Short report

The frequency, characteristics and prognosis of epileptic seizures at the onset of stroke

R A SHINTON, J S GILL, S C MELNICK, A K GUPTA, D G BEEVERS

From the Dudley Road Hospital, Birmingham, UK

SUMMARY In a series of 230 patients admitted to hospital with a stroke, the frequency and significance of epileptic seizures at onset was assessed. Thirteen (5.7%) suffered single or multiple witnessed seizures at the onset of their stroke. Seizures were evenly distributed among all pathological stroke sub-types but were restricted to lesions in the carotid artery territory. They indicated a poorer prognosis over the first 2 days. Six of the 13 presenting with stroke and seizures had prior seizures and, if they survived, continued to have fits. The five patients surviving with stroke and a first seizure were all fit-free after 30 months follow-up.

The common occurrence of epileptic seizures at the onset of stroke (Ep-S) is well established.¹⁻³ The frequency and significance of the association has been reported in three post-mortem studies of stroke patients.^{1,2,4} This frequency has varied between 2% and 18% depending on the study and stroke type. The findings in some studies have differed as to whether seizures are more common in cerebral haemorrhage or infarction.^{1,2,4} A survey of Ep-S among a clinically diagnosed stroke series has been reported, but it was restricted to non-embolic infarction and excluded any patients with prior epilepsy.³

In order, therefore, to assist the admitting hospital physician, a consecutive series of stroke patients was surveyed prospectively to assess the frequency and compare the characteristics and prognosis of those who presented with and without Ep-S.

Methods

All patients between the ages of 20 and 70 years admitted to Dudley Road Hospital, Birmingham, between January 1983 and July 1984, with a diagnosis of acute stroke, were studied prospectively. Details of the study have been described elsewhere.^{5,6}

Briefly, all patients admitted with a possible diagnosis of stroke were reviewed by a single observer (JSG) and entered into the study only if they satisfied the World Health Organisation criteria for stroke: "a focal or global disturbance of cerebral function leading to death or persisting for more than 24 hours, with no apparent cause other than

vascular".⁷ The diagnosis of cerebral haemorrhage or cerebral infarction was based upon the Guy's Hospital Score.^{8,9} From this scoring system a greater than 70% probability was used to classify the stroke as either infarction or haemorrhage. Those with a lower probability area were classified as of uncertain aetiology. The diagnosis of subarachnoid haemorrhage was based on signs of meningeal irritation without focal neurological deficit and the presence of uniformly blood stained cerebrospinal fluid on lumbar puncture. Twenty per cent of patients also underwent computed tomography of the head, carotid angiography or post-mortem examination. Six patients who were initially included in the study were later given a diagnosis of epilepsy without stroke or cerebral tumour and were excluded from the survey.

A detailed questionnaire was completed and included data on previous epilepsy, stroke and transient ischaemic attacks as well as current medication. The occurrence of witnessed epileptic seizures, either partial (focal) or generalised, at the onset of the stroke was recorded. Seizures were classified according to the recommendations of the International League against Epilepsy.¹⁰ They were only considered to occur at onset if noted within a 24 hour period before or after the initial development of the neurological deficit.

All patients with seizures at the onset of their stroke were followed for a minimum of 30 months and directly questioned about any subsequent fits. Follow-up mortality data on the whole stroke group was available at a point 27 months after the last patient entered the project.

Statistical analysis was performed using the chi-squared test with continuity correction. Two tailed values for *p* are quoted.

Results

Two hundred and thirty stroke patients with a median age 60 years, were studied. There were 143 males (102 white, 12 black, 29 Asian) and 87 females

Address for reprint requests: Dr R A Shinton, University Department of Medicine, Dudley Road Hospital, Birmingham B18 7QH, UK.

Received 18 August 1987.

Accepted 22 September 1987

(65 white, nine black, 13 Asian). Seventy-five per cent of patients were admitted to hospital within 24 hours of stroke onset and a further 11% within 48 hours. The stroke cases included nine with subarachnoid haemorrhage, 28 with intracerebral haemorrhage and 184 with cerebral infarction. The nature of the stroke was uncertain in nine patients. 176 patients were admitted with their first stroke.

Thirteen patients (5.7%) suffered witnessed epileptic seizures at the onset of their stroke (table 1). Eleven of these had suffered their first stroke. The neurological deficit was fatal or persisted after one week in all but one of the 13 (case No. 3).

Ep-S occurred in all pathological stroke types (table 2). In seven of these 13 patients a CT head scan or necropsy was performed; these demonstrated five cerebral infarctions, one cerebral haemorrhage and one subarachnoid haemorrhage. In two of these seven the lesion was cortical (cases 1 and 2), in three the internal capsule was involved (cases 4, 6 and 12), in one the infarct was near the roof of the lateral ventricle (case No. 11), and a further patient had an anterior communicating artery aneurysm with sub-

arachnoid and frontal lobe haemorrhage (case No. 10). Among all the 13 with seizures at onset, the cerebrovascular accident was considered to be in the internal carotid artery territory.

The mortality of patients with Ep-S was significantly higher than the whole stroke group at 48 hours, but similar during the hospital stay and at follow-up after 27 months (table 3).

Six patients with Ep-S had suffered witnessed recurrent seizures prior to their stroke or were already taking anticonvulsant therapy. Four of the previous epileptics survived and after discharge continued to have seizures, despite anti-convulsant medication. All those with seizures prior to as well as at stroke onset had developed epilepsy after the age of 30 years. In two cases this followed a previous stroke. Seven patients with prior epilepsy were admitted with a stroke and no Ep-S. Amongst these seven, seizures commenced under 30 years of age in two and after a previous stroke in a further two patients.

Seven patients had their first seizure with the onset of their first stroke. The five survivors, three of whom took anti-convulsants, had no further seizures during

Table 1 Details of stroke patients with epileptic seizures at onset

Patient no sex and age	Stroke sub-type	Seizure type at onset	Outcome after 27 months	Prior epilepsy	Subsequent seizures
1 M 54 years	Cerebral infarct confirmed by CT	Generalised	Alive	Yes	Yes
2 F 42 years	Cerebral haemorrhage confirmed by CT	Partial	Alive	Yes	Yes
3 M 66 years	Cerebral infarct	Partial	Alive	Yes	Yes
4 F 58 years	Cerebral infarct confirmed by CT	Generalised	Alive	No	No
5 M 68 years	Cerebral infarct	Generalised	Died after 1 day	Yes	—
6 F 54 years	Cerebral infarct confirmed by CT	Generalised	Home, died after 7 mths	No	No
7 M 67 years	Cerebral infarct	Partial	Alive	No	No
8 M 53 years	Cerebral haemorrhage	Generalised	Alive	No	No
9 M 60 years	Uncertain	Partial and Generalised	Home, died after 5 mths	Yes	Yes
10 M 63 years	Subarachnoid haemorrhage confirmed by necropsy	Generalised	Died after 1 day	Yes	—
11 F 62 years	Cerebral infarct confirmed by CT	Partial and Generalised	Alive	No	No
12 F 64 years	Cerebral infarct confirmed by CT	Generalised	Died after 1 day	No	—
13 F 68 years	Cerebral haemorrhage	Partial and Generalised	Died after 2 days	No	—

Table 2 Distribution of pathological stroke sub-types among all strokes and strokes with seizures at onset (%)

	Cerebral infarct	Cerebral haemorrhage	Subarachnoid haemorrhage	Unclassified
All stroke patients	184 (80.0)	28 (12.0)	9 (3.9)	9 (3.9)
Patients with seizures at stroke onset	8 (61.5)	3 (23.1)	1 (7.7)	1 (7.7)

Table 3 Mortality (%)

	Mortality 48 h after admission	Mortality during hospital admission	Mortality after 27 months follow-up
All stroke patients (n = 230)	17 (7.4)	48 (20.9)	59 (25.6)
Patients with seizures at stroke onset (n = 13)	4 (30.8) p < 0.01	4 (30.8) NS	6 (42.9) NS

NS = not significant.

a minimum of 30 months follow-up.

In none of the 13 with Ep-S was their evidence that anti-convulsants brought the fitting under control. The convulsions either resolved spontaneously (cases 1, 3, 5, 7, 8, 9, 11 and 12) or were resistant to anti-convulsant drugs (cases 2, 4, 6, 10 and 13).

Discussion

The frequency of Ep-S among all strokes in this series (5.7%) and the first-time strokes (6.2%) was similar but slightly higher than the previously reported clinical series amongst non-embolic cerebral infarctions (3.3%).³ This difference could be accounted for by the exclusion of known epileptics from the latter series. Alternatively the inclusion of intracerebral and subarachnoid haemorrhages in our series may account for the higher rate. Amongst those in our study thought to have had a cerebral infarction 4.3% suffered a seizure at onset.

The frequency of Ep-S has been reported in three post-mortem studies and two studies of those who underwent CT head scans.^{1,2,4,8,11} The first major necropsy based stroke series indicated that 10.2% of patients had suffered convulsions "during the course of the illness".² This group, however, included several with syphilis and an almost equal number of cerebral infarctions and haemorrhages. In the two more recent necropsy series the Ep-S frequencies were 7.7% and 8.5%.^{1,4} These higher values are, however, not surprising as the stroke cases had all died of severe cere-

brovascular disease. In one series of stroke patients undergoing CT of the head, 7.7% had seizures at onset, but these were not consecutive admissions and included a high proportion of cerebral haemorrhages.¹¹ A 4.2% frequency of Ep-S was found in a consecutive series of stroke patients admitted to hospital who underwent CT scanning or necropsy.⁸ This latter study was the most similar to ours and leads to the conclusion that around one in 20 stroke patients normally admitted to hospital will have witnessed epileptic seizures at the onset of their illness.

Our data suggest that the prognosis over the first few days, of those with Ep-S is worse than for the whole stroke group. Whilst the numbers are small, it is in agreement with previous anecdotal reports and the observation that the incidence is higher in necropsy series.¹ After these first few days, however, the outlook is similar to that with all stroke patients.

There has previously been conflicting information whether Ep-S is more or less frequent in cerebral haemorrhage or infarction. In a large necropsy series 13.8% of haemorrhages suffered seizures compared with 7.0% with cerebral infarction.² In two other necropsy studies and a CT based study, cerebral infarction appeared to precipitate convulsions more frequently.^{1,4,11} The occurrence of Ep-S in our series does not suggest they were particularly more common in any pathological stroke sub-type. The conclusion on the information so far available is, therefore, that seizures are not of any help in discriminating cerebral haemorrhage from infarction.

The restriction of the pathological lesions to carotid artery territory is in agreement with other reports on Ep-S.¹ There are no reports of patients with Ep-S in whom the stroke was restricted to the vertebral artery territory. These findings suggest that seizures, whether partial or generalised, are initiated in the damaged region of the brain. Although some authors have reported that superficial cortical lesions are far more likely to precipitate seizures, our data does not support this finding.¹

The observation that the known epileptic patients frequently (46%) suffered a seizure at the onset of their stroke is interesting. The six patients in our survey in whom this occurred, had all developed seizures after the age of 30 and no more than 10 years prior to their stroke. We believe these findings strengthen our case that cerebrovascular disease not only causes strokes but is also implicated in prior seizures.⁵

It is reassuring that of those with Ep-S, only patients with prior epilepsy continued to have fits. This is consistent with the findings in a group of patients with cerebral infarction reported by Louis *et al* in which only two of the 33 with stroke induced seizures suffered further fits.³ These observations, along

with the unproven therapeutic control over Ep-S, implies that the value of anti-convulsant drugs during and after these initial convulsions is questionable.

We thank the physicians at Dudley Road Hospital for allowing us to study their patients, Dr P Davies for statistical advice, and Mrs J Letts and Miss S Jeavons for secretarial assistance. JSG was supported by a grant from the West Midlands Regional Health Authority.

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