Occasional review

The temporal aspects of prognosis in epilepsy

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SUMMARY A major reason for the conflicting views concerning prognosis in epilepsy has been the failure to account for the temporal aspects of seizure relapse and remission. In this paper prognostic studies in a variety of areas are reviewed to emphasise this point. Most traditional studies (including studies of withdrawal of medication) show a generally poor prognosis for epilepsy. These have been hospital-based and, as such, inevitably over-represent patients with chronic epilepsy. Investigations (both hospital and community based) of patients from the onset of seizures show a much better prognosis, and most patients suffer only a small number of seizures in total over a relatively short period of time and then remit. The longer the epilepsy is active the less likely is eventual remission, but once remission is achieved it is usually permanent. The traditional view of epilepsy as a chronic condition with a continuing tendency to relapse is therefore not tenable for the majority of patients. The patterns of epilepsy are established relatively early in its course in most cases, and long term prognosis might therefore be predictable within a few years of the onset of seizures in most patients. Prior to the introduction of effective treatment, it was said that epilepsy rarely remitted, and it is possible that early treatment may actually improve long term prognosis.

Since the classic work of Gowers,¹ there have been a panoply of studies of prognosis in epilepsy. Typically, these have found prognosis to be poor, and the concept of epilepsy as a *chronic condition characterised by a continuing tendency to seizure relapse* has grown up and is of course widely accepted. Recent work, has challenged this, and the key to this disagreement may lie in the failure to appreciate the importance of the *temporal aspects of the epilepsy*: that is to say, in any individual case, the pattern and timing of previous relapse and remission. Here I will elaborate on this concept, and examine prognostic

studies in a variety of areas to emphasise the value of this approach.

The natural history of untreated seizures

Remarkably, since epilepsy was recognised at least 2500 years ago, we have few numerical data on the natural history of untreated seizures, and this is due largely to the fact that effective treatment for epilepsy has been available at least since the introduction of bromides in 1857. Gowers¹ whose practice spanned this period was the first to approach the subject of prognosis from a statistical base. He wrote of untreated epilepsy that "the spontaneous cessation of the disease is an event too rare to be reasonably anticipated in any given case," and this sums up most antecedent opinion. He considered that untreated epilepsy was unlikely to remit, that seizures tended to "self perpetuation" and that "each attack facilitates the occurrence of another." Against this background he observed the dramatic effect of bromides, "... the present generation has witnessed an advance in treatment in these diseases equalled perhaps in no other branch of therapeutics. Thanks to the influence of one drug (bromide of potassium)

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Received 6 March 1984. Accepted 24 March 1984

Footnote: Throughout this paper, the following definitions are used:

Remission—Freedom from seizures (usually over a defined period of time, for example two years)

Terminal remission—Freedom from seizures at the time of reporting (usually qualified by the definition of a minimum period of follow up).

Active Epilepsy—Seizures not in current remission.

and its combinations, hundreds of epileptics have been cured, and thousands are leading useful lives who would otherwise have been incapacitated by the disease". The possibility that treatment, by suppressing the "self perpetuation" of seizures in the short term, might in fact lessen the long term tendency to recurrence is inferred in Gowers' work, and I shall return to this later. Suffice to say here that as drug treatment has become almost universally obtainable, all subsequent prognostic investigations have been of the treated disease, and the opportunities now available to study untreated seizures are few.

Hospital and institution based prognostic studies

Almost all traditional prognostic studies have been carried out from hospital clinic or institution, and it is data from these studies that form the basis of most widely held views of prognosis. In such clinical settings, patients with chronic or uncontrolled epilepsy are inevitably over-represented, and those with newly diagnosed seizures or epilepsy in remission under-represented. The central importance of this selection bias has been usually ignored.

A most important landmark in the study of prognosis was the publication in 1968 of Rodin's book *The Prognosis of Patients with Epilepsy*. In this were summarised most previous prognostic studies, which were almost without exception hospital or institution based and in the form of retrospective (or partially retrospective) surveys. From this review, Rodin drew a number of conclusions, and I will single out three of these. First, he accepted that the overall prognosis of epilepsy was poor; he found from his review that only "approximately one-third of all epileptic patients are likely to achieve a terminal remission of at least two years." In table 1 I have

listed all the general prognostic studies in which terminal remission rates (or over 12 months) were given,³⁻¹⁶ and these seem to confirm his findings. Secondly, addressing the problem of length of follow up, he noted that relapse after short term remission was common, and that the longer a patient was followed the more likely was relapse, and concluded that, with prolonged follow up only "80% of all patients with epilepsy are likely to have a chronic seizure disorder. This does not rule out short-term remissions or changes in seizure patterns, it merely reemphasises that epilepsy should be regarded as a chronic condition with remissions and exacerbations." Finally, he noted that the longer the history of epilepsy the worse the prognosis and found from his review "remarkable unanimity" on this point. These conclusions have been widely accepted, but while they indubitably reflect the prognosis of chronic hospital patients, they do not hold true for most cases, as I hope to show below, and should not be applied to epilepsy as a whole.

Studies of newly diagnosed patients

In recent years, a number of prospective hospital studies of newly diagnosed patients at the onset of anticonvulsant treatment have been carried out, and their results are summarised in table 2.¹⁷⁻²⁸ Regardless of treatment regime, overall prognosis has been found to be good. Rapidly attained and long lasting remission was observed in most patients, and this is a striking contrast to the much poorer results in more chronic populations. The most comprehensive studies of newly diagnosed adult patients were carried out from Kings College hospital, under the direction of Dr EH Reynolds, and here the temporal patterns of remission/relapse was looked at.^{18,19}

Table 1 *Hospital/Institution Based Studies of Prognosis: Terminal Remission Rates*

Author	n	Minimum duration of term. Remission (yrs)	% in terminal remission
Haabermas (1901) ³	937	2	10
Turner (1907) ⁴	212	2	33
Kirstein (1942) ⁵	174	3	22
Alstroem (1950) ⁶	897	3	22
McNaughton (1954) ⁷	257	1	30
Kiorboe (1958) ⁸	130	4	32
Strobos (1959) ⁹	228	1	38
Trolle (1961) ¹⁰	437	1	42
Juul Jensen (1964) ¹¹	969	2	32
Kukl et al (1967) ¹²	173	4	34
Janz & Summer-Burkhardt (1976) ¹³	396*	2	72
Currie et al (1971) ¹⁴	666*	1	40
Okuma & Kumashiro (1981) ¹⁵	1838	3	58
Sofijanov (1982) ¹⁶	512†	2	51
		4	42

(Terminal remission rate = The proportion of patients in remission (for minimum stated period) at the time of the survey)

*Patients with Temporal Lobe Epilepsy only.

†Children only

(Included in this table are all studies of over 100 patients in which terminal remission rates (or 1 or more years) are given. Most studies were retrospective and all are hospital clinic or institution based. The selection bias towards chronic patients is least in the more recent and comprehensive reports, and it is noteworthy in these that the percentage of patients in remission is higher.)

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Table 2 Studies of seizure control in newly diagnosed patients at the start of anticonvulsant treatment

Author	n	Drugs used	Follow up on treatment	% complete control
Kings College Group*	94	DPH, CBZ	12-70 mns (median 32 mns)	49‡ 77§
Cork Group†	47	DPH, Pb, CBZ, Sul	2-22 mns	81
Strandjord & Johannessen (1979) ²⁴	24	CBZ	Mean 24 mns	83
Shakir et al (1981) ²⁵	21	SVP, DPH	Mean 26 mns	95%¶
Hakkarainen (1981) ²⁶	100	DPH, CBZ	24 mns	67
Turnbull et al (1982) ²⁷	88	SVP, DPH	>12 mns	58
Shorvon (survey of 155 clinical reports) (1983) ²⁸	419	DPH, CBZ	2-60	65**
	61		2-58	82††

DPH = phenytoin; CBZ = carbamazepine; SVP = sodium valproate; Pb = phenobarbitone; Sul = sulthiame

*Shorvon and Reynolds;^{17, 18} Elwes, Shorvon and Reynolds.¹⁹

†Callaghan et al.²⁰ Feely et al.²¹⁻²³

‡Overall, regardless of serum level.

§With optimum serum levels where necessary.

¶Initial control rate 67%, but increased to 95% with drug alteration.

||Control rate 50% in first year, but increased to 67% in 2nd year after drug changes.

**Retrospective survey of reports regardless of the use of serum level monitoring.

††Retrospective survey of reports using serum level monitoring.

Three points from these studies are relevant here. First, on treatment the great majority of first relapses (85%) occurred within 12 months of the onset of treatment (fig 1), and late relapse (say after two years of freedom from seizures) on treatment was rare. Secondly, the subsequent prognosis of those who did relapse in the first 12 months was considerably poorer than that of those who were seizure free at that stage. Thus, at a median follow up period of 32 months, 90% of those seizure free at 12 months were still seizure free compared with further seizure recurrence in 44% of those who had already relapsed. Finally, the proportion of patients in terminal remission (of two years) rose over time, initially sharply and then gradually.

Fig 1 The Kings College Hospital Study:^{17, 18, 19} actuarial calculation of the percentage of patients seizure free at monthly intervals from the onset of treatment.

Studies of recurrence after a single fit

The few studies in which the chance of recurrence after a single fit have been investigated are summarised in table 3.²⁹⁻³⁵ Their results are conflicting, with recurrence rates varying between 27-82%. Popula-

tion selection is partly responsible for this (see table 3), but a second reason lies in the temporal characteristics of recurrence. Gowers¹ himself noted that in 39% of the cases of epilepsy he studied, the second attack occurred within one month of the first, and it is apparent therefore that if an appreciable time elapses between a first seizure and inclusion in a study, a substantial proportion of patients will have already relapsed and be rendered ineligible for a study of "single" attacks. Nearly 50% of new patients referred to the New York study³³ were seemingly thus excluded, and in the Newcastle study,³² the mean period between first attack and inclusion was 6 weeks (in none of the other hospital studies were such details given). This may be the reason for the lower recurrence rates in the hospital based (27-58%) than the community based studies (67-83%). Both the Newcastle and New York studies looked at the temporal pattern of seizure recurrence; the second seizure occurred within 24 months of the first in the great majority of patients (over 80%) in both studies (figs 3 and 4), but even this figure is an underestimate if one accepts that patients with very early recurrence will have been excluded.

Studies of withdrawal of medication

The place for withdrawal of medication in patients whose epilepsy is in remission has been the subject of a number of prognostic studies, summarised in table 4.^{9, 11, 13, 35-42} Withdrawal is often considered after a period of 2, 3 or 4 years of freedom from attacks, but this is arbitrary, and, as shown in the table, the proportion of patients found to relapse has varied from 21-79%. The success of withdrawal may depend largely on the previous temporal pat-

Table 3 Studies of the recurrence of seizures after a first attack

Author	n	Patient selection	Follow up*	% Recurrence†
<i>Hospital Based Studies</i>				
Thomas (1959) ²⁹	48	Referred to EEG dept.	ns	27
Johnson et al (1972) ³⁰	77	Young adult males, naval recruits (excluding organic causes, alcohol, drug abuse)	6 mns 12 mns 24 mns 36 mns	34 49 57 58
Saunders and Marshall (1975) ³¹	33	Referred to EEG dept.	10–48 mns	33
Cleland et al (1981) ³²	70	Adult referrals to a neurology clinic, with untreated "major" seizures, (excluding head injury, drug overdose)	3–120 mns	39
Hauser et al (1982) ³³	244	"Unprovoked seizures," (incl. multiple seizures on a single day, excl. acute symptomatic fits)	12 mns 24 mns 36 mns >36 mns	16 21 27 27
<i>Community Based Studies</i>				
Hauser & Kurland (1975) ³⁴	769	Survey of Rochester, Minn. (inc. recurrent provoked seizures as single seizures)	>24 mns	67
Goodridge & Shorvon (1983) ³⁵	114	Survey of Tonbridge, Kent (all seizures regardless of aetiology)	>36 mns	82

(*Period of follow up after first seizure)

(†Percentage of patients in whom a second seizure occurs during the specified follow up period.)

Fig 2 The recurrence of seizures over time in a group of 244 patients after a first unexplained seizure.³³

Fig 3 Cumulative percentage over time of 27 patients who had a second seizure after a single isolated attack.³²

term of the epilepsy—particularly, the duration of active epilepsy—but this has not been considered in any previous study. In fact, although the question of withdrawal of medication looms large in hospital

Fig 4 The Rochester study:⁴⁶ remission of seizures over a twenty year period in 457 cases from the onset of epilepsy.

practice, this problem is seldom dealt with in its proper perspective, as the community based studies (discussed further below) show that most patients in remission have indeed successfully withdrawn medication (often on their own accord), have remained seizure free, and in fact have taken anticonvulsant drugs for a limited period only. Again this difference between community and hospital based studies is

Table 4 Studies of seizure relapse following the withdrawal of medication from patients in remission

Author	n	Minimum remission*	Follow up (yr)	% of patients relapsing during withdrawal	Total
Yahr et al (1952) ³⁶	15	2	ns	ns	71*
Zenker et al (1957) ³⁷	117	0-5	ns	ns	21
Strobos (1959) ⁹	25	1	ns	ns	79†
Juul Jensen (1964) ¹¹	192	2	5	18	36
Juul Jensen (1968) ³⁸	196	2	5	18	40
Holowach et al (1972) ³⁹	148	4	5-12	12	24
Janz et al (1976) ¹³	253	2	0-5-21	36	47
Oller-Daurella et al (1976) ⁴⁰	138	5	0-5-20	na	21
Emerson et al (1981) ⁴¹	68	4	0-5-6	13	26
Holowach-Thurston et al (1982) ⁴²	148	4	15-23	16	28

ns = Not stated; na = not applicable.

*Minimum period of remission from seizures before treatment withdrawal attempted.

†In these studies, only those successfully completing withdrawal of medication were included.

The two reports of Juul Jensen and the reports of Holowach *et al* and Holowach-Thurston *et al* were of the same patients followed for different periods of time.

due to the selection bias inherent in hospital studies which under-represent patients whose epilepsy is short-lived and quickly remits—a very common pattern. A further point is that, on attempted withdrawal, most patients who relapse, do so either during (50%) or soon after the discontinuance of therapy (almost all within 24 months).^{11 13 38 39 41 42} The longest study was that of Holowach-Thurston *et al*⁴² of 148 children followed for between 15 and 23 years, and they found, that 50% relapsed during drug withdrawal, two thirds within 2 years and 85% within 5 years of withdrawal. Late relapses are seemingly unusual.

Community based studies of prognosis and epidemiology

The selection bias introduced by studies confined to hospital populations can of course be avoided in community based investigations. Epidemiological surveys from various parts of the world have looked at the prevalence and incidence of epilepsy and epileptic seizures. It has been established that up to 5% of a general population will at some time in their lives suffer a well defined non-febrile epileptic seizure,^{34 43 44 45} and yet the prevalence rate for chronic epilepsy ranges between 4/1000 and 10/1000 (depending on definitions, methods of data collection etc.).⁴⁵ Simply on the basis of these figures, it is apparent that most patients who develop seizures do not become “chronic epileptics” and most must enter long term remission. The course of the epilepsy in these cases, however, can only be deduced from longitudinal community based studies of prognosis from the onset of seizures, and there have been only two such studies; the first from Rochester Minnesota,⁴⁶ and the second from Tonbridge Kent.³⁵ The Rochester study made use of the Mayo clinic record linkage system, and looked at all patients who had received an initial diagnosis of

epilepsy between 1935 and 1974 (excluding febrile convulsions, single seizures and convulsions associated with acute illnesses). Four hundred and seventy five patients were identified, and their remission patterns studied. Terminal remission rates (defined as a current remission of at least 5 years) at yearly intervals are shown in fig 4. It is noticeable that remission rates rise sharply in the early years after diagnosis (and hence treatment), and then continue to rise, albeit more slowly, throughout the period of observation. Thus, at 5 years 42% had entered a 5 year remission (that is had entered remission within one year of diagnosis), and 65% at 10 years and 76% at 20 years. Eventually, therefore, three quarters of the patients had entered long term remission, and indeed 50% had withdrawn medication. Furthermore, once remission had been achieved few patients subsequently relapsed and, for instance, at 20 years, 76% of all patients had entered a 5 year remission at some point and 70% were currently in remission.

Fig 5 The Tonbridge Study:³⁵ remission of seizures over a 15 year period in 122 patients from the onset of epilepsy.

The Tonbridge study was a survey of 6000 persons from a single general practice population in which 122 patients were identified who had suffered at least one non-febrile seizure (diagnosed by neurologist or paediatrician). The course of the seizures after the first attack in these 122 patients was then analysed (table 5). In 82% seizures recurred—a higher proportion than in hospital based studies—but the total number of attacks suffered by most patients was small (10 or less attacks in 68% of the group), and the epilepsy remained active for a short period of time only in most patients (50% of patients were in a remission of at least 2 years within 5 years of the onset of seizures). Once in remission this was usually permanent and relapse was unusual. Thus, only 10% of the patients achieved a two year remission period and then subsequently relapsed (the intermittent pattern). In 22% of the patients, the seizures did not remit (the continuous pattern), and it is these patients, and the few with the intermittent (relapsing/remitting) course who presumably make up the bulk of the chronic hospital population (whose prognosis was discussed above). Remission rates at yearly intervals are shown in fig 5, where it can be seen that nearly half the patients were in or entering terminal remission within 2 years of the onset of seizures. The percentage continued to rise slowly and by 15 years 70% were in remission.

Discussion

It is the thesis of this paper that conflicting views about prognosis for seizure control are due partly (possible largely) to the failure to appreciate the

importance of placing epilepsy in its correct temporal context. Thus, the traditional studies have been almost invariably of cross-sectional design and of patients drawn from specialised hospital clinics (or institutions) with an inevitable over-representation of the *chronic patient* (the patient whose epilepsy is active at an appreciable time after diagnosis) and under-emphasis of both those in remission and those early in the course of their epilepsy.²⁻¹⁶ The findings of such studies should not be extrapolated a priori to all patient groups, but there has been a tendency to do so. Thus, the opinions are widely held² that only 20-30% of patients with epilepsy will remit, that epilepsy is a chronic condition with a continuing tendency to relapse and that the longer a patient is followed the worse the prognosis. Whilst these rather pessimistic conclusions apply to chronic hospital populations, they patently do not to all patients who develop seizures. A crucial and neglected factor to consider in any individual patient is the previous seizure pattern, and especially the duration of previous seizure activity. There have been a number of investigations of newly diagnosed patients, in which, in contrast to the cross sectional studies, patients have been followed from the time of diagnosis.¹⁷⁻²⁸ Of these, for instance, Reynolds and the Kings College group,^{17-19,47} found a much better overall prognosis with over 70% of newly diagnosed adult patients entering terminal remission. Furthermore, remission was usually achieved within 12 months of starting treatment, the longer seizures continued the less likely was eventual remission, and at every stage the longer term prognosis in those already in remission was better than in those who had not yet remitted. The two community based studies,^{35,46} again of patients followed from the time of diagnosis found a good overall prognosis with eventually over 70% of all patients entering long term remission. Again in contrast to the findings from cross-sectional studies, the proportion of patients in remission continued to rise as follow up lengthened and the rate of rise was greatest in the early years after diagnosis. As shown in the Tonbridge survey,³⁵ once remission was achieved it was usually permanent. In this survey, patterns of epilepsy were studied in more detail. The commonest was the *burst* pattern in which seizures were active over a period of time (without remission) and then permanent remission ensued, and the period of activity was usually relatively short (less than 5 years in three quarters). The *intermittent* pattern (the relapsing/remitting course—which is the traditional concept of epilepsy) was observed in a minority of patients only. Most patients with active epilepsy fell into the *continuous* category, in which seizures had continued without remission from their

Table 5 The Tonbridge study.^{35,43} The number and pattern of seizures in the 122 patients with epileptic seizures identified from a general practice population of 6000 persons

Seizure Number (n = 117)*		Seizure Pattern (n = 113)†	
Single	19%	Burst	49%
2-10	49%	Continuous	22%
11-49	13%	Intermittent	12%
50-99	2%	Single	18%
100 or more	18%		

*In 5 cases not known.

†In 9 cases, onset of seizures too recent (less than three years) to categorise pattern.

Seizure Pattern (in those with seizure onset of at least 3 years).

Burst: Repeated attacks occurring initially without remission followed by a remission period continuing up to the time of the survey.

Intermittent: Repeated attacks occurring with at least one remission period interposed between attacks.

Continuous: Repeated attacks occurring without a remission up to the time of the survey.

Single: Single attack only without recurrence.

(Remission defined as a seizure free period of at least 24 months).

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onset. Indeed, amongst those with *chronic* epilepsy the continuous pattern was several times commoner than was the intermittent pattern. An important deduction, which can be drawn from these studies,^{18 19 35 46 47} is that the course of the seizure disorder in the *early years* after diagnosis can provide, with a fair degree of statistical accuracy, a useful guide to *long term outcome*, and those with a good and bad long term prognosis can be differentiated early on the basis of previous seizure pattern.

The importance of these points can be illustrated in specific studies in other areas. The variation, for instance, in the findings of studies of seizure recurrence after a single attack²⁹⁻³⁵ may be partly (possibly largely) due to the fact that they only included patients who had not recurred by the time of referral. Similarly, the studies of withdrawal of medication—hospital based and biased towards patients with chronic epilepsy—largely exclude those cases (possibly the majority) who rapidly enter long term remission and take drugs for a relatively short period.

A synoptical view of prognosis, based on seizure relapse and remission, is represented schematically in fig 6, in which the evolution of epilepsy in a population is divided into three time periods. The first is

after a first attack; up to 5% of a general population will experience a single non-febrile seizure, and following this a second attack will occur in over one half, usually within months of the first. Most patients will then receive a diagnosis of epilepsy and initiate treatment. In the second stage, over the next few years, most patients (perhaps 70%), suffer only a small number of further attacks, usually over a relatively short period of time, and then enter a remission which is usually permanent. A large number of patients at this stage will withdraw medication—often without hospital supervision—and most will remain free of attacks. In a smaller number of patients (about 30%) the epilepsy evolves and rapid remission does not occur. Such patients form a group of potentially chronic cases whose outlook is considerably less good. The third stage has now been reached, in which the epilepsy has either remitted or become established (chronic epilepsy). In those with continuing seizures, manipulation of treatment may result in perhaps 30% of so eventually entering long remission, but the longer the epilepsy remains active the less likely this is. Thus, within a relatively short time after the onset of seizures, the population of patients with chronic epilepsy is probably already identifiable. When

Fig 6 (see text)

remission does occur in this problematic group (and overall remission rates do continue to rise slowly over time), withdrawal of medication may be attempted (here is the experience of hospital based studies of withdrawal), but the success rate is less good than amongst patients in general. Moreover, amongst such chronic cases, and in contradistinction to the generality of patients with epilepsy, the longer a patient is followed the more likely is relapse. The long term patterns of epilepsy are thus often determined fairly early in a patient's history in most cases. In only a small minority does relapse occur after long remission (10% overall of patients in the Tonbridge study), a minority who will, however, feature strongly in a hospital clinic. The two most important conclusions to draw from such a picture are; first, that epilepsy in most cases is not a chronic condition characterised by a continuing tendency to seizure relapse; and secondly, that epilepsy tends to run 'true to form' and future prognosis may be predicted from the previous (and particularly the early) seizure pattern.

Of course, other factors are also important for prognosis, and it is intriguing to note that these tend to operate at whatever stage the epilepsy has reached. There is, thus, general agreement that the presence of neurological handicap, mental retardation, structural cerebral disease, psychiatric or behaviour disorder, partial or mixed seizure types carry a relatively poor prognosis.^{47,48} Similarly, if seizures occur in the context of an acute illness, the prognosis may be good. In a minority of cases, a single factor is of over-riding importance (eg a bad prognosis in progressive cerebral disease, or good prognosis for children with benign rolandic epilepsy), but this is uncommon. Usually prognosis can be predicted only from a more comprehensive assessment.

Finally, the effect of treatment must be added to the equation. There is little doubt that anticonvulsant therapy can suppress seizures in the short term, and this is common experience. A more intriguing question is that of the relation of effective early treatment to the long term outlook. Prior to the introduction of bromides, Gowers and others before him were of the opinion that untreated epilepsy seldom remitted, and that the chances of "cure" were slim. By contrast, with modern treatment, most patients go into rapid remission, which is as we have seen often permanent. This raises the possibility, first suggested by Gowers¹ and recently revived by Reynolds *et al*,⁴⁷ that treatment in suppressing seizures in the short term might in fact improve the long term prognosis and lower the long term tendency to recurrence (surely synonymous with cure). As yet there has been no investigation to test this proposi-

tion and this is an important area for further research.

This paper is based on a lecture given at the National Hospital, Queen Square on January 26th 1983 in the Sandoz series of Advanced Lectures in Clinical and Experimental Neurology. The Kings College hospital studies were carried out in collaboration with Dr R Elwes and under the directorship of Dr EH Reynolds who helped to develop many of the ideas discussed in this paper. The Tonbridge study was carried out in collaboration with Dr DMG Goodridge. I gratefully acknowledge their invaluable assistance and also the very helpful advice and comments of Dr M Espir, Dr J Oxley and Prof RW Gilliat.

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Matters arising

philosophy which is clearly detrimental to many patients.

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Hayward replies:

Thank you for allowing me to reply to Dr Epstein. I suspect that our views are not as different as his letter would imply.

As the provision of neurosurgical care for children in this country is still far from perfect and as the book covered by my original review was from the USA, I illustrated my views about the situation here by drawing attention (perhaps too light heartedly in view of the ponderous response I have elicited) to some of the differences that exist in the pattern of neurosurgical services between our two countries.

Let me explain this in even simpler terms than I used before.

In the UK, children can still be "occasional" patients in adult units, cared for by neurosurgeons who "dabble" in their problems. Fortunately the number of children requiring such care is small but the situation must be changed. How, given the conditions existing here, can this best be done?

A primary consideration concerns the numbers of neurosurgeons. I do not quote the following figures in order to show that one system is better than the other but to demonstrate the fundamental differences which must be taken into account when advocating change. If we accept the figures published by Paul Bucy in *Surgical Neurology* (1983), there is one neurosurgeon for every 372,673 of the population in the UK, compared to one for every 75,577 in the United States (where the range is from one per 16,780 for Washington DC to one per 168,101 for Kansas). There is a complete government monopoly in the provision of neurosurgical services here and there are no neurosurgeons below retiring age engaged exclusively in private practice.

These facts have some obvious practical consequences for the pattern of a British neurosurgeon's work.

Conditions will have changed in the US since 1977 when GD Zuidema, describing the SOSSUS US report (*J Neurosurg* 46:135-144), drew attention to the fact that the maximum number of craniotomies performed annually by Board certified surgeons in the four areas studied, averaged just under 14 and commented that

"the frequency of operations requiring special skill and expertise is surprisingly low". This potential dilution of experience by numbers is less of a problem here and this together with the more restricted nature of the cases dealt with (as described in my review) has helped to mitigate against some of the disadvantages of "general practitioner" neurosurgeons at least in the provision of our service to adults.

However, I do not think that this is acceptable for paediatric cases and I have therefore suggested, given the manpower available, solutions which have already been adopted in many areas. These may briefly be summarised:

- 1 Children to be cared for only in an environment equipped with all the paediatric services.
- 2 Regional neurosurgical centres to be of sufficient size that paediatric cases can be the responsibility of one consultant.
- 3 Supra-regional centres where the rarest and most complex problems can be dealt with by surgeons who have accumulated an experience in them.

In this way the problems associated with the staffing of super-specialist units can be overcome while trainees in neurosurgery may still gain experience in the management of paediatric problems. At the same time neurosurgery remains a complete speciality with continuing opportunity for cross-fertilisation of ideas between those engaged in adult and paediatric work.

This pragmatic approach may not allow the development of a situation where even such a rarity as a childhood spinal cord astrocytoma can have its own celebrity specialist but it would lead to the better care of children in this country. I would be borrowing Dr Epstein's conceits for me to assume that it would answer the needs of other communities where not only the financing but also the philosophy of health care delivery can be so very different.

Correction

In the paper "The temporal aspects of prognosis in epilepsy" *J Neurol Neurosurg Psychiatry* 1984;47:1157-65 a line was inserted which obscured the meaning of the chart (fig 6). In stage 1 *No recurrence* (<50%) should not have a line linking it with the next stage.