

Is there any relationship between propofol induction dose and duration of seizure for repetitive electroconvulsive therapies?

Tekrarlanan elektrokonvulsif tedavilerde propofol indüksiyon dozu ve nöbet süresi arasında ilişki var mıdır?

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Abstract

Aim: Anesthetic agents have been used during electroconvulsive therapy for years, but selecting the agent remains a challenge. Anesthetics may play a negative role on seizure duration, which directly affects the success of the treatment. This study is designed to see the relationship of repetitive sessions, anesthetic dose, and seizure duration.

Methods: A total of 73 ECT treatments for 11 patients were evaluated for this prospective-cohort study. After premedication, propofol was administered slowly until the patient lost eyelash reflex. The duration of the seizure, propofol dose administered, and the time between the end of the procedure and full recovery (as decided by Aldrete score) were recorded.

Results: The mean seizure time was 25.5 (10.2) seconds. There was a statistically significant correlation between seizure duration, the number of sessions and propofol dose, and no correlation between the time to reach an Aldrete score of 10 and both the number of sessions and propofol dosing.

Conclusion: An increased propofol dosage may be needed during ECT as the number of session increases, but this increase does not affect recovery time.

Keywords: Electroconvulsive therapy, Propofol, Seizure

Öz

Amaç: Elektrokonvulsif tedavi için yıllardır anestezi ajanları kullanılmaktadır, ancak ajanın seçiminde bir zorluk vardır. Anestezikler, tedavinin başarısını doğrudan etkileyen nöbet süresi üzerinde olumsuz rol oynayabilir. Bu noktada, bu çalışma tekrarlayan seanslarda anestezi doz ve nöbet süresi arasındaki ilişkiyi görmek için tasarlanmıştır.

Yöntemler: Bu prospektif-kohort çalışmada toplam 11 hasta, 73 EKT tedavisi değerlendirildi. Premedikasyondan sonra, hastanın kırpık refleksi kaybolana dek yavaş yavaş propofol uygulandı. Nöbet süresi, uygulanan propofol dozu kaydedildi. İşlemin bitimi ile tam derlenme (Aldrete skoru ile karar verildi) arasındaki süre de kaydedildi.

Bulgular: Ortalama nöbet süresi 25,5 (10,2) saniye idi. Nöbet süresi, seans sayısı ve propofol dozu arasında istatistiksel olarak anlamlı bir korelasyon vardı. Aldrete skoru 10'a ulaşma süresi ile seans sayısı ve propofol dozu arasında korelasyon saptanmadı.

Sonuç: Seans sayısı arttıkça EKT sırasında artmış bir propofol dozu gerekebilir, ancak bu artış iyileşme süresini etkilemediği görülmüştür.

Anahtar kelimeler: Elektrokonvulsif tedavi, Propofol, Nöbet

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Introduction

Electroconvulsive therapy (ECT) is a valuable option in the treatment of many psychiatric disorders. The procedure is performed following the administration of short-term general anesthesia using a neuromuscular-blocking agent by placing two electrodes on the temples and/or the forehead of the patient and delivering electrical pulses between the electrodes in order to induce a generalized convulsion [1].

Anesthetics have been used during ECT since the 1950s. The anesthesia is used to avoid unpleasant feelings that the patient may have during convulsion inducement [2]. No guidelines exist for the strategies regarding choice, and potential switching of narcotic agents throughout a course of ECT. While choosing the agent, it is suggested to consider a patient's individual risk factor profile, co-existing diseases, and concomitant medication [3]. Currently, propofol is one of the most favorable anesthetic agents used during ECT due to its rapid recovery and minor hemodynamic effects, however, little is known about its long-term usage in ECT patients [4].

This study is designed to evaluate the effect of repeated ECTs on propofol induction dose, seizure time and recovery parameters within the treatment period of patients undergoing ECT.

Materials and methods

Eleven patients who were scheduled for ECT treatment for depression (n=5) and schizophrenia with depression (n=6) were included this study. A total of 73 ECT treatments were evaluated after Institutional Ethics Committee approval (Ankara University Ethic Committee, 14835) and written informed consent forms were obtained. The study was performed in accordance with the most recent version of the Helsinki Declaration.

Exclusion criteria

The exclusion criteria for this study included (1) presence of any serious concomitant diseases, such as cardiovascular disease, cerebrovascular disorders, intracranial hypertension, respiratory tract diseases, or severe fractures, (2) presence of hypertension, glaucoma, arterial aneurysm, or cerebrovascular malformation, (3) presence of a foreign body, such as a pacemaker, intracranial electrode, or clips, (4) positive seizure history, (5) history of substance abuse or dependence, including alcohol abuse, (6) ASA IV–V status, (7) history of serious adverse effects related to anesthetics (8) coexistence of a mental disorder other than major depression, such as dementia and bipolar disorder, and (9) pregnancy.

Anesthesia and ECT administration

All chronic antidepressant medication was continued. After premedication with intravenous atropine sulfate (0.25 mg), propofol was administered slowly until the patient showed loss of the eyelash reflex. Then, succinylcholine, 1 mg/kg, was administered. Ventilation was assisted with 100 % oxygen in all patients during the procedure. The duration of the seizure and the administered propofol dose were recorded. After the procedure, the patient was awakened and followed-up during recovery until Aldrete score reached 10. The time between the end of the

procedure and full recovery (as decided by Aldrete score) were also noted.

The seizure threshold was determined according to half-age method (% energy=half the age [5]). A suprathreshold electrical stimulus was given via bifrontotemporal electrodes with a Thymatron System IV, ECT Instrument (Somatics, Lake Bluff, IL, USA). EEG electrodes were placed on the mastoid processes, and frontal leads were placed bilaterally on the midforehead directly above the eyes to allow two-channel (bihemispheric) recordings. Recording gain was set according to the manufacturer's recommendations. The duration of the motor seizure was defined as the time from the ECT stimulus to cessation of tonic–clonic motor activity in the 'isolated' arm.

All treatments were administered using the Thymatron System IV (Somatics, LLC, Lake Bluff, Ill; maximum energy 200%, 1008 mC, stimulus frequency 1 m/s) after induction with propofol, with the dosage determined by the anesthesiologist. The delivery of the electrical stimulus was bilateral. Stimulus dose titration was used to establish individual seizure thresholds. The dosage was set at 1.5 times the seizure threshold for bilateral treatment and at 6 times the seizure threshold for unilateral treatment. Dosage was adjusted during ECT to maintain a seizure duration of at least 20 seconds as measured with the cuff method, or 25 seconds on the electroencephalogram (EEG). An adequate seizure was defined as seizure duration of at least 20 seconds as measured with the cuff method, or 25 seconds on the EEG [6].

Statistical analysis

Statistical analysis was performed using SPSS for Windows, version 11.5 (SPSS, Chicago, IL, USA). Distribution of continuous variables was analyzed with the one-sample Kolmogorov–Smirnov test, and all data were distributed normally. Comparisons among groups with respect to seizure duration and recovery parameters were evaluated using one-way analysis of variance (ANOVA) with the Bonferroni post hoc test. Repeated ANOVA with Bonferroni post hoc tests were used to compare baseline and follow-up HR and MAP measurements. Side effects among groups were evaluated using the Chi square test. A two tailed *P*-value of 0.05 was considered statistically significant. The results were expressed as mean (SD). Power calculations based on a pilot study with 10 patients were used to detect a significant difference in the seizure duration ($\alpha=0.05$, power=0.80).

Results

Eleven patients were enrolled in the study and received a total of 73 sessions of ECT. The demographic and clinical characteristics are summarized in Table 1 and 2. The mean age was 37.2 years. Most of the patients were male (n: 9, 81.8%). The mean seizure time was 25.5 (10.2) minutes, with a minimum of 7 and maximum of 54 minutes. The patients had at least 1 and at most 15 sessions of ECT.

There was a statistically significant correlation between seizure duration and the number of sessions as well as propofol dose ($P=0.020$, $P=0.027$, respectively). The mean increase in the number of sessions was 1 time for every 0.6 sec decrease in seizure duration (95% confidence interval [CI], 1.83; $P=0.05$). The mean increase in propofol dose was 1 mg per 0.08 sec

decrease in seizure duration (95% confidence interval [CI], 1.08; $P=0.05$).

The mean propofol dose of the total 73 sessions is 110.89 (28.3) mg. The propofol need increased with the number of sessions (Figure 1). The mean seizure duration was 25.5 (10.2) sec. The mean time passed to achieve the Aldrete score of 10 was 10.9 (4.8) min. The time passed to reach an Aldrete score of 10 and duration of seizure did not any increase with the number of sessions (Figure 2 and 3). The mean dose of all sessions, seizure duration and time passed to reach an Aldrete score of 10 are summarized in Table 3.

The correlations between the time to reach an Aldrete score of 10 and both the number of sessions and propofol dose were statistically insignificant with p values of 0.308 and 0.627, respectively. The number of sessions and propofol dose did not impact the time to reach an Aldrete score of 10. The correlation between seizure duration and the time to reach Aldrete score of 10 was statistically insignificant ($P=0.126$).

Table 1: Patient characteristics

Patient characteristics	
Age (years) mean (SD)	37.2 (16.3)
Gender (n)	M: 9 F: 2
Height (cm) (SD)	173.3 (6.1)
Weight (kg) (SD)	76.1 (7.4)
Diagnosis (n)	1:7 2:2 3:2

Table 2: Clinical characteristics of the patients

Clinical characteristics	mean (SD)	min-max
t seizure (sec)	25.5 (10.2)	7-54
sessions (n)	4.86 (3.3)	1-15
propofol dose	110.8 (28.3)	80-200
t Aldrete(min)	10.95 (4.84)	5-20

Table 3: The propofol dosage (in mg), seizure duration (in sec), time to reach an Aldrete score of 10 (in min) according to the sessions

sessions	N of patients	Propofol dose(mg)	Seizure duration(sec)	T Aldrete (min)
		Mean (SD)	Mean (SD)	Mean (SD)
1	11	114.55(35)	28.2 (13.9)	11.6 (5)
2	11	105.45 (0.7)	32.6 (13.4)	12.2 (4.4)
3	10	109.5 (29.4)	22.2 (8.4)	11 (5.3)
4	8	110 (32)	23 (5.5)	11.1 (5)
5	7	101.43 (18.6)	27.2 (7.6)	9.4 (4.7)
6	5	112 (30.3)	26.6 (8.8)	9 (5.1)
7	5	106 (24)	25.4 (10.9)	10.6 (5.7)
8	5	114 (36.4)	18.2 (6.4)	12.8 (6)
9	5	108 (27.7)	24 (7.8)	12 (5.8)
10	1	120	27	9
11	1	120	14	8
12	1	130	12	7
13	1	140	30	6
14	1	150	21	8
15	1	130	23	11
Total	73	110.8 (8.3)	25.5 (10.2)	10.9 (4.8)

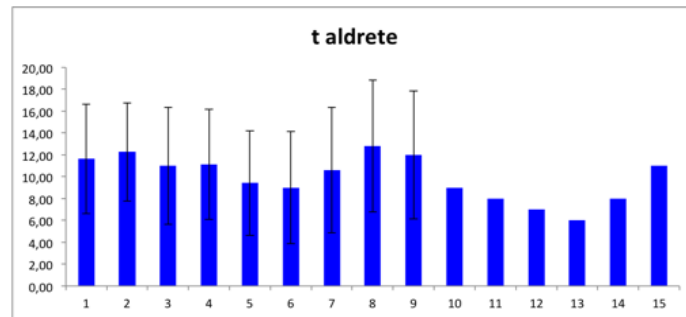


Figure 3: Time spent until reaching an Aldrete score of 10, according to the sessions (X axis: time until reaching Aldrete score of 10 in minutes, Y axis: number of sessions)

Discussion

This study was designed to investigate the relationship between repetitive ECT therapies, seizure duration and recovery time, as measured by the Aldrete score. The results of the study showed that there are statistically significant but weak negative correlations between propofol dose and both seizure duration and number of sessions. According to our results, the number of sessions and propofol dose does not affect recovery time, and there was no significant correlation between seizure duration and recovery time.

Electroconvulsive therapy is an alternative treatment for many psychiatric disorders. The aim of the procedure is to induce cerebral seizures, which may lead to changes in drugs' pharmacokinetics. Anesthesia has been used for electroconvulsive therapy since the 1950s. Many anesthetic agents have been compared to find the best option. Propofol seems to be most popular one in current clinical use with the advantages of decreased risk of hypertension and tachycardia, as well as faster recovery from anesthesia. However, there are challenges regarding correct dosage, duration of seizure and recovery with these patients. Data on cognitive functioning, although limited, generally indicate no reduction in cognition related to propofol use [7].

The anticonvulsant properties of certain anesthetic agents have repeatedly been shown to negatively impact seizure parameters [8-11]. This study also showed comparable results to the literature.

Many alternative methods like hyperventilation, using low dose of anesthetics and a combination of anesthetics have been assessed to prolong the duration of seizure [12]. In this study, we tried to find the optimal dose of propofol when used alone. There are studies regarding exceptionally low doses of propofol (0.75-1 mg/kg), but the current study used higher doses for loss of eyelash reflex [8].

The effectiveness of the procedure depends on duration of the seizure. When compared with other anesthetic agents, propofol seems to achieve a shorter duration of seizure, but questions remain about the efficacy of the treatment. The duration of the seizure may be related to the dose of propofol because of its antiepileptic properties. The findings of this study conclude that increase in propofol dose results in a decrease in seizure duration as expected. As the number of the sessions increase, so does the need for higher doses of propofol.

Another critical issue is the rapid and full recovery from anesthesia after ECT. Anesthetic agents used for ECT have long been evaluated from this perspective. When compared with other

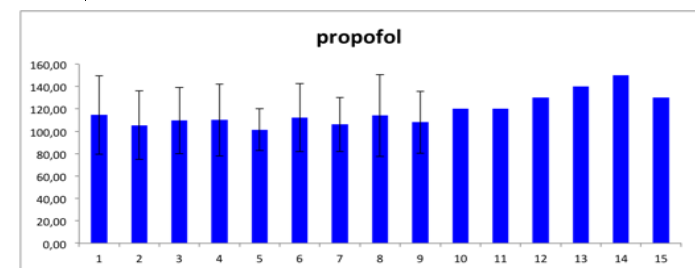


Figure 1: Propofol dosage according to the sessions (X axis: propofol dose, Y axis: number of sessions)

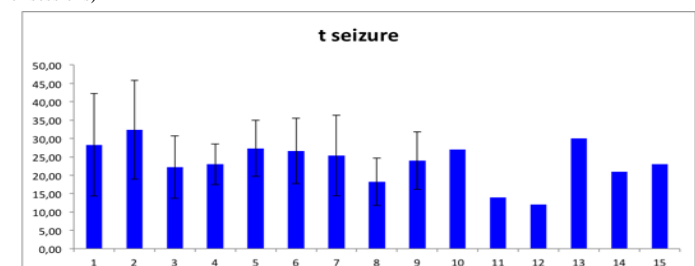


Figure 2: Seizure duration according to the number of sessions (X axis: seizure duration in seconds, Y axis: number of session)

agents, propofol has many advantages including rapid recovery [7]. As the propofol dose increases with increasing sessions, the effect on recovery becomes questionable. There is no positive relationship between recovery time and both propofol dosage and number of sessions.

Limitations

The limitation of the study is the absence of anesthetic depth monitoring, such as bispectral index monitoring (BIS) or entropy. The use of BIS or entropy during the ECT procedure would yield more accurate results regarding the dose of propofol.

Conclusion

Propofol is a suitable alternative as an anesthetic agent in the ECT procedure. An increased propofol dosage may be needed during ECT as the number of sessions increases, but this increase does not affect recovery time. The best maintenance of satisfactory and suitable anesthesia for ECT should utilize the guidance of anesthetic depth monitoring.

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