

## Review

# Neuropsychological Aspect of Epilepsy

Gauri Shanker Kaloiya<sup>1</sup>, Mohit Kumar<sup>2</sup>

Gauri Shanker Kaloiya: Associate Professor of Clinical Psychology, National Drug Dependence Treatment Centre (NDDTC), All India Institute of Medical Sciences (AIIMS), New Delhi<sup>1</sup>

Mohit Kumar: Senior Research Fellow (Clinical Psychologist), Department of Psychiatry, AIIMS, New Delhi.<sup>2</sup>

### Abstract

*The discipline of neuropsychology, the applied science concerned with the behavioural expression of brain dysfunction, came from the parent disciplines of Psychology and Neurology. A clinical neuropsychologist is a professional within the field of clinical psychology with specialized training in the brain-behaviour relationships (during M.Phil. & Ph.D. in Clinical Psychology) and uses this knowledge in the assessment, diagnoses, treatment, and rehabilitation of patients across lifespan with neurological, neuro-developmental, medical and psychiatric conditions. It is also described that their work in a different variety of settings where clinical neuropsychologist may encounter individuals with epilepsy<sup>1</sup>.*

***“The bravest sight in the world is to see a great man struggling against adversity.”***

*(Roman philosopher, mid-1st century AD)*

### Introduction

In addition, a rich literature emphasises that most of the neurotic problems like anxieties and fears are common in virtually every one's life. But for those who have epilepsy, anxieties and fears are usually much deeper than those who are healthy. It is very often the emotional effects that epilepsy has on patients go unknown as those with epilepsy grow up with a lot of psychological difficulties that usually last for years. The person who has fear of death with their physical anxiety of going into a seizure often leads to significant emotional struggles. A person who has epilepsy is more prone to carrying fear through every day of his life. This form of fear deals with the fear of having a seizure in front of acquaintances that might not be aware of their epilepsy. Although only the person who have epilepsy truly know and understand how having seizures affects one's personal and emotional state, there are many principles that others can follow to help patients cope better with their epilepsy.

### Brief History of Neuropsychology and Epilepsy

Evidence from as long as time of cave drawing that people have long been aware of brain-behaviour relationships. The earliest neuropsychological researches recognized how disease and blows to the

brain affect behaviour. Archaeologists who have recovered several thousand skulls worldwide show that trephination are one of the ancient surgical operations that involve cutting, scraping, chiselling, or drilling a plug like piece of bone from the skull. Some investigators proved that trephination which was a “magical” form of healing; perhaps for display of bizarre behaviours, including what we now recognize as epilepsy<sup>2</sup>. Ancient people thought epileptic seizures were caused by such as evil spirits or demons which had entered a person's body. Priests attempted to cure people with epilepsy by driving the demons out of them with prayers and magic. Superstition was challenged by ancient physicians like Atreya and later Hippocrates, both of them recognized a seizure as a dysfunction of the brain and not a supernatural event. Hippocrates (460-377 B.C.), a Greek physician honoured as the originator of modern medicine, argued that epilepsy, once considered the “Sacred disease” (Because many person thought the patient was possessed by gods or spirits) is, in fact, no more than any other disease, but has specific characteristics and a definite medical cause. These had been bold propositions at a time when people thought behaviour was mostly under divine control. Hippocrates and his colleagues could not, however, discuss exactly how such brain-behaviour relationships arose, perhaps it

was than sacrilegious to dissect the human body, especially the brain.

Because of this multiple disciplines (Neurophysiology, Neuropathology, Neuroradiology, Neurosurgery and Neuropsychology) have concerned with this disease, research in 'Epileptology' was interdisciplinary from the very beginning of the thoughtful that the source of epilepsy must be the brain. Traditionally defined, neuropsychology is the study of the assessment, understanding, and modification of brain-behaviour relationships<sup>3</sup>.

Neuropsychology seeks to gain the knowledge about human brain and their behavioural relationships through the study of both healthy and damaged brain systems. It seeks to classify the underlying biological roots of behaviours, from creative genius to mental disorder, which account for intellectual processes and personality. Clinical neuropsychology seeks such understanding mainly in the case of how damaged brain structures modify behaviours and interfere with mental and cognitive functions.

### **Major areas of Assessment in Neuropsychology**

The majority of people diagnosed with epilepsy have seizures that originate in the temporal or frontal lobes of the brain. These regions of the brain are responsible for many important aspects of thinking. For example in the brain, temporal lobes are very important aspect in the formation of new memories, whereas the frontal lobes help us to regulate our behaviour and thinking. The temporal and frontal areas of the brain have strong neural connections which support communication between these two regions and with the rest of the brain. Because the frontal and temporal lobes are often implicated in epilepsy, the most common problems associated with epilepsy are thinking skills organised by these areas of the brain. The following is a list of the 5 most common types of neuropsychological complications associated with epilepsy, all of which are mediated by the temporal or frontal lobes of the brain:

### **Epilepsy & Attention**

Attention as we formulate is a foundational neuropsychological function, facilitated by the frontal lobes. Before one can process, respond or learn to

something, must first focus and attend to it. Problems with attention can undermine all other aspects of learning and thinking. There is a high occurrence of attention problems in people who have seizures. It is very often that attention problems are also a common side effect of anti-epileptic medications. There are many aspects to attention, but the aspects that are very relevant to epilepsy have to do with the ability to concentrate and focus on something while ignoring distractions (i.e. selective attention) and the ability to sustain concentration and focus over long periods of time (i.e. sustained attention). People who have selective attention problems are likely to be easily diverted and have trouble ignoring non-relevant stimuli (e.g., ignoring a police van siren when listening to a lecture). People who have sustained attention problems tend to have trouble finishing longer tasks and may be prone to daydreaming (e.g., always difficulties to finishing the projects which was started earlier). As many as 40-60% of children who are diagnose with epilepsy have attention problems.

### **Epilepsy & Executive Functions**

Executive functions as we already define in various literature are a group of skills involved with regulating our behaviour and thinking. Executive functions guide our decision making and problem solving and are crucial for successfully managing more complex ideas or tasks. Skills which make up the executive functions include: planning and organization, self-monitoring, the ability to sequence, the ability to switch ideas or shift or plans if something is not working, the ability to carry-through or persist on something, and the ability to stop or inhibit oneself from doing or thinking something. As it suggests, executive functions serve as the "executive" of the brain and allow us to be more efficient and effective thinkers. Executive functions are facilitated by the frontal lobes of the brain. Like problems, attention with executive functions can undermine all other facets of thinking, particularly have more complex thinking. An executive function which has developed slowly through all childhood and are not fully developed till late adolescence or early adulthood. Therefore, problems with executive functions are not frequently recognized until a child is 8-10 years old or older. People who have executive function problems might

be impulsive, messy, lose track of their belongings, working efficiently or have trouble multi-tasking, procrastinate, or have trouble finishing projects. Problems with executive functions can result in failure in work situations or reduced/poor productivity. People who have epilepsy are at high-risk for problems in executive functions particularly those person who have seizures originating in the frontal lobes of the brain, and certain medications can also affect executive functions.

### **Epilepsy, Learning & Memory**

The thinking problems are most common reported by people who have living with epilepsy. The formation of the retrieval of information and memory over time involves multiple areas of the frontal and temporal lobes. Problems with certain facets of memory can be result from disruptions to specific frontal brain or temporal areas.

#### **Learning and memory is a multi-staged process involving the:**

- Encoding of information
- Storage of information
- Retrieval of information over time

A breakdown at any stage in life results in poor memory, but for the different reasons. For example, a person who have problems with creating a new memory or “encoding” can be results from inattention or problems with executive function. Think of memory as a file cabinet-if the new information have stored in an unsystematic way, it makes it much harder to find it later when you need it. If a memory is not stored in an organized or logical way, so it would be much harder to recall it accurately later. The memory in middle, the “storage” stage, this is the stage when we put information into our long-term memory. Patients who have epilepsy frequently complain of memory difficulties. Memory functioning is usually improved by improving control of seizures. The roles of anti-epileptic drugs (AEDs) reflect more on concentration, attention and psychomotor abilities than on memory function per se. Recent studies have suggested that the poor memory of patients

who have temporal lobe epilepsy does not associate with seizure frequency. Seizures may have an acute effect on memory but this is usually transient and does not affect prospective memory<sup>4</sup>. In large measure, the memory loss associated with epilepsy seems to be more related to the underlying pathology than to the seizures themselves<sup>5</sup>.

### **Epilepsy & Speed of Processing**

Processing speed refers to how quickly a healthy person can process and absorb new information and respond to it. Recurrent seizures and AEDs can slow a person’s speed of processing. When speed of processing is slowed, it might be feel as if everything is on “fast-forward” and a person can have trouble keeping in mind. People with speed of processing problems benefit from having have things presented to them very slowly. They can also benefit from repetition and review to confirm they have processed information fully. People with speed of processing problems can also struggle to get their views and ideas out quickly and many need some more time to complete assignments.

### **Epilepsy & Information Processing:**

Information processing is how healthy people understand and create meaning of the information they see or hear. Broadly speaking, there is visually-based processing (understanding visual images) and language-based processing (understanding language). People who have seizures in their left hemisphere of the brain are most likely to have language-based processing problems. They might have problem in understanding what other person is saying to them or difficulties to use the correct words to express themselves. People who have seizures in their right hemisphere of the brain are most likely to have visually-based processing issues, which can make it difficult for them to see patterns in details or designs in pictures.

### **Role of Neuropsychological Assessment in Epilepsy**

In patients who have epilepsy, the neuropsychological assessments are most frequently used to support diagnosis, and to evaluate the side effects of antiepileptic medications in cognitive functions and observe the cognitive decline connected with some epileptic disorders. In combination with MRI and other pre-surgical investigations, neuropsychological scores are also used to assess the appropriateness of patients for epilepsy surgery and can be used to forecast post-operative outcome, both in terms of seizure control and cognitive change. In an ideal world, all newly diagnosed patients who have epilepsy would undergo a brief neuropsychological screen before starting treatment. Whilst this may not provide important another diagnostic information at the time, it creates a valuable baseline data against which future assessments can be measured. Serial neuropsychological assessments can be used to evaluate the cognitive deterioration due to new or existing antiepileptic drug (AED) regimens and to observe the cognitive deterioration that may be associated with long-term poorly controlled epilepsy and episodes of status. However, repeated assessments over a short period of time can lead to the development of practice effects which can mask deterioration in function. In most patients it is therefore recommended that there is at least a six-month interval between assessments to maximise the validity and utility of the results. Single assessments can be beneficial in the localisation of cognitive dysfunction related with focal pathologies and also enable the setting of employment goals and realistic education. It also single assessments can reveal deficits that are amenable to rehabilitation<sup>6,7</sup>.

All neuropsychological treatment process must begin with an adequate neuropsychological assessment. The assessment should consist of neurocognitive, behavioural or social deficits. Which neuropsychological functions are impaired with associated to epilepsy, what zone groups or neural networks are impaired and what contributions each one makes to the injured functional system should also be assessed. The type of neuropsychological assessment is fundamental in the design of the chosen therapeutic approach. There are basically two assessment models that lead to different rehabilitation models<sup>8</sup> i.e.

Qualitative and Quantitative models.

Quantitative model is centred in the lesion and the neurocognitive deficits the patients show on standardized tests and neuropsychological batteries. This model focuses mainly on the disorder or deficits that the patient shows which is considered to be the direct result of a lesion in the brain tissue. Qualitative model is based on the Luria's principles. It is centred in what functions are intact in a particular patient along with what are the deficit areas. It is based on the view that neuropsychological rehabilitation must initiate with what remains intact and not from what has been damaged. Thus the main objective is not the patients return to his/her earlier normally but to achieve neuropsychological coherence in the person.

There are basically two standard comprehensive batteries that are widely used for assessment for treatment or rehabilitation. There are Halstead Reitan Battery<sup>9</sup>, and Luria Nebraska Neuropsychological batteries (LNNB)<sup>10</sup>. Both procedure have standard administration and scoring methods and both in lesser and greater details, provide evaluations of the various cognitive perceptual abilities, attention and language, memory and a variety of perceptual modification skills.

In addition to these batteries appropriate Wechsler Intelligence Scale-WAIS or WAIS-R, or their various subtests depending on the need of the patient may be used. Many researchers also use Wechsler Memory Scales, Boston Diagnostic Aphasia Scale. A single test widely used for neuropsychological rehabilitation is Wisconsin Card Sorting Test (WCST)<sup>11</sup>. It is basically a test of executive function that assesses planning, concept formation and conceptual flexibility.

Besides these standardized tests, behavioural observation and assessment play a vital role. Behavioural interviewing Scales, direct observation and checklists can all be used to identify and monitor the everyday implication of neuropsychological impairment. These identify problems for treatment and also can evaluate the effectiveness of treatment.

These test batteries; individual tests and behavioural assessment should fulfil the need to

- Know the cognitive abilities and deficits in

order to build a map of what is and what is not cognitively possible for the patients.

- Know how the problems are manifested in real life and what the people involved consider to be important.
- Individualize treatment; such individualization involves the identification of problems from the patient's point of view.

### Computerized Neuropsychological Assessment in Epilepsy

Computer assisted neuropsychological examinations are increasingly applied in health care. A major advantage of use of computers in the assessment are it is less time consuming and potentially more cost effective, once standardized it assures reliability and validity. In addition to these it enables precise time, quality monitoring and analysis of results. Though in many cases, validity and reliability of many tests remains a matter of controversy and more researches are yet to be designed. The following are some of the test available as computer programs or software.

- **The Computer Assisted Stroop Test (Golden & Freshwater, 1998):** In this test the stimuli cards are embedded within the software and can be printed on demand. The examinee responds verbally like he or she would in a standard administration. The examiner follows the examinee's responses and marks on the computer screen the non-corrected and self-corrected errors<sup>12</sup>.
- **The Controlled Oral Word Association Test (COWA) (Benton & Benton, 1981):** Requires the examinee to verbally recite as many names of a certain semantic or phonemic category. The examiner types the examinee's responses into the software. It will also record the examinee's voice for later replay and typing<sup>13</sup>.
- **Cambridge Neuropsychological Test Automated Battery (CANTAB, Downes et al., 2004):** This automated test battery is a simple flexible and easy to administer cognitive assessment tool on windows based PC system. It includes language independent tests and touch screen technology that deliver

rapid and non-invasive cognitive assessment<sup>14</sup>.

### Neuro-Rehabilitation in Epilepsy

In earlier times the interest of neuropsychologist was limited to few areas like assessment and diagnostic clarification. Later during the 1980s there was increasing interest in the application of neuropsychological knowledge to aid rehabilitation. Neuropsychological rehabilitation is a systematic, goal-oriented treatment program aimed at improving cognitive functions and to increase the level of self-management and independence after brain damage. The primary goal of neuropsychological rehabilitation is to restore the patient to premorbid level of functioning to the extent possible. And if the primary goal is not achieved or difficult to attain then the secondary goal would be to make the patient capable of continuing with family and social responsibility to the extent possible. Some of the earlier approaches to neuro-rehabilitation are described here:-

**Early Approaches to Neuro-rehabilitation:** Goldstein and Ruthven (1983) proposed behaviour therapy as way of managing cognitive deficits<sup>15</sup>. In which patients were treated by training discrete behaviours related to the cognitive areas of memory, perceptual ability, language and motor skills. Token economy served as a supplementary strategy for motivating the patient to continue the program.

### Neuro-rehabilitation in Specific Impairments

**Attention:** Attention deficits can be problems in sustaining attention, concentrating and in working memory. Recent development in the field of neurorehabilitation is the use of computer, which found systematic and at times more effective than the traditional way of interventions. There are a number of computer packages emerged during 1990s but its effectiveness are still under study in the field of neuro-rehabilitation. One such package was developed<sup>16</sup>. This package includes reaction time task, digit symbol translation and colour word Stroop test which found useful in improving attention. Another package named AINXTENT is also currently in use, include paradigms for improving alertness, sustaining attention, selective attention and divided attention in clinical setting<sup>17</sup>. A

modified version of<sup>18</sup> task by the use of environmental cues to enhance attention is also developed<sup>19</sup>.

**Memory:** The principle goal of neuro-rehabilitation for memory is to their day to day live events by improving their learning and memory. Cognitive retraining lacks effectiveness in the rehabilitation of memory though it is considered as part and parcel of any cognitive rehabilitation<sup>20</sup>. Both vanishing Cues and Errorless Learning techniques used for the rehabilitation of memory are based on behavioural principles. Vanishing cue technique<sup>21</sup> is a kind of backward chaining method where whole information initially provided to learn and gradually withdraws the letters. Errorless learning, which was used initially for learning disabilities, appeared recently in the process of rehabilitation of people with acquired neurological impairment. This program has been found to be effective in teaching the patients their real life task<sup>22</sup>. Kaloiya et al (2015) found cognitive retraining was effective when tasks given from patient's real life which are used in their day to day activities<sup>23</sup>.

## Conclusion

Epilepsy can affect anyone in human life, although it tends to be more common in children and the elderly. Epilepsy is still misunderstood in our society. This makes things more difficult for the many people who live with it, and their family and friends. You can help by learning the facts.

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