

S Tiamkao  
SD Shorvon

## Seizure-related injury in an adult tertiary epilepsy clinic

### 在一間成人癲癇症診所進行因癲癇引致受傷的調查

**Objective.** To assess the frequency, characteristics, and risk of injury during seizure attacks.

**Design.** Questionnaire survey.

**Setting.** Epilepsy out-patient clinic of the National Hospital for Neurology and Neurosurgery, Institute of Neurology, London.

**Patients.** One hundred consecutive epileptic patients and their caretakers or relatives, who attended the hospital between 1 May and 30 June 2000.

**Main outcome measures.** Details of epilepsy including the age of onset, causes, types, and number of seizures during the previous 12 months; injuries incurred as a result of seizures; and treatment required.

**Results.** The mean age of the 100 patients (38 male, 62 female) was 39 years (range, 16-78 years). Generalised tonic-clonic seizures occurred in 51% of patients and complex partial seizures in 40%. Hippocampal sclerosis was found in 12% of patients. Twenty-seven patients reported 222 seizure-related injuries. The total number of seizures per year was 4459 (mean, 45), of which 1094 (mean, 11) were with a fall (24.5%). Soft-tissue injury was the most common (61%), followed by burns (17%), head injury (14%), orthopaedic injury (5%), and injuries in water (3%). The most common site of soft-tissue injury and burns were to the face: 49% and 38% respectively. Burns occurred during cooking in 78% of cases. Two patients had skull fractures. Orthopaedic injuries usually occurred at home (73%). In cases of seizures in water, five of six occurred while swimming. Injury occurred once in every 20 seizures, every 11 generalised tonic-clonic seizures, and every five seizures with a fall. The significant risk factors for injury were generalised tonic-clonic seizures, high frequency of seizures, and seizures with a fall.

**Conclusion.** Soft-tissue injury was the most common seizure-related injury. Injury occurred once in every 20 seizures. The risk factors were generalised tonic-clonic seizures, high frequency of seizures, and seizures with a fall.

**Key words:**

Risk factors;

Seizures;

Soft tissue injuries

**關鍵詞：**

風險因素；

癲癇；

軟組織受傷

Hong Kong Med J 2006;12:260-3

Division of Neurology, Department of  
Medicine, Faculty of Medicine, Khon Kaen  
University, Khon Kaen 40002, Thailand

S Tiamkao, MD, FRCP

National Hospital for Neurology and  
Neurosurgery, Institute of Neurology,  
Queen Square, London WC1N 3BG, United  
Kingdom

SD Shorvon, MD, FRCP

Correspondence to: Dr S Tiamkao  
(e-mail: somtia@kku.ac.th)

**目的：**評估癲癇症發作的頻率、特性和病發時受傷的風險。

**設計：**問卷調查。

**安排：**倫敦神經病學院國立神經病學及神經外科醫院的癲癇症門診診所。

**患者：**2000年5月1日至6月30日期間，往該醫院就醫連續100名的癲癇病人，及其親屬或照顧者。

**主要結果測量：**癲癇症的情況包括發病年齡、成因、病類、過去12個月發病次數，以及因癲癇引致的受傷和所需治療。

**結果：**100名病人（38男，62女）的平均年齡為39歲（介乎16至78歲），當中51%患上全身強直陣攣癲癇，40%患上複合性部分癲癇。有12%病人出現海馬體硬化。有27名病人表示曾因癲癇病發引致受傷，總次數為222次。病人全年癲癇發作次數為4459次（每人平均45次），其中1094次（每人平均11次）會在病發時跌倒（24.5%）。最普遍的是軟組織受傷（61%），其次為燒傷（17%）、頭部受傷（14%）、骨傷（5%）和在水中受傷（3%）。在軟組織部位和燒傷個案中，面部是最經常受傷的部份，分別佔49%和38%。而有78%的燒傷事故是在煮食時發生的。有兩名病人發生頭顱骨折。骨傷通常都是在家中發生（佔73%）。在水中病發的六宗事件中，有五宗是病人在游泳時發生的。平均來說，每20次癲癇症發作便有一次引致受傷；而全身強直陣攣癲癇發作則每11次會有一次引致受傷；而每5次因癲癇引致跌倒，則有一次引致受傷。受傷的主要風險因素為全身強直陣攣癲癇、發作頻密和病發時跌倒。

**結論：**軟組織受傷是最常見的受傷案例。每20宗癲癇症發作便有一次引致受傷。受傷的風險因素為全身強直陣攣癲癇、發病頻密和病發時跌倒。

## Introduction

Patients with epilepsy are generally encouraged to lead as normal a life as possible. Nonetheless, in doing so, some are at risk of injury to themselves and others during the peri-ictal period.<sup>1,2</sup> Commonly recorded seizure-related incidents include traffic accidents, drowning, near drowning, burns, fractures, head injury, dental injury, and soft-tissue injury. The incidence and nature of seizure-related injuries differ from those that occur in the general population, and the associated risk is an important factor in guiding management decisions.<sup>3</sup> The risk of injury in epilepsy has received less attention than the risk of death; there being relatively meagre data to aid decision-making. The aim of this study was to assess the frequency, nature, circumstances, and consequences of seizure-related injuries in patients attending a tertiary epilepsy clinic.

## Methods

Between 1 May and 30 June 2000, a questionnaire on seizure-related injuries was administered to 100 consecutive epileptic patients and their caretakers or relatives. The patients attended the epilepsy out-patient clinic at the National Hospital for Neurology and Neurosurgery, Institute of Neurology, London. The clinic catered for tertiary referral patients, many of whom had severe epilepsy. Of the patients recruited, 24 were seizure-free, 31 reported seizure episodes 1 to 9 times per year, 15 reported 10 to 20 per year, and 30 experienced more than 20 annually. They were not representative of a general population of epileptic patients but did constitute an important subgroup.

Following informed consent, the questionnaire was administered face-to-face in a standardised fashion, by one of the authors. The questionnaire had been validated in a pilot phase involving 20 other patients. Age of onset of epilepsy, causes, and the types and number of seizures during the previous 12 months were recorded. Patients were asked whether they had sustained an injury or injuries during any seizures in the previous 12 months. The type of injury (soft tissue, head, burns, or orthopaedic), whether it occurred whilst in water, the circumstances and activity at that time, the body part(s) involved, and the treatment received were also recorded.

Patients with a history of seizure-related injury were compared with those not incurring injury using, as appropriate, Student's *t* test, the Chi squared test, or the Mann-Whitney *U* test ( $P < 0.05$  was considered significant).

## Results

The mean age of the 100 patients (62 female) recruited was 39 (range, 16-78) years. The mean age (and range) at onset

**Table 1. Types of injuries**

Type of injury	No. of patients, n=27*	No. of events, n=222
Soft-tissue injury	19	136
Head injury	13	32
Burns	4	37
Orthopaedic injury	3	11
Seizures in water	1	6

\* Some patients had more than one type of injury: seven patients reported head and soft-tissue injuries; two reported head, soft-tissue, and orthopaedic injuries; one reported soft-tissue and head injuries, and burns; one experienced seizures associated with fractures in water, and two reported burns and soft-tissue injuries

and illness duration were 17 (0.5-54) and 22 (1-73) years, respectively. Generalised tonic-clonic (GTC) seizures occurred in 51, complex partial seizures in 40, secondary GTC seizures in 24, simple sensory seizures in 3, and myoclonic seizures in 3. Twenty had no seizures, two reported atypical absences. None had severe neurological deficit or mental abnormality.

Epilepsy was categorised as symptomatic (ie secondary) in 39 patients, cryptogenic/idiopathic in 56, and of uncertain origin in 5. The most common identified causes in the symptomatic category were: hippocampal sclerosis (12), stroke (5), central nervous system infection (4), post-traumatic events (3), related to brain tumours (3), and other conditions (14). The latter included arteriovenous malformation, brain atrophy, cortical dysplasia, haematoma, severe brain damage, tuberous sclerosis, and scarring of the temporal lobe.

In all, 94 patients were taking antiepileptic drugs when interviewed (28 received one, 38 two, 18 three, 6 four, 1 five, and 3 more than five). In addition to antiepileptic drugs, five of the patients had had neurosurgery; two of the latter discontinued drug therapy post-surgery. Four others in whom pharmacotherapy was 'ineffective' had ceased taking their medication.

In all, 222 seizure-related injuries were reported by 27 patients. The mean (range) of annual self-reported frequency of daytime seizures (DS), night-time seizures (NS), all seizures (AS), and seizures with a fall (FS) were 35 (0-1000), 9 (0-250), 45 (0-1100), and 11 (0-600), respectively. The types of injury are summarised in Table 1.

The total number of recorded seizures in the 12-month period was 4459. Of these, 1094 (25%) involved a fall. Fifty-one patients experiencing GTC seizures had 1965 seizures of which 953 (48%) were associated with a fall. Patients with GTC seizures reported 188 injury events; 121 involved soft tissues, 25 the head, and 25 burns, 11 events of an orthopaedic nature, and 6 entailed water. The mean number of seizures per injury event was approximately 20

**Table 2. Relationship between annual seizure frequency and type and seizure-related injuries**

Seizure category	No. of seizures	Type of injury event	No. of injury events	Mean seizure No. per event*	% Risk of injury event
All	4459	All	222	20.1	5.0
		Skull fracture	2	2229.5	0.0
		Head injury	32	139.3	0.7
		Orthopaedic	11	405.4	0.2
		Soft tissue	136	32.8	3.1
		Burn	37	120.5	0.8
		Involving water	6	743.2	0.1
Generalised tonic-clonic seizure	1965	All	188	10.5	9.6
		Skull fracture	2	982.5	0.1
		Head injury	25	78.6	1.3
		Orthopaedic	11	178.6	0.6
		Soft tissue	121	16.2	6.2
		Burn	25	78.6	1.3
		Involving water	6	327.5	0.3
Generalised tonic-clonic seizure with a fall	953	All	188	5.1	19.7
		Skull fracture	2	476.5	0.2
		Head injury	25	38.1	2.6
		Orthopaedic	11	86.6	1.2
		Soft tissue	121	7.9	12.7
		Burn	25	38.1	2.6
		Involving water	6	158.8	0.6
Seizure with a fall	1094	All	222	4.9	20.3
		Skull fracture	2	547.0	0.2
		Head injury	32	34.2	2.9
		Orthopaedic	11	99.5	1.0
		Soft tissue	136	8.0	12.4
		Burn	37	29.6	3.4
		Involving water	6	182.3	0.5

\* Equivalent to No. needed to harm

(4459/222) and 21.3% of these involved GTC with a fall. Patients with GTC seizures were at greater risk of injury. The average number of seizures per injury was 10.5 (9.6%). For every seizure, GTC seizure, and FS, the frequency of a skull fracture was one for every 2229.5 (0.04%), 982.5 (0.1%), and 476.5 (0.2%) seizures, respectively. By comparison, one orthopaedic injury occurred for every 178.6 (0.6%) GTC seizures and 86.6 (1.2%) GTC seizures with a fall (Table 2). Approximately 63% of injuries occurred at home, and 12% occurred while at work, although only 32% of the patients were employed when the seizure occurred.

The soft-tissue injuries involved the face (49%), arms (44%), legs (43%), chin (4%), head (2%), back (2%), hands (2%), lips (2%), buttocks (1%), and eyes (1%). Nearly all (96%) lesions healed within a week with only topical treatment. Suturing was undertaken for 12 events and one patient was hospitalised. At the time of the seizure, these patients were: travelling, sleeping, working, or at home walking or doing housework. However, for 91 of the soft-tissue injury events the activity could not be recalled.

Four patients reported 37 episodes of burns that involved the face (38%), hands (35%), arms (19%), and legs (8%). Burns occurred while cooking (78%), ironing (16%), drinking a hot beverage (3%), and from other causes (3%). One patient had skin grafting, and the remainder, were treated with topical ointments. In 60% healing occurred within a week.

Thirteen patients reported 32 episodes of head injury that included head laceration (the commonest injury), concussion, and rarely skull fracture (6%). Management comprised medication (44%), suturing (28%), observation, and one patient was hospitalised; 62% received medical attention. The activities undertaken at the time of the index seizure were: playing sports (30%), sleeping (30%), working (20%), walking at home (15%), and travelling. In 12 episodes, the circumstances could not be recalled. Generalised tonic-clonic seizures, DS, and FS were the significant risk factors.

In three patients, there were 11 self-reported orthopaedic injuries. One patient experienced 10 episodes resulting in fractures and shoulder dislocation. The fractures entailed: bones of the arm (2), hand (2), leg (1) and shoulder (1), as well as the ribs (1) and nose (1). Most of these injuries occurred at home; 10 were treated by application of a plaster cast and one by surgery.

One patient reported five seizure-related injuries while swimming and one while bathing; for five of these no treatment was given, while 24-hour observation was deemed necessary for one. This type of injury occurred once in every 743 (0.1%), 328 (0.3%), and 182 (0.5%) seizures of all types, GTC seizures, and seizures with falls (while showering), respectively (Table 2).

Patients who sustained a seizure-related injury were more likely to have GTC seizures or seizures that occurred

during the day. There were no differences between the groups in terms of sex, age, age of onset, duration of disease, staying alone, working, partial seizure type, seizures without aura, neurological deficit, complex partial seizures, absence seizures, secondary GTC seizures, and taking more than two types of medication (data not shown in this report).

## Discussion

In this study, the mean annual frequency of AS was 45, and for FS it was 11. Half of the patients had GTC seizures, and 48% of these were associated with a fall. As in other studies,<sup>3-5</sup> epilepsy duration, sex, and age were not significant risk factors, whereas the presence of GTC was a good predictor of injury, followed by DS, NS, AS, and FS. However, a secondary GTC seizure was less likely to be associated with injury, perhaps because of the warning afforded by its focal onset.

Seizures with a fall had a 20% chance of injury. Compared to our patients (Table 2), previous studies have reported seizure-related injuries occur in 30 to 35% of patients per year<sup>3,4</sup>; most injuries (about 80%) were minor and healed with minimal or no intervention.<sup>3-6</sup> In our series too, most of the injuries involved soft tissues of the face, arms, and legs.

Kinton and Duncan<sup>7</sup> reported that hot water and rarely cooking were the cause of most burns, which was unlike our experience. This difference may have arisen because the former patients were living in an epilepsy centre and not exposed to the same risk of burns as in the community. Spitz et al<sup>8</sup> reported a linear relationship between the number of seizures and associated burns; cooking on a stove was the most influential factor and females were affected more often than males in a ratio of 3:1. Contrary to other studies,<sup>1,8,9</sup> we did not find gender to be a significant risk factor, which may be related to our small sample size.

Head injury accounted for 14% of all injury events; 45% occurred at home. Playing sports and sleeping were the most common pre-injury 'activities'. Russell-Jones and Shorvon<sup>10</sup> reported the occurrence of head injury once in every 37 (3%) seizures and once in every 17 (6%) FS. Suturing was required for one in every 82 seizures compared with one in every 37 seizures with falls.<sup>10</sup> The risk of injury in their series<sup>10</sup> may have been greater, because patients in their series represented a high-risk group than our patients.

Having seizure with a fall was an important risk factor for fractures (Table 2); about 1% were associated with fractures compared to about 0.25% following all seizures. Fractures to the humerus, acetabulum, and femur have also been reported following seizures without falls.<sup>11</sup> During seizures, shoulder joint adduction, internal rotation and flexion combined with contractions of the shoulder girdle muscle forces the humeral head against the acromion and glenoid fossa and causes posterior fracture dislocation. We encountered only one such case.

In our series, seizure-related injury in water was the least common; though one patient had six such injuries.

Guidelines for the prevention of seizure-related injury advocate aggressive treatment of the epilepsy, minimising drug-related ataxia, never swimming alone, and exercising regularly to maintain bone mass.<sup>12</sup> For high-risk patients: avoiding unsupervised bathing, minimising risk of burns, wearing a helmet, and avoiding high places is recommended. Other preventative strategies include: minimising the use of electric irons and hand-held hair dryers, using microwave ovens rather than stovetop cookers, and installing thermostats to control the water temperature in showers.<sup>8</sup> In addition, we would advise epileptic patients to avoid unsupervised sports and to sleep on a thin mattress placed directly on the floor and far from any heater.

## Conclusion

Patients with epilepsy can lead normal lives but certain precautions are needed to prevent seizure-related injury.<sup>12</sup> Soft-tissue injury was the most common, followed by burns, head injury, orthopaedic injury, and events related to seizures in water. Significant risk factors for injury were: GTC seizures, frequent seizures, and FS. More than half of all injuries occurred at home. The cost of excessive dependency must be balanced against the benefits of preventing injury.<sup>2</sup>

## Acknowledgements

The authors thank Mr Bryan R Hamman for assistance with the English-language presentation of the manuscript and Assistant Prof Chatlert Pongchaiyakul for statistical analysis.

## References

1. Josty IC, Narayanan V, Dickson WA. Burns in patients with epilepsy: changes in epidemiology and implications for burn treatment and prevention. *Epilepsia* 2000;41:453-6.
2. Spitz MC. Severe burns as a consequence of seizures in patients with epilepsy. *Epilepsia* 1992;33:103-7.
3. Neufeld MY, Vishne T, Chistik V, Korezyn AD. Life-long history of injuries related to seizures. *Epilepsy Res* 1999;34:123-7.
4. Buck D, Baker GA, Jacoby A, Smith DF, Chadwick DW. Patients' experiences of injury as a result of epilepsy. *Epilepsia* 1997;38:439-44.
5. Nakken KO, Lossius R. Seizure-related injuries in multihandicapped patients with therapy-resistant epilepsy. *Epilepsia* 1993;34:836-40.
6. Kirby S, Sadler RM. Injury and death as a result of seizures. *Epilepsia* 1995;36:25-8.
7. Kinton L, Duncan JS. Frequency, causes, and consequences of burns in patients with epilepsy. *J Neurol Neurosurg Psychiatry* 1998;65:404-5.
8. Spitz MC, Towbin JA, Shantz D, Adler LE. Risk factors for burns as a consequence of seizures in persons with epilepsy. *Epilepsia* 1994;35:764-7.
9. Hampton KK, Peatfield RC, Pullar T, Bodansky HJ, Walton C, Feely M. Burns because of epilepsy. *Br Med J (Clin Res Ed)* 1988;296:1659-60.
10. Russell-Jones DL, Shorvon SD. The frequency and consequences of head injury in epileptic seizures. *J Neurol Neurosurg Psychiatry* 1989;52:659-62.
11. Finelli PF, Cardi JK. Seizure as a cause of fracture. *Neurology* 1989; 39:858-60.
12. Spitz MC. Injuries and death as a consequence of seizures in people with epilepsy. *Epilepsia* 1998;39:904-7.