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Association of epilepsy and burns

A case control study

Background
General practitioners play a vital role in reducing risk for people with epilepsy through pharmacological prevention of seizures. Burns are the most common injury sustained during epileptic seizure. This article examines the risk of burns among patients with epilepsy in Victoria.

Methods
A case control study was conducted using the Victorian Admitted Episodes Dataset (VAED) from 2000–2005. Odds ratios were adjusted for potential confounders and 95% confidence intervals were calculated comparing burns among epilepsy versus nonepilepsy patients using multivariate logistic regression.

Results
Epilepsy was three times more likely to be associated with burns, with women being five times more likely to be burned. Hot drinks, food, fats, cooking oils, steam and household appliances, hot tap water, hot fluids other than water, and hot heating appliances were all significant causes. The strength of association between epilepsy and burns for these types of causes was consistently higher for women compared with men.

Discussion
This study has shown a strong association between epilepsy and burns in hospital admissions, and identifies the importance of using routine databases for contributing to the limited knowledge about seizure related burns in epileptic patients.

People with epilepsy are frequently restricted from potentially dangerous activities such as driving and swimming.[1,2] However, they are encouraged to lead as normal a life as possible.[3] This is best achieved by controlling seizures with anti-epileptic drug treatment as part of ambulatory care.[4] Epilepsy is therefore an 'ambulatory care sensitive condition' (ACSC) – a condition for which timely and appropriate outpatient care can reduce the risk of hospitalisation through application of preventive care and early disease management, usually delivered in the ambulatory setting.[5–7]

Timely and effective ambulatory care – particularly primary care – has the potential to decrease the need for ACSC associated hospitalisation.[8,9] As patients admitted to hospital with ACSCs lack either adequate primary care, or are not properly managed on an ambulatory basis, ACSCs have been widely used as indicators of access to and quality of primary care.[10,11]

Epilepsy patients whose seizures are not adequately controlled are at increased risk of injuries, burns being the most common.[12,13] There has been greater focus on seizure related burns in developing countries, where epilepsy management is inadequate and where there is frequent exposure to open fires.[14–16] In industrialised countries, studies exploring the association of epilepsy and burns are based on case series of patients,[17] review of medical records,[14,18,19] or ad hoc surveys.[3,12,13] Descriptive or analytical studies based on routine reporting of hospital discharges have not been used in describing the association between epilepsy and burns.

Methods

Hospital separation data for the financial period 2000–2001 to 2004–2005 (5 year period) were obtained from the Victorian

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Admitted Episodes Dataset (VAED). The VAED is a minimum dataset containing data on all admitted patient activity (submitted by all public and private acute hospitals in the state of Victoria) including acute facilities in rehabilitation, extended care institutions and day procedure centres.[20] Clinical data were stored as International Statistical Classification of Diseases and Related Health Problems, tenth revision (Australian modification) (ICD-10-AM) codes in the diagnosis fields of the VAED. Previous studies have identified the reliability and accuracy of coding in the VAED.[21,22]

Definitions, criteria and variables

Cases were defined as hospitalisations due to burns identified from the VAED where the principal diagnosis included mention of an injury due to burns (ICD-10-AM codes T2 or T30). Controls were identified from the same database where the principal diagnosis did not include mention of an injury due to burns. Exposure was defined as presence of epilepsy (ICD-10-AM codes G40 or G41) in the diagnosis fields (other than principal diagnosis).

With only three cases of epilepsy among burns patients aged less than 18 years, the case control study was restricted to ages 18 years and above. One control was randomly selected from the VAED for each case (n=6491) using the above criteria. The power to detect an odds ratio (OR) of 2.0 for an association of epilepsy and burns, with a significance level set at 0.05 (2 sided), was greater than 0.95 using a case to control ratio of 1:1.

Other variables included type of epilepsy, intractable epilepsy (defined as an average of one or more seizures per month with impairment of consciousness despite treatment with anti-epileptic drugs), gender, location of residence (metropolitan vs. rural), and circumstances of burns.

Circumstances and severity of burns

Circumstances of burns were identified using the external cause codes (burns with designated cause) in the VAED, which included smoke, fire and flames, hot drinks, food fats, cooking oils, steam or contact with hot household cooking appliances, hot tapwater, hot fluids (other than water), and contact with hot heating appliances.

Severity of burns was classified according to extent of body surface involved. Age, comorbidities, and gender (except where gender was an independent variable) were considered as potential

Table 1. Case control study of the association of epilepsy and burns based on the VAED, 2000–2001 to 2004–2005

Variables	Cases N (%)	Controls N (%)	Crude OR (95% CI)	OR_{adj}* (95% CI)	*p* value for OR_{adj}
Epilepsy					
No	6420 (98.9)	6468 (99.6)	1.00 (–)	1.00 (–)	
Yes	71 (1.1)	23 (0.4)	3.11 (1.94, 4.98)	2.97 (1.82, 4.84)	$p<0.001$
Grand mal epilepsy					
No	6490 (99.9)	6486 (99.9)	1.00 (–)	1.00 (–)	
Yes	1 (0.02)	5 (0.08)	0.20 (0.02, 1.71)	0.14 (0.02, 1.21)	$p>0.05$**
Intractable epilepsy					
No	6490 (99.9)	6491 (100.0)	1.00 (–)	NA	NA
Yes	1 (0.02)	0 (0.0)	NA	NA	NA
Men					
No epilepsy	3990	2837	1.00 (–)	1.00 (–)	
Epilepsy	31	14	1.57 (0.84, 2.96)	1.25 (0.64, 2.41)	$p>0.05$**
Women					
No epilepsy	2430	3631	1.00 (–)	1.00 (–)	
Epilepsy	40	9	6.64 (3.22, 13.71)	6.26 (3.02, 12.98)	$p<0.001$
Metropolitan					
No epilepsy	4476	4701	1.00 (–)	1.00 (–)	
Epilepsy	34	17	2.10 (1.17, 3.76)	1.93 (1.05, 3.55)	$p<0.05$
Rural					
No epilepsy	1944	1767	1.00 (–)	1.00 (–)	
Epilepsy	37	6	5.60 (2.36, 13.31)	5.52 (2.28, 13.35)	$p<0.001$

* Adjusted for age, comorbidity and gender (except where gender is an independent variable)
** Not significant

confounders. Comorbidities were identified by the Charlson/Deyo index,[23] using ICD-10-AM codes in any of the diagnosis fields. The comorbidity score is an index for measuring disease severity using routine databases such as the VAED.

Association between epilepsy and burns

Univariate and multivariate logistic regression were used to study the association of epilepsy and burns. Odds ratios for burns versus a reference (no burns) were based on maximum likelihood techniques.[24] The results of univariate logistic regression reports crude OR (without accounting for age, gender and comorbidities). The effects of age, gender and comorbidities were adjusted in the multivariate logistic regression model, and adjusted OR (OR_{adj}) are reported in the results. An asymptotic 95% confidence interval (CI) for the OR was constructed by exponentiating the limit of ±1.96 standard errors about the coefficient.[24] To study the association of epilepsy and severity of burns, multinomial logistic regression was used as the outcome variable had three categories: burns involving 0–9%, 10–19% or 20+%). The data were analysed using the software SPSS.

Results

Cases were more likely to be men compared with controls (61.9% vs. 43.9%). Cases tended to be younger compared with controls (mean age 46.1 vs. 55.8). Comorbidity scores were normally distributed, with burns cases having a lower average comorbidity score compared with controls (0.26 vs. 0.73). The frequency of epilepsy was higher among cases (1.1%) compared with controls (0.4%).

Epilepsy was about three times more likely to be associated with burns (OR_{adj}=2.97, 95% CI 1.82–4.84) (*Table 1*). Grand mal epilepsy was not significantly associated with burns. Intractable epilepsy could not be analysed in the statistical model due to small numbers.

Epilepsy was a significant predictor of burns in females (OR_{adj}=6.26, 95% CI: 3.02–12.98). The risk of burns among males with epilepsy was much lower (OR_{adj}=1.25, 95% CI: 0.64–2.41). Gender modified the association of epilepsy and burns: in a logistic model, after adjusting for the effect of age and comorbidity, an interaction term (sex * epilepsy) was a significant predictor of burns (OR_{adj}=4.59, 95% CI: 1.72–12.26). Patients with epilepsy in both metropolitan (OR_{adj}=1.93, 95% CI: 1.05–3.55) and rural locations (OR_{adj}=5.52, 95% CI: 2.28–13.35) had increased risk of sustaining burns, but there was no significant difference in risk of burns in association with epilepsy between rural and metropolitan locations.

Circumstances surrounding the cause of the burns in association with epilepsy were further examined (*Table 2*). Epilepsy was significantly associated with burns from hot drinks, food, fats, cooking oils, steam and household appliances (OR_{adj}=1.91, 95% CI: 1.01–3.61), hot tap water (OR_{adj}=7.58, 95% CI 4.29–13.42), hot fluids other than water (OR_{adj}=4.78, 95% CI 2.80–8.14) and hot heating appliances (OR_{adj}=5.09, 95% CI 2.41–10.73).

Epilepsy was not associated with severity of burns, although the direction of effect for 20+% severity burns (OR_{adj}=0.54) indicates the likelihood of less severe burns in association with epilepsy (*Table 3*).

Discussion

The frequency of burns in association with epilepsy admissions was 1.1%. Earlier studies have identified admission rates of burns as a result of epilepsy of 7%,[25] 10%,[26] 5%,[27] and 8.6%.[28] In these studies, the predominant burning agent was unguarded coal fire. Our results are similar to Josty et al[18] who observed an admission rate of burns as a result of epilepsy of 1.6%.

Table 2. Association of epilepsy and circumstances of burns based on the Victorian Admitted Episodes Dataset, 2000–2001 to 2004–2005

Variables	Cases (burns) N (%)	Controls (no burns) N (%)	Crude OR (95% CI)	OR_{adj}* (95% CI)	*p* value for OR_{adj}
Smoke, fire, flames					
No epilepsy	1610 (99.4)	11 278 (99.3)	1.00 (–)	1.00 (–)	
Epilepsy	10 (0.6)	84 (0.7)	0.83 (0.43, 1.61)	0.73 (0.38, 1.41)	$p>0.05$**
Hot drinks, food, fats, cooking oils, steam, hot household appliances					
No epilepsy	760 (98.6)	12 128 (99.3)	1.00 (–)	1.00 (–)	
Epilepsy	11 (1.4)	83 (0.7)	2.12 (1.12, 3.98)	1.91 (1.01, 3.61)	$p<0.05$
Hot tap water					
No epilepsy	344 (95.8)	12 544 (99.4)	1.00 (–)	1.00 (–)	
Epilepsy	15 (4.2)	77 (0.6)	6.92 (3.95, 12.15)	7.58 (4.29, 13.42)	$p<0.001$
Hot fluids (other than water)					
No epilepsy	538 (96.9)	12 350 (99.4)	1.00 (–)	1.00 (–)	
Epilepsy	17 (3.1)	77 (0.6)	5.07 (2.98, 8.63)	4.78 (2.80, 8.14)	$p<0.001$
Hot heating appliance					
No epilepsy	284 (97.3)	12 604 (99.3)	1.00 (–)	1.00 (–)	
Epilepsy	8 (2.7)	86 (0.7)	4.13 (1.98, 8.60)	5.09 (2.41,10.73)	$p<0.001$

* Adjusted for age, comorbidity and gender ** Not significant

Table 3. Association of epilepsy and severity of burns based on the VAED, 2000–2001 to 2004–2005

Severity of burns (%)	N (%)*	Number of cases with epilepsy (%)	OR_{adj}** (95% CI)
Burns 0–9	4504 (1.2)	54 (1.2)	1.00 (–)
Burns 10–19	621 (1.3)	8 (1.3)	1.15 (0.54–2.44)
Burns 20+	789 (0.8)	6 (0.8)	0.54 (0.23–1.28)

* 8.9% of the cases did not have severity of burns coded ** OR adjusted for age, comorbidity and gender

The changing epidemiology of decreasing frequency of burns in association with epilepsy may reflect the use of central heating instead of coal fire.[18] Advances in management of epilepsy[4] and other health promotion/accident prevention strategies usually conducted by epilepsy societies[29,30] may have reduced the admission rate of burns as a consequence of epilepsy. In addition to the changing aetiology of burns, there has been reduction in the size of burns from about 15 to 2.2% over several decades.[18,28]

Gender comparisons

Epilepsy was strongly associated with burns admissions in this study, and this association was modified by the effect of gender, with women being five times more likely to have burns with epilepsy compared with men. This finding is unlikely to be explained by differential probability of admissions for women with epilepsy compared with men with epilepsy, as there was no difference in emergency admissions between the two groups.

Although not statistically significant, there was a tendency for women with epilepsy to be burned with hot tap water, hot drinks, food, fats, cooking oils and steam, and hot household appliances. Previous studies have also identified higher risk of burns among women, which has been attributed to greater likelihood for women to be involved in daily living or self care activities compared with men.[3,12,18,26]

Preventing burns among patients with epilepsy

Several strategies have been identified to prevent burns as a consequence of epilepsy.[12–14,18,29,30] Preventive measures stress the need for safety precautions around the home, such as placing guards securely in front of fires and heaters in the living room,[13,18] use of microwave ovens rather than stovetop cookers or conventional ovens, use of antispill mugs, use of insulated plastic kettles or kettles with automatic switch off and safety cradle,[30] minimal use of hand held hair dryers and electric irons,[12] and installation of thermostats to control water temperature in showers.

Several studies have identified inadequate management of epilepsy as an important predictor of burns,[17,31] however the authors could not evaluate whether the patient experienced their burns during seizures. Frequency and duration of seizures have been identified as risk factors for burns, highlighting the importance of optimal seizure control in preventing burns.[3,12,14]

Patients burned during an epileptic fit are either not taking their medications, are receiving inappropriate therapy, or have failed to take appropriate doses of anticonvulsants.[4,17,31,32] It is well known that undertreated and inappropriately treated patients have a high risk of being burned, and it is important that epilepsy is properly managed, including accurate diagnosis coupled with education, lifestyle advice and drug therapy (including simple treatment regimen, maintenance of an adequate supply of drugs, monthly review, and specialist advice for refractory cases).[4,17,31]

Limitations of this study

It is important to acknowledge the limitations of using routinely collected hospital discharge dataset for conducting a case control study.

Strengths of this study

Cases and controls in this study are population based and representative of people with and without epilepsy in the general population of a developed country.

Conclusion

Burning and scarring as a consequence of epilepsy is an avoidable human tragedy associated with significant stigma, suffering and social isolation. There is a need for a greater recognition of seizure related burns among the medical profession; earlier research[13] has noted that only 5% of patients with epilepsy had been warned about this danger. Appropriate management of epilepsy and control of seizures needs to be complemented by education regarding the risk of burns, especially for women who have a much higher risk of burns compared with men.

As epilepsy is an ACSC, it is possible that patients with epilepsy are experiencing access barriers, with the result that their epilepsy is poorly managed. These access barriers are complex; they can be financial, geographic, organisational and cultural.[7] It is important that future studies identify the impact of these access barriers among patients with epilepsy to improve epilepsy management in the community and to design interventions that can fit the unique ambulatory needs of patients with epilepsy, so that burns and other injuries can be prevented.

Conflict of interest: none declared

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