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A Method for Seizure Duration Estimation from Single Channel EEG Records

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Abstract

EEG seizure end point was defined as the occurrence of last spike on the EEG. Seizure EEG records, one from each of 19 patients receiving ECT were selected for the present exercise. Two raters independently estimated the seizure duration, from the end of stimulus toend of seizure as defined. The correlation between the two raters was significant (Pearson's 'r'=0.9831, $p < 0.001$). Motor seizure estimates to which raters were blind correlated significantly ($p < 0.05$) with the EEG seizure duration for both the raters (r=0.5471 and r=0.5195).

Key words -
Electroconvulsive therapy,
EEG seizure duration,
Interrater reliability

Seizure is the essential therapeutic component of ECT [1]. EEG monitoring during ECT has been recommended to ascertain occurrence of a seizure when muscle relaxants modify the peripheral convulsions [2]. Adequacy of a seizure during ECT is defined by its duration, i.e. 25 seconds of EEG seizure is considered adequate [3]. Seizure duration estimates from single EEG channel have variable reliability. Some studies report good interrater reliability [4], [5], whereas others report poor reliability [6], [7].

A universally agreed definition to identify seizure end point is lacking. Thus there are multiple approaches. Abrupt termination of large electrical discharges followed by a flat line helps in precise identification of seizure end point, but such termination occurs only in 40% of records [8]. Warmflash et al [4] defined the seizure end point as the mid point between the end of unequivocal seizure and the onset of unequivocal no seizure. McCreadie et al [2] defined the end point on the basis of the beginning of a flat line and in its absence, as the point of last spike.

During a seizure spikes are necessary and unequivocal indices of a seizure. Standard definition of a spike is available [9]. The last spike identified can hence be defined as the end point of a seizure. This study examined the interrater reliability of seizure duration estimates using this definition.

Material and Methods

Nineteen consenting depressive subjects receiving ECT formed the sample of this study. Bilateral sine wave ECT was administered using a device designed indigenously [10].Thiopentone (250 mg), succinylcholine (30-40 mg) and atropine (1.3 mg) were used intravenously for modification. Peripheral seizure was monitored on the cuffed forearm [11]. The sine wave ECT device was coupled to MECTA Model D for recording EEG during ECT. Single channel EEG recording (vertex referenced to right mastoid with ground on forehead) was obtained.

End of the seizure was defined as the occurrence of last spike. A spike was recognised on the post-stimulus EEG if a waveform transient met the following criteria [9],

(a) a surface negativity,
(b) a width of 70 m sec or less at zero crossings,
(c) a sharp apex and
(d) an amplitude twice or more of background (prestimulus EEG).

EEG seizure duration was estimated from the start of EEG recording following stimulus to the last spike so recognised. The same was approximated to the nearest 0.5 secs.

Ratings were done by two psychiatrists not involved in the ECT procedures (K.M.J. & B.L.S) The raters were initially trained to estimate the seizure duration from the sample records not used in this study. The raters conducted the estimates independently of each other and without any clinical information of the records.

Results

The correlation between the two raters on the EEG seizure duration estimates was significant (Pearson's $r=0.9831$, $p < 0.001$).The two raters differed by less than 5 seconds on all but three records. The raters estimates of seizure duration (secs) on the EEG records were as follows:

In one patient motorseizure on cuffed arm was not noticed during ECT and hence motor seizure duration was available for 18 records. The motor seizure duration was correlated with the EEG seizure duration estimates of both raters in these 18 records. EEG seizure duration correlated significantly with the motor seizure duration for both raters. (rater 1, $'r'=0.5471$, $p < 0.05$ and rater 2, $'r'=0.5195$ $p < 0.05$). Fisher's 'Z' transformation was used on the correlation co-efficient between motor and EEG seizure duration of each rater; the co-efficient of the two raters did not significantly differ ($t=0.06$, $p > 0.05$).

Discussion

Earlier definitions of seizure end point have limitations.The definition by Warmflash et al [4] is still subjective with no criteria for identifying the two points (i. e. end of unequivocal seizure and the start of no seizure). It is possible that the seizure duration may be over-estimated by using this definition. The approach by McCreadie et al [2] is an improvement in defining the seizure end point. The authors

laid down criteria for identifying seizure end point by way of recognising flat line or the last spike. However, it still has the disadvantage of applying one criterion on some occasions and another criterion on other occasions.

Spikes during a seizure are unequivocal indices of seizures. Standard definition of spike is available and identification of last spike would allow estimation of the duration of unequivocal seizure. The interrater reliability using this definition in the present study was high (r=0.9831). The seizure duration estimates of each of the raters by this definition has significant correlation ($p < 0.05$) with the motor seizure duration. This may be regarded as partial validation of this definition.

The raters were blind to the motor seizure duration estimates, unlike in the studies by Ries et al [6] and Guze et al [7] thus eliminating possible bias.

The bifrontal electrodes were not used in this study as the EEG recordings are susceptible to contamination by electromyographic and eye movement artifacts [7] thus eliminating possible bias.

The bifrontal electrodes were not used in this study as the EEG recordings are susceptible to contamination by electromyographic and eye movement artifacts [7], although most studies have adopted this procedure [4], [5], [7]. Therefore, this study used the vertex and right mastoid electrodes for EEG recording.

The reliability of this definition to measure seizure duration when ECT is unilateral and/or with brief pulse stimulus remains to be examined.

In summary, reliable estimates of seizure duration from single channel EEG records are possible. The identification of last spike can be a reliable strategy for seizure duration estimation. The seizure duration estimated by this definition significantly correlated with motor seizure duration, thus partially validating the method.

1.Ottoson J O, Electro-convulsive therapy of endogenous depression: analysis of the influence of various factor on the efficacy of the therapy
Journal of Mental Sciences Page: 108: 694-703, 1960

2.McCreadie R G, Phillips K, Robinson A D T, Gilhooly G & Crombie W, Is electrocephalographic monitoring of electroconvulsive therapy clinically useful?
British Journal of Psychiatry Page: 154: 229-231, 1989

3.Freeman C, Crammer J L, Deakin J F W, McClelland R, Mann S A & Pippard J, *The Practical Administration of Electro-convulsive Therapy. London, Gaskell*1989

4.Warmflash V L, Stricks L, Sackeim H A, Decina P, Neely P & Malitz S, Reliability and validity of measures of seizure duration
Convulsive Therapy Page: 3 (1): 18-25, 1987

5.Kramer B A, Pollock V E, Schneider S L & Gray E G, Interrater reliability of MECTA SR-1 seizure duration
Biological Psychiatry Page: 25: 42-644, 1989

6.Ries K Richard, Poor interrater reliability of MECTA EEG seizure duration measurement during ECT
Biological Psychiatry Page: 20: 94-98, 1985

7.Guze H B, Liston H L, Baxter L R, Richeimer S H & Gold M E, Poor interrater reliability of Mecta EEG recordings of eCT seizure duration
Journal of Clinical Psychiatry Page: 50: 140-142, 1989

8.Fink M & Johnson L, Monitoring the duration of electroconvulsive therapy seizures
Cuff and EEG Methods Compared Page: 39: 1189-1191, 1982

9.Ktonas P Y, Automated spike and sharp wave (SSW) detection
In: A S Gerins and A Remond. (Eds): Methods of Analysis of Brain Electrical and Magnetic Signals. E Page: 211-241, 1987
10.Gangadhar B N, Lakshmanna G, Andrade C, Janakiramaiah N & Channabasavanna S M, The NIMHANS model ECT instrument: A technical report
Indian Journal of Psychiatry Page: 30: 247-251, 1988
11.Jain S, Seshadri S & Gangadhar B N, [Monitoring seizure during ECT]
NIMHANS Journal Page: 7: 115-117, 1989