War Medicine Series

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MEDICAL ASPECTS OF HEAD INJURY

BY

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The title of this paper is inappropriate, for there are no exclusively medical aspects of head injury. Surgeons, medical neurologists, and psychiatrists have all contributed to our knowledge of the subject, while experience of working in a hospital for head injuries makes it evident that those who wish to treat these injuries should be familiar with all three aspects of the condition, whether they be surgeons, physicians, or psychiatrists. In this short article I shall refer to elementary aspects of head injury which will be of practical help to those who treat these cases and to those who as yet have made no special study of the subject.

Those who have witnessed a severe closed head injury can readily appreciate the popular alarm which is prompted by this form of trauma. The sickening thud as the head strikes on a hard surface is followed by a physical state which is nearly related to death and which must necessarily suggest serious injury to the brain. Moreover, in medical practice we are all familiar with cases of the chronic post-concussional syndrome, which appears to cause marked disability for many years. These patients are unhappy invalids and are often resistant to treatment. Experience of cases such as these causes both the medical officer and the layman to take a pessimistic view with regard to prognosis in cases of head injury.

It is important, therefore, that there should be a clear understanding regarding the incidence of symptoms following head injury. Figures for Service cases are not yet available, but in the civilian closed injuries from road accidents, falls, etc., the following figures indicate that the incidence of post-concussional symptoms is much lower than is generally realized and that the duration of disability is surprisingly short.

In Table I 200 consecutive patients, admitted to the Royal Infirmary, Edinburgh, were interviewed 18 months after their head injury. They were asked about their symptoms since leaving hospital (including slight ones, such as nervousness, occasional headache, or giddiness); and the duration of any symptoms referable to the injury was noted.

TABLE I.—Duration of Symptoms (Severe or Slight) after Head Injury in 200 Unselected Cases

Duration of Symptoms	No. of Cases
Under 2 months	80
2-6 months	11
6-18 months	30
Over 18 months	79

It will be seen from the table that in 40% of cases there were no symptoms after 2 months, but in an equal number symptoms (often slight) persisted for over 18 months.

TABLE II.—Duration of Unfitness for Full Work in 100 Working Men and Women under the Age of 50—Compensation Cases excluded

Interval after Injury of Successful Return to Full Work	No. of Cases
Under 2 months	61
2-6 months	26
6-18 months	7
Unfit after 18 months	6

The severity of the post-concussional symptoms in the average case of the working man or woman is indicated by

Table II, where the period off full work (following the injury) is recorded.

It should be noted that 87% had returned to full work within 6 months of the injury. Compensation cases and patients over 50 years of age were excluded.

Table III compares the period off work with the severity of the injury (as indicated by the duration of post-traumatic amnesia). This group consists of 92 working men and women under the age of 40.

TABLE III.—Duration of Unfitness for Full Work compared with Duration of Post-traumatic Amnesia

Interval after Injury of Successful Return to Full Work	Duration of Post-traumatic Amnesia		
	1 hour	1-72 hours	Over 72 hours
Under 2 months	30	25	4
2-6 months	1	8	13
6-18 months	1	3	3
Unfit after 18 months	0	1	3
Totals	32	37	23

This table gives a striking indication of the quick return to work of young people, even after severe injuries.

TABLE IV.—Duration of Unfitness for Full Work compared with the Presence of Fracture of the Skull

Interval after Injury of Successful Return to Full Work	Fractured Skull	No Fracture
Under 2 months	11	31
2-6 months	17	10
6-18 months	6	2
Over 18 months	6	7
Totals	40	50

In Table IV the rates of return to work in those with and without a fracture of the skull are compared: it demonstrates clearly that the duration of disability bears little relation to the presence of fracture.

These tables indicate that, though head injury may cause permanent damage to the brain and, in some, symptoms of varying degree, these disabilities should only rarely prevent resumption of manual work within 2 to 6 months of the injury. Reduction of efficiency is common after severe injuries, but is rarely sufficient to cause much disability. It is obvious, therefore, that far from being pessimistic regarding the prognosis after head injury, we can usually be confidently optimistic. The importance of expressing this optimism during treatment will be stressed.

I shall not here refer to the treatment of the acute stage. The recognition of complications in the early days, such as cerebral compression by haemorrhage, depends chiefly on the study of the temperature, pulse, blood pressure, and respiration, the degree of consciousness, and the development of abnormal neurological signs such as hemiplegia.

Meningitis is one of the most dreaded complications, but is often prevented by modern surgical treatment of wounds and by chemotherapy. All cases in which there is a persistent discharge of cerebrospinal fluid from the nose, however slight it may be, should be transferred promptly to a neurosurgeon so that he may close the meningeal fistula and thus prevent the dangerous complication of meningitis. The earliest signs of meningitis are a delayed rise of temperature, neck rigidity, and increased clouding of consciousness. An early increase in the white cell count in the cerebrospinal fluid provides the first evidence that this complication is developing. When the fluid is blood-stained both red and white cells must be counted to enable this pleocytosis to be recognized. Blood contamination of the cerebrospinal fluid will account for only one or two white cells per thousand red blood cells.

Complications which Often Cause Unnecessary Alarm

To those who are unfamiliar with the varied clinical course that may follow head injury it may be helpful, to consider certain complications which sometimes cause needless anxiety and unnecessary operation.

An *epileptic fit* occurring during the first two or three weeks, whether local or general, does not indicate any serious complication unless it is followed by clinical evidence of further damage to the brain, such as hemiplegia; nor are these cases much more liable to develop traumatic epilepsy after recovery.

Delayed facial paralysis is common when there has been bleeding from the ear. The paralysis, which is usually complete, comes on within two or three days of the injury, and is probably due to some chemical change in blood clot in the facial canal. The paralysis should be treated as in Bell's palsy; recovery occurs usually in a few weeks, but sometimes by regeneration after several months (see below).

Neck rigidity is often thought to be due to meningitis, but is usually due to subarachnoid haemorrhage. Both these complications, however, may coexist; they can then only be clearly distinguished by counting the red and white cells in the cerebrospinal fluid as described above. Injuries to the cervical vertebrae are referred to later.

Bradycardia.—Abnormal slowing of the pulse often develops 2 to 4 days after severe closed head injury, and may continue for 2 weeks or more. During this period a pulse rate of 40 to 50 a minute is not uncommon. This complication need cause no anxiety, provided there is no associated deepening coma or other neurological evidence of progressive cerebral compression.

Papilloedema.—Contrary to much former teaching, increased intracranial pressure is seldom a dangerous complication in uncomplicated head injury. Papilloedema is not often present, but it occasionally develops to a slight degree 1 to 3 weeks after severe closed injury. This complication may occur without there being intracranial clot or other similar complication; apart from delaying convalescence, it is in itself of little importance.

Prolonged confusion or delirium is common after severe closed head injury and may continue for several weeks. This is not usually due to any vascular complication, such as cerebral oedema or compression by clot, but is apparently dependent on the nature of the original brain commotion. Careful nursing, with forced food and fluids if necessary, is the most important part of the treatment of these cases. Remarkably good mental recovery ultimately occurs in many severe cases, and a bad prognosis in this respect should not be given during the period of confusion. Sedatives should be avoided so far as is possible, as these delay mental recovery. Physical restraint should be minimal; after the early days a bath, sitting in a chair, or a walk along the ward will do no harm and often relieves restlessness.

Associated Injuries.—These may cause confusion in diagnosis and are easily overlooked. Injury to the cervical vertebrae sometimes results in weakness of the arms or legs which may be mistaken for cerebral paralysis. This injury causes a painful stiffness of the neck, movements of rotation being specially affected—unlike the stiffness due to subarachnoid haemorrhage or meningitis, which affects forward flexion of the head. Tearing of the brachial plexus may be a cause of paralysis, as also may fractures of the extremities or dislocation of joints; such paralysis is sometimes erroneously thought to be due to the brain injury.

Examination during Recovery.—Repeated examination during recovery should be made with a view to determining whether mental and physical functions are being restored. Regarding the intellectual functions, the unskilled observer is often misled by the patient's statement that he has quite recovered and by his apparently normal speech, when in fact he is still confused and disorientated. Disorientation for time and place is common, the patient often thinking that he is living in a period several years earlier. For example, a Polish airman seen recently after a crash was convinced that he was in Poland; he said the year was 1936, and that he had crashed in a German sports plane; he discussed intelligently the prospects of future war with Germany. As the intellectual functions recover, this long retrograde amnesia usually shrinks to a period of less than half an hour before the accident. Questions and discussion regarding recent world news will give a good idea regarding the state of intellectual recovery. Simple memory and calculation tests may also be used. When there is evidence of dysphasia this requires careful investigation.

Physical Examination

Physical neurological examination is necessary to detect damage to cranial nerves and brain. *Anosmia* is common in severe fractures of the anterior fossa and in occipital injuries (by contre-coup). This disability is usually permanent, and of course renders the soldier unable to detect many poisonous gases, including coal-gas. Damage to the *optic nerves* or *chiasma* is also usually permanent, and is recognized by loss of vision, by defects in the visual fields, and by pallor of the optic disks, which appears in about two weeks. Most *oculomotor palsies*, even when complete, recover well after a few weeks, but damage to the superior oblique muscle or its nerve may result in permanent diplopia. Ophthalmologists have recently discovered how to cure this disabling diplopia by operation.

Damage to the branches of the *trigeminal nerve* produces areas of anaesthesia over the face. This usually causes no disability, but sometimes leads to a troublesome form of neuralgia, which may be difficult to relieve even by operation on the nerve.

Peripheral *facial paralysis* associated with fracture of the base of the middle fossa may be immediate or delayed, as referred to above. Many of these cases recover completely in less than two months. Others recover gradually by regeneration over a period of up to 18 months; but this recovery may be incomplete, as in comparable cases of Bell's palsy. Recovery by a process of regeneration is recognized by faulty voluntary control of the facial muscles—attempts to move the upper facial muscles causing movements round the mouth, and vice versa. Complete failure of recovery after traumatic facial paralysis is extremely rare.

Fracture through the base of the middle fossa with haemorrhage into the middle-ear causes slight *middle-ear deafness* but no permanent disability. *Inner-ear deafness* is usually permanent, and occasionally becomes progressively worse. *Tinnitus*, often associated with inner-ear deafness, may be permanent, causing mental discomfort, which varies according to the loudness of the tinnitus and the patient's sensitivity to this irritating symptom; in many cases it occasions no disability and requires no treatment. *True vertigo* may also be troublesome.

Gross injury to the cerebral hemispheres, causing, in the acute stage, hemiplegia, astereognosis, homonymous hemianopia, or aphasia, often recovers well. Most of the possible recovery occurs within 3 months, and thereafter slight improvement continues for as long as 2 years.

Treatment during Recovery

In most cases of closed injury in young subjects a good recovery can be confidently predicted if the patient survives the first 24 hours. It is noteworthy, therefore, that within a short period of admission to hospital the atmosphere around the patient should change from one of anxious care to that of cheerful optimism. The second stage should be reached, if possible, before recovery of full consciousness. The patient's mental reaction to recovery of consciousness in bed, surrounded by dim lights and shadowy figures, with a splitting headache, confused thoughts, and complete amnesia for the reason of it all, may be almost catastrophic, and frequently sows the seed of a future anxiety neurosis. Medical and nursing personnel often aggravate this reaction by talking to him of severe concussion, fracture of the base, probable long incapacity, and possible after-effects. These sadistic activities must be rigorously suppressed. Nurses and relatives must be clearly told, whenever possible, that an excellent recovery is expected within a reasonable period. The patient's fears regarding his amnesia for the accident and its possible effects are relieved by simple explanation, and the expectation of good recovery is impressed on him. It is obvious that in cases with destructive lesions of the brain causing perhaps hemiplegia or aphasia the prognosis must be more guarded. It is important to remember, especially if there is a personal or family history of nervous instability, that head injury is one of the most common nuclei around which a patient will weave neurotic symptoms or exaggerations of slight bodily sensations. Careful convalescence and rehabilitation under intelligent and inter-

ested medical supervision have proved to be of the greatest value in ensuring the quickest and most complete recovery.

The period of rest in bed is the first point to consider. There are commonly applied rules for cases of fracture of the skull that are better discarded, as the radiograph gives little indication of the degree of brain damage. There is no need to keep a man who feels perfectly well after head injury lying in bed for 3 to 4 weeks just because the radiograph shows a slight fracture. His symptoms and clinical state provide the best basis on which to judge of the necessary period of rest.

In the average case the patient should be kept strictly in bed for about 7 days after full return of consciousness, or 5 days after relief from headache. Thereafter, allow him up for half to one hour more each day, according to the severity of the injury; slow down this process, or reverse it with a whole day in bed, if symptoms recur. After he has been up all day with little or no symptoms, start graduated physical exercises of a degree which causes little headache or dizziness, and work up gradually to the full exercises of the fit soldier. While little attention should be paid to slight headache or dizziness, medical supervision should be continued, as some patients require slower convalescence than others and some should not be expected to do the heaviest forms of P.T. in the early months following the injury. Some patients will require to be kept back, while others need encouragement. Under ideal conditions the same medical officer will supervise the case till the patient is fit to return to duty.

Prognosis

The prognosis and duration of treatment in all cases, whether acute or chronic, depend on three main factors: first, the severity of the injury, as indicated by the duration of amnesia and clinical evidence of brain damage; secondly, the age of the patient—if under 30 recovery is usually very good, it is slower between 30 and 40, and at over 40 it is often definitely slower and less complete; finally—and often the most important, as Symonds has stressed—the patient's previous personality and intelligence. The man with a good brain and personality recovers best; while the neurotic, the psychopathic personality, and the mentally dull often recover slowly and with many setbacks. An essential part of the investigation is therefore an inquiry into the soldier's previous intelligence, work and service record, tendency to neurosis, and family history.

An approximate time-table for closed head injuries with no complications or evidence of gross brain damage is as follows, severity of injury being roughly estimated by the duration of post-traumatic amnesia:

Slight cases—amnesia less than 2 hours—should be fit for full duty, category A, in 3 to 6 weeks. Delay for 2 to 4 weeks if fractures of skull are extensive or if symptoms are severe.

Moderate cases—amnesia of 2 to 48 hours—should be fit for full duty, category A or B, in 1 to 4 months, according to severity of post-concussional symptoms.

Severe cases—amnesia of over 2 days—should be fit for duty in category A, B, or C in 3 to 6 months.

This programme suits the average case of closed head injury, but a small proportion from all three groups will be permanently unfit for any form of service. The chief causes of permanent unfitness are:

1. *Physical destruction of brain tissue or of cranial nerves*, causing, for example, hemiplegia or hemianopia.

2. *Intellectual and Memory Impairment*.—This rarely occurs in young patients to an incapacitating degree, but is commonly severe in those over the age of 40 who have had very serious injuries. It produces considerable disability in N.C.O.s, especially if their previous intelligence was below the average. They are forgetful, are easily flustered, and quickly break down with anxiety, depression, and psychogenic headache. A slight degree of intellectual impairment often causes no noticeable disability to the private soldier, unless his previous intelligence was low. Transfer to the Pioneer Corps may sometimes be a satisfactory method of disposal. Intellectual impairment may result in a striking change of personality with behaviour disorder. This occurs most frequently in children and in adults of unstable personality. Soldiers of this type usually prove to be unfit for further service.

3. *Traumatic epilepsy* develops in about 3% of closed injuries, but in a much larger proportion after penetrating gunshot wounds. The fits usually develop 3 to 18 months after the injury; but the onset may be much later, especially after penetrating wounds.

4. *Organic Complications during Convalescence*.—Though the great majority of cases of head injury improve steadily and satisfactorily during convalescence, it must be remembered that chronic subdural and chronic extradural haemorrhage, delayed cerebral haemorrhage, arteriovenous aneurysm, cerebral abscess, and meningitis are occasional delayed complications. Abnormal drowsiness and other evidences of impaired cerebral function are important early signs of those complications, and call urgently for full investigation of the case, as prompt surgical treatment may be required.

5. *The Chronic Post-concussional Syndrome*.—This syndrome consists of symptoms such as headache, dizziness, nervousness, loss of concentration, and anxiety, which persist indefinitely after a head injury that is often slight. The headache is in many cases described as "terrible," is frequently continuous, and is not relieved by headache powders. The dizziness is seldom due to true vertigo, but is usually a feeling of light-headedness during which "things go black" and the patient requires to steady himself or to sit down for a few seconds to get relief. On careful analysis of the chronic cases it generally becomes apparent that the physical symptoms are slight but are grossly aggravated and exaggerated by psychological factors, of which, as a rule, anxiety is the most prominent—the patient having become "head-conscious," in the same way that the dyspeptic may become "stomach-conscious."

This troublesome syndrome can usually be prevented if convalescence and rehabilitation are organized and supervised as described above. The point to be emphasized is that though headache, dizziness, and nervous symptoms may persist as occasional post-concussional complaints for many months or even years, they cause negligible disability in the stable young soldier or airman.

The mental attitude of some Service patients to their injury corresponds to that observed in civilian compensation cases, and consequently the duration of disability is prolonged by the aggravating effect of anxiety neurosis or sometimes by deliberate exaggeration. In soldiers a fear of future head injury is a common cause for anxiety, and may develop, for example, when doing guard duties at night.

It is important to realize that graduated physical re-education will do these chronic cases no harm, and indeed has been proved to be the best treatment for the chronic headache and dizziness: it must, however, be combined with simple psychotherapy.

Psychoneurosis following head injury is more easily prevented than cured, especially when there is an element of malingering; but much can be done by explanation, encouragement, physical re-education, and discipline. For the difficult cases, duties should be chosen which suit individual temperament, interests, and capabilities. A feeling of discontent or a sense of grievance will greatly increase the difficulty of handling these cases.

Conclusion

It should be noted that modern treatment of head injuries aims at returning the soldier to duty sooner than some old traditions would allow. As has been pointed out, this programme is based on a study of the quick rate of recovery in patients of good type in whom there was no compensation or other factor which retarded progress. Experience has fully justified this aim, and has led to a considerable reduction in the period of disability. We have some failures, but even with these it is evident that vigorous methods of physical rehabilitation have at least done no harm.

In an experimental investigation into the effect of plasma transfusion on serum proteins, E. W. Shearburn (*Surg. Gynec. Obstet.*, 1942, 74, 343) fed dogs with what was essentially a protein-free diet. On this diet the blood protein and blood volume decreased. A single transfusion of plasma calculated to restore the concentration of serum protein to animals proved ineffective, but the hypoproteinaemia was corrected by small plasma transfusions given once or twice daily.