THE ATLANTIC Journal of Medical Science and Research

Atlantic J Med Sci Res 2026;6(1):14-9
DOI: 10.5455/atjmed.2026.01.05

Original Article

Meryem Betos Kocak[1], Erkan Ayhan[2]

[1]Balıkesir Atatürk City Hospital, Department of Family Medicine, Balıkesir, Türkiye
[2]Balıkesir Atatürk City Hospital, Department of Cardiyology, Balıkesir, Türkiye

Received: 12 January, 2026
Accepted: 09 February, 2026
Published: 10 March, 2026

Corresponding Author: Meryem Betos Kocak, Balıkesir Atatürk City Hospital, Department of Family Medicine, Balıkesir, Türkiye
Email: meryembetoskocak@gmail.com

CITATION
Betos Kocak M, Ayhan E. Investigation of the effect of bupropion on electrocardiographic findings: Smoking cessationoutpatient clinic experience. Atlantic J Med Sci Res. 2026;6(1):14-9. DOI: 10.5455/atjmed.2026.01.05

Investigation of the effect of bupropion on electrocardiographic findings: Smoking cessation outpatient clinic experience

Abstract

Aim: Bupropion is frequently preferred for smoking cessation, which is an important public health problem. Side effect profiles are the most important drawback in drug use. In our study, we investigated the cardiac side effects that may interfere with Bupropion use through ECG changes. In our study, we aimed to determine the effect of Bupropion on ECG by comparing ECGs before and after 2 months of Bupropion use. This is the first article in the medical literature investigating the effect of Bupropion on ECG.
Materials and Methods: Our study is a retrospective cohort study. It was conducted on patients who applied to the smoking cessation outpatient clinic of our hospital and were started on Bupropion. ECGs were classified according to Minnesota Code (MC) criteria.
Results: Our study was completed with 452 patients. Before Bupropion use, 305 patients had normal ECG, 96 patients had minor ECG changes and 51 patients had major ECG changes. After 2 months of Bupropion use, premature beats were detected in only 2 patients.
Conclusion: Some side effects may occur without manifesting clinically, so we planned this study to determine the cardiac side effects of Bupropion that are not reflected in the clinic. In our study, we found that Bupropion had no serious side effects on ECG after 2 months of Bupropion use.

Keywords: Smoking cessation, bupropiyon, smoking

INTRODUCTION

The Ministry of Health of the Republic of Türkiye has implemented comprehensive measures to combat smoking. Many measures and regulations have been implemented for this purpose. One of these regulations is establishment of the smoking cessation counseling line, which has been available 24/7 since October 27, 2010. Individuals who wish to quit smoking receive support and information about quitting smoking from this line (1). Another regulation made by the Ministry of Health is the establishment of smoking cessation outpatient clinics. Certified physicians who have received specialized training in smoking cessation outpatient clinics. In these outpatient clinics, treatments related to smoking cessation are planned. Drug treatment is started for patients deemed appropriate by the physician. In Türkiye, bupropion is used as a pharmacological treatment in smoking cessation outpatient clinics.

Bupropion is an atypical antidepressant belonging to the aminoketone class, a highly lipophilic drug structurally related to cathinone. Bupropion exerts its effect mainly by inhibiting dopamine and norepinephrine reuptake and blocking various nicotinic receptors (2). Bupropion has been shown to have anti-inflammatory activity in the treatment of major depression, prevention of depressive episodes in patients with affective disorders, alleviation of symptoms of attention deficit hyperactivity disorder, and, more recently, in inflammatory diseases such as Crohn's disease (3).

Bupropion has been shown to be clinically effective in smoking cessation treatment which has been used in the United Kingdom since 2000 and in the United States since 1997 (3,4). Bupropion has been shown to have a 20% one-year continuous smoking cessation rate in many clinical groups, including smokers with no known comorbidities (e.g. cardiovascular disease, chronic obstructive respiratory disease, depression, and schizophrenia). Bupropion is frequently used in smoking cessation treatment (3). The most common side effects reported for bupropion are insomnia, dry mouth, nausea, and allergic reactions. The most serious side effect for bupropion is seizures (5). Studies evaluating the cardiac adverse effects of bupropion have generally been conducted with small sample sizes and were not adequately powered to assess safety outcomes (6).

It has been reported that bupropion has cardiotoxic effects when taken in high doses (7). Since the effectiveness of bupropion has a wide inter-individual variability (2), this study aimed to investigate the cardiac effects of bupropion by investigating the effects of bupropion on ECG.

MATERIALS AND METHODS

Study Design and Participants

Our study is a retrospective cohort study that was conducted on patients who presented to the Smoking Cessation a Outpatient Clinic of Balıkesir Atatürk City Hospital to quit smoking. Patients who presented to the hospital between 01.03.2023 and 30.01.2024 were included in our study.

Vital signs (blood pressure, pulse, body temperature, respiratory rate, oxygen saturation) were recorded during the first visit to the smoking cessation clinic, and vital signs were recorded again after medication administration. All these data were obtained from patient files created separately for each patient during the initial visit to the smoking cessation a outpatient clinic.

Inclusion Criteria:

- Being between 18 and 65 years of age,
- Patients presenting to Smoking Cessation Outpatient Clinic of Balıkesir Atatürk City Hospital.

The exclusion criteria were adopted from the exclusion criteria used in Wilkes S.'s (8) study.

Exclusion Criteria: (8)

- Having a history of seizures,
- Having bipolar affective disorder,
- Having eating disorder,
- Pregnancy and breastfeeding,
- Patients using drugs that lower the seizure threshold (antidepressants, antipsychotics, systemic corticosteroids, theophylline and tramadol),
- Patients taking SSRIs, tricyclic antidepressants, beta-blockers, propafenone, flecainide, risperidone, thioridazine. Bupropion is a cytochrome p450(2D6) inhibitor and has a decreasing effect on the clearance of drugs metabolized by this enzyme. Since these drugs are metabolized by Cytochrome p450(2D6), bupropion was not started in patients taking these drugs),
- Patients with missing or incorrect data in the patient file,
- Patients with nonattendance at the 3-month follow-up visit,
- Patients with irregular use of bupropion,
- Patients who stop taking bupropion.

Procedure

The study data were obtained from patient files. Patient files were completed in by a physician separately for each patient who presented to the smoking cessation a outpatient clinic. Since bupropion causes widening of the QRS complex (7), an ECG was performed both at baseline and after treatment in patients who presented to the smoking cessation a outpatient clinic. Bupropion initiation is determined by a physician who has appropriate certification. Patients who are to start the drug are given a period in which to quit smoking (8-12 days), and this period is decided together with the patient and the physician. During this period, patients may continue smoking while receiving the medication until its therapeutic effect is achieved; however, they are required to cease smoking on the quit date agreed upon with the physician. Bupropion was administered once a day for the first 3 days and twice a day from the 4th day onwards. After the smoking cessation day, the medication was continued at the recommended dose until the follow-up visit. All patients received treatment for the same duration (2 months) and at the same dose. After completion of treatment, all patients were called for the final follow-up visit a follow-up at 2 months During the follow-up visits after drug use, side effects were assessed, vital signs and an ECG were checked again. All these data were recorded in the patient file. In patients with abnormal electrocardiographic findings, bupropion therapy was initiated following approval by a cardiologist.

The patients underwent a 12-lead ECG using a standard protocol and in a supine position. ECGs were recorded at a speed of 25 mm/s The ECGs of the patients included in the study were recorded at the time of admission and after 2 months of treatment. The patients' ECGs were jointly interpreted by two independent specialist physicians. In cases of disagreement, a decision was made by obtaining the opinion of a different specialist physician. ECGs were classified according to the Minnesota Code (MC) criteria (9). Accordingly, ECGs were classified as normal, minor changes, and major changes. Minor ECG abnormalities include: borderline Q waves, borderline ST segment depression, moderate T wave inversion, first-degree AV block, Mobitz type I, incomplete bundle branch block, frequent premature beats, high voltage QRS, and axis deviation. Major ECG abnormalities include: pathological Q waves, significant ST segment depression, deep T wave inversion, complete(second degree) Mobitz type II, complete left or right bundle branch block, or intraventricular block, atrial fibrillation/flutter, left ventricular hypertrophy and, right or left atrial enlargement. ECGs without major or minor

abnormalities were considered normal.

Approval for our study was obtained from the local ethics committee (Ethics committee date: 29.02.2024 and approval number: 2024/02/06, Balıkesir Atatürk City Hospital Ethics Committee). Written in accordance with the Declaration of Helsinki.

Statistical Analysis

Statistical analyses were performed using SPSS version 20 (IBM Corp). Data were presented as mean, standard deviation, median, minimum, maximum, percentage, and counts. The normality of continuous variables was assessed using the Shapiro–Wilk test. Comparisons between pre- and post-intervention measurements of the same patients were performed using the paired t-test for normally distributed data. The Wilcoxon signed-rank test for non-normally distributed data respectively. Changes in paired categorical variables were analyzed using the McNemar test. A p-value <0.05 was considered statistically significant.

RESULTS

The number of patients who presented to the smoking cessation a outpatient clinic in the 11-month period was 651. Of these patients, 71 were excluded from the study because the physician did not find the drug treatment appropriate, 51 did not want to start the drug treatment on their own.

Fourteen patients were nonadherent to the prescribed drug therapy, 18 patients discontinued treatment, 28 patients failed to attend follow-up visits, and 17 patients had missing data in their medical records. The final study population consisted of 452 patients. The patients flowchart of the study is summarized in Figure 1.

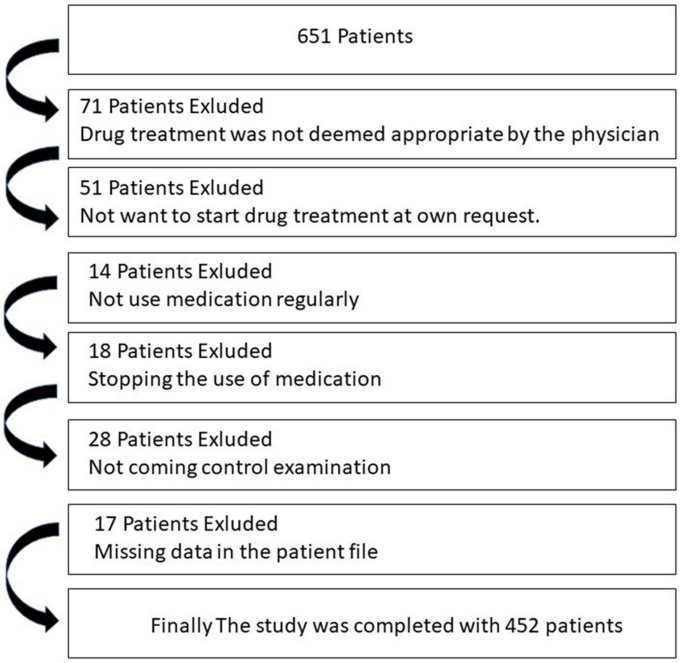

Figure 1. Flowchart of the Study

The patients included in our study were between 18 and 79 years of age with a mean age of 50.29 years (±15.24). Of the patients in the study, 296 (65.5%) were male. The comorbidities of the patients in the study were as follows: cardiovascular disease 307 patients (67.9%), pulmonary disease 163 patients (36.1%), hypertension 82 patients (18.1%), diabetes 48 patients (10.6%), thyroid disease 30 patients (6.6%), peripheral arterial disease 12 patients (2.2%).

The daily cigarette consumption of our patients was as follows: 18 patients (4%) smoked 0 to 10 cigarettes/day, 123 patients (27.2%) smoked 11 to 20 cigarettes/day, 237 patients (52.4%) smoked 21 to 30 cigarettes/day, and 74 patients (16.4%) smoked >30. cigarettes/day. The duration of smoking of our patients were as follows: 108 patients (23.9%) smoked for 0 to 10 years, 118 patients (26.1%) smoked for 11 to 20 years, 151 patients (33.4%) smoked for 21 to 30 years, and 75 patients (16.6%) smoked for >30 years.

The comparison of the vital signs of the patients at admission and after 2 months of treatment is shown in Table 1.

There was no statistically significant difference between systolic blood pressure, diastolic blood pressure, pulse rate, oxygen saturation, temperature, respiratory rate values at baseline and after bupropion use (p>0.05). The distribution of patients according to Fagerström Test for Nicotine Dependence was as follows: 8 patients with very low dependence (1.8%), 32 patients with low dependence (7.1%), 21 patients with moderate dependence (4.6%), 130 patients with high dependence (28.8%), 261 patients with very high dependence (57.7%).

Of the 452 patients who presented to our hospital and started drug treatment, 309 (68.4%) quit smoking after the 2 months follow-up period.

At the time of their initial visit, the ECGs of the patients included in the study demonstrated that 305 (67.5%) were normal, 96 (21.2%) had minor ECG abnormalities, and 51 (11.3%) had major ECG abnormalities. After 2 months of bupropion use, 303 (67%) patients had normal ECGs, 98 (21.7%) had minor ECG abnormalities, and 51 (11.3%) had major ECG abnormalities. Only two patients (0.4%) developed new electrocardiographic abnormalities, including minor ECG abnormalities. While the number of patients with normal ECGs before drug use was 305/452, the number of patients with normal ECGs after 2 months of bupropion use was determined as 303/452.

Minor and major ECG findings detected in the patients are summarized in Table 2.

Two patients who had normal initial ECG findings developed new abnormalities in their follow-up ECGs. ECG abnormalities in the patients during follow-up were as follows: Frequent premature beats were detected in 2 patients as newly identified findings in minor ECG category. The number of patients with minor ECG findings increased from 96 to 98. Among major ECG findings, no new ECG abnormalities were detected. Premature beats were not detected again in subsequent follow-up examinations.

Table 1. Vital signs of the study population at initial visit and after bupropion treatment

Vital signs	Minimum	Maximum	Mean	Standard Deviation
Systolic blood pressure[1] (mmHg)	108	162	134.55	13.149
Diastolic blood pressure[1] (mmHg)	60	105	77.41	7.155
Pulse [1] (beats/min)	65	118	88.75	7.740
Oxygen saturation [1] (%)	84	100	92.25	4.856
Body temperature [1] (°C)	36.0	36.8	36.390	.2321
Respiratory rate [1] (min)	12	22	15.71	2.387
Systolic blood pressure [2] (mmHg)	102	167	133.24	13.591
Diastolic blood pressure [2] (mmHg)	56	102	78.11	8.383
Pulse [2] (beats/min)	60	103	87,69	10.182
Oxygen saturation [2] (%)	85	100	92,70	3.659
Body temperature[2] (°C)	36.0	36.8	36.381	.1983
Respiratory rate [2] (min)	10	21	15.48	2.255

1: The patient's admission time, 2: After using bupropion

Table 2. Minor and major ECG findings

	Before Use Bupropion (n)	After Use Bupropion (n)
Minor ECG findings		
Borderline Q waves	7	7
Borderline ST segment depression	2	2
Moderate T wave inversion	15	15
First-degree AV block	9	9
Mobitz type I	-	-
İncomplete bundle branch block	23	23
Frequent premature beats	20	22
High voltage QRS	1	1
Axis deviation	19	19
Total	96	98
Major ECG findings	**n**	**n**
Pathological Q waves	12	12
Significant ST segment depression	3	3
Deep T wave inversion	7	7
Complete or Mobitz type II	-	-
Complete left or right bundle branch block or intraventricular block	3	3
Atrial fibrillation/flutter	11	11
Left ventricular hypertrophy	10	10
Right or left atrial enlargement	5	5
Total	51	51

DISCUSSION

ECG is used for diagnostic purposes in a wide range of diseases; moreover, it can identify many conditions that are otherwise asymptomaticFor example, it can diagnose many diseases that are not clinically apparent such as first- or second-degree conduction blocks or sinus arrhythmia, ventricular extrasystole. In our study, we aimed to investigate whether bupropion has cardiac side effects that is not clinically recognized but can be diagnosed by ECG. In the present study, we found that bupropion did not cause any major changes on ECG findings

Smoking is the major preventable risk factor for many diseases. Smokers have an average risk of dying 10 years earlier than nonsmokers. For every additional year of smoking from middle age onwards, life expectancy shortens by approximately three months. Therefore, it is essential for smokers to quit smoking as early as possible, completely and permanently (10). One of the widely accepted drugs for smoking cessation is bupropion (8). The success rate of bupropion use in smoking cessation in smokers varies between 49%–72% (11). The effect of smo The effects of smoking on cardiovascular disease are well established. Since patients who already smoke have an increased cardiovascular risk, it is important to choose a drug with no or minimal cardiac side effects. Therefore, we investigated the cardiac side effects of bupropion using ECG findings. Although studies have examined the cardiovascular adverse effects of bupropion treatment, we investigated its effects on electrocardiographic parameters. Due to the effect of bupropion on norepinephrine reuptake, cardiovascular side effects may manifest as an increase in blood pressure (12).

Consistent with our findings, analyses suggest that bupropion's cardiovascular effects in therapeutic use are typically minimal in patients without pre-existing severe cardiac conditions. A study of depressed patients with left ventricular dysfunction and other cardiac comorbidities reported that bupropion was associated with increases in blood pressure. However, it did not result in significant conduction abnormalities or exacerbation of ventricular arrhythmias, indicating a relatively neutral effect on electrocardiographic parameters at standard clinical doses (13). Another study conducted in 81 patients receiving bupropion for smoking cessation reported no cases of hypertension, increased heart rate, or coronary artery disease (6). In other studies, no effects on heart rate and blood pressure were found (14,15). In our study, patients who used bupropion for 2 months did not experience a statistically significant change in blood pressure values.

Furthermore, retrospective analyses comparing antidepressants, including bupropion have found no significant association between bupropion and QTc prolongation, further supporting the safety profile seen in clinical populations undergoing ECG monitoring (16).

While rare case reports and toxicity studies have described ECG abnormalities such as QRS widening or QTc prolongation, these occurrences are predominantly reported in the context of overdose or severe toxicity, rather than at therapeutic doses. Case series of bupropion poisoning have documented significant changes in ECG intervals and conduction disturbances. These findings suggest that cardiac electrophysiological effects may occur at supratherapeutic doses or in the presence of concomitant metabolic derangements, rather than within the therapeutic range evaluated in the present study. Therefore, the absence of major ECG changes in our study further supports the conclusion that bupropion, when used at standard smoking cessation doses, does not significantly impact cardiac conduction in in clinically healthy individuals (17).

Similarly, randomized clinical trials evaluating the safety of bupropion for smoking cessation have not reported clinically significant changes in ECG parameters, heart rate, or blood pressure during treatment. In a multicenter study of smokers with cardiovascular disease, bupropion sustained-release (bupropion SR) was effective in achieving smoking abstinence without clinically significant alterations in cardiovascular parameters compared with placebo. The overall safety profile was consistent with that observed in general smoking populations.This aligns with our findings under routine clinical practice, where no major ECG abnormalities emerged following bupropion administration (18). In our study, we did not identify any major ECG abnormalities associated with bupropion use.

Most previous studies on bupropion focus on major cardiac side effects or its effects on heart rate and blood pressure. The present study, on the other hand, is aimed at detecting conditions that do not produce overt clinical symptoms but can be diagnosed by ECG. The most significant cardiovascular adverse effect potentially associated with bupropion has been reported as a case report describing myocardial infarction in an adolescent using bupropion in combination with erythromycin and methylphenidate, as documented by George et al (19).

Limitations

The study excludedpatients who did not come for visits or stopped the medication. These excluded patients may have stopped the medication due to a cardiac symptom, which could have affected the internal validity of the results. In our study, patients using beta-blockers or SSRIs, as well as those with a history of seizures or bipolar disorder, were excluded. This suggests that our study was conducted on a relatively healthier group, which could be considered a limitation.

CONCLUSION

Patients who smoke already have an increased risk of cardiac disease. Therefore, cardiac side effects of drugs used in smoking cessation treatment should be well known. In our study, we investigated the effect of a frequently preferred drug such as bupropion on ECG in order to identify conditions that do not show clinical symptoms but can be diagnosed by ECG. In our study, we found that bupropion did not cause major ECG abnormalities. Further prospective studies with longer follow-up are warranted to clarify this topic.

Acknowledgements
The authors express their gratitude to the Family Medicine staff at Balıkesir Atatürk City Hospital.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that there is no financial support.

Ethical Approval
The study protocol received approval from the Balıkesir Atatürk City Hospital Ethics Committee (date:29.02.2024 and approval number: 2024/02/06).

REFERENCES

1. ALO 171 Sigara Bırakma Danışma Hattı. https://hsgm.saglik.gov.tr/tr/alo-171.html access date 09.01.2024
2. Costa R, Oliveira NG, Dinis-Oliveira RJ. Pharmacokinetic and pharmacodynamic of bupropion: integrative overview of relevant clinical and forensic aspects. Drug Metab Rev. 2019;51:293-313.
3. Wilkes S. Bupropion. Drugs Today (Barc). 2006;42:671-81.
4. Khan SR, Berendt RT, Ellison CD, et al. Bupropion hydrochloride. Profiles Drug Subst Excip Relat Methodol. 2016;41:1-30.
5. Cahill K, Stevens S, Perera R, Lancaster T. Pharmacological interventions for smoking cessation: an overview and network meta-analysis. Cochrane Database Syst Rev. 2013;2013:CD009329.
6. Silva AP, Scholz J, Abe TO, et al. Influence of smoking cessation drugs on blood pressure and heart rate in patients with cardiovascular disease or high risk score: real life setting. BMC Cardiovasc Disord. 2016;16:2.
7. Curry SC, Kashani JS, LoVecchio F, et al. Intraventricular conduction delay after bupropion overdose. J Emerg Med. 2005;29:299-305.
8. Wilkes S. The use of bupropion SR in cigarette smoking cessation. Int J Chron Obstruct Pulmon Dis. 2008;3:45-53.
9. Prineas RJ, Crow RS, Zhang ZM. The Minnesota Code Manual of Electrocardiographic Findings. Springer, New York, 2009.
10. Kotz D, Batra A, Kastaun S. Smoking cessation attempts and common strategies employed. Dtsch Arztebl Int. 2020;117:7-13.
11. Hajizadeh A, Howes S, Theodoulou A, et al. Antidepressants for smoking cessation. Cochrane Database Syst Rev. 2023;5:CD000031.
12. Sobieraj DM, White WB, Baker WL. Cardiovascular effects of pharmacologic therapies for smoking cessation. J Am Soc Hypertens. 2013;7:61-7.
13. Roose SP, Dalack GW, Glassman AH, et al. Cardiovascular effects of bupropion in depressed patients with heart disease. Am J Psychiatry. 1991;148:512-6.
14. Settle EC, Stahl SM, Batey SR, et al. Safety profile of sustained-release bupropion in depression: Results of three clinical trials. Clin Ther. 1999;21:454-63.
15. Rigotti NA, Thorndike AN, Regan S, et al. Bupropion for smokers hospitalized with acute cardiovascular disease. Am J Med. 2006;119:1080-7.
16. Straley CM, Sochacki M, Reed E, et al. Comparison of the effect of citalopram, bupropion, sertraline, and tricyclic antidepressants on QTc: a cross-sectional study. J Affect Disord. 2022;296:476-84.
17. Isbister GK, Balit CR. Bupropion overdose: QTc prolongation and its clinical significance. Ann Pharmacother. 2003;37:999-1002.
18. Tonstad S, Farsang C, Klaene G, et al. Bupropion SR for smoking cessation in smokers with cardiovascular disease: a multicentre, randomised study. Eur Heart J. 2003;24:946-55.
19. George AK, Kunwar AR, Awasthi A, et al. Acute myocardial infarction in a young male on methylphenidate, bupropion, and erythromycin. J Child Adolesc Psychopharmacol. 2005;15:693-5.