Eur Arch Psychiatry Clin Neurosci (2008) 258:319–323 DOI 10.1007/s00406-007-0798-z

ORIGINAL PAPER

Emin Önder · Ümit Tural · Mehmet Gökbakan

# Does gabapentin lead to early symptom improvement in obsessive-compulsive disorder?

Received: 6 August 2007 / Accepted: 19 November 2007 / Published online: 23 February 2008

**Abstract** *Objective* The aim of this study was to compare efficacy of fluoxetine alone and co-administration of gabapentin and fluoxetine in patients with obsessive compulsive disorder (OCD). *Methods* Forty outpatients with a DSM-IV diagnosis of OCD were randomized to open label treatment, 20 of whom were treated with fluoxetine alone and the remaining 20 with fluoxetine plus gabapentin during 8 weeks. The severity was assessed by Yale-Brown Obsessive Compulsive Scale (Y-BOCS) and Clinical Global Impression (CGI). *Results* Final CGI-I and Y-BOCS scores were not significantly different in both groups. However, in repeated measures ANOVA, compared to fluoxetine group, we found significantly a better improvement in the fluoxetine plus gabapentin group at week 2 by means of YBOCS and CGI-I scores. Comparisons on weeks 4, 6 and 8 revealed no statistical differences between the groups. There was no significant difference of adverse effects between two groups. *Conclusions* Adding gabapentin to fluoxetine in the treatment of OCD seems to shorten the time to onset of fluoxetine's anti-obsessive effect without a significant increase in adverse effects. In order to accelerate the clinical response, co-administration of fluoxetine and gabapentin may be a preferable strategy. On the other hand, further controlled studies are needed to support this finding.

**Key words** OCD · fluoxetine · gabapentin · co-administration

This study was done at Kocaeli University.

E. Önder · Ü. Tural (✉) · M. Gökbakan
Department of Psychiatry
Medical Faculty of Kocaeli University
Kocaeli, Turkey
Tel.: +90-262/3037508
Fax: +90-262/3037003
E-Mail: turalu@kou.edu.tr

## Introduction

Obsessive-compulsive disorder (OCD) is a disabling disorder with a chronic course. The lifetime prevalence of OCD was reported in a range of 2.5–6.2%, and 12-month prevalence was 0.5–5.6% in general population [7, 12, 13, 24]. Serotonin reuptake inhibitors (SRIs), and cognitive-behavioral therapy (CBT) have been widely used with success in the treatment of OCD. Clinical interventions commonly used for the treatment of OCD provide symptom improvement in about 40–60% of patients with OCD; however, there are a considerable number of patients in whom enough symptom reduction (20–40%) cannot be obtained [20]. Despite recent therapeutic approaches that have made the therapists more optimistic about prognosis of this disorder, there is, again, a considerable amount of patients who do not respond to treatment [32]. Moreover, OCD responds slowly to pharmacotherapy, improvements are generally reached in weeks and months [36]. In the case of insufficient response to medication, clinician should first prefer to increase the dose of the drug actually chosen, and a second option may be co-administration of another drug.

Gabapentin was demonstrated to have an anxiolytic-like action by preclinical [10, 33] and clinical [29] studies. However, gabapentin's exact mechanism of action is not completely understood. Gabapentin does not possess a high affinity for either $GABA_A$ or $GABA_B$ receptors, nor does it influence neural uptake of GABA or inhibit GABA-metabolizing enzyme transaminase [2, 15]. Preclinical studies put forth a possible role for the glycine/*N*-methyl-D-aspartate receptor in gabapentin's mechanism of action [33, 34]. There are also reports proposing other modes of action such as binding at the $\alpha_2$ subunit of a calcium channel [2, 15] or enhancing non-vesicular release of GABA [18]. It seems that GABAergic and glutamatergic systems are involved in gabapentin's mechanisms of action.

Clinical evidence also suggests a potential utility of gabapentin in anxiety disorders [3, 4, 29, 30]. There are double-blind placebo-controlled trials in which effectiveness of gabapentin in panic disorder and social phobia was proven [11, 28, 29]. In anxiety disorders, various neurotransmitter systems such as dopamine, norepinephrine, $\gamma$-amino butyric acid (GABA)-benzodiazepine (BZD) receptor complex, and serotonin (5-HT) are involved [22]. On the other hand, it is known that glutamatergic system is involved in the neurochemical disturbances that exist in OCD [1, 6, 27, 31], and there was a reciprocal relation between glutamatergic and GABAergic systems [2, 15, 33, 34].

The interaction between glutamatergic and GABAergic systems has been considered to improve the symptoms of OCD, and gabapentin has been shown to be efficient in reducing the symptoms of anxiety; therefore, we thought that gabapentin might be useful in the treatment of OCD as add-on medication. The aim of this study is to determine whether the add-on of fluoxetine with gabapentin is effective enough to consider this option in the pharmacological treatment of OCD.

## Methods

### Subjects

Forty patients (20 male and 20 female, aged between 18 and 60 years) with OCD according to DSM-IV using Structured Clinical Interview for DSM-IV, Clinical Version (SCID-I) were included in the study. All the patients were recruited from University Medical Faculty Psychiatry Department's outpatient clinic. After detailed explanation about the study, informed consent was obtained. The inventories were rated by the authors EO, UT, MG. Physical examination, routine blood and urine tests and electrocardiogram were carried out. After evaluation, only patients with normal results were included in the study. Exclusion criteria were determined as follows: medical or neurological illnesses, pregnancy, breastfeeding, substance abuse within 1 year, lifetime history of substance dependence (except nicotine), comorbid current psychiatric disorder and suicidal ideation. Computer based randomization procedure was used. No further effort was made to balance the samples, for example according to duration or severity of OCD, during randomization process.

### Assessment tools

Yale-Brown Obsession-Compulsion Scale (Y-BOCS): it is used to detect the character and severity of obsessive-compulsive symptom, and consists of two parts [16]. Questions 1–5 evaluate severity of obsessions; questions 6–10 evaluate severity of compulsions. Validity and reliability for Turkish language is available [23].

Structured Clinical Interview for DSM-IV, Clinical Version (SCID-I): It is used to detect DSM-IV Axis I diagnosis [14]. SCID-I consists of six modules, explores 38 DSM-IV Axis I disorder with diagnostic criteria and ten DSM-IV Axis I disorder without diagnostic criteria. Adaptation for Turkish language is available [8].

Clinical Global Impression (CGI): it is used to rate the severity of illness, improvement and side effects of the treatment [17]. The severity of psychiatric symptoms was clinically assessed by means of the CGI-S that gives a score ranging from 1 (disease-free) to 7 (greatest severity possible) at the baseline. Clinical response was evaluated using Clinical Global Impression of Improvement (CGI-I). Symptoms were clinically assessed by means of the CGI-I that gives a score ranging from 1 (disease-free) to 7 (greatest improvement possible). Drug side effects were evaluated by CGI-SE ranging from 1 to 4 with the statements as follows: 1-absent, 2-no important influence on functioning of the patient, 3-important influence on functioning of the patient, 4-important influence to ignore benefits of therapeutic effect.

### Treatment

This study was designed as an 8-week, randomized, open-label trial in which efficacy of fluoxetine alone and efficacy of fluoxetine plus gabapentin treatments of OCD were compared. At each assessment, adverse events were recorded (including onset, duration, and severity). These were detected effects by observation, examination or could be reported by the patient either spontaneously or in response to the open question: "Do you feel different in any way since starting the treatment or since the last visit?" Multiple episodes of the same complaint were counted only once, although the greatest level of severity was rated. Each subject was aware of her/his treatment and specific expected side effects.

Additional psychotropic medication or treatment was prohibited, but the use of alprazolam for the night-time sleeping was allowed if needed. No structured psychotherapeutic intervention was performed. After the baseline assessment, other assessments were performed at the end of weeks 2, 4, and 8 using the Y-BOCS and CGI improvement item. There was no drop-out due to drug adverse events during whole study period. However, four patients from the fluoxetine group and five from the fluoxetine plus gabapentin group were lost during follow-up due to unknown reasons. Twenty mg of fluoxetine was given orally as a single dose in the morning (9 a.m.). Gabapentin was given 150 mg four times daily. In the case of no response to the medication at week 4, drug dosages were increased as follows: fluoxetine increased to 40 mg or 60 mg/day, gabapentin to 900 mg/day.

### Analyses

Differences between continuous variables were assessed using unpaired $t$ tests or Mann–Whitney test depending on their distribution properties. Those between categorical variables were assessed using Pearson chi-square test with Yates' correction for all $2 \times 2$ tables. Fisher's Exact Test was used instead of Pearson chi Square test when the cells' expected count was less than 5. Group differences in Y-BOCS and CGI-I scores, collected over four consecutive measurements, were the main outputs of the study, and were analyzed with repeated measures ANOVA (one between subjects, one within subjects). Box's test of equality of covariance matrices for multivariate approach and Levene's test of equality of error variances for testing between subjects effects were evaluated to see whether the assumptions of the statistical tests were met or not. Multivariate tests were used to evaluate the effects of time and time by group interaction for group differences in repeated measures at first. If significant differences were found then univariate comparisons were evaluated in terms of within subjects and between subjects effects. Type III sum of squares was used in the statistical models. A response to the treatment was defined as 35% or more drop in Y-BOCS scores. Response rates were compared between the groups at the endpoint. All $p$ values were two-tailed, and statistical significance was set at the 5% level. All analyses were performed on ITT and LOCF principles. Statistical assessments were performed by SPSS for Windows version 12.0.

## Results

There were 11 women and 9 men in the fluoxetine group, ten women and ten men in the fluoxetine plus

gabapentin group. There was no difference in sex ($\chi^2 < 0.0005$, $df = 1$, $P = 1.000$), age (for flx alone group mean = 31.75 ± 11.27, for fluoxetine plus gabapentin group mean = 34.60 ± 10.96; $t = -0.811$, $df = 38$, $P = 0.422$) or fluoxetine dose (for fluoxetine alone group mean = 38.00 ± 8.94, for fluoxetine plus gabapentin group mean = 39.00 ± 10.21; $t = -0.330$, $df = 38$, $P = 0.744$) between fluoxetine and fluoxetine plus gabapentin groups. Mean gabapentin dose was 735.00 ± 153.12. Similarly, we did not observe significant difference in baseline mean scores of final Y-BOCS (for fluoxetine alone group mean = 21.80 ± 5.98, for fluoxetine plus gabapentin group mean = 23.60 ± 8.92; $t = -0.749$, $df = 38$, $P = 0.458$) or mean scores of CGI-S (for flx alone group mean = 4.35 ± 0.93, for flx + gbp group mean = 4.60 ± 0.88; Mann–Whitney $U = 170.50$, $z = -0.0841$, $P = 0.400$) between two groups.

Twelve patients (60%) reported adverse effects of the treatment in fluoxetine alone group; six patients reported an increase in anxiety symptoms, five reported headache, two reported nausea, and three reported insomnia. Fifteen patients (75%) reported adverse effects of the treatment in fluoxetine plus gabapentin group; seven patients suffered from sedation, four from dizziness, four from dry mouth, two from gastrointestinal discomfort (Table 1). There were no drop-outs because of adverse effects.

Multivariate tests on Y-BOCS scores showed that there were significant main effect for time (Wilks' $\lambda = 0.144$, $F_{(3, 36)} = 71.202$, $P < 0.0005$, eta$^2 = 0.856$) and time by group (Wilks' $\lambda = 0.745$, $F_{(3, 36)} = 4.111$, $P = 0.013$, eta$^2 = 0.255$). Contrast analyses revealed that time by group interaction was significantly different only at week 2 in favor of flx + gbp group ($F_{(1, 38)} = 11.528$, $P = 0.002$, eta$^2 = 0.233$), but not at week 4, and 8 in terms of Y-BOCS scores (Fig. 1). The main effect of between subjects (group) was not significant ($F_{(1, 37)} = 0.040$, $P = 0.843$, eta$^2 = 0.001$). In the analysis of CGI-I scores, again, we found a significant difference in both main effect of time (Wilks' $\lambda = 0.079$, $F_{(3, 36)} = 140.781$, $P < 0.0005$, eta$^2 = 0.921$) and a time by group interaction (Wilks' $\lambda = 0.772$, $F_{(3, 36)} = 3.546$, $P = 0.024$, eta$^2 = 0.228$) using multivariate tests. Contrast analyses revealed that time by group interaction was significantly different only at week 2 in favor of fluoxetine plus gabapentin group ($F_{(1, 38)} = 7.435$, $P = 0.010$, eta$^2 = 0.164$), but not at week 4, and 8 in terms of CGI-I scores. The main effect of between subjects (group) was not significant ($F_{(1, 38)} = 2.612$, $P = 0.114$, eta$^2 = 0.064$). At the endpoint analyses, there were no significant differences between the fluoxetine alone and fluoxetine plus gabapentin groups in either CGI-I scores or the treatment response rates as well as Y-BOCS scores at the end point (Table 1). Again, Mann–Whitney test revealed that there was no difference in CGI-SE between two groups (Table 1).

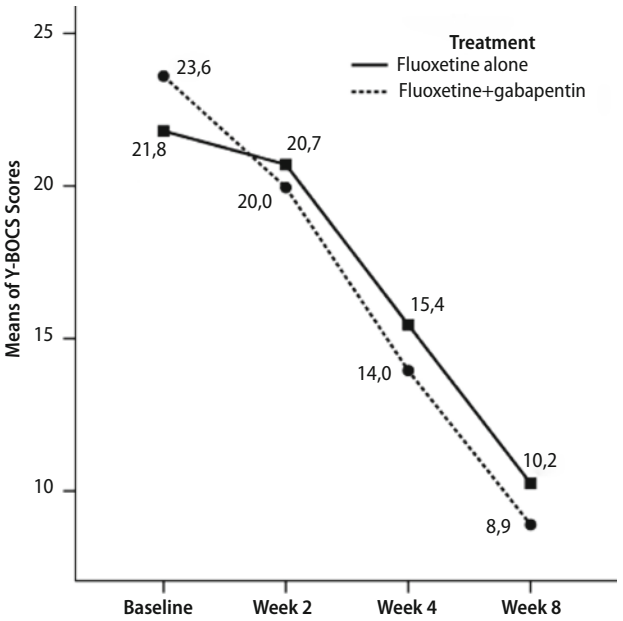


**Fig. 1** Changes in the Y-BOCS scores throughout the study

## Discussion

We observed an improvement in OCD symptoms with both treatment options (fluoxetine alone or fluoxetine plus gabapentin co-administration). However, fluoxetine plus gabapentin group had a significantly greater decrease at the second week than fluoxetine group, as assessed with Y-BOCS and CGI-S, which means that decrease of symptom severity was accelerated by adding gabapentine on fluoxetine. Considering the whole study period, nevertheless, the study's results have not supported the superiority of gabapentin as add-on medication in comparison to fluoxetine alone in the treatment of OCD. It is known that OCD responds slowly to pharmacotherapy, and

**Table 1** End point comparisons between the groups

| | Flx alone group | Flx + gbp group | Statistic and *P* value |
|---|---|---|---|
| Y-BOCS score | 10.25 ± 7.55 | 8.90 ± 7.43 | $t = 0.570$, $df = 38$, $P = 0.572$ |
| CGI-I median score | 3 (45%) | 2 (45%) | Mann–Whitney $U = 146.500$, $z = -1.554$, $P = 0.120$ |
| CGI-SE median score | 2 (61%) | 2 (47%) | Mann–Whitney $U = 121.500$, $z = -1.655$, $P = 0.096$ |
| Frequency of side effects | 12 (60%) | 15 (75%) | $\chi^2 = 0.456$, $df = 1$, $P = 0.500$ |
| Use of alprozolam | 6 (30%) | 4 (20%) | $\chi^2 = 0.133$, $df = 1$, $P = 0.715$ |
| Response to treatment | $N = 13$ (65%) | $N = 18$ (90%) | Fisher's exact test, $P = 0.127$ |

*Flx* fluoxetine, *Flx + gbp* fluoxetine plus gabapentin

improvements are generally reached in weeks and months [32]. This latent period is generally not comfortable for the patient and it may damage the continuity of therapeutic relationship. As no significant increase of adverse effects was observed between two groups in the present study, adding gabapentin to fluoxetine might be a treatment option that accelerates the response without impairing compliance.

It is thought that glutamatergic system is strongly involved in the neurochemical disturbances that are present in OCD. In preclinical and neuroimaging studies, glutamatergic hyperactivity or increased concentration was observed in the increased regional brain metabolism associated with OCD [1, 6, 27, 31]. Moreover, following SRI treatment, a decrease in OCD symptom severity was associated with a decrease in caudate glutamatergic concentrations [31]. Neuroimaging studies identified increased blood flow, glucose metabolism and brain activity in the cortico-striothalamic (CST) network of individuals with OCD [1, 6]. As cerebral glucose metabolism and glutamatergic neurotransmission are known to be related [26], reduction in glutamatergic neurotransmission may attenuate the regional CST hyperactivity observed in patients with OCD and regulation of CST may be a critical tool for treatment [6]. Therefore, antiglutamatergic agents may be considered as a treatment strategy in order to enhance response to standard SRI treatment in OCD. Riluzole, a potent antiglutamatergic agent, which reduces glutamatergic neurotransmission in several ways, was shown to be efficacious in treatment-resistant OCD [6]. Therefore, one can think that a GABAergic agent does improve symptoms of OCD by modulating the glutamatergic system. In fact, the use of GABAergic anticonvulsants has yielded inconsistent results; there are positive results with gabapentin [4] and valproate series in OCD [5, 9]. Mixed results were observed in case series of carbamazepine [19, 21]. Adjunctive use of lamotrigine, an antiglutamatergic anticonvulsant agent, in the treatment of SRI resistant OCD was not found to be effective [25]. One of the agents, that enhances the activity of $GABA_A$ at non-BZD sites, blocks voltage-gated sodium channels, and directly inhibits glutamate action, is topiramate. The case series suggests some preliminary evidence that the addition of topiramate may be useful in treatment-resistant OCD [35].

It should be also noted that the present study is not without its limitations. The main limitation of our study is the lack of blindness. Authors were aware of patients' medication as well as patients. This could lead a bias, thus it might be producing an increased effect size. Second limitation to consider is the relatively small number of patients. Larger number of patients could give us more valuable results. Another limitation of our study is the fact that we did not use any anxiety scales. Although we used Y-BOCS to assess OCD, if we had applied Hamilton Anxiety Scale or Beck Anxiety Inventory, we could have obtained information about the patients' anxiety.

As mentioned in the results, we used a maximum gabapentin dose of 900 mg/day. The maximum gabapentin dose in this preliminary study can seem relatively low compared to the doses used in other anxiety disorders and epileptic disorders. We think that, in further studies a higher dose of gabapentin could lead not only to early symptom improvement but also to a better final outcome.

## Conclusions

Using certain anticonvulsants as anxiolytics is giving hope for the treatment of anxiety disorders; however, before determination of their role in these disorders, more large-scale, placebo controlled trials are needed clearly. From our experience, gabapentin, a new generation antiepileptic drug may be worth considering in the pharmacological treatment of OCD. The main advantage, as seen from the results of our study, is that gabapentin co-administration provides better improvement at the early phases of the treatment. The co-administration of fluoxetine and gabapentin, in this preliminary study, gives hope for planning controlled studies in the pharmacotherapy of treatment resistant OCD cases.

## References


1. Baxter LR (2001) Functional imaging of brain systems mediating obsessive-compulsive disorder. In: Charney DS, Nestler EJ, Bunny BS (eds) Neurobiology of mental illness. Oxford University Press, New York, pp 534–547
2. Brown JP, Gee NS (1998) Cloning and deletion mutagenesis of the $\alpha_2\delta$ calcium channel subunit from porcine cerebral cortex. J Biol Chem 273:25458–25465
3. Chouinard G, Beauclair L, Bélanger MC (1998) Gabapentin: long-term antianxiety and hypnotic effects in psychiatric patients with comorbid anxiety-related disorders (Letter). Can J Psychiatry 43:305
4. Cora-Locatelli G, Greenberg BD, Martin J, Murphy DL (1998) Gabapentin augmentation for fluoxetine-treated patients with obsessive-compulsive disorder (Letter). J Clin Psychiatry 59:480–481
5. Cora-Locatelli G, Greenberg BD, Martin J, Murphy DL (1998) Valproate monotherapy in an SRI-intolerant OCD patient. J Clin Psychiatry 59:82
6. Coric V, Taskiran S, Pittenger C, Wasylink S, Mathalon D, Valentine G, Saksa J, Wu YT, Gueorguieva R, Sanacora G, Malison RT, Krystal JH (2005) Riluzole augmentation in treatment-resistant obsessive-compulsive disorder: an open-label trial. Biol Psychiatry 58:424–428
7. Çilli AS, Telcioğlu M, Aşkın R, Kaya N, Bodur S, Kucur R (2004) 12 month prevalence of obsessive-compulsive disorder in Konya, Turkey. Compr Psychiatry 45:367–374
8. Çorapçıoğlu A, Aydemir Ö, Yıldız M, Danacı AE, Köroğlu E (1999) DSM-IV Eksen I bozuklukları için yapılandırılmış klinik görüşmenin Türkçe'ye uyarlanması güvenirlik çalışması. (Adaptation to Turkish and reliability of Structured Clinical Interview for DSM-IV, Axis I disorders). İlaç ve Tedavi Dergisi 12:233–236 [Turkish]
9. Deltito JA (1994) Valproate pretreatment for the difficult-to-treat patient with OCD (Letter). J Clin Psychiatry 55:500

10. De-Paris F, Busnello JV, Salgeuiro JB, Quevedo J, Izguierdo I, Kapczincki F (2000) The anticonvulsant compund gabapentin possesses anxiolytic but not amnesic effects in rats. Behav Pharmacol 11:169–173
11. De-Paris F, Sant'Anna MK, Vianna MRM, Barichello T, Busnello J (2003) Effects of gabapentin on anxiety induced by simulated public speaking. J Psychopharmacol 17:184–188
12. Doğan O, Gülmez H, Ketenoğlu C, Kılıçkap Z, Özbek H, Akyüz G (1995) Ruhsal bozuklukların epidemiyolojisi [Epidemiology of psychiatric disorders]. Dilek Matbaası, Sivas, pp 50–52 [Turkish]
13. Erol N, Kılıç C, Ulusoy M Keçeci M, Şimşek Z (1997) Türkiye Ruh Sağlığı Profili [Mental health profile of Turkey main report. Ministry of Health Publications]. Sağlık Bakanlığı Temel Sağlık Hizmetleri Genel Müdürlüğü, Ankara [Turkish]
14. First MB, Spitzer RL, Gibbon M, Williams JBW (1997) Structured clinical interview for DSM-IV clinical version (SCID-I/CV). American Psychiatric Press, Washington, DC
15. Gee NS, Brown JP, Dissanayeke VUK, Offord J, Thurlow R, Woodruff GN (1996) The novel anticonvulsant drug gabapentin (neurontin), binds to the $\alpha_2\delta$ subunit of a calcium channel. J Biol Chem 271:5768–5776
16. Goodman WK, Price LH, Rasmussen SA, Mazure C, Fleischmann RL, Hill CL, Heninger GR, Charney DS (1989) The Yale-Brown obsessive-compulsive scale I: development, use, and reliability. Arch Gen Psychiatry 46:1006–1111
17. Guy W (1976) Early clinical drug evaluation until assessment manual for psychopharmacology. Publication ADM 76–338. US Department of Health, Education and Welfare, Washington, DC
18. Honmou O, Oyelese AA, Kocsis JD (1995) The anticonvulsant gabapentin enhances promoted release of GABA in hippocampus: a field potential analysis. Brain Res 692:273–277
19. Iwata Y, Kotani Y, Hoshino R, Takei N, Iyo M, Mori N (2000) Carbamazepine augmentation of clomipramine in the treatment of refractory obsessive-compulsive disorder. J Clin Psychiatry 61:528–529
20. Jenike MA (2004) Obsessive-compulsive disorder. N Engl J Med 350:259–265
21. Jenike MA, Brotman AW (1984) The EEG in obsessive-compulsive disorder. J Clin Psychiatry 45:122–124
22. Johnson MR, Lydiard RB (1995) The neurobiology of anxiety disorders. Psychiatr Clin North Am 18:681–725
23. Karamustafalıoğlu OK, Üçışık AM, Ulusoy M, Erkmen H (1993) Yale-Brown Obsesyon Kompülsiyon Derecelendirme Ölçeğinin geçerlik ve güvenirlik çalışması [Validity and reliability study of Yale-Brown Obsession-Compulsion Scale]. Poster presented at 29th Congress of National Psychiatry Procedings book, 1993, p 86 [Turkish]
24. Kırpınar İ, Çayköylü A, Kuloğlu M (1994) Erzurum'da ruh sağlığı birimlerine ulaşım yolları [pathways to psychiatric units in Erzurum]. Turk Psikiyatri Derg 5:175–181 [Turkish]
25. Kumar TC, Khanna S (2000) Lamotrigine augmentation of serotonin re-uptake inhibitors in obsessive-compulsive disorder. Aust N Z J Psychiatry 34:527–528
26. Magistretti PJ, Pellerin L, Rothman DL, Shulman RG (1999) Energy on demand. Science 283:496–497
27. McGrath MJ, Campbell KM, Parks CR, Burton FH (2000) Glutamatergic drugs exacerbate symptomatic behavior in transgenic model of comorbid Tourette's syndrome and obsessive compulsive disorder. Brain Res 877:23–30
28. Pande AC, Davidson JR, Jefferson JW, Janney CA, Katzelnick DJ, Weisler RH, Greist JH, Sutherland SM (1999) Treatment of social phobia with gabapentin: a placebo-controlled study. J Clin Psychopharmacol 19:341–348
29. Pande AC, Pollack MH, Crockatt J, Greiner M, Chouinard G, Lydiard RB, Taylor CB, Dager SR, Shiovitz T (2000) Placebo-controlled study of gabapentin treatment of panic disorder. J Clin Psychopharmacol 20:467–71
30. Pollack MH, Matthews J, Scott EL (1998) Gabapentin as a potential treatment for anxiety disorders (letter). Am J Psychiatry 155:992–993
31. Rosenberg DR, MacMaster FP, Keshavan MS, Fitzgerald KD,Stewart CM, Moore GJ (2000) Decrease incaudate glutamatergic concentrations in pediatric obsessive-compulsive disorder patients taking paroxetine. J Am Acad Child Adolesc Psychiatry 39:1096–1103
32. Schruers K, Koning K, Luermans J, Haack MJ, Griez E (2005) Obsessive-compulsive disorder: a critical review of therapeutic perspectives. Acta Psychiatr Scand 111:261–271
33. Singh L, Field MJ, Ferris P, Hunter JC, Oles RJ, Williams RG, Woodruff GN (1996) The antiepileptic agent gabapentin (Neurontin) posesses anxiolytic-like and antinociceptive action that are reversed by D-serine. Psychopharmacology 127:1–9
34. Suman-Chauhan N, Webdale L, Hill DR, Hunter JC, Oles RJ, Williams RG, Woodruff GN (1993) Characterisation of [3H] gabapentin binding to a novel site in rat brain: homogenate binding studies. Eur J Pharmacol 244:293–301
35. Van Ameringen M, Mancini C, Patterson B, Bennett M (2006) Topiramate augmentation in treatment resistant obsessive-compulsive disorder: a retrospective, open-label case series. Depress Anxiety 23:1–5
36. Zohar J, Fineberg N (2001) Practical pharmacotherapy. In: Fineberg N, Marazitti D, Stein D (eds) Obsessive-compulsive disorder: a practical guide. Martin Dunitz, London, pp 103–117