THE COMPLEXITIES OF EPILEPSY

An estimated 50 million people worldwide have epilepsy. But research funding is low, treatment can fail and the mechanisms of the disease are a mystery. By Neil Savage.

ARCHITECTURE OF EPILEPSY

Epilepsy is one of the most common neurological disorders and is characterized by uncontrolled firing of the brain's neurons. There are more than a dozen types of epilepsy but the main ones are described below; a person can have more than one type. Precisely what happens in the brain during an epileptic seizure and the combination of brain areas involved have experts disagreeing on how to categorize the many forms of the disease. See page S4.

GENERALIZED EPILEPSY

Affects most or all of the brain

Typically congenital and occurs simultaneously in both sides of the brain. The most widely recognized form is tonic-clonic, which involves a fall to the floor, jerky convulsions and unconsciousness. Absence seizures are another form of generalized epilepsy — these involve transient loss of consciousness, which may last for only a few seconds.

PARTIAL EPILEPSY

Affects one part of the brain

Usually limited to a specific region in one area of the brain. This form of epilepsy is often the result of an accident or neurological disease. Manifestations — such as hallucinations, twitching, smelling things or uncontrolled limb movements — can differ considerably.

FRONTAL LOBE EPILEPSY

Affects a specific brain region

Seizures originating in the frontal lobe may develop into partial or generalized epilepsy. The frontal lobe brain tissues are associated with motor function and cognition. Epilepsy arising here may induce temporary alterations in personality.

TEMPORAL-LOBE EPILEPSY

Affects a specific brain region

The temporal lobes are associated with the brain's language and auditory centres, as well as memory and emotion. This form of epilepsy varies in intensity and often arises within the hippocampus and amygdala — two structures that are deep in the brain's centre.

- 1 Occipital lobe
- 2 Parietal lobe
- 3 Frontal lobe
- 4 Temporal lobe
- 5 Hypothalamus
- 6 Amygdala

60%

of cases of epilepsy arise from unknown causes¹.

YOUNG AND OLD DANGERS

In developed countries, epilepsy is more common in children and the elderly².

GEOGRAPHICAL VARIATION

Worldwide prevalence of lifetime epilepsy and active epilepsy³.

- Developed countries
- Developing countries (urban)
- Developing countries (rural)

SURGICAL GAINS

Temporal lobe epilepsy is the kind most likely to be resistant to drug treatment. Fortunately, this form of epilepsy responds well to surgery. In most people suitable for surgical treatment, surgery to one side of the brain is sufficient to control seizures but sometimes the surgeon will need to operate on both sides of the brain.

How effective is surgery?

A study published in 2012 involving 38 patients reported that 11 of the 15 patients with drug-resistant mesial temporal lobe epilepsy who received surgery to alleviate seizures had two seizure-free years. None of the 23 patients who hadn't been recommended for surgery and continued with drug-only treatment had a seizure-free year*.

Anterior temporal lobe

Preparation for an epilepsy operation

Data from neuroimaging techniques are used to map the brain to precisely identify regions that give rise to epileptic activity. During surgery, the aim is to remove affected tissue without damaging functionally important regions. See page S7.

DRUGS AT WORK

Epilepsy becomes more common as people grow older (see 'Young and old dangers') but effective antiepilepsy drugs are available for patients over the age of 55 (ref. 5). See page S12.

PSYCHIATRIC CONDITIONS

In general, people with epilepsy have more chance of developing psychiatric disorders, particularly depression, but having a psychiatric condition also raises the likelihood of developing epilepsy*.

*The data used to compile the bars was extracted from studies that looked diagnosed psychiatric conditions in the general population and in people with epilepsy. The studies analysed were published between 1970 and 2002.

UNBALANCED ATTENTION

US National Institutes of Health spending on epilepsy in 2010 lagged behind less common neurological conditions. A variety of factors, from historical issues at health agencies to social stigma, may explain this discrepancy*. See page S10.

References: 1. The WHO Epilepsy Fact Sheet No. 999; 2. Thurman, D. J. See, *go.nature.com/2spiwk*; 3. Ngugi, A. K. *et al*; *Epilepsia* **51**, 883–890 (2010); 4. Engel, J. Jr. *et al*. *J. Am. Med. Assoc.* **307**, 922–930 (2012); 5. Arif, H. *et al*. *Arch. Neurol.* **67**, 408–415 (2010); 6. LaFrance, W. C. Jr., Kanner, A. M. & Hermann, B. *Int. Rev. Neurobiol.* **83**, 347–383 (2008); 7. Meador, K. J. *et al*. *Neurology* **77**, 1305–1307 (2011).