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ANALYSIS OF 1,400 CASES OF ACUTE INJURY TO THE HEAD*

BY

G. F. ROWBOTHAM, B.Sc., F.R.C.S.

Regional Consultant in Neurological Surgery

I. N. MACIVER, M.B., F.R.C.S.Ed.

JUNE DICKSON, M.B., B.S.

AND

MARJORIE E. BOUSFIELD

(From the Regional Centre of Neurological Surgery, Newcastle-upon-Tyne)

Between the years 1941 and 1951 2,000 cases of acute injury to the head were admitted to the General Hospital, Newcastle-upon-Tyne, and were treated in the department of neurological surgery. Of these, 1,544 were aged 13 and over (1,281 male, 263 female), and 456 were children up to the age of 12. The death rate in this consecutive series of cases was 10.5%.

In this paper a detailed analysis is given of 1,000 of the adults and 400 of the children; these cases were those of the above series who were admitted to hospital between the years 1945 and 1951. The adults were nursed in the department of neurological surgery; most of the children were nursed in the department of paediatrics.

The primary objects of this study were: (1) to determine the sources and causes of acute head injuries that occur in a provincial city and area engaged in the heavy industries of shipbuilding and mining; (2) to set on record a statistical statement of the severity and the nature of the injuries sustained; (3) to analyse the cause of death and to appraise methods of surgical treatment; (4) to inquire into the long-term results with the object of discovering whether and how morbidity can be minimized; and (5) to bring to the notice of the surgical world once again the magnitude and importance of this branch of medicine.

An analysis of 1,000 adult cases is given (Table I). It will be seen that 444 of them, or nearly half the total, were due to road accidents, and just over 19% of these accidents were fatal. Table II shows the great preponderance of these injuries in the productive period of life, underlining once more the serious social and economic aspect of injuries which for the most part should not happen.

Table III shows, what would be expected, a graver prognosis for patients admitted in a state of semicomatose and coma.

*The preparation of this work was assisted by a Research Grant from No. 1 Regional Hospital Board.

TABLE I.—Analysis of 1,000 Consecutive Adult Cases

Cause of Injury	No.	Deaths
Road:		
Car	59	12
Motor-cycle	125	25
Pedal cycle	109	17
Pedestrian	151	33
Industry	248	38
Mines	59	7
Home	77	17
Simple fall outside	59	7
Struck by another	28	2
Sport	29	—
Gunshot wound	4	3
Air crash	2	—
Miscellaneous	10	4
Unknown	40	10
Total	1,000	175

TABLE II

Age	No.		Deaths	
	Male	Female	Male	Female
13 to 20	141	43	16	—
21 " 30	203	23	25	3
31 " 40	159	15	21	2
41 " 50	122	29	25	2
51 " 60	82	33	23	6
61 " 70	67	23	27	7
71 " 80	27	22	13	2
81 " 90	4	7	—	3
Total	805	195	150	25

TABLE III

Level of Consciousness on Admission	No.	Deaths
Consciousness to confusion	724	27
Semicoma	101	27
Coma	175	121
Total	1,000	175

In 940 of the cases the injury was closed, with possible internal compounding; among these there were 151 deaths. Sixty patients had an open injury of the vault, and 24 of them died. There were 221 associated injuries in the 1,000 cases, as follows: abdominal 3 (2 deaths); thoracic 19 (6 deaths); limbs 114 (16 deaths); spine 11 (no deaths); facio-maxillary 74 (9 deaths). Major operations had to be performed in 209 cases (74 deaths) and minor operations in 166 (16 deaths). The duration of stay in hospital averaged 12.9 days. The disposal of those who survived is shown in Table IV.

TABLE IV.—Disposal of 825 Patients

Home	756
Rehabilitation centre	18
Convalescent	12
Military or naval depot	12
Transfer to other centres (thoracic, facio-maxillary, psychiatric)	6
Miscellaneous	21

To complete the analysis of the cases we give (Tables V and VI) some figures relating to the 400 cases of injury to the head in children (up to the age of 12). Of these, 147 were due to road accidents; there were 20 deaths (13.36%). As many as 149 of the 400 children sustained injury as a result of falling from a height; 5 (3.3%) of these died.

Table VII gives details of the level of consciousness on admission. In the great majority of the cases (368) the injury was closed, with possible internal compounding; 26 (7.1%) of these children died. In 32 cases there was an open injury of the vault, with 8 (25%) deaths. Among the 400 cases there were 38 associated injuries, as follows: thoracic, 3 (no deaths); limbs, 20 (2 deaths); facio-maxillary, 14 (no deaths); pelvis, 1 (1 death). A major operation was necessary in 70 cases (6 deaths)

TABLE V.—*Analysis of 400 Consecutive Cases in Children (to Age 12)*

Cause of Injury	No.	Deaths
Road:		
Car	4	—
Pedal cycle	31	3
Pedestrian	112	17
Home	5	—
Fall from height	149	5
Simple fall	41	4
Sport	12	1
Miscellaneous	40	4
Unknown	6	—
Total	400	34

TABLE VI

Age in Years	No.		Deaths	
	Male	Female	Male	Female
Under 1	12	5	—	—
1	12	5	—	—
2	15	15	1	4
3	23	19	1	1
4	31	10	3	—
5	23	14	1	—
6	27	8	6	1
7	28	7	1	—
8	25	11	2	—
9	22	11	3	2
10	28	5	4	—
11	20	3	3	—
12	19	2	1	—
Total	285	115	26	8

TABLE VII

Level of Consciousness on Admission	No.	Deaths
Consciousness to confusion	322	5
Semicoma	27	9
Coma	51	20
Total	400	34

and a minor operation in 27 cases (no deaths)—that is, out of the total 400. The average duration of stay in hospital was 9.3 days. Of the 366 survivors, 351 were discharged home, 7 to a convalescent centre, and 8 to other hospitals.

Cause of Death in Adult Cases

The cause of death in the 175 fatal adult cases is briefly reviewed below.

Group 1. Admitted in Coma

Of the 175 patients admitted in a state of coma, 121 died (69.1%). A high death rate from head injuries sufficiently severe to render a man comatose is, of course, to be expected, particularly as it is in this group that severe associated injuries are encountered. In 80 cases examined at necropsy cerebral contusions and lacerations, and surface and intracerebral haemorrhages, were found in all varieties of combination, degree, and extent. In every case the macroscopical injuries of the brain tissue were judged to be severe enough either to account for or to contribute substantially to the cause of death. In many there were extensive macroscopical injuries to non-vital areas only; in these, however, the physics of injury were such that vital centres (brain stem, thalamus, and hypothalamus) must, to some extent, have been damaged. In those cases in which there was no vital evidence of macroscopical or microscopical damage to the vital centres it was impossible to judge whether presumed submicroscopical damage could have accounted for death.

In all cases in which there was no gross demonstrable damage to the vital centres there was always gross damage to the non-vital areas; in other words, no patient died of uncomplicated concussion. This does not mean, of course, that a patient could not, in fact, die from injuries to the vital centres of submicroscopical dimensions: this problem is still far from final solution.

In no instance did we come to the conclusion that life could have been saved either by surgical decompression or by the turning of a bone flap, since massive oedema of the brain never occurred without septic encephalitis, and since, in those cases in which there was a local blood clot, there was a contusional or lacerational damage in other parts of the brain. From the surgical point of view we came to the conclusion that the only procedure that might have been of value was drainage of the cerebrospinal fluid, either by lumbar puncture or through a trephine hole in the vault of the skull.

Group 2. Cases Admitted in Semicoma

Of the 101 patients found on admission to be in a state of semi-coma, 27 died (26.7%).

At post-mortem examination 10 were judged to have died as the result of irreversible physical injuries to the brain tissues similar in severity and nature to those found in the coma group.

In a further 10 cases there were obvious contusional injuries in non-vital areas, but these were judged not to be irreversible. We came to the conclusion that in these cases a substantial contribution to the cause of death was the effect of injuries elsewhere in the body. This subgroup particularly calls attention to the importance of the integration of the treatment of a patient as a whole and of the close observation of the minutiae of nursing. When a patient, for example, is in a state of shock it is obviously wrong to inflict further shock by, say, reducing a fracture or submitting him to any other operative procedure before it is absolutely necessary. Also, any kind of asphyxia due to a faulty airway will aggravate the cerebral state, as will overheating or the incorrect administration of fluids.

In the remaining seven cases in which there were no injuries elsewhere in the body to contribute to the cause of death, the extent and degree of the damage to the brain was such that we felt that better-designed surgical therapy might have saved lives; this applied particularly in those cases in which there was a large unilateral acute subdural haemorrhage. We are now coming to the conclusion that when, for some clinical evaluation, open operation is deemed necessary acute subdural haemorrhages can be treated most adequately by the turning of a large osteoplastic flap with wide opening of the dura mater.

In actual practice the difficulty, of course, is to correlate the clinical picture with the pathological happenings. Our objective here is to show that in borderline cases of life and death pathological phenomena amenable to surgical treatment do, in fact, occur in a small percentage of cases. Therefore, skilled and painstaking clinical examinations may occasionally meet with gratifying reward.

Group 3. Cases Admitted in a State of Confusion or Full Consciousness

Of the 724 patients who were either conscious or in a state of confusion, 27 died (3.7%). The causes of death can be classified as follows:

(1) *Injuries to the brain unassociated with extradural haemorrhage.*—There were 19 cases of this type: five patients died from pyogenic infection resulting from massive compound frontal injuries; three died following operations for severe compound frontal injuries (sepsis did not develop); four died from massive intracerebral haemorrhages such as occur from natural processes—although classified as having died from the head injuries, they probably died from apoplexy; six died from lacerations of the brain associated with either subdural or subarachnoid haemorrhages (three of these were over the age of 70); and one died of cerebral thrombosis.

(2) *Mild concussion with severe injuries elsewhere in the body.*—In these three cases severe associated injuries were the obvious cause of death.

(3) *Extradural haemorrhages complicated by injury elsewhere in the brain.*—In the three cases in this group there were (a) a unilateral extradural haemorrhage, associated

with a subdural haemorrhage on the same side, and cerebral oedema; (b) small bilateral extradural haemorrhages, associated with a laceration of the brain and bilateral subdural haemorrhages; and (c) an extradural haemorrhage, associated with a large intracerebral haemorrhage.

(4) *Uncomplicated extradural haemorrhages.*—The following were the findings in the two cases recorded: (a) a large extradural haemorrhage due to laceration of the lateral sinus (the onset of compression in this case was so rapid that operation was not possible); (b) a large extradural clot developed after operation for the lifting of a simple depressed fracture—the result, probably, of faulty surgical technique.

From the above description it will be seen that a patient can lapse into unconsciousness from a wide variety of causes after a latent interval following a head injury. Nevertheless, in clinical practice it is dangerous not to diagnose every case of latent unconsciousness as being due to compression of the brain by a surface haemorrhage that can be relieved by surgery. In all cases in which there had been a history of a latent interval, whether the patient was admitted unconscious or conscious, the presence or absence of an extradural clot was always determined either in life or at necropsy.

Extradural haemorrhages occasionally occur associated with severe intrinsic injuries in which there has been no latent interval. More rarely, bleeding from a torn dural sinus may be so rapid that the latent interval is virtually non-existent.

Mechanical Forces Causing Brain Injury

By the nature, degree, and distribution of the lesions found at necropsy in many of the brains, it was judged that the head at the time of accident had been subjected to a series of forces, each acting differently. For example, a patient's brain may be injured when he is flung from his seat, when his head strikes a resistant object, or, again, when it is jerked violently backwards in a rebound. From the distribution of the major lesions it was obvious that the hemispheres, rather than the brain stem and cerebellum, take the brunt of the injury. It was also clear that the hemispheres of the brain not only move in relation to each other but they both frequently move across the brain stem to injure it. Subdural and subarachnoid bleeding is caused not only by the tearing of veins that drain from the surface into dural sinuses but also as the result of laceration and contusion. Severe lacerations are almost certainly caused by the impact of the brain on the cutting edges of bone or of dural partitions. A ruptured vessel on the surface can bleed inwards to cause an intracerebral haemorrhage. No special structure remains immune from injury. Linear as well as rotational forces are nearly always active. Whatever the acting force, it is distortion that ultimately produces the pathological lesion. From the post-mortem findings it is impossible precisely to reconstruct the physics of the injury.

Analysis of Operations

The details of the 209 major operations and 166 minor operations carried out in the 1,000 cases are as follows:

<i>Major Operations</i>	
Compound fractures of the vault	44
Compound fractures of the base (internal compression)	3
Closed depressed fractures of the vault	41
Extradural haemorrhages:	
With latent interval	27
Without	5
Acute subdural haematoma	69
Decompressions	2
Enucleation of eye	4
Major lacerations of the scalp	14

Minor operations for minor lacerations of the scalp were done in 139 cases, and for burr-holes for inspection or drainage in 29.

In addition many lumbar punctures were carried out for drainage and diagnostic purposes.

Extradural Haemorrhages

Among the 1,000 adult cases investigated there were 28 cases of extradural haemorrhage with compression of the brain in which there was a latent interval. Operations were carried out in 27 and one patient died before operation could be performed. Of the 27 patients who were operated on, 17 survived and 10 died. The main details are given in Table VIII.

TABLE VIII.—*Massive Extradural Haemorrhages with Latent Period*

Sex	Age	Cause	Site	Source
<i>Recoveries</i>				
M	22	Fall of 12 ft.	Right temporal	M.M.A.
M	45	Struck by metal strap	" parietal	Diploic
M	27	Bicycle accident	Occipital	Lateral sinus
M	18	Motor-cycle accident	Right parieto-occipital	M.M.A.
F	55	Knocked down by car	Parieto-occipital	Sagittal sinus
M	43	Fall of stone in mine	Left fronto-parietal	M.M.A. (trunk)
M	13	Knocked down by car	Left frontal	M.M.A. (ant. branch)
M	32	Bicycle accident	Right temporal	M.M.A. (trunk)
M	28	Hit by cricket ball	Left "	M.M.A.
M	29	Fall of 15 ft.	" parietal	M.M.A. (post. branch)
M	34	Motor-cycle accident	Right fronto-temporal	M.M.A. (ant. branch)
M	52	Fall of stone in mine	Left fronto-temporal	Diploic
M	23	Bicycle accident	Left temporo-parietal	M.M.A. (ant. branch)
M	33	Fall of 45 ft.	Left fronto-parietal	M.M.A. (ant. branch)
M	40	Struck by metal sheet	Right parietal	M.M.A. (trunk)
F	62	Fell from ladder	" temporo-parietal	M.M.A. (post. branch)
M	50	Knocked down by car	Left fronto-temporal	M.M.A. (trunk)
<i>Deaths</i>				
M	46	Struck by another	Right temporal	M.M.A. (post. branch)
M	44	Fell downstairs	" temporo-posterior	M.M.A. (post. branch)
M	29	Fall of stone in quarry	Left parieto-occipital	M.M.A. (ant. branch)
M	31	Bicycle accident	Right parieto-occipital	M.M.A. (trunk)
M	25	Motor-cycle accident	Left temporal	M.M.A. (trunk)
M	55	Struck by metal bar	" "	M.M.A. (ant. branch)
M*	25	Motor-cycle accident	Right "	Lateral sinus
F	31	Fall of 7 ft.	Left "	M.M.V.
M	23	Bicycle accident	Right fronto-parietal	M.M.A.
M	26	Motor-cycle accident	Right temporal	Diploic
F	25	Dragged by rope	Left "	M.M.A. (post. branch)

M.M.A. = Middle meningeal artery. * Operation was not performed in this case.

Of the 10 patients who died following operation, it was found at necropsy that in five cases there were other injuries in the brain, such as lacerations, and subdural and intracerebral haemorrhages.

In the four cases in which complications were not found in the brain, each patient had been in a state of deep unconsciousness on admission, and death in every instance was due to brain-stem compression resulting from too-long-delayed operation. Death in the tenth case was due to a post-operative extradural clot after elevation of a simple depressed fracture—the result, probably, of faulty surgical technique.

Based on our experience, our guides for operative procedure are as follows: (1) Whenever possible the operation is carried out under local analgesia, care being taken to procure a free airway and full oxygenization. (2) The clot is widely uncovered, if necessary by a bone flap; we now rarely use the classical subtemporal exposure by the muscle-split method. (3) (a) After gentle evacuation of the clot and sealing of the bleeding vessels, care being taken at all stages not to inflict further pressure on the already embarrassed brain, the operation is halted until signs of recovering consciousness are obvious. When this stage is reached the wound can be closed in the usual way. (b) If, half an hour after the removal of the blood clot, there is no sign of returning consciousness the dura mater is widely opened. (c) If there is still no sign of return of consciousness half an hour after the decompression has been provided, then the temporal lobe of the brain is lifted and the edge of the tentorium severed to relieve possible tentorial herniation.

Crushing Injuries of the Head

For the head to be crushed between two external objects without first being put into violent motion must, by the circumstances of accident, be exceedingly rare. After having applied the strictest criteria we found that only nine cases fulfilled the requirements of a true crushing injury.

If a head be crushed heavily enough it will disintegrate and death will be more or less instantaneous. In our short series, in the eight patients who lived we could recognize three degrees of injury: (1) severe compound fracture with laceration of the brain; (2) compression of the brain and fracture of the skull without compounding; and (3) fracture of the skull without brain compression.

The crushing type of injury is particularly apt to inflict irremediable damage on special structures and the cranial nerves.

The following were sequels of the above eight cases: unilateral deafness in three, labyrinthine injury in one, unilateral blindness in two, unilateral anosmia in one, and squints in three.

One of the examples of crush injury to the head was that of a young miner whose head became trapped between two tubs. He tried unsuccessfully to free himself; the tubs moved towards each other and the man heard a loud cracking sound as his skull fractured. He then felt himself going unconscious and remembered no more until he woke up in hospital 36 hours later to find that an operation had been carried out. On admission he was deeply unconscious. X-ray examination of the skull showed that a piece of bone as large as the palm of a hand had been pushed inwards towards the brain. The bone was elevated and the patient made a complete recovery, there being no retrograde amnesia. The particular interest in this case is that forces of compression produced a state of unconsciousness indistinguishable from that caused by change in speed of movement.

Cerebral Injury During Pregnancy

In two instances women were injured when pregnant and in neither case did the injury cause abortion.

One woman aged 20 was two months pregnant when she sustained a compound wound of the frontal bones with laceration of the brain tissue. She also sustained a comminuted fracture of the upper jaw and lacerations about the face. After extensive cerebral, facial, and dental surgical treatment she made a satisfactory recovery. Her child was born at the normal time, was healthy in every way, and remains so at the age of 4 years. Another observation of interest is that the patient's mother has noticed that her daughter has been much more optimistic and even-tempered since the accident, the change no doubt being due to the leucotomizing effect of the injury on the frontal lobes of the brain. Temperamental changes following head injury are almost invariably in the adverse direction.

The second case was that of a woman aged 28 who was eight months pregnant when she was injured. She survived for three and a half days only, but at no time during this period were there any signs of abortion, the foetal pulse being plainly heard until the mother's circulation began to fail on the third day.

Associated Injuries

In cases of head injury associated injuries to the face, body, and limbs are common. Dislocation of the cervical spine with cord contusion is a well-known complication, as are injuries to the pleura and lungs.

We are, however, particularly anxious to call attention to the facio-maxillary problem which occurs in head injuries and to the necessity for co-operation between the neurological and the facio-maxillary surgeon.

Apart from severe lacerations about the face and scalp that necessitated special plastic repair, 17 complicated frac-

tures of the jaw were treated by our colleague Mr. Godfrey Hutchinson, in his dental department.

When a fracture of the jaw is associated with a state of concussion the decision of when to operate is one which requires considerable surgical experience and judgment. As regards concussion it is wiser to delay facio-maxillary treatment until the patient is well on the way to recovery. On the other hand, if repair of a fractured jaw is delayed too long a satisfactory end-result is jeopardized. It has been our experience that when a mouth injury does not immediately interfere with breathing, treatment of a fracture of the jaw can be postponed until the third day, provided systemic antibiotic treatment is started immediately.

Microscopical Examination of the Brain Stem*

Of the brains obtained whole at post-mortem examination and hardened in 10% formalin, the brain stems of 50 have been cut in their longitudinal axis and examined microscopically.

In five cases there was evidence of gross contusions, the microscopical details of which were similar to those found in the hemispheres. In themselves, these contusions were judged to be severe enough to account for death; in other words, the vital centres had been irrevocably damaged. From the sections it was obvious that post-traumatic hemiplegia must, on occasion, be due to brain-stem damage, the crus cerebri in one case having been torn. Brain-stem and basal ganglia damage may occasionally result from the tearing effects of haemorrhages that start at the surface.

Injuries undetectable by naked eye were easily demonstrable in 10 cases by magnification and showed as typical contusions. Indeed, it is becoming increasingly obvious that in many of the cases that end in death the brain stem has been injured in a physical way. Whether these lesser contusions could in themselves have accounted for death it has not yet been possible to judge; they must, however, have substantially contributed to it.

By definition, presumed injuries of submicroscopical dimensions cannot, of course, be seen through the microscope, but this does not mean that they do not in fact exist; newer methods might demonstrate them. Damage to neurones can be direct or indirect through injury to their supplying blood vessels. No uniform pattern of change in angio-architecture can be determined in the brain stem.

Follow-up Reports

An inquiry was made into the long-term results of 250 consecutive adults who were injured during the years 1949 and 1950. The survey was carried out by means of a questionnaire, and 236 replies were received.

Of these, 169 patients reported that they had returned to normal work and 57 to light work, but 38 of these were eventually able to resume their original work, giving a total of 207 who finally were able to return to normal employment. Nineteen have remained on light work up to the time of writing. Ten have so far not returned to any form of work. Of the 226 patients resuming work of any kind only 10 have been unable to work regularly.

Seventy-eight patients were free from symptoms on leaving hospital; the symptoms of the remaining 158 were headache, dizziness, loss of smell and taste, and tinnitus. Four patients reported attacks of black-outs.

Changes in personality were reported in 49 cases, severe changes such as mental delusions occurring in only three, the remainder being lack of concentration, bad temper, depression, nervousness, and loss of memory.

The average length of time after discharge from hospital before starting work and the type of work undertaken are given in Table IX.

*This is a preliminary statement on work being carried out in the Research Laboratory of the Department of Surgery, University of Durham.

A similar inquiry was made into the long-term results of 100 children who had received injuries to the head during the years 1949 and 1950; this group was also consecutive.

TABLE IX

Type of Work	Average Period After Discharge Before Resuming Work
Return to normal work	10½ weeks
Return to light work and then normal work resumed	27 "
Remaining on light work up to date	32 "
Worked irregularly	16 "

The survey was carried out by means of a questionnaire to the parents; 82 replies were received.

Of these children, 51 were of school age when injured, 30 were below that age, and one child was already mentally retarded and unable to attend school.

Forty-three children were able to return to school in their pre-accident class and were able to compete with their age groups. In eight cases the educational standard was affected, the children either being returned to their original class but not moved up with their age group in the normal way or, immediately on return to school, being found to be below standard and placed in a lower class. In these eight cases it is judged that an intellectual injury of some degree has occurred which is likely to influence adversely the scholastic career of these children for the rest of their lives.

Fifty-two children were free from symptoms. Thirty complained of headache and/or dizziness. Fits were reported in four cases.

Changes in temperament were noticed in 27 instances, the main symptoms being nervousness, lack of concentration, faulty memory, bad temper, and bed-wetting, the parents stating in each instance that these manifestations had not been present before the injury.

Discussion

From the figures announced by the Ministry of Transport 5,250 people died during 1951 as the result of injuries received on the roads. So far as can be estimated, at least 60% succumbed as a direct result of injury to the head, and for every death four or five people receive non-fatal injuries.

This subject is important, not only because of the magnitude of these figures but because healthy people, not those already incapacitated by disease, lose their lives or are maimed. Indeed, the economic loss to the nation because of injuries to the head is enormous. Our figures, however, show that road carnage constitutes only 44% of the total number maimed or killed, the remainder being due to accidents in industry, in the mines, in the home, etc.

To meet the increasing needs of cerebral trauma, not only are further facilities for treatment and rehabilitation necessary but postgraduate schools at university level must soon be established for the instruction of those whose responsibility it will be to care for the head injured away from special centres. Whether such centres should be named "head injury" or "traumatic" is of little importance. A seven-day, 24-hour service is necessary, including facilities for radiology and for all other ancillary investigations. Here again we should like to call attention to the necessity for the closest co-operation between the neurological and the facio-maxillary surgeons in the treatment of head injuries.

The imperfect liaison between the hospital and the general practitioner has been, and still remains, a weak link in the problem of head injury. We believe that much advantage would accrue from visits by the general practitioners to patients in hospital during the acute stages of the injury, and this important postgraduate association should be fostered. Also, much waste of man-power could be avoided if, when the time comes for consideration of a patient's

return to work, a conference between the general practitioner and the specialist were held in the patient's home surroundings when every aspect of the case could be reviewed. In this way unnecessary hardships could be eliminated and extremes of judgment tempered.

Finally, our post-mortem studies have shown that in a considerable percentage of deaths the injuries received are of such magnitude that they must be irreversible from the moment of infliction. Therefore, again we should like to stress the importance of prevention in the solution of this problem, which should be constantly in the minds of the medical profession, the ruling bodies, and the general public. The chance of serious injury about the head to the individual remains far too high.

Summary

Between 1941 and 1951 2,000 cases of acute injury to the head were admitted to the General Hospital, Newcastle-upon-Tyne. The results of an analysis of 1,400 of these (1,000 adults and 400 children) are given. In the 1,000 adult cases there were 175 deaths, 87 of them due to road accidents; 38 of the deaths resulted from accidents in industry. Of the 175 patients admitted in a state of coma, 121 died. There were 28 cases of extradural haemorrhage with compression of the brain in which there was a latent interval of consciousness: one patient died before operation was possible; of the 27 operated on 17 survived and 10 died.

Of the 400 cases in childhood (up to the age of 12 years) 147 were due to road accidents and 149 to falling from a height: 34 of the children died, 20 of them having been admitted in a state of coma.

CLINICAL AND EXPERIMENTAL STUDY OF SEGMENTAL PAIN FROM THE SHOULDER

BY

N. W. NISBET, F.R.C.S.Ed.

*Associate Professor of Orthopaedic Surgery, Dunedin
Hospital, New Zealand*

The pain from diseases of the shoulder such as supraspinatus tendinitis or capsulitis is always referred. Although radiation to the arm and hand has been recorded, the distribution of this referred pain has received scant attention in studies of this common group of diseases from orthopaedic sources, nor indeed has it often been mentioned. The importance of its recognition lies in the differentiation from other causes of referred pain into the upper limb, so that unnecessary mistakes in diagnosis can be avoided. Further, clinical and experimental studies of this sort may shed light on the problem of referred pain and on the segmental supply to the shoulder-joint and related structures.

The pain is diffuse and deep, and can be reproduced by experimental noxious stimuli in several ways: one is by injections of 6% saline into the deep structures around the joint. If carried out accurately this method correlates the structure of origin and the segmental reference arising therefrom. It also closely simulates the pain found in clinical cases. Kellgren (1949), in