

# RES MEDICA

Journal of the Royal Medical Society



## The Consequences of Severe Head Injury

**Dr Brian Pentland**

### **Abstract**

Severe head injury is a common problem, usually due to road traffic accidents, accounting for an estimated 400 hospital admissions each year in Scotland. This paper describes the mechanisms, effects and management of such injury.

Since early caveman courted the object of his desire by clubbing her, traumatic brain injury (TBI) has been a common problem. Nowadays the male of the species is more likely to be the victim receiving the trauma during sexual display at the wheel of a car or in conflict with a rival. Such acts of youthful bravado, often assisted by alcohol, can have life-long consequences not only for the individual but for his family. Rehabilitation of people after TBI is one of the most exciting challenges in modern medicine. Few conditions provide such a variety and complexity of disabilities to address in close collaboration with a team of skilled colleagues from a range of professions.

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ISSN: 2051-7580 (Online) ISSN: ISSN 0482-3206 (Print)

Res Medica is published by the Royal Medical Society, 5/5 Bristo Square, Edinburgh, EH8 9AL

Res Medica, Vol. III No. 1 1992: pp.4-9

doi: [10.2218/resmedica.v3i1.968](https://doi.org/10.2218/resmedica.v3i1.968)

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Since early caveman courted the object of this desire by clubbing her, traumatic brain injury (TBI) has been a common problem. Nowadays the male of the species is more likely to be the victim receiving the trauma during sexual display at the wheel of a car or in conflict with a rival. Such acts of youthful bravado, often assisted by alcohol, can have life-long consequences not only for the individual but for his family. Rehabilitation of people after TBI is one of the most exciting challenges in modern medicine. Few conditions provide such a variety and complexity of disabilities to address in close collaboration with a team of skilled colleagues from a range of professions.

## The Size of the Problem

TBI accounts for about 300 hospital admissions per 100,000 of the population each year. Fortunately the great majority of these people will have suffered relatively minor injuries and will be allowed home within a

few days with no significant after effects. Some of these minor injuries will however subsequently be discovered to have problems which do affect their lives adversely. It is estimated that of the 300 there will be 18 with moderate and 8 with severe injuries. The classification of TBI into different categories of severity is rather loosely based on such variables as depth of coma (usually measured using the Glasgow Coma Scale [GCS]. See Table I)<sup>1</sup>, length of unconsciousness (unconsciousness being GCS of 9 or less) and duration of post-traumatic amnesia (PTA). Table II summarises one such classification.

Although falls account for the majority of all head injuries admitted to hospital, road traffic accidents are responsible for about two-thirds of severe injuries.

## The Nature of TBI

The mechanism(s) of injury depend on the nature, direction and size of the forces applied to the brain. These forces may be classified as CONTACT or ACCELERATION phenomena. Thus when a blow is struck which bends or fractures the skull it

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*Table I Glasgow Coma Scale*

Eye Opening (E)	Score
Spontaneous	4
To speech	3
To pain	2
Nil	1
<b>Best Motor Response (M)</b>	
Obeys command	6
Localizes pain	5
Normal flexion	4
Abnormal flexion to pain	3
Extension to pain	2
No response	1
<b>Best Verbal Response (V)</b>	
Orientated, normal speech	5
Confused, normal speech	4
Inappropriate speech/words	3
Incomprehensible sounds	2
Nil	1

Coma Score=E+M+V

Minimum = 3 Maximum=15

The damage resulting from these forces of primary impact may be one or all of the following: (1) FOCAL, (2) POLAR or (3) DIFFUSE AXONAL INJURY (DAI). Focal damage refers to localised areas of contusion, laceration or haematoma; polar damage to the injury to frontal, temporal and occipital poles resulting from the brain impacting against the inner walls of the skull; and DAI describes the effects of shear and tensile strains on axons.

Apart from these primary types of damage secondary insults occur to the brain both systemically and locally. It is estimated that 16% of cases of TBI have an additional major extracranial injury. These may be responsible for severe blood loss, interference with respiration or metabolic disturbances which impair the oxygen and energy supply to the brain with resulting further damage. Local secondary insults include such things as the effects of haematomas pushing and compressing areas of the brain, meningitis and vasospasm.

These various mechanisms of damage have widespread effects on brain function which explains why the consequences of TBI are very variable and unpredictable. Modern scanning techniques with CT and MRI imaging identify major lesions, particularly life-threatening complications such as haematomas and hydrocephalus, but cannot be relied on to exclude more diffuse lesions such as DAI or some of the hypoxic-ischaemic phenomena of secondary insults.

### Principles of Rehabilitation

Rehabilitation is, in essence, the management of the results of injury or disease. Its components consist of identifying the dysfunctions, planning and executing strategies to deal with them, and reviewing and adjust-

can lead to contact damage in the form of underlying contusion of the brain. Acceleration forces cause deformations described as tensile (pulling apart), compressive (pushing together) and shear strains (parallel deforming forces). In acceleration mechanisms it is probably the speed of displacement of the brain relative to the skull which is the most crucial factor.

*Table II Classification of severity of Traumatic Brain Injury (TBI)*

Severity of Injury	GCS	Coma Duration	PTA
Minor	13-15	<15 mins	<1 hr
Moderate	9-12	15 mins-6 hr	1-24 hrs
Severe	3-8	>6 hrs	>24 hrs

ing any intervention according to the results. In dealing with the acute life threatening crises that can occur in the initial phases, the trauma or neurosurgical team apply these same principles with the aim of promoting maximal recovery and preventing avoidable complications. They also institute rehabilitation as they have to address the wider issues involved in recovery from TBI. Formal rehabilitation which may take place in another unit is a continuation of this process rather than a separate treatment and at most may represent a shift in focus after the life has been saved. Apart from a brief description of coma rehabilitation, discussion will concentrate on the problems encountered once the individual is medically stable.

### Coma Arousal

A small proportion of people remain in coma for a prolonged period after initial resuscitation and neurosurgical treatment and attempts are made to wake them from the state of unconsciousness using a 'coma arousal programme'. Sensory and sensorimotor stimuli including touch, taste, smell, hearing, vision and movement are applied in a graded manner with careful attention to timing, duration and reinforcement. Thus for example visual stimuli may start with short exposure to flashing light, move through the use of bright colours or

moving objects to showing them pictures and photographs depending on response. These techniques are far from proven in terms of promoting recovery and need scientific study. They do help by providing the opportunity for close relatives to feel involved in the care of the patient, at a time when they are beset by mind-numbing feelings of impotence, as they can get involved in obtaining the stimulants and administering them under direction.

### Assessment of Dysfunctions

Once the patient is awake and medically stable the task of comprehensive assessment of their dysfunction can start in earnest. Because of the diffuse nature of the damage which may have occurred various areas of function must be checked and a number of different professionals are needed to do this properly. The major areas of function are: mental, communication and neurological. In addition the individual's independence in performing activities of daily living (ADL) has to be determined and social issues such as housing, vocational and recreational needs have to be explored.

To detail all possible disorders would require several issues of this journal or tedious lists covering most of the ailments that flesh in heir to. Only some common examples are given.

## **Mental Consequences**

Memory impairment and disorientation were found in over three-quarters of patients seen in the Astley Ainslie rehabilitation unit. Memory is essential for learning and much of rehabilitation involves re-learning old skills or acquiring new ones so that often many hours of patient, repetitive work is needed. Disorientation can be associated with a tendency to wander off or even get lost within the confines of a ward. Other individuals have very limited attention span or are markedly apathetic and lethargic. Such dysfunctions are generally labelled as cognitive function and the expertise of the clinical psychologist, occupational therapist and others in the team are called upon to accurately identify the nature of the difficulty and advise on strategies to deal with them.

Personality change is one of the most frequently noted features described by families. Not having had the opportunity to know the person before the injury the team has to rely on family, friends, school, employment or even police records to gauge what change if any has occurred. It should be remembered that although people from all walks of life sustain head injuries, those from the lower echelons of society are over-represented. In some series about one in five have had a criminal history. On some occasions personalities change for the better but unfortunately the reverse is more common. The sensitive and thoughtful husband may be transformed into a rather brutish and ill-tempered individual who rejects his wife's affection; the bright and likeable sports enthusiast become a lethargic, humourless laggard. Behavioural change may be marked and very difficult to manage in the hospital environment if it includes severe

aggressive or noisy components. Such cases may require specialist psychiatric/psychological management using behavioural management techniques.

In addition to cognitive and behavioural changes, TBI victims often have changes of affect with severe depression, anxiety or emotional lability where they vacillate between tears and laughter.

## **Communication Difficulties**

Dysphasia, dysarthria and dysphonia are all common after head injury either as a result of focal or diffuse damage. Indeed any disorder of speech or language can occur and difficulties with communication may result from cognitive, emotional or behavioural disorders. Expert assessment of just what the nature of the disturbance is in an individual is a necessary pre-requisite to doing something about it

## **Neurological Consequences**

The neurological evaluation of a TBI patient is essentially the same as the standard neurological examination. Neurological diagnosis is sometimes divided into locating the site of the lesion(s), determining the general pathology and then the specific pathological nature of the damage. The first of these is of paramount importance in TBI cases. Work-up includes testing higher cortical function, assessing speech, checking cranial nerves, examining motor, sensory and reflex function and investigating stance and gait. Obviously this overlaps with some of the factors already discussed and described below under activities of daily living later. The physiotherapist in rehabilitation is usually particularly expert in accurate evaluation of motor function and mobility.

*Table III Help needed with Activities of Daily Living (ADL) in 100 Traumatic Brain Injury (TBI) patients*

Activities of Daily Living	Number needing help
Feeding	45
Personal hygiene/grooming	48
Dressing	57
Bathing	71
Bowel continence	33
Bladder continence	54
Use of toilet	54
Mobility	71

The variety of disturbed neurological function seen in this population is vast. So much so that in comparison with some other conditions TBI is often considered 'messy' and 'untidy'. The same patient may have evidence of cerebral, cerebellar and brain stem or upper spinal cord disorder. It is worth noting that head injury is one of the few causes of loss or impairment of smell, it can cause bizarre disturbances of vision, epilepsy with complex partial seizures and complex dyspraxias to name but a few examples.

### Activities of Daily Living

The clinical signs familiar to doctors represent impairments but their real importance to the patient is how these disturb function or result in disabilities. The effect on the individual's ability to look after himself is particularly pertinent. Activities of daily living (ADL) describes the everyday things we all do for ourselves. In the study of 100 cases of TBI<sup>2</sup> the number of patients needing help with different tasks is shown in Table III.

### Housing

Severe physical disability can have major repercussions on the accommodation needs of patients. The most obvious example would be the person who becomes dependent on a wheelchair for mobility. If such an individual lives in an upstairs flat a change of house may be necessary. Others may need a lift installed in their home or a toilet put in downstairs. Some who have no family home to return to may need to be placed in sheltered accommodation where a warden or other responsible adult can provide some supervision.

### Vocational and Recreational

The person who survives a serious head injury, with few exceptions such as those classified as in the 'persistent vegetative state', is likely to have a normal life expectancy. In other words most have 40-50 years ahead of them. They are entitled to expect opportunities in terms of employment and pursuit of leisure just like any other citizen. Because of their disabilities, particularly

those connected with mental function, their vocational placement may be difficult and special provision should be made to train them and place them in employment. Sadly the services available for this purpose are severely limited.

Particularly when work is not available, but in all cases the ability to participate in sporting activities or indulge in hobbies or other interests is vital. To facilitate this consideration must be given to access for the physically disabled to public facilities. There also needs to be opportunities for the mentally impaired person to attend classes or receive guidance in the use of their leisure time to enhance the quality of their life.

### Conclusions

The effects of TBI can be profound and it is families which suffer the consequences. The cost in terms of human misery can be staggering. In the United Kingdom provi-

sion from Health, Social Services, Educational and Employment Services are woefully inadequate<sup>3</sup> and, sadly, despite authoritative recommendations to improve the situation regularly appearing in the last 50 years, little progress has been made. Specialised rehabilitation units are beginning to appear in some parts of the country but no coordinated plan to provide the necessary network of services exists.

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