit of right hemiparesis implies damage to the left motor strip or its associated nerve fibres; and the focal neuropsychological deficit of poor verbal memory implies damage to the dominant (usually left) temporal lobe. There are other deficits (eg generalized dementia) which imply generalized brain damage.

#### **FRONTAL LOBE**

The front part of the brain (see Appendix 1). It may be divided into DORSOLATERAL AREA, ORBITO- MEDIAL AREA, and MOTOR STRIP (see Appendix 1). The first two make up most of the frontal lobe and give rise to the major 'frontal' symptoms. The characteristic function of the frontal lobes is to drive and monitor behaviour. While other parts of the brain are concerned with making sense of inputs, the frontal lobes are responsible for (1) driving outputs - for attention to task, for 'get up and go', and also (2) for regulating outputs - for ensuring social and sexual behaviour is appropriate to the situation.

#### **FRONTAL LOBE SYNDROME**

This has several elements. A common pattern related to damage to the dorsolateral frontal lobes, is loss of attention to task, manifested as

**PERSEVERATION** (qv) or as **LOSS OF SET** (qv). A second pattern, related to damage to the orbito-medial frontal lobes, is loss of **INHIBITION** (qv) which results in outbursts of temper, and inappropriate social and sexual behaviour.

#### **FUNCTIONAL**

The term 'functional' is used in opposition to 'organic'. Whereas 'organic' disorders are directly due to brain damage, 'functional' disorders represent a reaction to disability or to the horrific experiences of an accident. Disorders which are 'functional' may nevertheless carry a very poor prognosis (see **POST TRAUMATIC STRESS DISORDER**).

#### **FUNCTIONAL MRI (fMRI)**

Functional MRI visualises changes in chemical composition of brain areas or changes in the flow of fluids. Since blood oxygen level relates to brain activity, fMRI can correlate brain function with mental tasks.

#### **GCS**

See **GLASGOW COMA SCALE**

#### **GLASGOW COMA SCALE** (See Appendix 3).

This scale is used throughout the westernised world to measure level of responsiveness and to define coma and severity of head injury.

#### **GLASGOW OUTCOME SCALE**

This scale is used throughout the westernised world and beyond to measure outcome of head injury. For a fuller description, see Appendix 2.

#### **GOS**

See **GLASGOW OUTCOME SCALE**

#### **GRAND MAL**

A form of **EPILEPSY** (qv) in which there is loss of consciousness and generalized convulsions.

#### **GYRI** (singular: **GYRUS**)

The convolutions which make up the surface of the brain. (See also **SULCI**).

#### **HAEMATOMA**

A collection of clotted blood. The expansion of a blood collection can rapidly cause severe brain damage and death. The great majority of those patients who are conscious after the initial blow but subsequently die ('talk and die' cases) have developed haematomas.

#### **HEMIANOPIA** (see also **VISUAL FIELDS** and **HOMONYMOUS HEMIANOPIA**).

A loss of part of the visual field so that half of the visual field in each eye is lost. The exact area of vision lost depends on where in the complex visual pathways the damage occurs.

#### **HEMIPARESIS**

A weakness of a limb (or limbs) so that useful function is lost or limited.

#### **HEMIPLEGIA**

A loss of movement in a limb (or limbs). If this is combined with spasticity, the affected limb is fixed and rigid.

#### **HOME SUPPORT WORKER (HSW)**

The concept of 'carers' for individuals who have had a brain injury is only appropriate sometimes – with the most disabled. Many persons who have had brain injury do not need care so much as prompting with some tasks, and a degree of assistance with others. Therefore enablers/home support workers (HSWs) are often more appropriate. The HSW has to have enough appreciation of the effects on the injured person to know what to do for them and what to prompt them to do.

#### **HOMONYMOUS HEMIANOPIA**

The most common form of hemianopia, in which the same (left or right) half of the visual field is lost in both eyes.

#### **HYDROCEPHALUS**

"Water on the brain". An excess of **CEREBRO-SPINAL FLUID** (qv) becomes trapped inside the ventricles of the brain, compressing brain tissue by pushing it outwards. This is potentially very damaging and may occur as a complication after head injury.

#### **HYPOTHALAMUS**

A gland in the mid part of the brain which is responsible for controlling many aspects of basic body functions.

#### **HYSTERIA**

A mental disorder which appears on the surface to be a physical symptom. For example, a seeming paralysis which is not based on physical impairment but is a manifestation of mental distress would be called an 'hysterical paralysis'. Obviously care needs to be taken to distinguish such a disorder from frank malingering and faking of symptoms.

#### **IMPAIRMENT**

A cognitive function, such as memory, is said to be impaired if the individual performs less well than would be expected in the light of estimated **PREMORBID ABILITY** (qv). Cognitive impairments may be subtle (a loss of sharpness) through to severe (a major handicap).

#### **INATTENTION**

See **NEGLECT**.

## **INFARCT**

An area of dead or damaged tissue (eg brain tissue) resulting from loss of oxygen due to a vascular event, which causes blockage or arterial spasm.

## **INHIBITION**

The 'damping down' of basic reactions, so that socially acceptable behaviour is maintained.

Disinhibited patients may be prone to angry outbursts for little cause, boastfulness, swearing in inappropriate situations, unacceptable sexual advances, etc.

## **INTACT** (and 'grossly intact')

Showing normal function. 'Grossly intact' means that on fairly cursory examination, no deficit was detected.

## **INTRACRANIAL HYPERTENSION**

Increased pressure within the skull, often the result of swelling (oedema). An episode of high intracranial pressure can devastate the brain in a short period.

## **INTRACRANIAL PRESSURE (ICP)**

The pressure within the skull. See INTRACRANIAL HYPERTENSION.

## **ISCHAEMIA**

Diminished supply of blood. The brain's supply of blood may be diminished by other injuries (eg to the chest) or by impaired PERFUSION (qv).

## **JACKSONIAN FITS**

Local spasm, affecting one side of the body or limb, due to irritation/damage to a particular area of the brain. (See also EPILEPSY).

## **LATERALIZING**

Deficits which point to dysfunction on one side of the brain are said to have 'lateralizing' value. A left hemiparesis points to right hemisphere damage and vice versa. Similarly, in most people, verbal deficits indicate left hemisphere damage, and visuo-spatial deficits indicate right hemisphere damage.

## **LOBE**

There are four lobes on each side of the brain. See Appendix 1 and the entries for **FRONTAL**, **TEMPORAL**, **PARIETAL**, and **OCCIPITAL LOBE**.

## **LOCALIZING**

(1) Localizing to pain: When assessed on the **GLASGOW COMA SCALE** (qv), the best response to the pain stimulus is to 'localize to pain' ie to brush away the source of the discomfort. (2) A deficit has 'localizing' value if it points to dysfunction in a particular area (eg a particular lobe, or part of a lobe) in the brain.

There is an enormous scientific/medical literature tracing the connections between structural damage to areas of the brain and specific higher mental functions. It is important that when you obtain a psychological assessment, you obtain it from a **NEUROPSYCHOLOGIST** (qv) who has a grasp of this literature.

## **LOCKED IN STATE**

This is virtually unknown after serious head injury although relatives often believe otherwise. It results from a rare kind of stroke affecting part of the brain stem, which connects brain and spinal cord. The patient is tetraplegic and mute but responsive and sentient. Communication may be by coded blinking, jaw or eye movements which are all spared.

## **'LOGICAL MEMORY' TEST**

A test of verbal memory from the **WECHSLER** (qv) scales in which a paragraph is read to the patient who is to recall as much as he/she can, both immediately and after a delay of about 30 minutes.

## **LOSS OF SET**

See **SET**.

## **MAGNETIC RESONANCE IMAGING (MRI)**

Like the **CT SCAN** (qv) the **MRI** (or **MR**) scan produces, in effect, 3-D images of the brain. Unlike **CT**, it is not the 'workhorse' of radiology departments but is used for more specialised investigations.

## **MALINGERING**

Presenting with symptoms which are incompatible with the severity of injury and in which there is clear evidence of the conscious attempt to deceive.

## **MAXILLO-FACIAL INJURY**

This refers to damage to the soft tissues and bones of the face. It is very common after severe head injury and may cause scarring with obvious cosmetic implications.

## **MEMORY**

The process of storing, retaining and subsequently retrieving information. Memory is almost always adversely affected after significant head injury. Individuals who have had such injury often say their "short term memory" is affected.

Psychologists have a technical meaning for the term, and prefer the term "recent" memory to describe the memory problem after head injury. The memory problem after head injury is often that day-to-day events, arrangements for appointments, conversations, etc may be forgotten, things may be mislaid, and shopping

and various tasks may be forgotten etc. By contrast, remote memory, memory for things that happened many years ago, is usually spared. The failures of recent memory are of two main types. In right-handed people (and most left-handers), damage to the left side of the brain impairs memory for verbal information, yet leaves memory for visuospatial information intact. Right-sided brain damage leads to the opposite pattern (impaired visuospatial, but preserved verbal memory).

#### **MIGRAINE**

A localized headache often associated with visual sensations, nausea and malaise. It is not common after head injury, but is a recognised rare sequel of minor head injury.

#### **MOTIVATION**

A condition of inner drive or energy enabling the achievement of goals or needs. This energy or drive can be disturbed by brain damage, particularly damage to the frontal parts of the brain. Such patients are sometimes dismissed as "difficult", but care must be taken not to confuse "can't" with "won't".

#### **MOTOR DISORDERS**

Disturbances in the ability to move. These are common after very severe injury, but many patients go on to make remarkably good recoveries in this respect. The deficits may involve any or all of the limbs or extremities, or trunk. They may include weakness ("-paresis"), inability to move ("-plegia"), or unco-ordinated or involuntary movements (chorea, athetosis, etc).

#### **MOTOR STRIP**

The area of cortex (see Appendix 1) which controls physical movement. The left sided cortex controls the right side of the body and vice versa.

#### **MRI SCAN**

See MAGNETIC RESONANCE IMAGING.

#### **NEGLECT**

A common consequence of damage to the right cerebral hemisphere in which the patient ignores (neglects) the right side of space and often the right side of the body (failing to wash or shave or dress the right half of the body). It is not common after head injury except in the very acute early stages.

#### **NEURASTHENIA**

A term no longer in use, referring to a neurosis.

#### **NEUROENDOCRINE DISORDER**

A wide range of medical complications following damage to important glands in the brain. The most important glands are the hypothalamus and

pituitary. Damage to the pituitary or hypothalamus can lead to DIABETES INSIPIDUS (qv), which often recovers spontaneously within the first year after injury. Damage to the hypothalamus can lead to disorders of eating, heat regulation and sleeping.

#### **NEUROPATHOLOGY**

The study of the gross and microscopic changes in the brain and nervous system.

Neuropathological studies of the brains of patients who died following head injury have been invaluable in identifying the main causes of death and disability (in patients who survive).

#### **NEUROPSYCHOLOGIST**

A person with a degree in psychology and specialist training or experience in the practice of neuropsychology. The study and practice of neuropsychology involves the identification, analysis and treatment of the cognitive, behavioural and affective consequences of brain damage.

#### **OCCIPITAL LOBES**

The rear part of the brain (see Appendix 1) which is vital in vision. Destruction of both left and right occipital lobes leads to complete blindness ("cortical blindness"), but this is very rare after head injury. However, lesser degrees of visual impairment resulting from occipital damage are often seen.

#### **OCCUPATIONAL THERAPY**

A range of treatments administered by Occupational Therapists (OTs). These therapists are specialists in enabling patients to achieve performance in aspects of daily life. These include ACTIVITIES OF DAILY LIVING (qv) or ADLs, such as washing, dressing and toileting, and advanced ADLs, such as planning, budgeting, etc. Occupational therapy may involve practice and training within a hospital or clinic, or within the patient's home. Such therapists may be expert in the use of aids and adaptations to assist patients in ADLs.

#### **OEDEMA**

A condition of swelling of tissues. The brain may swell after a severe head injury, and this is a very serious complication necessitating neurosurgical management. The problem is that the swelling, by compressing brain tissue against the skull, or by forcing brain down into the top of the spine can cause death, or further serious brain damage.

#### **OLFACTORY NERVE**

One of the cranial nerves (the first nerve). This nerve is responsible for allowing us to smell. Loss

of the sense of smell (ANOSMIA – qv) is quite common after head injury as this nerve sits at the front of the brain in an area often damaged in head injury.

#### **ORBITO-MEDIAL CORTEX**

See Appendix 1.

#### **PACED AUDITORY SERIAL ADDITION TASK (PASAT)**

A demanding test of attention in which the patient hears a series of numbers. He must add the 2nd to the 1st; the 3rd to the 2nd; the 4th to the 3rd; and so on. Performance is often severely impaired after head injury. Along with memory performance, performance on PASAT and similar measures is a key predictor of ability to return to work after brain injury.

#### **PARIETAL LOBE**

The part of the brain located above and behind the temples (see Appendix 1). The parietal lobe deals with the perception of touch and the integration of all the senses. Damage here can lead to varied consequences ranging from a difficulty in mathematics (dyscalculia) to a failure to recognise previously well-known faces.

#### **PASAT**

See PACED AUDITORY SERIAL ADDITION TASK.

#### **PENETRATING HEAD INJURY**

This kind of head injury is caused by a bullet or other missile. The effects differ from CLOSED HEAD INJURY (qv): in penetrating head injury the particular part of the brain destroyed determines the effects which can be highly variable.

#### **PERFUSION**

This is the process by which the brain is supplied with blood and therefore oxygen. The process is complicated and not yet fully understood. Where blood pressure falls, or where INTRACRANIAL HYPERTENSION (qv) creates resistance to normal blood flow, perfusion may be impaired. The damaged brain is less good at making normal adjustments in arterial size to 'autoregulate' blood flow, adding a further complication. Obviously, this problem requires skilled neurosurgical management.

#### **PERSEVERATION**

A common consequence of frontal brain damage. The perseverating patient shows inert and often stereotyped behaviour. He is rigid and may repeat action sequences or phrases. He may answer a question in a way that was appropriate for the previous question, but is no longer appropriate.

#### **PERSISTENT VEGETATIVE STATE (PVS)**

A state following very severe injury in which patients remain speechless and devoid of any meaningful contact with others. Patients show sleep/wake cycles but no evidence of conscious awareness. The condition is due to very extensive damage to the fibres under the cerebral cortex. PVS should be distinguished from the LOCKED IN STATE (qv).

#### **PERSONALITY**

A habitual tendency to feel, think, and behave in certain ways. Personality change is common after severe head injury, particularly when there is damage to the frontal or temporal lobes. The change is very often negative; unpleasant aspects of personality (eg aggression, boastfulness) which before injury were suppressed, may become prominent and may prevent the patient returning to his previous occupation, or even to his family.

#### **PITUITARY**

Gland in the base of the skull which secretes hormones necessary for the regulation of various bodily systems.

#### **PLANNING**

Disturbances in planning are a common and potentially disabling consequence of damage to the frontal parts of the brain.

#### **POST-CONCUSSIONAL SYNDROME (PCS)**

A group of symptoms including headache, vertigo, poor memory and concentration and anxiety and depression. Soon after concussion it is thought that these are a direct result of injury to the brain. If unduly prolonged, it is thought that psychological factors are responsible. Many patients who show a prolonged PCS have signs of premonitory personality or situational factors which are likely to predispose them to develop a neurotic condition. Neuropsychological assessment may clarify the nature of the condition.

#### **POST-TRAUMATIC AMNESIA (PTA)**

The period between the injury and regaining day-to-day memory so that the patient knows where he is, what happened to him, etc. The period of PTA always includes the period of coma. PTA duration is a good index of the severity of the underlying brain damage. Its significance is discussed in Appendix 4.

#### **POST-TRAUMATIC EPILEPSY**

A well recognised complication of head injury. Predictive factors for the development of epilepsy include haematomas, long post-traumatic amnesia, penetrating injury, depressed fracture

and a seizure within the first week after injury. Most patients who go on to develop epilepsy do so within the first 5 years after injury, but the risk may still be present thereafter. For the patient there are the obvious psychosocial consequences (stigma, driving, employer's reluctance) and side effects of some kinds of anticonvulsant medication (slowing, poor memory).

#### **POST-TRAUMATIC PSYCHOSIS**

A PSYCHOSIS (qv) following head injury. This is a rare condition found more with missile wounds than the blunt head injuries of civilian life. It has been associated particularly with damage to the TEMPORAL LOBES (qv) of the brain and with dementia.

#### **POST TRAUMATIC STRESS DISORDER (PTSD)**

PTSD may arise after an extreme traumatic stressor. Such events may include disasters (natural or man-made), assaults, or serious accidents. It is possible for prolonged stress (eg being a hostage) as well as sudden horrific events to cause PTSD. Symptoms include repeated flashbacks, an inability to stop dwelling on the event, feeling of detachment/estrangement from others, sleep disturbance, and difficulty concentrating. There is now a large medical/scientific literature documenting the various aspects of PTSD, which can be a very long lasting disorder. However, it is very rare after brain injury, as the injured person does not remember the accident/injury due to RETROGRADE AMNESIA (qv) and POST - TRAUMATIC AMNESIA (qv).

#### **PREFRONTAL**

The extreme front of the brain. This part of the brain plays a part in many of the "highest" human functions such as planning, envisaging the consequences of actions, recognising the effects of one's behaviour on others, etc, etc. Damage here can leave the patient looking perfectly normal, yet rendering him profoundly inert, "concrete" and simplistic in thinking and behaviour. The resulting personal and social handicap can be very profound.

#### **PREMORBID ABILITY**

Level of intellectual ability before a brain injury. This may be gauged in broad terms from the individual's educational/occupational history. There are also specialised neuropsychological tests which can measure previous ability. These tests measure a (verbal) ability which is robust to the effects of brain injury and is also related to IQ.

These measures therefore provide a kind of permanent marker of how intelligent someone has been, and can be used (eg) after brain injury, in individuals who are dementing, etc.

#### **PSYCHOMOTOR SEIZURES**

A kind of epilepsy arising from scar tissue in the temporal lobes of the brain. The patient shows abnormal repetitive and stereotyped patterns of behaviour.

#### **PSYCHOSIS**

A severe disorder of behaviour, feeling, and thinking. Contact with reality is impaired, and there may be hallucinations and delusions. The psychoses may be classified into "organic" (dementia) and "functional" (depression and schizophrenia). Both are very rare sequelae of blunt head injury.

#### **PSYCHOSOCIAL PROBLEMS**

The changes in behaviour and affective status in the patient, following head injury, and the effect these changes have on those around the patient, particularly his immediate family.

#### **RADIOGRAPHY/RADIOLOGY**

The theory and practice of the use of x-rays in the diagnosis and management of patients following head injury. A more modern term is that of "brain imaging" which refers to the use of various computer-based techniques to picture or "image" the brain. The commonest methods are CT SCANS (qv) and MRI SCANS (qv). These allow the production of pictures or "slices" (tomography) of the brain and are crucial in the detection of complications such as bleeding inside the head or brain.

#### **REACTION TIME (RT)**

The fastest speed of response that a person can achieve. It is often tested by having the patient press a button in response to a light ("simple RT"), or press one of a series of buttons depending which of a series of lights comes on ("choice RT"). Choice reaction time is invariably delayed after severe head injury.

#### **READING**

Disorders of reading (dyslexia) are found after left-sided brain damage but are not common in head injury except in the early acute stages.

#### **REHABILITATION**

The process after that of immediate medical/surgical care by which the patient is assisted in achieving his full physical, cognitive, behavioural, social and occupational potential. The 2 main phases are acute (starting just after

initial medical/surgical care) and transitional (bridging the gap back to community re-entry).

#### **RETROGRADE AMNESIA (RA)**

The period of amnesia for events before the injury. This is almost always much less than the period of POST TRAUMATIC AMNESIA (qv) and is not as good a predictor of outcome as PTA. However, given that there is a period of RA and PTA where significant head injury occurs, it means that the patient will not remember the moment of impact nor, usually, the events leading up to it. Due to RA (and also PTA), it is rare to find POST TRAUMATIC STRESS DISORDER (qv) after brain injury.

#### **REY FIGURE**

A psychological test in which the patient copies and then draws from memory, a complex asymmetric geometric design. The copy gives information about the patient's perceptual and constructional abilities. The recall gives information about non-verbal memory.

#### **RHINORRHOEA**

A leak of CEREBRO-SPINAL FLUID (qv) from the nose. This is a serious complication which shows that there has been a fracture of the base of the skull, thereby rendering the patient at risk of intracranial infection.

#### **RIGHT-LEFT CONFUSION**

A problem in spatial ability manifested as a difficulty in distinguishing left from right. This is a complex and ill-understood problem that may follow damage to the left parietal lobe of the brain. Also called "right-left disorientation".

#### **SCOTOMA**

A hole in the visual field resulting from damage to fibres in the visual system of the brain. The location and size of the scotoma helps the neurologist or neurosurgeon in locating the damage. Patients may be unaware of scotomas, due to the ability to "complete" the missing information and to use visual scanning to compensate.

#### **SECONDARY BRAIN DAMAGE**

A range of complications which may follow the primary impact damage. Common complications include brain swelling, bleeding inside the head or brain, infection of the brain or its coverings.

#### **SEIZURES**

See EPILEPSY.

#### **SET**

The capacity to maintain a consistent approach to a task is called 'set'. Where patients suffer 'loss of set' (usually after frontal lobe damage) they are

unable to maintain a consistent approach to a task. This is not a memory failure (they may be able to tell you exactly what they should be doing) but a failure of the 'programmes' that direct behaviour.

#### **SEVERITY (of blunt head injury)**

The main indices of severity are the depth and duration of coma – assessed using the GLASGOW COMA SCALE (qv) – and duration of POST-TRAUMATIC AMNESIA (qv). Where there is a need for an intracranial operation, that in itself suggests that the injury was serious. (See also Appendices 3 and 4.)

#### **SHEARING**

The mechanism by which nerve fibres are damaged or destroyed in blunt head injury, leading to the tearing of the main processes (axons) of the nerve fibres in a widespread, patchy fashion. Hence the description "DIFFUSE AXONAL INJURY" (qv).

#### **SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY**

See SPECT

#### **SKULL FRACTURE**

A possible element of head injury. A linear fracture may be of little significance of itself. The problem is that it may act as a route for infection of the brain or its coverings. A depressed fracture is usually more serious, as a route for infection and a source of direct brain damage by in-driven fragments of the skull.

#### **SPATIAL DISORDERS**

These are found with damage to the posterior portions of the brain. They are common in the early phase after injury, but less common later, unless the injury was very severe or focally located at the rear of the brain. Patients with spatial disorders may have difficulty in judging distances or angles; they may have problems in recognising previously familiar faces, or in finding their way around in familiar or unfamiliar places.

#### **SPECT (Single Photon Emission Computed Tomography)**

A slightly radioactive tracer is injected into the body and taken up in the brain, showing which parts of the brain are active.

#### **SPEECH DISTURBANCE**

A distinction should be made between problems of speech (dysarthria or anarthria) and of language (dysphasia or aphasia). Both happen commonly, but through different kinds of brain damage. The speech problems are probably more common than the language problems, but both

can interfere with return to work. The Speech and Language Therapist is skilled at dealing with both problems (see also SPEECH AND LANGUAGE THERAPY.)

#### **SPEECH AND LANGUAGE THERAPY (SALT)**

A range of treatments administered by Speech and Language Therapists (SALTs). These therapists are specialist in helping patients deal with a wide range of disorders of communication including DYSPHASIA (qv).

#### **STATUS EPILEPTICUS**

A continuous series of epileptic fits. Unless vigorously treated the patient may become exhausted and die.

#### **SULCI (Singular: SULCUS)**

The furrows in the brain between the GYRI (qv).

#### **TEMPORAL LOBES**

The parts of the side of the brain which are located adjacent to the temples. Damage to the temporal lobes can lead to cognitive, behavioural and physical disorders. The cognitive disorder is memory; the behavioural disorder ranges widely, including changes in anger and sexuality; the physical disorder is epilepsy. The memory disorder is likely to be "lateralized"; a left temporal disorder leading to disturbed verbal memory but preserved non-verbal memory. The opposite pattern is found with right temporal damage (with some exceptions).

#### **VENTRICLES (Cerebral ventricles)**

A series of fluid-filled spaces inside the brain. The fluid they contain is CEREBRO-SPINAL FLUID (qv). They can be seen on brain images. Enlargements of the ventricles can indicate increased pressure inside the brain or the loss of brain cells.

#### **VISUAL DISTURBANCES**

Patients with damage to the "visual system" may have characteristic disturbances in which they have holes ("scotoma") or gaps in their VISUAL FIELD (qv). These are due to damage to the fibres or cells involved in the transmission or interpretation of visual information.

#### **VISUAL FIELDS**

The range within which we can see without moving our eyes. Restriction in this range follows damage to the visual system of the brain. (See also HEMIANOPIA.)

#### **WECHSLER**

David Wechsler (1896-1981), a Roumanian-born psychologist, was for many years chief psychologist at the Bellevue Psychiatric Hospital in New York and developed the Wechsler-Bellevue Intelligence Scale, which became the Wechsler Adult Intelligence Scale (WAIS), as well as various other scales. His first measures were introduced in 1939, and the Psychological Corporation continues to develop and build on his work. These are generally considered the best psychological measures in terms of reliability and validity and the most recent versions, including WAIS-III, have very extensive normative data available including UK data collected by teams of collaborators.

#### **WERNICKE'S AREA**

The part of the brain (see Appendix 1) which decodes incoming language. Where it is damaged there will be receptive DYSPHASIA (qv) in which words sound unintelligible, as if in a strange foreign language.

#### **WRITING**

Disorders of writing ("Dysgraphia") sometimes follow head injury. Except in the very early stages they are not common.

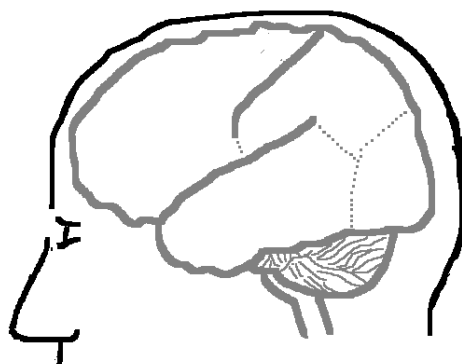
#### **X-RAY**

See "Radiography/Radiology"

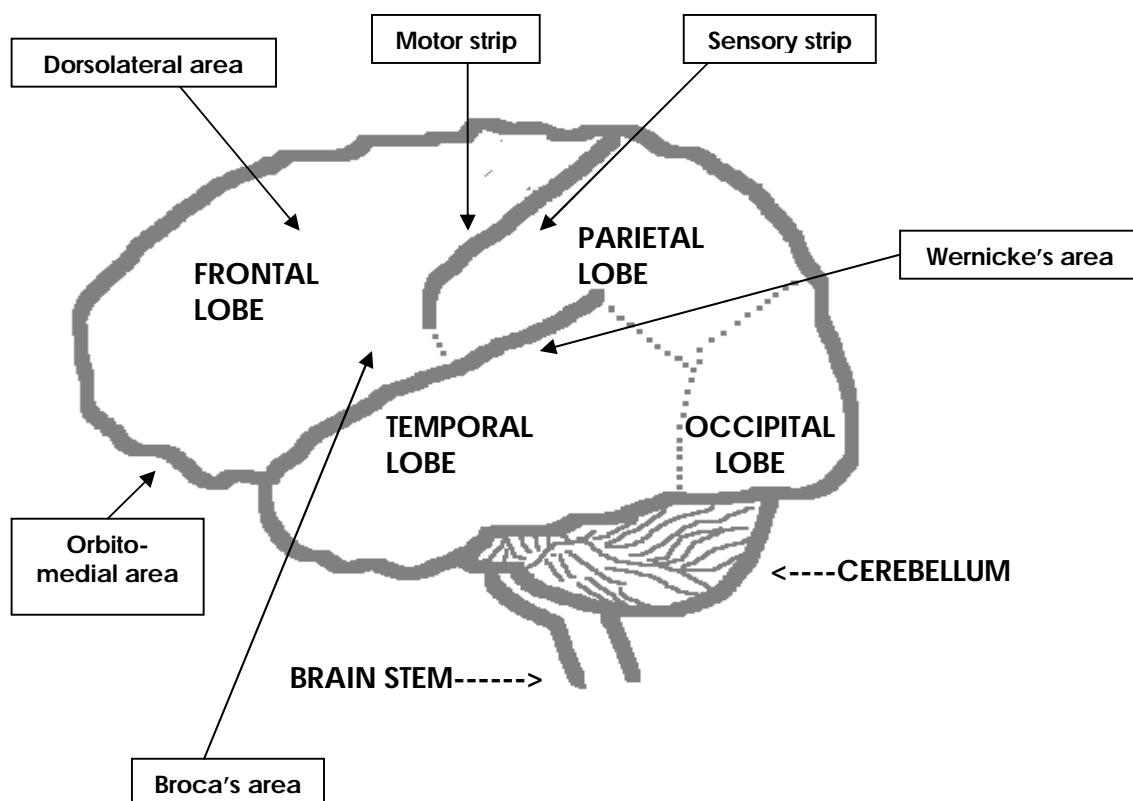
## Appendix 1

### Outline diagrams of the brain

In these diagrams, the brain is viewed from the left hand side.



The main diagram below shows the brain from the left hand side (as illustrated above).



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## **Appendix 2**

### **Glasgow Outcome Scale**

Reference: Jennett B et al: Disability after severe head injury: Observations on the use of the Glasgow Outcome Scale. Journal of Neurology Neurosurgery and Psychiatry 44: 285, 1981.

This scale has been widely used in research and is very useful in that context for giving a broad impression of outcome very quickly. However, it is too crude for medico-legal evaluation. For example, it has been shown that patients classified as 'Good Recovery' (GR) may have very considerable deficits. Many GR patients will not in fact be able to resume employment.

The scale classifies all individuals under 5 categories:

**1 DEATH**

**2 VEGETATIVE STATE**

No behavioural evidence of cerebral cortical function. Patients may open their eyes, sometimes follow with their eyes, but never speak nor make any "psychologically meaningful" response. They do not obey even simple commands, and do not utter even simple words.

**3 SEVERE DISABILITY (conscious but dependent)**

Dependent on another person for some activity during every 24 hours. The worst are physically disabled, or marked dysphasia may be the major handicap. Marked handicaps in such cases are associated with severely restricted mental activity; however some patients are physically well but are so affected mentally that they require permanent supervision.

**4 MODERATE DISABILITY (independent but disabled)**

Can look after themselves, can travel by public transport, and some may be capable of work which may be sheltered work. Most "moderately disabled" after head injury have memory deficits and/or personality changes and/or hemiparesis, ataxia, dysphasia, epilepsy, etc.

**5 GOOD RECOVERY**

The definition notes that this "need not imply the restoration of all normal functions". However, "the patient is able to participate in normal social life" and "could" return to work (but may not have done so). However, in practice 'Good Recovery' is often used simply to denote a better state of affairs than 'Moderate Disability' - studies have found considerable deficit in such patients including an inability to resume work on the open market.

### **Appendix 3**

#### **Glasgow Coma Scale (GCS)**

Reference: Teasdale G, Jennett B: Assessment of coma and impaired consciousness: A practical scale. Lancet 2: 81, 1974.

GCS is used to measure level of responsiveness. It provides a measure of the severity of brain injury (although POST-TRAUMATIC AMNESIA (qv) most also be considered). It also allows the patient to be monitored, as any decline in level of responsiveness would raise the question of whether there were developing intra-cranial complications. Responsiveness is measured in three domains:

#### **EYE OPENING**

Spontaneous=4; To speech=3; To pain\*=2; Nil=1

#### **BEST MOTOR RESPONSE**

Obeys=6; Localizes pain\*=5; Withdraws from pain\*=4; Abnormal flexion\*=3; Extensor response\*=2; Nil\*=1

**VERBAL RESPONSE** Orientated=5; Confused conversation=4; Inappropriate words=3; Incomprehensible sounds=2; Nil=1

\* A STANDARD BUT HARMLESS PAIN STIMULUS IS ADMINISTERED, USUALLY BY ROLLING AN OBJECT OVER THE EYEBROW, OR TWISTING A NIPPLE.

The total score ranges from 3 (worst) to 15 (best). It has become common to describe a total GCS score after resuscitation as indicating degrees of severity of brain injury as follows:

3-5 "very severe"

6-8 "severe"

9-12 "moderate"

13-15 "minor".

However, this classification is not universally accepted and the duration of POST-TRAUMATIC AMNESIA (qv) should not be overlooked as a guide to severity.

## **Appendix 4**

### **Duration of Post Traumatic Amnesia (PTA) is a key yardstick of the severity of injury.**

A version of this classification was originally proposed by N Brooks and W McKinlay in "Evidence and Quantification in Head Injury – Seminar Notes" (unpublished material, 1989). A further version appears in a chapter by WW McKinlay & AJ Watkiss: "Cognitive and behavioural effects of brain injury" In M Rosenthal (ed) "Rehabilitation of the Adult and Child with Traumatic Brain Injury", 3<sup>rd</sup> Edition, Philadelphia: FA Davis Company, 1999.

PTA is the period between the injury and regaining day-to-day memory so that the patient knows where he is, what happened to him, etc. It includes the period of coma. In some cases there is long PTA (suggesting severe injury) while the Glasgow Coma Scale score was never particularly low (suggesting the injury was not severe). In these circumstances, PTA is generally the preferred index as there is a group of head injured patients with severe injury and poor outcome who have long PTA but whose GCS is never low.

The significance of PTA duration may be gauged in broad terms by the following summary:

**PTA 1 DAY OR LESS** Expect quick and full recovery with appropriate management. A few may show persisting disability, usually so-called "post-concussion syndrome".

**PTA OVER 1 DAY, LESS THAN 1 WEEK** Recovery period more prolonged - now a matter of weeks or months. Full recovery possible, for most of these cases, with good management.

**PTA 1 TO 2 WEEKS** Recovery a matter of many months. Many patients will be left with residual problems even after "recovery" process has ended but one can be reasonably optimistic about functional recovery (taking up employment, social activities, etc) with good management.

**PTA 2 TO 4 WEEKS** Process of recovery will be very prolonged - 1 year or even a little longer would not be unusual. Permanent deficits are likely. There must be increasing pessimism about functional recovery when PTA reaches these lengths.

**PTA OVER 4 WEEKS** Permanent deficits, indeed significant disability, now certain. It's not just a matter of "recovery" but of long-term retraining and management.

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