Extradural Hematoma*

Report of 167 Cases

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OF ALL the potentially lethal complications of head injury, extradural hemorrhage is the most readily diagnosed and remediable, yet the mortality rate remains distressingly high. It is not our intention here to discuss in detail the pathology of the condition or the pathogenesis of its symptoms and signs, for these matters have been fully dealt with by various authors,[1-3,5,6,8,16,24] and our own practice has been described for teaching purposes in a previous publication.[12] The purpose of this paper is to present a series of 167 cases of surgically treated extradural hematomas in which there were 26 deaths (15.6%) including only 10 deaths in the last 105 cases, and to analyze the factors conducive to lowering the mortality rates.

Source of Patients

The 167 cases have accumulated in 11 years between March, 1956, and March, 1967. The majority have been treated at the Royal Brisbane Hospital, a lesser number at the Princess Alexandra Hospital, Brisbane, and a few at other hospitals; most of the children were admitted to the Brisbane Children's Hospital. The 167 cases have been drawn from a total of approximately 11,000 patients admitted with head injury in this time, of which they represent 1.5%, although selected patients are referred from other centers in Queensland.

The series starts from the first appointment of a neurosurgeon to these hospitals in March, 1965. The annual incidence and mortality rate (Table 1) shows a general trend toward better results after the disastrously high mortality rate of the earlier years, although the occasional transfer of a moribund patient without decompression interrupts this pattern, most noticeably in 1959 and in 1965. Of the first 60 patients, 16 (26.7%) died, but of the last 60 only 5 (8%) died ($X^2 = 5.7618$, $p < 0.02$). Table 1 shows also the number of these patients who had sustained cerebral lacerations, and subdural or intracerebral hematomas warranting surgical intervention in addition to their extradural hematomas. (No cognizance is taken of cerebral contusion, or of the commonly found subdural fluid, or of clinical or autopsy evidence of brain stem and other lesions not submitted to surgery in the assessment of "intradural lesions.") It is apparent that neither the improving results, nor their occasional annual fluctuation, can be accounted for by change in severity of injury as evidenced by the incidence of these intradural lesions.

TABLE 1

Annual incidence and mortality rate of extradural hematoma and associated intradural lesions

Year	No. of Cases	Extradural Hematoma Deaths		Associated Intradural Lesions*	
		No.	%	No.	%
1956	16	6	37.5	11	68.8
1957	16	2	12.5	6	37.5
1958	18	3	16.6	8	44.4
1959	11	5	45.5	5	45.5
1960	13	2	15.4	9	69.2
1961	18	1	5.6	11	62.2
1962	17	2	11.8	5	29.4
1963	12	1	8.3	7	58.3
1964	16	1	6.3	6	37.5
1965	16	3	18.8	7	43.8
1966	11	0	—	4	36.4
1967	3	0	—	0	—
Total	167	26	15.6	79	47.3

* See text for definition.

Age and Sex

The ages of the patients ranged from 9 months to 84 years (Table 2). Extradural hematoma is an affliction of youth, with dis-

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TABLE 2

Age, incidence, and mortality rates of extradural hematoma related to fractures and associated intradural lesions

Age (yrs)	No. of Cases	Deaths		Fracture		Intradural Lesions	
		No.	%	Present	Depressed	No.	%
0–10	22	1	4.5	14	5	6	27.3
11–20	51	7	13.9	34	9	19	37.3
21–30	30	4	13.3	21	6	16	53.3
31–40	26	6	23.1	16	2	13	50.0
41–50	24	4	16.6	16	0	14	58.3
51–60	7	2	↑	5	1	4	↑
61–70	4	1	28.6	1	0	4	78.6
71–80	2	0		2	0	2	
81–90	1	1	↓	0	0	1	↓
Total	167	26	15.6	109	23	79	47.3

proportionately strong representation in the 11 to 20 year-old group, and also in the very young. The mortality rate in this series is minimal among the children and rises fairly smoothly with increasing years, almost in parallel to the increasing incidence of associated intradural lesions which were almost the rule over the age of 50 years.

The frequencies of fractures reported do not represent their full incidence, since many patients were not submitted to x-ray examination when the need for early surgery was apparent, while in some cases the presence or absence of fracture was not determined, or not noted, at operation. However, the proportion of cases in which a fracture was reported is about 2 in 3 in most age groups. Several other authors have commented previously on the absence of fracture in some cases of extradural hematoma.[20] On the other hand, the incidence of depressed fractures recorded probably represents the total, or almost so. This incidence is greatest in children, with a steady decline in subsequent decades in inverse relationship to the frequency of intradural lesions. This might be explained by the absorption of part of the energy of impact by the depressed fracture, sparing the brain from so violent an acceleration or deceleration stress.

TABLE 3

Sex, incidence, and mortality of extradural hematomas

Sex	No. of Cases	Deaths		Aged 10 yrs or less	
		No.	%	No.	%
Male	130	22	16.9	9	6.9
Female	37	4	10.8	13	35.1
Total	167	26	15.6	22	13.2

Males outnumbered females by almost 4 to 1 (Table 3) but among the children there were more girls than boys, a fact reflected in the slightly lower mortality rate for females

Cause of Injury

Traffic accidents caused injuries to 76 (45.5%) of the 167 patients, a relatively lower percentage than the official figure in this state of 60% of all head injuries.[13] This disproportion supports the common impression that extradural hemorrhage often follows relatively minor injury. In any case, the severe acceleration-deceleration stresses commonly experienced in traffic accidents, which are so damaging to the brain, play no part in the production of extradural hematoma which depends entirely on the type and degree of local deformation of the skull.[21]

The cause of injury varied with age, as expected. Falls about the home accounted for most in children, while traffic injury assumed prominence in the second and third decades. Alcoholic brawls, and again domestic accidents, were of increasing importance with advancing years. The industrial group consisted mainly of falls from heights but also included some agricultural and tree-felling ac-

TABLE 4

Site of extradural hematoma in relation to age

Age (yrs)	Number of Cases and Percentage of Total						
	Lateral	Frontal	Vertical	Basal	Occipital	Post. Fossa	Total
0–10	15 (68.2)*	—	—	—	2 (9.1)	5 (22.7)	22
11–20	31 (60.8)	11 (21.6)	1 (2.0)	2 (3.9)	2 (3.9)	4 (7.8)	51
21–30	23 (80.0)	5 (16.6)	—	—	2 (6.6)	—	30
31–40	17 (65.4)	3 (11.5)	2 (7.7)	1 (3.8)	2 (7.7)	1 (3.8)	26
41–50	20 (83.3)	—	—	3 (12.6)	1 (4.1)	—	24
51–60	6 (85.7)	—	—	—	1 (14.3)	—	7
61–70	3 (75.0)	—	—	—	—	1 (25.0)	4
71–80	1 (50.0)	—	—	—	—	1 (50.0)	2
81–90	1 (100.0)	—	—	—	—	—	1
Total	117 (70.1)	19 (11.3)	3 (1.8)	6 (6.0)	10 (7.2)	12 (7.2)	167

* Percentage of age group in each site given in parentheses.

cidents. Among females there were practically no injuries caused by altercation or industrial accident and a relatively higher incidence from traffic accidents, sport and domestic injury.

Site of Extradural Hematoma

The sites in which the hematomas were found were grouped as frontal when the hematoma was confined to the anterior cranial fossa,[29] vertical when it overlay the sagittal sinus,[26] basal when it was on the floor of the middle fossa, and occipital when it was above the transverse sinus. Other supratentorial hematomas over the general convexity of the skull, whether frontal, temporal, or parietal, were grouped as "lateral," while those situated chiefly or entirely below the transverse sinus were listed as "posterior fossa." Five patients had bilateral hematomas; two were biparietal, and three, bitemporal. Thus, bilateral hematomas are not so uncommon as might be imagined.[19]

The site of the hematoma in relation to the patient's age is shown in Table 4. The great majority of hematomas were in the lateral group (70.1%), although a proportion of these would have been missed completely by routine burr holes over the anterior and posterior branches of the middle meningeal artery. The "atypical" sites were relatively more common in the earlier years and curiously rare recently. That they were not being missed was apparent from autopsy findings.

Posterior fossa hematoma was particularly common among children and teenagers and again in the elderly where falls onto the back of the head were common. Anterior fossa hematoma was found in teenagers and young adults who tended to meet their sporting or traffic accidents head-on.

TABLE 5

Site of extradural hematoma in relation to mortality rate and incidence of associated intradural lesions

Site	No. of Cases	Deaths		Intradural lesion	
		No.	%	No.	%
Lateral	117	19	16.2	54	46.1
Frontal	19	0	—	9	47.4
Vertical	3	0	—	1	33.3
Basal	6	1	16.7	4	66.7
Occipital	10	2	20.0	4	40.0
Posterior fossa	12	4	33.3	7	58.3
Total	167	26	15.6	79	47.4

The influence of the site of the hematoma on mortality rate, and the incidence of intradural lesions in relation to site, are set out in Table 5. Posterior fossa lesions had the highest mortality rate (including the one death in a child under 10 years who had also a depressed fracture and gross cerebellar laceration), despite their frequency in children. All patients with frontal or vertical hematomas survived, because they developed hematomas more slowly and fewer had lost consciousness. The mortality rates do not parallel the incidence of intradural lesions although the posterior fossa hematomas had a high incidence of associated intradural lesions.[23]

Intradural Lesions

Subdural or intracerebral hematomas or cerebral lacerations warranting surgical intervention were associated with a mortality rate 4 times higher than that of extradural hematomata alone, whether treated at the time of the original operation for extradural hematoma or at a second operation because of later development or contrecoup site (Table 6).

The types of intradural lesion seen and the associated mortality rates are shown in Table 7. The presence or absence of cerebral laceration as the cause of subdural hematoma did not affect the mortality rate, while purely intracerebral hematomas did not increase the risk of death above that of subdural hematoma. Multiple lesions, however, in the form of separate subdural and intracerebral hematomas were almost always fatal.

The difference between the mortality rate of extradural hematoma alone and that experienced with associated intradural lesions is highly significant statistically ($X^2 = 14.6441$, $p < 0.001$).

Lucid Interval

Only 20 of the 167 patients followed the classical course of concussion to lucidity to unconsciousness. At the time of operation, 33 patients were conscious after initial concussion, 35 not originally concussed had lost consciousness, 38 had been unconscious from the time of injury, and 41 (25%) had been conscious throughout.

Table 8 relates these various levels of consciousness to the type of lesion. Concussion occurred in 91 (54.6%) patients: 42 of 88 (47.7%) with extradural hematoma only, and 49 of 79 (62.1%) with associated intradural lesions. This latter difference is not statistically significant ($X^2 = 3.4318$, $0.1 > p > 0.05$) although it might be expected that concussion would be more common in the case of those acceleration-deceleration injuries which produce cerebral

TABLE 6

Effect of intradural lesions on mortality rates of extradural hematoma

Lesion	No. of Cases	Deaths	
		No.	%
Extradural hematoma only	88	5	5.7
Associated intradural lesion	79	21	26.6
Total	167	26	15.6
Intradural lesion requiring second operation (included above)	23	6	26.1

TABLE 7

Types of intradural lesion associated with extradural hematoma

Lesion	No. of Cases	Deaths	
		No.	%
Subdural hematoma	35	8	22.9
Cerebral laceration with subdural hematoma	30	8	26.7
Cerebral laceration with intracerebral and subdural hematoma	4	0	—
Intracerebral hematoma	5	1	20.0
Intracerebral hematoma and separate subdural hematoma	5	4	80.0
Total	79	21	26.6

lacerations and subdural hematoma. A higher proportion of patients with intradural lesions had been unconscious throughout, while almost one-third of those with uncomplicated extradural hematoma did not lose consciousness at any stage. Some 54.5% of the patients with extradural hematoma only, but only one-third of patients with associated intradural lesions, were conscious at the time of operation. This difference is highly significant ($X^2 = 7.8281$, $p < 0.01$). The classical lucid interval was more frequently seen in the presence of subdural lesions than with extradural hematoma alone.

The level of consciousness of patients is related to mortality rate in Table 9. The low mortality rate among those who were conscious at the time of surgery (one in 74) is in striking contrast to the higher rate of those who were unconscious, whether after a lucid interval or not.[18] This point is even clearer in Table 10, where those patients whose surgery was delayed until they had lost consciousness after a lucid period are seen to have a mortality rate similar to those who were unconscious throughout from injury to operation. The state of consciousness at the time of operation may be determined not only by delay, but also by the rate of evolution of the lesion.

The course of consciousness varied with the age of the patient. The proportion of those who were initially concussed rose with the age of the patient, while the proportion of those who were conscious throughout their clinical course fell with increasing years. On the other hand, the proportions of those conscious or unconscious at the time

TABLE 8

Level of consciousness in extradural hematomas

Course of Consciousness	Total Cases		Extradural Only		Assoc. Intradural	
	No.	%	No.	%	No.	%
Unconscious to lucid to unconscious	20	12.0	5	5.7	15	19.0
Unconscious to lucid	33	19.8	20	22.7	13	16.5
Lucid to unconscious	35	21.0	18	20.5	17	21.5
Unconscious throughout	38	22.8	17	19.3	21	26.6
Conscious throughout	41	24.6	28*	31.8	13†	16.4
Total	167	100.0%	88	100.0%	79	100.0%
Initially unconscious	91	54.6	42	47.7	49	62.1
Conscious at time of surgery	74	44.3	48	54.5	26	32.9
Unconscious at time of surgery	93	55.7	40	45.5	53	67.1

* None with depressed fracture.
† 11 with depressed fracture.

of operation were relatively constant and almost equal in all age groups, despite the rise in mortality rate with increasing years.

The patterns of change in consciousness also varied with the site of the hematoma. Of particular note were the high proportion of patients with frontal hematoma who were conscious throughout (8 of 19) and the even higher proportion who were conscious at the time of operation (12 of 19), in contrast to the high proportion of patients with posterior fossa hematoma who were unconscious throughout (4 of 12) or unconscious at the time of operation (7 of 12). The relationship of these characteristics to the mortality rates for the two sites are apparent. (The proportion of patients with frontal lesions who were conscious throughout may, however, be only a chance finding since $\chi^2 = 2.8202$, $0.1 > p > 0.05$.)

Other Symptoms and Signs

While the detection of complications of head injury, and the early diagnosis of extradural hematoma, is based primarily on recognition of slight changes in the state of consciousness, other symptoms and signs may be of value usually as supporting evidence, but occasionally as the initial indication of deterioration. We have analyzed those associated symptoms and signs in an attempt to assess their relationship to mortality. Thus, the frequency of a symptom or sign refers to evidence of deterioration rather than to mere incidence.

Abnormality of one pupil (which does not necessarily refer to full dilation and loss of light reflexes) was a stimulus to diagnosis in over one-third of the patients, and of one or both pupils in almost one-half. Bradycardia was observed in only one-fifth, and hypertension in less than one-tenth, but hemiparesis was noted in almost one-third. The incidence of these various signs varied little with age, except in the case of hemiparesis, which was uncommon in children (3 in 22) but progressively more common with advancing years.

The site of the hematoma influenced the incidence of these signs. Pupillary abnormality was most common with laterally situated hematoma, less common but more common than one might expect with posterior fossa lesions, and rare with frontal hematoma. Bradycardia, on the other hand, was common in frontal, basal, and posterior fossa hematoma. Hemiparesis was rare with basal and posterior fossa sites.

All of these signs, like a lucid interval, were more likely to be observed when there was also an intradural lesion. In those patients who never lost consciousness or who had recovered from initial unconsciousness and were operated on while still conscious, headache was an important symptom in more than half while pupillary abnormality, bradycardia, and hemiparesis were each found in only one-quarter. In patients who were continuously unconscious or lost consciousness before operation, pupillary abnormality was noted in two-thirds. Bradycardia was not notable in this group but occurred in over one-third of those with a classical lucid interval. Hemiparesis was seen in two-thirds of those with a classical lucid interval, but occurred in only a little over one-quarter of other unconscious patients.

Headache, irritability, and bradycardia were noted in more than half of the patients reaching surgery while conscious. On the other hand, three-quarters of those with one dilated pupil, more than half of those with hemiparesis or hypertension, and all of those with bilateral dilated pupils or decerebrate rigidity were unconscious when they came to operation. In seven patients headache alone, and in three patients irritability alone, pointed to the diagnosis. In nine, a combination of headache and irritability proved grounds for suspicion, while in another nine the addition of bradycardia led to diagnosis.

The mortality rate associated with the presence (or recognition) of these signs is shown in Table 11. Dilatation of one pupil was associated with a mortality rate of 17.2% and of both pupils 46.7%, while decerebrate rigidity had a mortality rate of 77.7%.

The Classical Picture

The textbook sequence of initial concussion, lucidity, and unconsciousness, together with pupillary dilatation, circulatory disturbance, and hemiplegia, was observed in only four of the 167 patients. One of these had a posterior fossa hematoma with a depressed fracture and an intradural lesion, and three had lateral hematomas, only one of which

TABLE 9

Mortality rate of extradural hematoma related to consciousness

Course of Consciousness*	Total Cases			Extradural Only			Intradural Lesion		
	No.	Deaths	%	No.	Deaths	%	No.	Deaths	%
ULU	20	5	25.0	5	0	—	15	5	33.3
UL	33	1	3.0	20	0	—	13	1	7.7
LU	35	10	28.6	18	3	16.6	17	7	41.2
U	38	10	26.3	17	2	11.8	21	8	38.1
C	41	0	—	28	0	—	13	0	—
Total	167	26	15.6%	88	5		79	21	

* U = unconscious, L = lucid, C = conscious.

TABLE 10

Mortality rate related to consciousness at time of surgery

Consciousness*	Total Cases			Extradural Only			Intradural Lesion		
	No.	Deaths	%	No.	Deaths	%	No.	Deaths	%
C at some time	129	16	12.4	71	3	4.2	58	13	22.4
C at surgery	74	1	1.4	48	0	—	26	1	3.8
Lost C before surgery	55	15	27.3	23	3	13.0	32	12	37.5
U throughout	38	10	26.3	17	2	11.8	21	8	38.1
U at surgery	93	25	26.9	40	5	12.5	53	20	37.7

* U = unconscious, C = conscious.

TABLE 11

Significance of pupillary signs and concomittant states

Sign	No. of Cases	Deaths		Common Associated Signs		
		No.	%	Circulatory	Hemiplegia	Decerebrate
One pupil	64	11	17.2	12	18	10
Both pupils	15	7	46.7	5	0	7
One or both pupils	79	18	22.8	17	18	9
Circulatory change only	28	3	10.7	0	0	0
Hemiplegia only	27	4	14.8	0	0	0
Decerebrate	9	7	77.7	0	0	0

was classical in being associated with a fracture. To achieve a low mortality rate, one must prevent the appearance of the "classical picture" by early recognition and surgery.[11] The one fully classical case was observed to death by a resident who did not appreciate the significance of the signs that a nurse had faithfully recorded over a period of 12 hours. Many others would doubtless have achieved a "classical picture" and death, if they had been allowed to do so.

Development of Presenting Signs

The rate of development of clinical signs warranting diagnosis of extradural hematoma after a head injury varied in this series from less than 1 hour to 14 days. In analyzing this factor, the interval from injury to operation was used, and no attempt was made to analyze the first 12 hours since our information was often not sufficiently accurate to permit further subdivision.

Table 12 shows the speed of developing symptoms related to mortality. Almost 30% came to operation within 12 hours, more than half within 24 hours, and almost three-quarters within 48 hours. Over 10% were delayed beyond 5 days. There was little variation with age, although children tended to come to operation a little earlier,[4] and teenagers a little later, than average.

However, the site of the hematoma did influence the speed with which symptoms developed. Frontal lesions not only were associated with the lowest mortality rate but had by far the slowest rate of development. Posterior fossa lesions, which had the highest mortality rate, developed signs at the same rate as lateral lesions, while occipital lesions tended to develop faster.

The few patients who had a classical lucid interval and were unconscious at the time of operation developed symptoms fastest, those who were unconscious throughout or lost consciousness before operation came to operation faster than the average, those who were initially concussed but conscious at the time of operation were slower than average, while the slowest development occurred in those who were conscious the whole time, as in those with frontal hematomas.

Pupillary abnormality developed much faster than other signs. Thus, two-thirds of those with bilaterally dilated pupils were operated on within 24 hours. Of those patients operated on within 12 hours, three-quarters, and of those operated upon within 48 hours, one-half, had pupillary signs, but these signs were present in less than one-quarter of those operated upon after 48 hours.

TABLE 12

Rate of development of signs related to mortality

Interval	No. of Cases	Deaths	Mortality (%)
Less than 12 hours	49	14	28.6
12 hours, less than 24	43	6	14.0
24 hours, less than 48	31	5	16.1
3rd or 4th day	24	1	4.2
5th to 7th day	9	0	—
2nd week	8	0	—
Not recorded	3	0	—
Total	167	26	

Table 12 indicates that a high mortality is associated with rapid development of signs. Table 13, however, presents a more critical analysis of these figures indicating the importance of an associated intradural lesion; this complication critically affects the mortality rate. With extradural hematoma alone the rate of presentation had little effect on mortality rate, but with associated intradural lesions the mortality rate approached 50% in the first 12 hours and fell steadily when development was slower. Patients with associated intradural lesions also developed signs considerably faster than those with extradural hematoma alone. There were 65.9% with intradural lesions, but only 45.5% with extradural hematoma only, who presented signs within 24 hours, a difference that is statistically highly significant ($X^2 = 6.9805$; $p < 0.01$).

Angiography and Ventriculography

Carotid angiography was used in only 26 of these 167 cases. We do not emphasize the value of angiography in the diagnosis of extradural hematoma despite its known usefulness in atypical cases.[9,22] Only two patients had ventriculograms.

Type of Operation

Almost all the hematomas were dealt with through decompressions (subtemporal or suboccipital) or local craniectomies, devel-

TABLE 13

Rate of development of signs related to intradural lesions and mortality

Interval	Extradural Hematoma Only			Associated Intradural Lesion		
	Cases	Deaths	%	Cases	Deaths	%
Less than 12 hours	21	1	4.8	28	13	46.4
12 hours, less than 24	19	1	5.3	24	5	20.8
24 hours, less than 48	21	3	14.3	10	2	20.0
3rd or 4th day	12	0	—	12	1	8.3
5th to 7th day	7	0	—	2	0	—
2nd week	5	0	—	3	0	—
Not recorded	3	0	—	0	0	—
Total	88	5	5.7	79	21	26.6

oped from exploratory burr holes. In a few cases, large (5 cm) trephine openings were used, but osteoplastic flaps were cut in only 18 cases. Nine of the 18 flaps were for frontal hematomas (two were cut actually for anterior cranial fossa repair for concomitant cerebrospinal fluid rhinorrhea), two were for posterior fossa lesions (to expose a torn transverse sinus), three for occipital, two for vertical, and only two for lateral hematomas. Thus, osteoplastic flaps were much more commonly used for hematomas with unusual complications. Nor were they used in case of emergency, but rather in relatively elective procedures.

Discussion

Hooper,[8] in his excellent paper on extradural hemorrhage, reviewed the current mortality rates in relation to his own of 23% in 83 cases and concluded that, while a mortality rate of over 25% was indicative of faulty organization or management of these cases, the appropriate and inevitable mortality rate in these patients should be 10%, which he had achieved in his recent experience. McKissock and his associates[17] reported a mortality rate of 27% in their 125 cases (including some discovered at autopsy) and, while agreeing with Hooper that 10% represented the mortality that ultimately should be attained, drew attention to the fact that no series of over 40 cases with a mortality rate of under 20% had then been published. Recently, Weinman[28] of Colombo reported a series of 144 cases with only 26 deaths (18%) and analyzed the factors concerned. In our series, the over-all mortality rate of 15.6% represents an improvement from 26.7% in the first 60 cases to 10% in the last 100. Thus, the "ideal" mortality rate predicted by Hooper has been achieved in a significant series, and yet it is apparent to us that even recently some few deaths were due to error.

It has been seen in the earlier analyses that mortality rates do not correlate well with the simple fact of the presence or absence of severe brain damage as represented by intradural lesions warranting surgical intervention. Of greater significance in relation to death is the question of the rate of development of clinical signs in these patients. It is our firm conclusion that the improvement seen over the years has resulted from a better staff organization and awareness regarding the diagnosis of extradural hemorrhage from minimal signs. Our hope for future improvement rests upon even further advance in this direction.

The most important single sign of a developing extradural hematoma is clouding of consciousness, or deepening of the degree of unconsciousness. In the instruction of nursing and medical students, the stress should be on intelligent observation of how well the

patient is, and how well his brain is functioning, rather than on any arbitrary grading of consciousness by such terms as alertness, drowsiness, stupor, semicoma, and coma. It is tragic when the wardsmaid appreciates deterioration by recognizing that a patient "is not as bright now as earlier," while trained staff await the development of the next stage in their preconceived and rigid scale of deterioration.

The development of associated signs should be regarded not only as an important aid to a diagnosis for which the clinician should have been prepared by the character of the original trauma, but also as an indication that the situation is already urgent, for these signs occur in those groups of patients who already have a significant risk of death.

In this series, many patients were not submitted to x-ray examination not because this was neglected but because it was already apparent that intracranial hemorrhage was occurring, and the clinical evidence was sufficient to permit localization without the additional delay imposed by radiography, often outside routine working hours. Craniotomy was performed not at routinely dictated sites over the anterior and posterior branches of the middle meningeal artery, nor, as suggested by some, above the frontal sinus in case an anterior fossa hematoma was being missed, but in relation to the area of skull trauma in the particular patient. Only thus will hematomas be found regularly and readily without recourse to less reliable and time-consuming neuroradiological investigations, which have no place in the urgent situations engendered by the frequently rapid development of extradural hematomas. When the development of signs is slower, special radiological procedures may be both justifiable and helpful, but routine dependence on these investigations in all cases will be associated with a considerably higher mortality rate than that reported in this series.

Emphasis should always be placed on the simplest, most readily available, and most useful of all investigations, the exploratory burr hole craniotomy correctly placed in relation to the bruise on the head.

Most of the patients in our series received their injuries close to a neurosurgical center, although some were transferred from great distances when presentation was slower. Weinman attributed his improving mortality rate to the policy of admitting all cases of head injury in Ceylon to neurosurgical care within 2 hours. A general policy of this sort is utterly impractical in a country of great distances such as Australia, where many patients suffering head injury may be a long way from neurosurgical care. The neurosurgeon's responsibility in relation to this problem is clear; he must teach simple concepts and basic procedures that are within the technical capacity and equipment of those doctors who must manage these patients. The neurosurgeon who from within his ivory tower writes of the necessity or desirability of special investigation, neuroradiological or otherwise, instead of emphasizing simple clinical appraisal, or who advocates osteoplastic flap craniotomy instead of the simpler and more readily accomplished decompression or local craniotomy, does a grave disservice to the injured. Not only does he jeopardize the chances of that large number of patients who cannot benefit directly from his care, but he is also likely to find that his own mortality rate, based on such a policy, is higher than that desirable and attainable.

Summary

We have operated on 167 patients with extradural hemorrhage in the last 11 years. The over-all mortality rate of 15.6% includes a decline from 26.7% in the first 60 cases to only 8% in the last 60. We have analyzed these cases with particular reference to the presence or absence of intradural lesions and the rate at which diagnostic signs developed.

The outstanding avoidable cause of death was undue delay in diagnosis and treatment. We have emphasized clinical assessment rather than special investigation, and simple rather than more complex surgical procedures, as well as the need for clear and concise teaching of medical and nursing students.

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