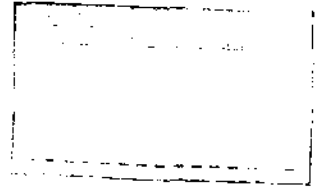


Dr. William Lawler, M.D., F.R.C.Path.



## Re: Robert HAMILL (deceased)

Further to my report, dated November 23<sup>rd</sup>, 2005, I have been asked to provide definitions of some of the medical terms used, not only by me but also by others, in this case.

For convenience and, hopefully, for ease of use, I have arranged the terms which I have been asked to explain, in alphabetical order.

**AUTOLYSIS**: This is the change which occurs after cell death whereby the enzymes within the cell cause destruction (i.e. lysis) of the cell contents. This is an inevitable post mortem change, and it may be apparent within a few hours of death. Hence **AUTOLYTIC**.

**CARDIO-RESPIRATORY ARREST**: This is a state where the patient's heart has stopped beating and he/she has also stopped breathing. It is, of course, an indication of somatic death, but intense resuscitation very soon after its onset, including cardiac massage, artificial ventilation and, possibly, drug administration, may restore cardiac activity; if successful, this may then be followed by restoration of spontaneous breathing.

**CHLORPROMAZINE**: This is a drug (major trade name **LARGACTIL**) of the chemical group **PHENOTHIAZINE**, and it is used largely as a **neuroleptic**, - i.e. to treat various psychiatric conditions or states, including schizophrenia, paranoid psychosis, mania, anxiety, agitation, and violent or dangerously impulsive behaviour.

**CHOREA**: This is a series of involuntary, unpredictable, irregular, jerky and explosive movements which flit from one part of the body to another in

random sequence. Each muscle contraction is brief, and it often appears as a fragment of what might have been a normal movement.

**COAGULASE NEGATIVE STAPHYLOCOCCI:** Please see below under STAPHYLOCOCCI.

**COLIFORM BACTERIA:** This is a convenient collective term for a group of bacteria which are capable of causing clinically significant gastrointestinal tract infections. They are identified in the microbiology laboratory because they are able to ferment lactose, and they include *Escherichia coli*.

**CORTICAL TUBULE CHANGES ARE ISCHAEMIC:** The kidney is a very complex organ which primarily filters waste products from the blood, and the cortical tubules, which can be seen microscopically, contribute significantly to that filtration. An important feature of these tubules is that they are particularly sensitive and susceptible to inadequacy of blood supply to the kidney (i.e. to **ischaemia**), for whatever reason.

In this case, I am sure that the **ischaemic cortical tubule changes**, seen histologically, reflect prolonged hypotension (low blood pressure).

**DYSPHAGIA:** This is a difficulty in swallowing. At its worst, it represents a complete inability to swallow.

**DYSTONIA:** These are sustained spasms of muscle contraction which distort the body (i.e. limbs and trunk) into one or more fairly characteristic postures which include a twisted, flexed or extended neck, an arched or twisted back, an outwardly rotated forearm, and a downwardly flexed foot. Dystonic spasms may be intermittent, repetitive or prolonged.

**ENTEROCOCCI:** This is a rather non-specific collective term used to include all the various streptococci (a group of bacteria) which normally reside in the lower part of the gastrointestinal tract. The general point about enterococci is that they are harmless when within the intestines, but that they can cause clinically significant infections if they are able to gain access to other areas of the body, - e.g. the blood stream, skin wounds, the kidneys or the heart valves.

**FRONTAL LOBE ATROPHY:** The front part of each of the hemispheres of the brain is referred to as the frontal lobe. The term atrophy refers to a loss of size or bulk, and histologically, there is a reduction in the number of cells present.

Frontal lobe atrophy is a rather non-specific finding. In elderly patients, it may be associated with dementia, but in younger individuals, as here, I do not think that it has any clinical significance.

**GLASGOW COMA SCALE (GCS):** This is a very widely used and reliable measure of conscious level and coma, and it is calculated by subjective assessment of the circumstances in which a patient opens his eyes, plus his best verbal response to questions, and plus his best physical reaction to commands and pain. The scoring system is such that a fully conscious individual will score 15 out of 15, whilst the most deeply unconscious patient will score 3 out of 15; not surprisingly, degrees of unconsciousness or coma between these two extremes will score accordingly.

The major intention of the **GCS** is to detect changes, sometimes very subtle, in the level of consciousness, and it seems to be very successful in so doing, even when different observers are responsible for sequential examinations.

**HAEMOCONCENTRATION:** This is a generalised increase in the concentrations of all the various constituents of the blood, including the cells, the proteins, the enzymes, and the electrolytes. Several causes exist, the commonest being dehydration, - and I think that this is the explanation in this particular case.

**HYPOTENSION:** This is a sustained fall in the systemic blood pressure from the "normal" levels of (very) approximately 120/80 mm Hg.

**HYPOXIC/ISCHAEMIC CHANGES:** By definition, **HYPOXIA** is the inadequacy of oxygen supply to organs or tissues; in contrast, **ISCHAEMIA** represents inadequacy of blood supply to the relevant area. In practice, both often occur simultaneously, at least to a greater or lesser extent, - e.g. during **CARDIO-RESPIRATORY ARREST** (please see above), where failure of respiration causes hypoxia and cessation of the heart produces ischaemia.

Pathologically, the changes produced in the affected tissues are essentially the same, whether the causative mechanism is hypoxia or ischaemia, - hence the apparently rather generic term **HYPOXIC/ISCHAEMIC CHANGES**.

**INTRA-ALVEOLAR HAEMORRHAGE**: Alveoli are the terminal air sacs within the lung substance. Normally, they contain air (for gaseous exchange), but under a wide range of circumstances, they may contain extravasated red blood cells, - i.e. **INTRA-ALVEOLAR HAEMORRHAGE**. Often intra-alveolar haemorrhage is a non-specific finding, especially when, as here, there is a rather aggressive illness and there has been unsuccessful cardio-pulmonary resuscitation following **CARDIO-RESPIRATORY ARREST** (please see above).

**INTRATUBULAR CASTS**: These are proteinaceous deposits within cortical tubules as seen histologically on microscopic examination of the kidney. They occur under various circumstances, but the one relevant to this case is in association with **MYOGLOBINURIA** (please see below).

**LEUCOCYTOSIS**: This is an increase in the concentrations of the various white cells within the blood. It often reflects some form of infection somewhere in the patient's body, but it does occur in **HAEMOCONCENTRATION** (please see above), - and I think that this was the cause in this case.

**MACROPHAGES**: These are scavenger cells, and they can be seen in the blood and in most organs and tissues. They normally ingest a wide range of foreign cells, debris and pigments in order to neutralise or to destroy them. In this case, microscopic examination of the lungs showed intra-alveolar macrophages containing pigment; these are not uncommon, and the pigment, which almost certainly was inhaled, is usually derived from smoking cigarettes or, sometimes, cannabis.

**MYOGLOBINURIA**: Myoglobin is a protein, found within skeletal muscle fibres, which acts as an oxygen store. When there is damage to skeletal muscles, whatever the cause, myoglobin gains access to the blood stream and it is then filtered out by the kidneys into the urine, - thus producing **MYOGLOBINURIA**. When there is significant myoglobinuria,

microscopic examination of the kidneys may identify the myoglobin within the cortical tubules, and it will be seen as **INTRATUBULAR CASTS**.

The significance of these findings in this case is that the **NEURILEPTIC MALIGNANT SYNDROME** (see below) is one of the many well recognised causes of skeletal muscle damage and the consequent release of myoglobin to produce **MYOGLOBINURIA** and **INTRATUBULAR CASTS**.

**NASOGASTRIC FEEDING:** There are occasions when individuals are unable to feed themselves or to be fed normally by mouth, - e.g. when unable to swallow, when unconscious or when, as in this case, agitated and restless. One solution, under these circumstances, is to pass a tube up the nose, through the pharynx and down the oesophagus into the stomach – a **NASOGASTRIC TUBE** – and to syringe, very gently, pre-prepared “feed” directly into the stomach: this is **NASOGASTRIC FEEDING**.

**NEUROLEPTIC MALIGNANT SYNDROME:** This is a rare but potentially very serious and sometimes fatal reaction to antipsychotic drugs, especially phenothiazines in general and **CHLORPROMAZINE** (please see above) in particular. It is described in detail in my report at pages 17-19, and it may be associated with many of the features defined and discussed in this list.

**OCCIPUT:** This is the area at the back of the head around the midline and representing that derived from the occipital bone of the skull. (Please see the diagram at Appendix 1.)

**OPISTHOTONUS:** This is a state in which muscle spasms cause the back to be over-extended such as to produce “arching”. The legs are usually also over-extended (“arched”), with the arms showing flexion at the elbows and wrists.

**ORBITAL ROOF:** The **ORBIT** is the “cavity” in the skull which contains an eyeball and its various muscles. The **ORBITAL ROOF** (i.e. the upper part of the orbit) comprises a thin bone which also serves to provide the base of the front of the cranial cavity immediately below the frontal lobe of the brain. (The cranial cavity is the part of the skull which encloses the brain.)

Consequently, when the brain is removed at post mortem examination, it becomes possible to look down at the base of the cranial cavity; that seen at the front is the **ORBITAL ROOF**, and this is how orbital roof fractures are identified.

**PSEUDOMONAS**: This is a particular type of bacterium, and the commonest of this group is *Pseudomonas aeruginosa*. Like many other bacteria, it is widely distributed, but it is often only relevant as the cause of an opportunistic infection in debilitated or immunocompromised patients.

**SERUM ASPARTATE AMINOTRANSFERASE (AST) ENZYME CONCENTRATION**: Aspartate aminotransferase (AST) is an enzyme which is normally found in the blood at a low concentration. As AST is largely derived from the liver, its concentration in the blood rises when there is liver cell damage for whatever reason. It is, therefore, one of the measurable indications of liver cell dysfunction. Of relevance in this case is the fact that AST can also be released from damaged muscle cells, and so this deceased's elevated AST concentration probably reflected muscle rather than liver damage, particularly as his serum total bilirubin concentration was not above the upper limit of the normal range.

**SERUM CREATININE KINASE (CK) ENZYME CONCENTRATION**: Creatinine kinase (CK) is an enzyme which is normally found in the blood at a low concentration, and almost all of it is derived from skeletal muscle. Consequently, when skeletal muscle is damaged, for whatever reason, the serum CK concentration rises. The **NEURILEPTIC MALIGNANT SYNDROME** (please see above) is a very well recognised, but uncommon, cause for a significant rise in the serum CK concentration.

**STAPHYLOCOCCI**: These represent a group of bacteria which can cause infections in humans, and of these, the most important and the most commonly encountered is *Staphylococcus aureus*. One of the characteristic features of *Staphylococcus aureus* (and this is something which can be identified quite easily in the microbiology laboratory) is that it produces coagulase, - an enzyme which causes plasma to clot. *Staphylococcus aureus* is widely encountered, and it is clinically important because it can produce a range of enzymes and toxins; it can therefore cause such conditions as skin

abscesses, wound infections, bone and heart valve infections, toxic shock syndrome, and food poisoning.

All the remaining staphylococci do not produce the enzyme coagulase, and so they are often collectively referred to as **COAGULASE NEGATIVE STAPHYLOCOCCI**. Although these coagulase negative strains may cause infection in unusual circumstances (e.g. in immunocompromised patients or in association with foreign bodies), they only very rarely cause clinically significant infections in "healthy" individuals.

**TACHYCARDIA**: This is an increase in the heart rate, - i.e. an increase in the number of heart beats per minute from the "normal" of approximately 70 b.p.m.

**TACHYPNOEA**: This is an increase in the number of breaths taken per minute; the "normal" is approximately 12-15.

**TEMPORALIS MUSCLE**: This is a fan-shaped muscle at the side of the head. It arises from almost the entire temporal bone of the skull (please see the diagram at Appendix 1), and it descends to become attached to the uppermost parts of the lower jaw, - thus assisting with mastication.

**TEMPORO-OCCIPITAL REGION**: This is the region of the skull and overlying scalp, at the lower part of the side at the back, around the junction of the temporal and the occipital bones of the skull. (Please see the diagram at Appendix 1.)

**TEMPORO-PARIETAL REGION**: This is the region of the skull and overlying scalp, at the side towards the back, around the junction of the temporal and the parietal bones of the skull. (Please see the diagram at Appendix 1.)

**TRANSAMINASE LEVELS**: Transaminases are a group of enzymes found mainly in the liver, and so elevated **TRANSAMINASE LEVELS**, as found on biochemical testing of the blood, usually reflect liver damage. One

of the transaminases is **SERUM ASPARTATE AMINOTRANSFERASE** (AST), and it is considered as a specific entity above.

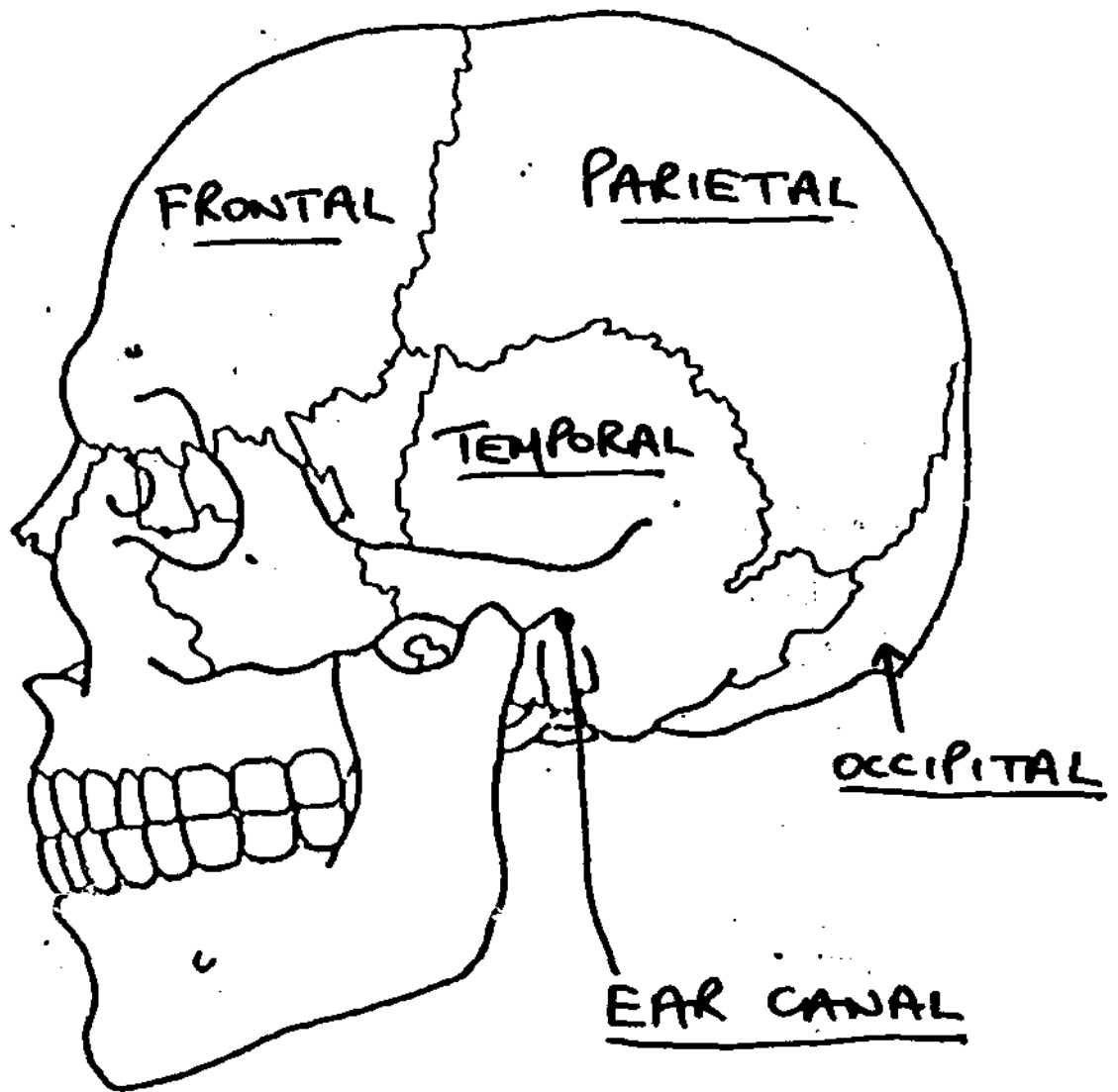
**TRAUMATIC DIFFUSE AXONAL INJURY:** This is a specific type of primary traumatic injury to the brain; it is **diffuse** (i.e. it is seen throughout the various parts of the brain) and it involves damage to **axons** (the elongated processes of nerve cells along which impulses travel).

The importance of **TDAI** is that it reflects shearing or twisting forces. These forces are often complex, and involve acceleration, deceleration, rotation and, sometimes, shaking of the brain within the skull. Consequently, whilst TDAI often results from road traffic incidents or falls from a height, it is well recognised to occur during assaults, particularly when the head is subjected to repeated kicking, punching or stamping.

**TRISMUS:** This is often referred to as "lockjaw". It represents difficulty in opening the mouth because of abnormal stiffness in the muscles which pull the lower jaw up against the upper jaw as when masticating; consequently, these muscles can not relax properly to allow the mouth to open normally.

A handwritten signature in black ink, appearing to read 'W. Lawler', with a large, sweeping flourish at the end.

WILLIAM LAWLER  
Consultant Forensic Pathologist  
Home Office Pathologist.  
01.02.06.



APPENDIX 1. THE MAJOR REGIONS OF THE SKULL.