'Brain attack'—aneurysmal subarachnoid haemorrhage: death due to delayed diagnosis

ABSTRACT—The objectives of this study were to determine how quickly patients who have an aneurysmal subarachnoid haemorrhage are diagnosed and referred to a regional neurosurgical unit for assessment and management. We examined whether delayed diagnosis resulted in poorer management outcome and how such delays could and should be avoided.

An in-depth analysis of pre-hospital and hospital management of 180 consecutive patients with an aneurysmal subarachnoid haemorrhage was carried out at the Wessex Neurological Centre, a regional neurosurgical unit with a catchment population of 2.8 million people. One hundred and eighty patients with a proven (computed tomography and/or lumbar puncture) aneurysmal subarachnoid haemorrhage were studied. The main outcome measures were management of mortality and morbidity using the Glasgow Outcome Scale (three months to one year follow-up period).

Of the 180 patients, 136 were suitable for the study. Diagnosis was delayed in 69 (51%). In this group, failure to recognise this condition resulted in 45 patients (65%) suffering a second or third haemorrhage before being diagnosed. As a direct consequence of this delay significantly more patients died or were severely disabled than those whose haemorrhage was diagnosed without delay ($\chi^2 = 8.27$, $p < 0.005$). Delays in diagnosis and transfer to a neurosurgical unit are largely avoidable.

Myocardial infarction (MI) patients present with an easily recognised clinical picture. The only delay in management is the time the patient takes to seek treatment. Early intervention, within hours, has been the key to successful management and the medical press and the media have played an important role in getting this message across[1,2].

Unfortunately, after a stroke or 'brain attack' the general approach is one of therapeutic nihilism [3]. This approach also pertains to aneurysmal subarachnoid haemorrhage (SAH), where rebleeding carries a mortality of 40–50% and the same management time frame as for a 'heart attack' is required. The term 'heart attack' promotes a sense of urgency, a need to diagnose and treat; a 'brain attack' (stroke and/or SAH) needs the same degree of immediate attention if the present devastating patient outcome is to be improved. But evidence indicates a profoundly different approach [3].

Aneurysmal SAH occurs in 6–16 patients per 100,000 population per year [4-6]. It results in the death of 70% of otherwise healthy patients, often in their most productive years.

Despite improved neurosurgical results there has been little change in the overall management of mortality and morbidity associated with aneurysmal SAH [7,8]. Neither the consequences of delayed diagnosis and referral to the neurosurgical unit (NSU), recognised for years by neurosurgeons and more recently by patients and the legal profession, nor the deleterious effect on outcome have been statistically assessed. Identified avoidable delays have major implications for acceptable standards of clinical practice.

This paper attempts to address these issues in the setting of a large neurosurgical unit serving a population of 2.8 million people in the south of England.

Patients and methods

All SAH patients were rigorously assessed over an 18 month period to obtain a step-by-step account of events prior to admission to the NSU. The initial history was recorded before admission to the NSU in the patients' general hospital notes. The referral to the NSU was made by telephone, with the computed tomography (CT) scan transferred by an image link system. The neurosurgical registrar prospectively recorded the information on a specially designed form. The history was further evaluated when the patient was admitted to the NSU. The information entered into the NSU notes identified the exact sequence of events from the haemorrhage to the eventual admission to hospital, with particular emphasis on the precise symptoms experienced by the patient, the time of the ictus and any subsequent developments. The data were therefore obtained from the hospital notes, the NSU telephone referral form and notes in a stylised manner designed to answer the specific question concerning delay.

It proved straightforward to divide the patients into two groups: delayed diagnosis and referral; prompt diagnosis and referral. Delay was deemed to have occurred if a patient had a classical history of sudden onset of severe persistent headache, following which the condition was not recognised medically either at home (by the general practitioner), in an accident and emergency department (by a doctor) or when admitted to hospital (by a hospital physician), ie the diagnosis was 'missed' and resulted in inappropriate action being taken. This had caused a clear delay in time (ranging from a matter of hours to many weeks) and a

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further clinical event occurred before appropriate diagnostic investigations were done.

The group of patients whose diagnosis was not delayed also had a history of sudden, severe persisting headache but were immediately admitted to hospital and all had a CT scan on the day/night of the haemorrhage, ie within 18 hours or less from the onset of symptoms. Patients whose presentation was atypical or insufficiently recorded in the notes were excluded from the study. Also excluded were moribund patients and those with idiopathic intracerebral haemorrhage, hypertensive intracerebral haematoma, arteriovenous malformations, and any patients on anticoagulants.

Management outcome was assessed using the Glasgow Outcome Score [9] at a minimum of three months (maximum one year). This is a validated and standard method of assessing outcome and takes into account overall social outcome as well as neurological disability. Using this outcome scale, a severely disabled patient is one who is dependent on a relative or carer for some or all aspects of daily living. A patient with moderate disability is independent for all aspects of daily living; such patients may have residual disability but this does not usually preclude work. A good recovery implies that the patient resumes a normal life—the capacity to return to work is implied but residual minor neurobehavioural/neurophysical sequelae are not precluded.

Results

Over an 18 month period from January 1993 to June 1994 180 patients were admitted to the NSU after a SAH due to a ruptured intracranial aneurysm. Forty-four patients' records either contained insufficient detail for analysis or the patients' presentation was atypical. Altogether 136 records were scrutinised for delay in diagnosis and management outcome. The patients' characteristics are summarised in Table 1.

Delayed diagnosis

The time from the ictus to the recognition that the patient had suffered a haemorrhage ranged from one day to six months (Fig 1). In 36 patients (52%) the delay was up to one week; in 16 patients (23%) the haemorrhage was not recognised for two weeks or longer. In two patients the delay was one day: one of them had no diagnosis; the other was diagnosed as having a viral illness. Both these patients deteriorated significantly within hours and were then admitted to hospital.

Delay was usually due to failure to make a clinical diagnosis. In 45 patients no diagnosis was made by their general practitioner (Table 2).

Ten of these patients were then seen and discharged from hospital with an incorrect diagnosis; six had been inpatients (two having had CT scans) and four had been seen in an accident and emergency department.

Table 1. Patient characteristics, January 1993 to June 1994

Number of SAH patients	180	exclusions 44
Number studied	136	women 88
Age range	11-72	mean 50 years
Delayed patients	69	women 44
Age range	11-70	mean 50 years
Non-delayed patients	67	women 44
Age range	26-72	mean 48 years

Three of the 10 patients had a past history of operation for an intracranial aneurysm.

The histories and CT scans of these 45 patients indicated that they had experienced more than one haemorrhage before admission to hospital; 13 had multiple rebleeds.

Surgery

The surgical data are shown in Table 3.

Outcome (Table 4)

There was a significant difference in outcome between patients in whom the diagnosis was delayed and in those in whom there was prompt recognition of the diagnosis (Kruskal–Wallis = 9.617, $p < 0.002$). The delay itself or sequelae of delay, eg rebleeding, were unequivocally the cause of the poor outcome and no other responsible factor could be identified.

Fig 1. The time from the ictus to the recognition that the patient had suffered a haemorrhage

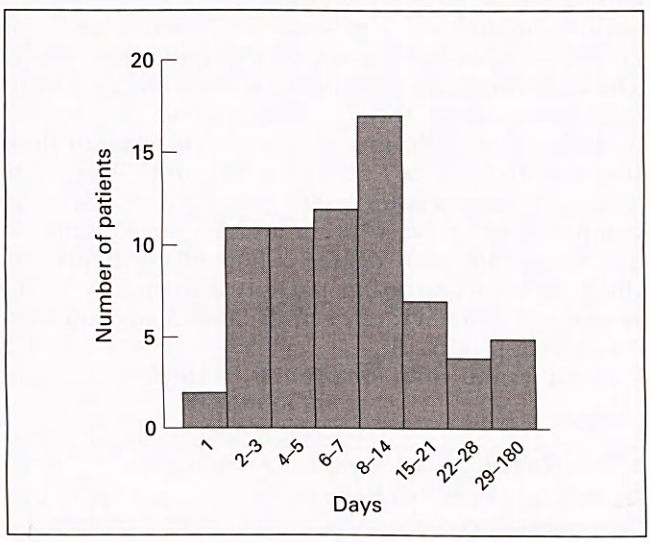

Table 2. Diagnostic delay in patients after aneurysmal subarachnoid haemorrhage

Patients	Diagnosis
45	No diagnosis
9	Migraine
6	Viral illness
4	Meningitis/encephalitis
3	Acute neck disorder
1	Depression
1	Transient ischaemic attack

Table 3. Surgical data: delayed and non-delayed patients

	Delayed (69)	Non-delayed (67)
Aneurysms clipped	57	63
No operation	12	4
Poor clinical condition	5	2
Rebled and died	7	0
Neurosurgical contraindication	0	2

Table 4. Outcome after subarachnoid haemorrhage

	GR	MD	SD	D
Delay (69)	30	10	16	13
No delay (67)	46	9	6	6

GR = good recovery
MD= moderately disabled
SD = severely disabled
D = dead
Kruskal–Wallis statistic = 9.617, $p < 0.002$

Discussion

To our knowledge this is the first study to offer statistical evidence that delay in diagnosis of aneurysmal SAH may result in a devastating outcome.

The most important causes of delay were: failure to recognise the classical presentation of SAH (sudden, severe and sustained headache); failure to obtain or correctly interpret a CT scan; failure to perform or correctly interpret lumbar puncture (LP) findings.

The vast majority of patients who have a subarachnoid haemorrhage report sudden headache, quite unlike any headache previously experienced. Patients will often remember the exact time the headache started and will readily recall the exact activity, often trivial, in which they were engaged in at the moment of onset of headache—a point worth remembering when taking the history. Only 2% of patients deny headache [10]. Clinical signs include neck stiffness (60%) which may not be present for some hours after the haemorrhage [11], and its absence resulted in some of our patients being misdiagnosed. While 40% of patients may have no confirmatory signs, the majority (75% of 180 in this study) will give a history clearly indicative of a sudden intracranial event [11]. Therefore it is the history of headache, with its mode of onset, severity and persistence, which is the single most certain way of making a diagnosis of SAH.

CT scan

CT detects SAH in 95% of cases if done within 24 hours of the bleed; by one week this falls to 50%. After 10 days the probability of CT detecting subarachnoid blood is virtually nil [12,13].

Lumbar puncture

A lumbar puncture is mandatory if the history suggests SAH and the CT scan is normal, especially if the CT scan is done later than 72 hours after the onset of the headache. If CT and cerebrospinal fluid (CSF) examination with spectroscopy are normal there is evidence that the outlook for these patients is good [14].

In this study rebleeding occurred in 65% of patients in whom the diagnosis was delayed. Previous papers have emphasised the increased risk of rebleeding—20% of patients within the first two weeks of the initial SAH and 50% by six months—and the high mortality rate of those who rebleed [15-17]. The poor outcome in the delayed group of patients was principally due to rebleeding and other unrecognised sequelae of SAH.

Immediate referral of SAH patients to an NSU leads to an early operation to clip the aneurysm, thus avoiding rebleeding; intensive treatment of both the neurosurgical and systemic complications of haemorrhage is facilitated [7,8]. Our findings confirm the value of early diagnosis of SAH and referral of patients to the NSU.

This is not a new message [18-20]. The ubiquitous nature of the problem was identified in the International Co-operative Study (15 countries, 115 hospitals) where 43% of patients were admitted to the NSU after a delay in diagnosis of three or more days as a result of rebleeding. [21]. Unfortunately, new generations repeat the mistakes of previous generations, with the neurosurgeon often accused of living in an ivory tower and using a retrospectroscope [22,23]. In this study patients with unimpressive headache and symptoms or signs not regarded as 'classical' were excluded in order to avoid this criticism. In 69 patients (51% of patients

studied), the obvious diagnosis of SAH was not made or delayed and their poor outcome cannot be ignored.

Recommendations

Osler made the point that specialists have an 'inevitable tendency to a narrow and perverted vision in which the life of the anthill is mistaken for the world at large' [24]. We would argue the need for:

- improved postgraduate education for general practitioners and hospital doctors
- early consultation with the neurosurgical unit
- re-establishment of the role of lumbar puncture
- referral of all suspected SAH patients to a district general hospital with CT scanning and CSF spectroscopy to avoid delay in obtaining appropriate investigations
- national guidelines from the Society of British Neurological Surgeons which should be agreed or modified in line with local practice and facilities by neurosurgical units and their associated referring hospitals.

Conclusion

In the midst of a high technology age, and in what has been described as an 'industrial revolution in neurosurgery' [25], the fundamental cornerstone of good clinical practice remains a detailed and carefully taken history. This alone, with the traditional clinical practice of lumbar puncture in doubtful cases, would have avoided death and prevented disastrous disability in a significant number of patients.

Failure to diagnose SAH due to a ruptured intracranial aneurysm has already been the basis of a number of medical negligence actions. In these cases it is usually the second haemorrhage which has led to the correct diagnosis at a time when, sadly, the patient is either beyond all neurosurgical help, or when the natural history and surgery have left the patient severely disabled. Since the essential clinical features for the correct diagnosis of the first haemorrhage are usually straightforward, it is often impossible to mount a successful defence on liability. This is as important to doctors who strive to maintain acceptable standards of practice as it is to lawyers representing their clients, be they plaintiffs or defendants.

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