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Prevalence of MRI abnormalities in people with epilepsy in rural China

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Abstract

Objective

To assess the prevalence of brain MRI abnormalities in people with epilepsy in rural China and to compare this with individuals in the United Kingdom.

Methods

Brain MRI scans were obtained in people with epilepsy who participated in a rural community-based program in China between July 2010 and December 2012. Individual epileptogenic lesion types were reviewed and their associations with seizure control examined. The MRI findings were compared with two previous similar studies in the United Kingdom.

Results

Among the 597 individuals (58% males; median age 38 years) with MRI scans analyzed, 488 (82%) had active epilepsy. The MRI was abnormal in 389 subjects (65%), with potentially epileptogenic lesion in 224 (38%) and non-specific abnormalities in 165 (28%), and 108 (18%) were potentially resectable. The potentially epileptogenic lesions were less frequently detected in children (<18 years old, 12/68, 18%) than in adults (212/529, 40%; $p<0.001$). In people with potentially epileptogenic lesions 67% (150/224) had failed two or more antiseizure medications. They had higher risk of uncontrolled epilepsy than those with normal MRI (risk ratio [RR]=1.25; $p<0.001$) and those with non-specific abnormality (RR=1.15; $p=0.002$), after adjusting for age and sex. The diagnostic yield of MRI was similar to that reported in community- and hospital-based studies in the United Kingdom.

Conclusions

Over one-third of people with chronic epilepsy in rural China have potentially epileptogenic

lesions identifiable on brain MRI, with two-thirds fulfilling the definition of

pharmacoresistance. These findings highlight the magnitude of the unmet needs for epilepsy

surgery in China.

INTRODUCTION

The detection of localized pathology on MRI can decisively impact the diagnostic and management pathways in epilepsy, particularly in people refractory to pharmacological therapy for whom surgery may be a treatment option. Population-based studies on the prevalence of MRI detected lesions have mostly been reported from high-income countries, examining people with new onset[1] or established epilepsy[2, 3]. In comparison, MRI studies have rarely been performed in low-to-middle income countries, where the majority of people with epilepsy live. Given that the incidence and life-time prevalence of epilepsy varies with socio-economic factors[4], it is possible that the spectrum and frequency of epileptogenic lesions may also vary depending on the socioeconomic and environmental setting of the population. A recent hospital-based study of people with new-onset epilepsy in India identified potentially epileptogenic lesions on MRI in almost half of the cohort, mostly due to infection and inflammation[5].

Six million people are estimated to have active epilepsy in China[6] where epilepsy surgery is increasingly performed.[7] To help estimate the unmet needs for epilepsy surgery in China, we evaluated MRI findings of people with established epilepsy living in the rural communities. The findings were compared with results in previously reported studies from the United Kingdom[2, 3].

METHODS

Participants

People with epilepsy aged 2 to 80 years being treated in the National Epilepsy Control Program[8] in rural areas in four Chinese provinces (Henan, Hebei, Ningxia and Shanxi) were

recruited between 1 July 2010 and 31 December 2012. People were not included if they had dissociative seizures, alcohol or drug related seizures, progressive or degenerative neurological or systemic disorders, and those whose seizure control or treatment adherence could not be adequately assessed. Pregnant women, people with an intellectual disability unable to provide informed consent, and people in whom MRI is contraindicated, including those with metallic implants or devices and claustrophobia were not included. Seizure outcomes were assessed at recruitment. Seizure freedom was defined as having no seizures for at least the previous 12 months.

Standard Protocol Approvals, Registrations, and Patient Consents

The study was approved by the Joint Chinese University of Hong Kong-New Territories East Cluster Research Ethics Committee and by the institutional review board of the Beijing Neurosurgical Institute in China. Written informed consent was obtained from all participants or assent by legal guardians when appropriate.

Clinical assessment tools

As previously described[9], predesigned epilepsy history and seizure classification questionnaires were used to collect medical history and seizure information from participants or their carers by primary care physicians. The clinical questionnaire consisted of 19 points covering birth, developmental, family, epilepsy, other medical and drug history. The 33-question seizure classification questionnaire covered a broad range of seizure semiology for classification in accordance with the updated ILAE terminology.[10] The questionnaires were developed based on those previously employed for seizure classification[11-13] and were piloted before deployment. Training and standardization workshops for physicians involved were conducted by senior epilepsy specialists (JWS and PK).

MRI protocols

Common brain MRI protocols were developed for the participating epilepsy centers. An MRI (1.5T) brain protocol optimized for the investigation of epilepsy which was feasible in the local settings was established. The scanning protocol included a T1-weighted 3D-volumetric acquisition sequence with 1 mm isotropic resolution as well as oblique coronal proton density, T2-weighted and fluid-attenuated inversion recovery (FLAIR) sequences[14, 15].

Imaging Analysis

The MRI acquisitions were anonymized and only identifiable by the designated individual study identification number. These were systematically evaluated on Osirix PACS (Pixmeo, Geneva)[16] with high-resolution diagnostic monitors by consensus between two senior neuroradiologists (ID and CH) blinded to the demographics, seizure semiology and all other clinical details. The scans were evaluated for abnormalities which were potentially epileptogenic as previously classified[1] as well as all other cranial/intracranial abnormalities.

Statistical analysis

Epilepsy was considered as active or uncontrolled if the individual had at least one seizure in the preceding 12 months at the time of recruitment. For the purpose of analyzing its association with MRI findings, age was grouped into <18 years, 18-34, 35-64, and 65 years and older. Fisher's exact test was used to compare categorical variables and proportions of potentially epileptogenic lesions between the rural China cohort and UK cohorts. Multivariable generalized linear models were performed to assess the associations between presence of potentially epileptogenic lesion and epilepsy type, age and sex, and epilepsy control and MRI findings. Statistical significance level was set at $p<0.05$. Holm-Bonferroni

method was applied to correct for multiple comparisons. All statistical tests were performed by using *Stata* version 15 (StataCorp, College Station, TX).

Data Availability

Anonymized data will be shared by request from any qualified investigator.

RESULTS

Demographics and clinical characteristics

A total of 637 individuals were recruited, of whom 39 were excluded as MRI incompatible and one did not complete the questionnaires. Among those 597 who had an MRI, 344 (58%) were males. The median age at entry was 38 years (interquartile range [IQR] 27-48), median age of epilepsy onset was 14 years (IQR 6-25) and median duration of epilepsy was 19 years (IQR 11-28). As previously described[9], 525 (88%) individuals had focal epilepsy, 54 (9.1%) had generalized, 1 (0.17%) had combined, and 17 (2.9%) had unknown classification. At recruitment, 524 (88%) were taking anti-seizure medications (ASMs) and additional 46 (7.7%) individuals had been previously treated with ASMs (median number of total ASMs tried 2, IQR 1-3). Among all participants, 488 (82%) individuals had active epilepsy.

MRI findings

Abnormalities are summarized in Table 1. Of the 597 individuals, MRI was abnormal in 389 (65%), including potentially epileptogenic lesions in 224 (38%) and non-epileptogenic abnormalities in 165 (28%). Gliosis or encephalomalacia (109/597, 18%) was the most common type, which included ulegyria and changes consistent with previous stroke, trauma and surgery. Mesial temporal sclerosis (83/597, 14%) was the second most common epileptogenic lesion found, followed by developmental abnormality (39/597, 6.5%). Vascular

anomaly (9/597, 1.5%) and brain tumors (8/597, 1.3%) were relatively uncommon. Twenty-seven individuals had dual pathology, including 19 with mesial temporal sclerosis and gliosis/encephalomalacia, 4 with two types of developmental abnormality, 2 with ulegyria and other types of gliosis or encephalomalacia, and 2 with gliosis or encephalomalacia and developmental abnormality.

The vast majority (219/224, 98%) of people with potentially epileptogenic lesions had focal onset seizures, 4 (1.8%) had generalized seizures and 1 (0.45%) had seizures of unknown classification (Table 2). Individuals with focal onset seizures had a significantly higher chance of having a detectable potentially epileptogenic lesion in MRI compared to those who only had generalized onset seizures (42% vs. 7.4%; risk ratio [RR]=5.54; 95% confidence interval [CI] 2.14-14.3; $p<0.001$) after adjustment for age and sex.

Potentially epileptogenic lesions were less frequently detected in children (<18 years old; 12/68, 18%) than in adults (212/529, 40%; RR=0.44; 95% CI 0.26-0.74; $p<0.001$). Multivariable analysis showed that, compared to children, the risk of detecting potentially epileptogenic lesion were significantly higher in adults aged 18-34 (RR=1.91; 95% CI 1.12-3.27; $p=0.018$) and 35-64 (RR=2.05; 95% CI 1.22-3.44; $p=0.007$) years, but was not significantly different from those aged 65 years or older (RR=1.17; 95% CI 0.50-2.76; $p=0.71$).

Association between MRI findings and seizure control

Epilepsy was controlled in 25% (53/208) of those with normal MRI and 22% (36/165) in those with non-specific abnormality, but only 9% (20/224) of those with potentially epileptogenic lesion had full seizure control. People who had potentially epileptogenic lesion

had significantly higher risk of uncontrolled epilepsy than those who had normal MRI (RR=1.25; 95% CI 1.14-1.36; p<0.001) and those with non-specific abnormality in MRI (RR=1.15; 95% CI 1.06-1.26; p=0.002) after adjusted for age and sex. Among the 224 individuals with potentially epileptogenic lesion, 150 (67%) had active epilepsy despite trials of two or more ASMs.

Comparison with previous similar studies

Table 3 illustrates the rates of potentially epileptogenic lesions detected on MRI in rural China and two previous studies in United Kingdom using the same scanning protocol. The early study[2] was community-based and consisted of 174 people with chronic epilepsy who had MRI (1.5T) performed between June 1995 and May 1997. 81/174 (47%) were males. Their median age was 37 years (range 15-73 years). 72% had focal, 25% generalized, and 3% combined focal and generalized epilepsy. All had 4 or more-year history of epilepsy with at least 1 seizure during the preceding 12 months. The proportion and individual types of potentially epileptogenic lesions were similar to our cohort. Another hospital-based study[3] of 804 individuals (87% focal, 8% generalized and 5% unclassified epilepsy) first attendance for an epilepsy MRI scan (1.5T) between May 1995 to June 2004 also reported similar potentially epileptogenic lesion rate (36%) and types.

DISCUSSION

We identified potentially epileptogenic lesions in brain MRI in over one-third of people with epilepsy living in rural China. Gliosis or encephalomalacia accounted for nearly half of the epileptogenic lesions found. The prevalence of mesial temporal sclerosis was also high in the cohort. A number of individuals were found to have various developmental abnormalities. Presence of potentially epileptogenic lesion was associated with focal onset seizures and

uncontrolled epilepsy. The potentially epileptogenic lesions were less prevalent in children compared to adults, likely because a higher proportion of children would have genetic epilepsies while acquired epilepsies are more common in adults. The diagnostic yield and types of lesions were comparable to findings in the United Kingdom.

Notably, a large proportion of the lesions identified are generally considered as amenable to resective epilepsy surgery, including mesial temporal sclerosis (14% of the total cohort), vascular malformations (1.5%), focal cortical dysplasia (1.3%) and tumors (1.3%). Combined, these lesions were found in almost a fifth of the participants. These lesions are frequently associated with pharmacoresistance[17]. Indeed, less than 10% of individuals with potentially epileptogenic lesions had full seizure control in our cohort, and 67% would be considered to have pharmacoresistant epilepsy having failed two or more ASMs[18].

While the mesial temporal sclerosis rate was high in our cohort, it was reported that surgeries for mesial temporal sclerosis in epilepsy centers in western countries has declined[19]. People with mesial temporal sclerosis in our cohort may have been previously missed due to the lack of radiological expertise in Rural China. Epilepsy surgery also has shorter history in China particularly in rural setting. Further, even when hippocampal sclerosis was detected, people might not have had access to further pre-surgical evaluation and subsequent intervention. It is also possible that the incidence of mesial temporal sclerosis developing in rural China is higher than in high-income countries. Improvement in pediatric care has been associated with a decline of new cases of mesial temporal sclerosis over the last 30 years in high income countries. We speculate that these factors might have accounted for the relatively high prevalence of mesial temporal sclerosis detected in this study compared with the declining rate of this pathology in surgical series from western countries.

These findings have major implications for service provision and highlight the considerable

unmet needs in epilepsy management in China, particularly surgical therapy and the required

access to specialist neuroimaging. Six million people in China have active epilepsy[6], for

whom neuroimaging with MRI should be an integral part of evaluation. Extrapolating our

findings to the rest of the population, it may be estimated that as many as 1 million

individuals with epilepsy may have potentially resectable epileptogenic lesions in China. The

most common type of such lesions we identified was mesial temporal sclerosis, for which

anterior temporal lobectomy could achieve seizure freedom in over 70% of people[20].

Identification of these lesions on MRI should, therefore, trigger presurgical evaluation in

epilepsy centers, including optimization of drug treatment, video-EEG monitoring and

neuropsychological assessment. It is almost certain that only a small fraction of people with

these lesions has been evaluated for, and even fewer received surgery[21].

Meeting this demand would require concerted effort in healthcare resource planning. As the

potentially resectable epileptogenic lesions were more prevalent in people with focal seizures

than those with generalized seizures, seizure classification may be used to help prioritize the

provision of MRI services. Our findings show that this is possible with the use of

standardized questionnaires even in the primary care setting.

Two previous studies in United Kingdom using similar protocols also had high proportions of

focal epilepsy (72% and 87%) comparable to the rural China cohort (88%). The three studies

also had similar MRI diagnostic yields, detecting similar types of potentially epileptogenic

lesions and high proportions of mesial temporal sclerosis. Given that these studies employed

1.5T MRI scanners, with the advent of high-field magnets at 3T and internationally

recommended imaging protocol[22], it is likely that the detection rates of lesions reported in these studies represented an under-estimation, and the number of cases who should be considered for pre-surgical evaluation might be even higher.

The study has limitations. There was a bias towards people with convulsive seizures. This might be because those with non-convulsive seizures were less likely to seek medical care in the rural setting. Moreover, most of the individuals in this cohort had chronic and active epilepsy. Therefore, the findings may also not reflect the etiologies of new onset epilepsy, but rather the burden of pathological lesions in people with active or pharmacoresistant epilepsy.

Through a standardized and locally feasible MRI protocol we found a high prevalence of potentially epileptogenic lesions in people with epilepsy in rural China, particularly in those with focal seizures. Careful seizure classification, aided by standardized questionnaire on semiology, may help prioritize the use of MRI in resource limited settings. Our diagnostic yield was comparable to people with chronic epilepsy in high-income countries, suggesting similar burden of pathological lesions in people with active epilepsy despite different socioeconomic settings. With an estimated one million people having potentially resectable epileptogenic lesions, these findings call for urgent actions to address this huge unmet need in epilepsy management in China.

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APPENDIX 1: AUTHORS

Name	Location	Contribution
Indran Davagnanam, FRCR	UCL Queen Square Institute of Neurology, Queen Square, London, UK	Analyzed and interpreted the data; drafted the manuscript for intellectual content
Zhibin Chen, PhD	Monash University, Melbourne, Australia	Analyzed and interpreted the data; conducted the statistical analysis; drafted the manuscript for intellectual content
Chandrashekar Hoskote, FRCR	National Hospital for Neurology & Neurosurgery, Queen Square, London, UK	Analyzed and interpreted the data
Ding Ding, MD, PhD	Fudan University, Shanghai, China	Design and conceptualized study; analyzed and interpreted the data; revised the manuscript for intellectual content
Bin Yang, MD	Jiaozuo People's Hospital, Henan Province, China	Acquisition of data
Yingli Wang, MD	Ningxia Medical University, Ningxia Province, China	Acquisition of data
Taiping Wang, MD	Jincheng Emergency Medical Rescue Center, Shanxi Province, China	Acquisition of data
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John S. Duncan, DM, FRCP	UCL Queen Square Institute of Neurology, Queen Square, London, UK	Design of study; interpreted the data; revised the manuscript for intellectual content
Wenzhi Wang, MD	Beijing Neurosurgical Institute, Beijing, China	Acquisition of data; analyzed and interpreted the data; revised the manuscript for intellectual content
Josemir W. Sander, PhD, FRCP	UCL Queen Square Institute of Neurology, Queen Square, London, UK	Design and conceptualized study; analyzed and interpreted the data; revised the manuscript for intellectual content
Patrick Kwan, PhD, FRACP	Monash University, Melbourne, Australia	Design and conceptualized study; analyzed and interpreted the data; revised the manuscript for intellectual content

REFERENCES

1.   Hakami T, McIntosh A, Todaro M, et al. MRI-identified pathology in adults with new-onset seizures. Neurology 2013;81:920-927.

2.   Everitt A. The structural basis of the epilepsies: An MRI and epidemiological study. The University of London, 2003. Available at: https://search.proquest.com/docview/1752382883 (accessed 19 January 2020).

3.   Winston GP, Micallef C, Kendell BE, et al. The value of repeat neuroimaging for epilepsy at a tertiary referral centre: 16 years of experience. Epilepsy Res 2013;105:349-355.

4.   Bell GS, Neligan A, Sander JW. An unknown quantity--the worldwide prevalence of epilepsy. Epilepsia 2014;55:958-962.

5.   Ponnatapura J, Vemanna S, Ballal S, Singla A. Utility of Magnetic Resonance Imaging Brain Epilepsy Protocol in New-Onset Seizures: How is it Different in Developing Countries? J Clin Imaging Sci 2018;8:43.

6.   Wang WZ, Wu JZ, Wang DS, et al. The prevalence and treatment gap in epilepsy in China: an ILAE/IBE/WHO study. Neurology 2003;60:1544-1545.

7.   Xu L, Xu M. Epilepsy surgery in China: past, present, and future. Eur J Neurol 2010;17:189-193.

8.   Wang W, Wu J, Dai X, et al. Global campaign against epilepsy: assessment of a demonstration project in rural China. Bull World Health Organ 2008;86:964-969.

9.   Wang F, Chen Z, Davagnanam I, et al. Comparing two classification schemes for seizures and epilepsy in rural China. Eur J Neurol 2019;26:422-427.

10.   Berg AT, Berkovic SF, Brodie MJ, et al. Revised terminology and concepts for organization of seizures and epilepsies: report of the ILAE Commission on Classification and Terminology, 2005-2009. Epilepsia 2010;51:676-685.

11.   Reutens DC, Howell RA, Gebert KE, Berkovic SF. Validation of a questionnaire for clinical seizure diagnosis. Epilepsia 1992;33:1065-1071.

12.   Placencia M, Suarez J, Crespo F, et al. A large-scale study of epilepsy in Ecuador: methodological aspects. Neuroepidemiology 1992;11:74-84.

13.   Ottman R, Barker-Cummings C, Leibson CL, Vasoli VM, Hauser WA, Buchhalter JR. Validation of a brief screening instrument for the ascertainment of epilepsy. Epilepsia 2010;51:191-197.

14.   Recommendations for neuroimaging of patients with epilepsy. Commission on Neuroimaging of the International League Against Epilepsy. Epilepsia 1997;38:1255-1256.

15.   Duncan JS. Neuroimaging of the Epilepsies. Rivista di Neuroradiologia 2004;17:446-463.

16.   Rosset A, Spadola L, Ratib O. OsiriX: an open-source software for navigating in multidimensional DICOM images. J Digit Imaging 2004;17:205-216.

17.   Semah F, Picot MC, Adam C, et al. Is the underlying cause of epilepsy a major prognostic factor for recurrence? Neurology 1998;51:1256-1262.

18.   Kwan P, Schachter SC, Brodie MJ. Drug-resistant epilepsy. The New England journal of medicine 2011;365:919-926.

19.   Jehi L, Friedman D, Carlson C, et al. The evolution of epilepsy surgery between 1991 and 2011 in nine major epilepsy centers across the United States, Germany, and Australia. Epilepsia 2015;56:1526-1533.

20.   West S, Nevitt SJ, Cotton J, et al. Surgery for epilepsy. Cochrane Database Syst Rev 2019.

21.   Xiao B, Huang ZL, Zhang H, et al. Aetiology of epilepsy in surgically treated patients in China. Seizure : the journal of the British Epilepsy Association 2004;13:322-327.

22.   Bernasconi A, Cendes F, Theodore WH, et al. Recommendations for the use of structural magnetic resonance imaging in the care of patients with epilepsy: A consensus report from the International League Against Epilepsy Neuroimaging Task Force. Epilepsia 2019;60:1054-1068.

TABLES

Table 1. Summary of MRI findings in the 597 people with epilepsy in rural China

Epileptogenic lesion - n (%)	224[a]	(38)	Non-epileptogenic abnormality - n (%)	165[b]	(28)
Gliosis/Encephalomalacia	109	(18)	Nonspecific white matter/T2 weighted hyperintensity	73	(12)
Ulegyria	42		Cerebellar volume loss and atrophy	39	(6.5)
Poststroke	22		Cerebral volume loss and atrophy	27	(4.5)
Posttraumatic	18		Small vessel disease	25	(4.2)
Postoperative	12		Nonspecific small infarcts	21	(3.5)
Unspecified	15		Small ischemic damage	12	(2.0)
Mesial temporal sclerosis	83	(14)	Small granuloma	4	(0.67)
Developmental abnormality	39	(6.5)	Corpus callosum agenesis	3	(0.50)
Grey matter heterotopia	10		Developmental venous anomaly	3	(0.50)
Focal cortical dysplasia	8		Hippocampal structures asymmetry	3	(0.50)

Polymicrogyria	8	Chiari I malformation	1	(0.17)
Arachnoid cyst	4	Choroidal fissure cyst	1	(0.17)
Tuberous sclerosis	4	Cystic lesion	1	(0.17)
Nodular heterotopia	1	Leukodystrophy	1	(0.17)
Band heterotopia	2	Local dystrophy	1	(0.17)
Subdural cystic hygroma	1	Nonspecific nodule	1	(0.17)
Perinatal ischemic lesion	1	Rathke's cleft cyst	1	(0.17)
Vascular anomaly	9	(1.5)		
Cavernoma	6			
Arteriovenous malformation	3			
Tumors	8	(1.3)	**No abnormality detected - n (%)**	**208** (35)
Glioma	5			
Nonspecific tumor	3			

mass

Neurocysticercosis	2	(0.34)
Granulomatous inflammation	1	(0.17)

Total percentage totals to slightly more than 100% owing to rounding.

a. Twenty-seven people had dual pathology.

b. Among people without epileptogenic lesions, 38 had dual abnormalities and seven had three types of non-epileptogenic abnormalities.

Table 2. Frequency of MRI findings according to seizure types and epilepsy classifications

	Epileptogenic lesion (%)		Non-epileptogenic abnormality (%)		No abnormality detected (%)		Total
Type of seizure type							
Focal to bilateral tonic-clonic	179	(41)	119	(27)	140	(32)	438
Multiple focal onset	24	(46)	13	(25)	15	(29)	52
Focal Impaired awareness	15	(56)	6	(22)	6	(22)	27
Focal aware^	1	(13)	4	(50)	3	(38)	8
Generalized motor^	4	(8.5)	15	(32)	28	(60)	47
Generalized motor and non-motor	0	(0)	2	(29)	5	(71)	7
Combined focal and generalized onset	0	(0)	0	(0)	1	(100)	1
Unknown	1	(5.9)	6	(35)	10	(59)	17
Type of epilepsy							
Focal	219	(42)	142	(27)	164	(31)	525
Generalized^	4	(7.4)	17	(31)	33	(61)	54
Combined	0	(0)	0	(0)	1	(100)	1
Unknown^	1	(5.9)	6	(35)	10	(59)	17
Total^	**224**	**(38)**	**165**	**(28)**	**208**	**(35)**	**597**

^ Percentages total to slightly more or less than 100% owing to rounding.

Table 3. Potentially epileptogenic lesions detected on MRI in people with epilepsy in studies in rural China and United Kingdom

	Rural China (N=597)		UK Community-based (N=174)						UK Hospital-based (N=804)					
	n	(%)	n	(%)	RR	(95% CI)	p-value	Corrected p-value	n	(%)	RR	(95% CI)	p-value	Corrected p-value
People with potentially epileptogenic lesion[a]	**224**	**(38)**	**≤71[b]**	**(≤41)**	**0.92[c]**	**(0.75-1.13)**	**0.48**	**0.96**	**293**	**(36)**	**1.03**	**(0.90-1.18)**	**0.70**	**0.70**
Gliosis/Encephalomalacia	109	(18)	36	(21)	0.88	(0.63-1.24)	0.51	>0.99	145	(18)	1.01	(0.81-1.27)	0.94	0.94
Mesial temporal sclerosis	83	(14)	29	(17)	0.83	(0.57-1.23)	0.39	0.39	88	(11)	1.27	(0.96-1.68)	0.10	0.20
Developmental abnormality	39	(6.5)	4	(2.3)	2.84	(1.03-7.84)	0.037	0.074	42	(5.2)	1.25	(0.82-1.91)	0.30	0.30
Vascular anomaly	9	(1.5)	0	(0)	NA	NA	0.22	0.44	9	(1.1)	1.35	(0.54-3.37)	0.63	0.63
Tumors	8	(1.3)	2	(1.1)	1.17	(0.25-5.44)	>0.99	>0.99	9	(1.1)	1.20	(0.46-3.08)	0.81	>0.99
Neurocysticercosis	2	(0.34)	0	(0)	NA	NA	>0.99	>0.99	0	(0)	NA	NA	0.18	0.36
Granulomatous inflammation	1	(0.17)	0	(0)	NA	NA	>0.99	>0.99	0	(0)	NA	NA	0.43	0.85

a. Total number of people with potentially epileptogenic lesions may be smaller than the sum of numbers of individual type of potentially epileptogenic lesion as individuals could have more than one type of potentially epileptogenic lesion.

b. As individuals might have multiple potentially epileptogenic lesions, there was insufficient information to estimate the exact total number of people with potentially epileptogenic lesion in the UK community-based study[2]. It is reasonable to believe, however, the total number of cases with potentially epileptogenic lesion should be equal to or slightly less than the sum of numbers of individual types of potentially epileptogenic lesion.

c. The sum of numbers of individual types of potentially epileptogenic lesion was used in the comparison analysis.

CI, confidence interval; NA, not applicable; RR, risk ratio