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The association between beta-blocker use and depression – narrative review

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Summary

Depressive symptoms are increasingly observed in people with somatic diseases, while depression increases the likelihood of coronary heart disease and has a negative impact on its course. Due to the widespread use of beta-blockers in cardiovascular diseases and the increased likelihood of depressive symptoms in this group of patients, the impact of the use of beta-blockers on the frequency of induction or severity of depressive symptoms was analyzed. The focus was primarily on the central effect of beta blockers on mood, but the effect of their peripheral action was also taken into account. The issue was examined based on the most commonly used medications. More lipophilic substances penetrate the central nervous system to a greater extent than hydrophilic ones, usually leading to a higher incidence of depressive symptoms; however, this effect can vary depending on the study cited. It was noted that carvedilol, bisoprolol and propranolol did not induce depressive symptoms, unlike metoprolol, which in most studies showed a positive effect on the development or worsening of depressive symptoms. Based on the analysis of medical data, it was concluded that betablockers have no significant effect on the induction of depressive symptoms, or this effect is clinically insignificant, and selected groups of these drugs may prevent the induction of depression or reduce its symptoms. Moreover, a positive effect of beta-blockers on reducing the level of anxiety was noted, and it was emphasized that they may cause both fatigue and sleep disorders in patients using them.

Key words: beta-blockers, depression, anxiety

Introduction

The beginnings of the use of beta-blockers date back to 1964, when propranolol was first introduced for the treatment of hypertension. In the following years, drugs belonging to this group with a more selective effect on the beta receptor were introduced [1].

Currently, they are the most commonly used drugs in the treatment of hypertension, but also in heart failure, coronary heart disease and heart rhythm disorders [2]. There are 11 β-blockers approved in Poland, of which bisoprolol, metoprolol and nebivolol are the most frequently used [3]. Data show that in 2018–2020, beta-blockers accounted for approximately 20–25% of all antihypertensive drugs prescribed in Poland [4].

It is estimated that in 2030, depression will be the most frequently diagnosed disease in the world [5]. The World Health Organization (WHO) informs that in 2023, 280 million people around the world suffered from depressive disorders, while according to the report of the National Health Fund (NFZ), in Poland this problem affects approximately 1.2 million patients [6]. Depression affects people of all ages, and after the age of 50 it affects about 6% of the population, its incidence increases with age [7].

The increased incidence of depressive disorders among patients with hypertension is well documented in the medical literature, and depression is an independent risk factor for the development of coronary artery disease and worsens its course [8]. A systematic review based on analyzes involving people suffering from ischemic heart disease, including people after myocardial infarction, showed that 15–20% of respondents reported an increased level of depression [9], and the occurrence of depressive symptoms in this group of patients increased the chances of recurrence of a heart attack twice. In turn, the incidence of depressive disorders in people after stroke is 20–80%, and their development most often occurs within 3–6 months after a diagnosed stroke [10]. Depression also increases the likelihood of recurrence of a stroke by three times, which was observed in a prospective study in which stroke patients were followed for 10 years. In patients with cardiovascular diseases, the incidence of depressive symptoms that require treatment is higher than in the general population. These symptoms worsen the course of the somatic disease and thus adversely affect its prognosis [11]. A retrospective cohort study of 6,915 patients covered by a multicenter integrated healthcare system who was diagnosed with a heart attack in 2008–2014 showed that 1,252 people were diagnosed with depressive disorders. During an average follow-up period of 2.6 years, it was found that patients with depression not treated with a beta-blocker had a higher mortality rate than patients without symptoms of depression. However, when beta-blockers were used, the risk of death was significantly reduced [12].

Beta-blockers, which are widely used in cardiology, have a long-established position in psychiatry, especially in reducing the vegetative symptoms of anxiety and reducing the severity of some symptoms associated with psychiatric treatment. In the context of the interdisciplinary use of these drugs, both in the treatment of cardiovascular diseases and in psychiatry, the authors of this study attempted to organize the knowledge about the impact of these drugs on the emotional state of patients, taking into account the negative or unclear effect of beta-blockers on the emotional state of patients often described in the literature.

Purpose and method

The aim of the following article was to collect and organize knowledge regarding the relationship between the use of beta-blockers and the development or intensification of depressive symptoms. Publications were reviewed in the archives of PubMed, National Institute of Mental Health and Google Scholar. In order to precisely analyze the data, the following phrases were used: "beta-blockers and depression," "propranolol and depression," "carvedilol and depression," "metoprolol and depression," "bisoprolol and depression," "beta-blockers and central nervous system." The study is a narrative review, which was created from November 5, 2023 to January 15, 2024. Full-text review and research papers in English and Polish were taken into account. The authors of the work ultimately selected 41 items (13 review papers, 27 research papers, 1 book chapter). In addition, information provided on the websites of the National Health Fund and WHO was used to present possibly objective statistical data. The selection of works was made in accordance with the PRISMA scheme in accordance with Figure 1 (Figure 1)

When selecting material for selection, items that did not directly concern the impact of the use of beta-blockers on mental health were rejected. Due to new reports on the described issue, the analysis was based on data from the last 15 years, while the publications from the end of the 20th century cited in this review only served the authors as a point of reference in the context of the changing approach to the role of these drugs in psychiatry. Research carried out at the end of the last century strongly supported the negative impact of all beta-blockers on the patient's mental state and indicated the induction of depression. Most of the current information contradicts this theory, pointing to no or slight negative effects, and in selected preparations there is a noticeable positive effect of the drug on the human mental state. Due to the fact that establishing a clear position on the influence of beta-blockers (as a group of drugs) on the development of depressive symptoms seems difficult, for example, due to the different pharmacokinetic properties of individual preparations, there is, according to the authors of this study, a need to analyze the considered problem in relation to each commonly used drug from this group separately.

Peripheral and central mechanism of action of beta-blockers

Cojocariu [13] proposed a classification of beta-blockers based on the tendency of drug molecules to dissolve in fats (lipophilicity) and water (hydrophilicity), which he associated with neuropsychiatric effects. The first subgroup with high lipophilicity included propranolol, timolol, pindolol, and penbutolol. A separate subgroup with moderate lipophilicity includes, among others: metoprolol, bisoprolol, nebivolol and carvedilol, acebutolol, betaxolol, and the last, third one contains hydrophilic beta-blockers or those with low lipophilicity – labetalol, atenolol, esmolol, sotalol, carteolol, nadolol.

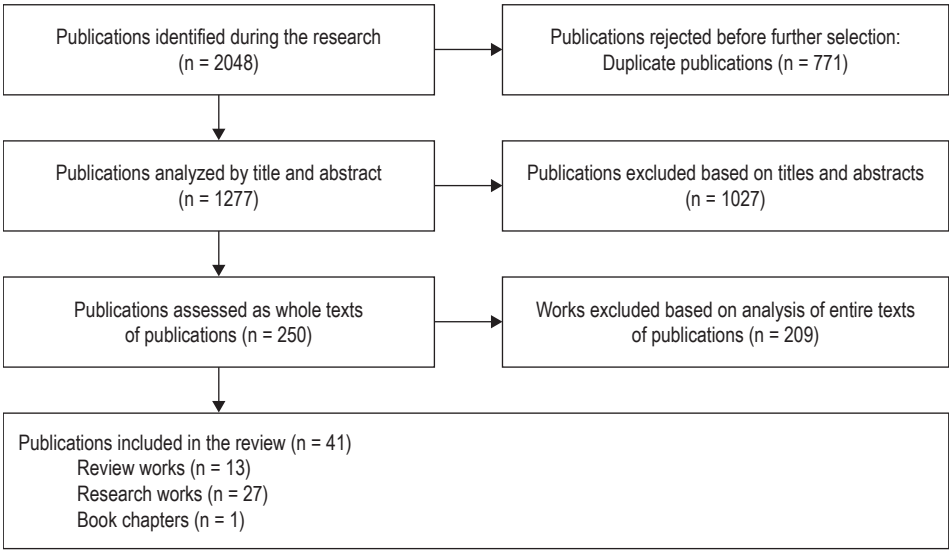

Figure 1. **Diagram showing the selection of scientific publications that were included in the narrative review**

According to a different scheme [14], beta-blockers were divided into three subgroups, depending on the effect on the central nervous system due to: cardioselectivity, lipophilic nature of the drug and intrinsic sympathomimetic activity. Lipophilic substances cross the blood–brain barrier with varying efficiency, depending on the size of the drug. The smaller the lipophilic molecule, the more efficiently it overcomes this barrier and the transport takes place by diffusion, while in the case of transcytosis, the beta-blocker inhibits the attachment of the beta-agonist to the adrenergic receptor, blocking its transport to astrocytes [15] – see Figure 2.

Beta-blockers, which have lipophilic properties, easily penetrate the CNS, causing fatigue, headache, insomnia, and retardation, may cause parkinsonian symptoms and increase the number of falls. This group includes metoprolol and propranolol. A group of hydrophilic drugs do not penetrate or penetrate the blood–brain barrier in very small amounts [16]. The effect on the central nervous system in this case may be induced by the induction of the release of signaling molecules in the hypothalamus. It has been proven that small doses of hydrophilic atenolol and nadolol are able to induce the release of NO, and large doses of these substances cause a sharp increase in the release of H2O2 in the hypothalamus [17]. Another way in which beta-blockers affect the CNS is through the mechanism of vasodilation. This effect is demonstrated by carvedilol and nebivolol, which have a beneficial effect on the functioning of the brain by improving its blood supply [8].

In turn, the peripheral mechanism is based primarily on a negative inotropic effect on the heart and reducing the frequency of its contractions, thereby reducing cardiac

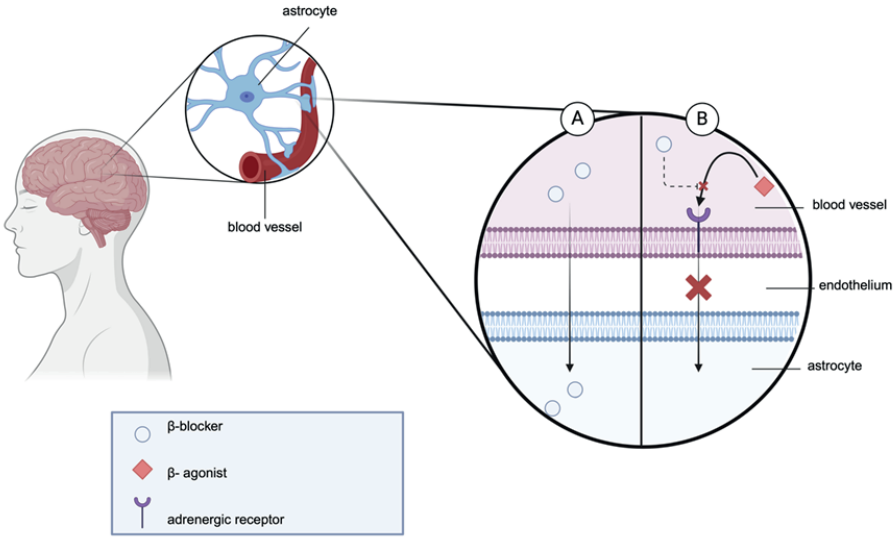

Figure 2. **Transport of beta-blockers in the CNS. A – diffusion of high-lipid beta-blockers, B – transcytosis via beta-adrenergic receptors (figure created using BioRender.com).**

output. Additionally, it has been shown that the antagonistic effect on the beta 1 receptor in the renin-angiotensin system of juxtaglomerular cells reduces its activity, thereby lowering blood pressure. Despite the common mechanism of beta-blockers described above, these drugs show pharmacodynamic differences consisting in different selectivity towards the adrenergic receptor. The first generation includes non-selective beta-blockers in relation to the beta 1 and beta 2 receptors, the second generation consists of preparations showing greater selectivity for the beta 1 receptor in relation to the beta 2 receptor, while the third generation includes drugs with vasodilatory properties. The vasodilatory mechanism includes an inhibitory effect on the alpha 1 receptor and an activating effect on the beta 3 adrenergic receptor, which consequently increases the production of nitric oxide (II) [18].

The use of beta-blockers and the risk of depression

Although it is widely believed that beta-blockers contribute to the occurrence of depressive symptoms, in 1989 a study was published in which it was recommended to treat depression and post-traumatic stress disorder (PTSD) with these drugs [19]. A later meta-analysis from 2002, covering 35,000 people and referring to studies published over the years 1966–2001, did not present an association of beta-blockers with a significant, absolute, annual increase in reported depressive symptoms [20]. In recent years, more articles have been published indicating the lack of connection between the use

of beta-blockers and the occurrence of depression [21] or, due to the lack of sufficient data, the lack of a clear position on this topic [22]. The latest reports presented below will, according to the authors of this study, allow the reader to familiarize themselves with the current position regarding the relationship between these drugs often used in practice and the induction or intensification of previously existing depressive symptoms.

Ringoir et al. [23] studied hypertensive patients in primary care, without a history of myocardial infarction, treated with lipophilic beta-blockers and not undergoing such treatment. 46% of people not taking beta-blockers and 35% of patients taking these drugs obtained results on the patient health questionnaire (PHQ-9) indicating the absence of symptoms of depressive disorders. Moreover, it was shown that people using lipophilic beta-blockers presented an increased severity of depressive symptoms [23].

A study conducted among patients undergoing percutaneous coronary intervention, which assessed the relationship between beta-blocker therapy and the reduction of depressive symptoms, showed that the risk of developing depressive symptoms 12 months after the procedure was lower in the group taking beta-blockers and additionally lower for patients using higher doses of the drug. The potential effect of the type of beta-blocker (i.e., hydrophilic or lipophilic) was not taken into account in the statistical analyses, as the majority (89%) of patients were using a lipophilic beta-blocker. Based on the percentages, people using lipophilic beta-blockers were more likely to experience depressive symptoms compared to people using hydrophilic beta-blockers (16.0% vs. 8.0% at baseline and 10.3% vs. 4.0% after 12 months after the procedure) [24]. The same conclusions are also supported by studies on diabetic patients on dialysis and taking beta-blockers [25].

A study of 3,470 patients with acute myocardial infarction who were not taking beta-blockers at the time of admission to hospital compared the severity of depressive symptoms in the group that started treatment with a beta-blocker (91.9%) with those who did not receive this treatment (8.1%) [26]. For this purpose, the PHQ-8 (Personal Health Questionnaire Depression Scale) was used, consisting of 8 questions, where a higher score correlates with an increase in the severity of depressive symptoms [27]. Initially, the results were higher in patients not taking beta-blockers, but later repeated tests showed a decrease in results by an average of 1.16 points in the group receiving a beta-blocker and 1.71 points in the group without a beta-blocker [26]. Such results indicate an insignificant effect of beta-blocker therapy on depressive symptoms in the study group. However, it should be emphasized that the vast majority of patients took hydrophilic (according to the authors) metoprolol, which is why the study authors themselves point out that the study results could differ when lipophilic beta-blockers were used.

A univariate analysis of beta-blocker treatment in patients with an implanted cardioverter-defibrillator did not show a significant association of therapy with symptoms of anxiety and depression. This study involved 429 patients who were assessed with the Hospital Anxiety and Depression Scale (HADS) and the Involvement Evaluation Questionnaire (ICD), and 80% of them were treated with one of the listed beta-blockers: bisoprolol, metoprolol, carvedilol, sotalol or nebivolol [28].

The use of beta-blockers and side effects

A systematic review and meta-analysis describing adverse events during beta-blocker therapy found that, although depression was the most frequently reported psychiatric adverse event, it did not occur more frequently in the drug group than in the placebo group (odds ratio (OR) was 1.02). Moreover, the use of beta-blockers was also not associated with drug discontinuation due to depression (OR 0.97). However, in 79% of the assessed studies, the risk of bias was considered high [29]. In 2022 clinical follow-up studies, there was only an increase in depressive symptoms with short-term use of any beta-blocker. Long-term use of the drug was not associated with a risk of depression compared with never taking the drug [30].

In T.G. Rimer's randomized, double-blind study of beta-blocker adverse events, the most frequently reported and primary reason for study discontinuation was fatigue. Various sleep disorders were possibly more frequent during the use of beta-blockers, while depressive mood was reported regardless of the drugs used, suggesting no effect of beta-blockers on the incidence of depression. Additionally, beta-blockers were found to reduce the incidence of anxiety in patients in the above study. The obtained results are presented in Table 1 [29].

The meta-analysis conducted by Andrate et al. included studies on people taking beta-blockers both for cardiological indications, most often hypertension (197 studies), myocardial infarction, heart failure, and angina pectoris, as well as for non-cardiovascular indications, which most often included migraine. Based on the data, an increased risk of abnormal dreams was established in the group taking beta-blockers compared to the group receiving placebo, which, combined with fatigue, may be wrongly interpreted as symptoms associated with a depressive syndrome, creating an incorrect relationship between the use of beta-blockers and the risk of depression [31]. Another explanation for this correlation is the fact that beta-blockers are commonly used by patients with ischemic heart disease, and such people have an increased risk of depression [8, 32].

Table 1. **Incidence of depressive and other psychiatric symptoms during beta-blocker therapy in a double-blind randomized controlled trial. Own work based on a graphic summary of the item [29].**

Possibly rarer	No influence	Possibly more frequent	Probably more common
Feeling anxious	Depressed mood	Insomnia	Fatigue
	Somnolence	Dreams	
	Loss of appetite	Sleep disorder	
	Memory impairment		
	Decreased libido		
	Irritability		

Another study assessing the impact of 4 classes of antihypertensive drugs (including beta-blockers) on the risk of depression, showed that patients treated with

the studied preparations had higher rates compared to patients not using the studied antihypertensive drugs. This shows an increased risk of depression in the entire group of respondents, i.e., those suffering from hypertension and other cardiovascular and cerebrovascular diseases. Despite this, of the 41 drugs tested, 15 substances were identified that were associated with a reduced incidence of depressive symptoms. This group includes 4 drugs from the beta-blocker group: propranolol, atenolol, bisoprolol, and carvedilol [33]. In turn, a meta-analysis of patients treated for hypertension with calcium channel blockers, angiotensin antagonists, beta-blockers, and diuretics showed a significant impact on the risk of depression only of the first of these groups of drugs. The remaining groups, including beta-blockers, showed a slight relationship with the incidence of depressive disorders. Only the comparison of those using beta-blockers with patients taking diuretics indicated an increased risk of depression during beta-blocker therapy (OR 1.53) [34].

Propranolol as a drug protecting against the induction of depression

Previous data on the relationship between propranolol and symptoms of depression indicated the induction and deepening of depressive symptoms in people using this drug [35]. However, reports from the last decade suggest that the use of propranolol is associated with a small risk of depression and, in some cases, may prevent it, additionally indicating its anti-anxiety and supportive effects in the treatment of post-traumatic stress disorder (PTSD). Other publications emphasize the pleiotropic effect of the drug [36].

The study checked whether emergency treatment with propranolol would prevent post-traumatic stress disorder (PTSD), anxiety and depression in children hospitalized in the pediatric intensive care unit with major burns. The researchers hypothesized that the incidence of PTSD, anxiety and depression would be significantly lower in the propranolol groups than in the non-propranolol groups. The study involved 202 people, of whom 89 took propranolol and 113 were in the control group. The average body surface area that was burned was approximately 56.4%, and the dose of propranolol taken was 3.64 ± 3.19 mg/kg body weight per day, while the average duration of treatment was 26.5 ± 19.8 days. The study was performed 7 years after the burn incident, in the group of subjects taking propranolol, the prevalence of post-traumatic stress disorder was 3.5%, while in the control group – 7.2%. It was observed that people with post-traumatic stress disorder were more likely to suffer from depression, compared to people with burns who did not show signs of PTSD [37].

In 2022, a case-control study was conducted involving 237,410 patients, half of whom reported incidents of depression in the past, while the remaining part constituted the control group. Patients did not report any symptoms of anxiety, stress or decreased well-being over the last year. Among patients using propranolol for a short term, an increased likelihood of developing a depressive syndrome was observed, but only in the group of people with psychiatric problems, in which the odds ratio for depres-

sion (aOR) was 6.33. At the same time, it was observed that the risk of developing depressive disorders in people taking the drug for cardiovascular diseases was slightly increased (aOR – 1.44). The authors clearly emphasized that a significant increase in the likelihood of depression occurred in patients with a history of neuropsychiatric symptoms, and on this basis a clear cause-and-effect relationship between the use of beta-blockers and depression cannot be concluded [30].

Another research project involved 312 patients aged 22 to 59 years with untreated hypertension taking propranolol at a dose of 80 to 400 mg/day for one year. No predisposition to the development of depressive symptoms was observed in these people. Depression parameters were assessed based on questionnaires at the beginning of therapy and one year after its initiation. In the group of 75 people treated with beta-blockers, half of them treated with propranolol, an improvement in the quality of life and better work efficiency was noted, however sexual dysfunction was observed. In the above analysis, there was no negative effect of propranolol on emotional and cognitive functioning in people with hypertension [38].

A review of publications conducted in Romania observed an association between the use of propranolol and depression in the elderly. It was noticed that in people treated with beta-blockers, the frequency of using antidepressants is much higher compared to patients not using propranolol. The probable cause of insomnia in these patients is due to the inhibitory effect of beta-blockers on the paradoxical phase of sleep (REM). In turn, a study on 312 patients after a year of using propranolol did not show an increased risk of depression. In other publications, it was observed that there are factors predicting the occurrence of depression, in particular: female gender, symptoms of anxiety and the use of non-selective beta-blockers. It has been noticed that the side effects of beta-blockers are influenced not only by the type of preparation used, but also by the dosage, which should be determined individually for each patient [13].

Interesting information is contained in an article published 12 years ago relating to a series of publications on the interrelationships between the use of beta-blockers and the occurrence of depression. In most of the 22 analyzed studies on which this meta-analysis is based, a specific publication pattern was repeated. Each study that reported statistically significant results was followed by several others that refuted the previous findings. This concerned cross-sectional studies, longitudinal studies and meta-analyses, as well as others directly related to the effect of beta-blockers as a group of drugs, propranolol itself and non-selective beta-blockers on the incidence of depressive symptoms [39].

It should be mentioned that researchers pay a lot of attention to the impact of this group of drugs on the functioning of rodents. Propranolol occupies a special place among these preparations, which is the subject of a study conducted by Zaidi et al. [36]. During studies on rats, in which the animals received 50 mg/kg/day of propranolol for 36 days, behavioral tests were carried out to assess the occurrence of anxiety, symptoms of poor well-being, learning ability, including memory, and social interactions. Rats not taking propranolol showed anxiety and depressed mood, while those taking this beta-

blocker did not show these features. Significantly lower effectiveness of propranolol was observed among individuals with post-traumatic stress symptoms, therefore the researchers recommended preventive measures consisting in administering propranolol before events that may have negative consequences on the mental state of rats [36].

Other beta-blockers and their effect on depressive symptoms

In this part of the work, the authors reviewed scientific studies in which metoprolol, bisoprolol and carvedilol were used. The above-mentioned drugs, together with propranolol and nebivolol, are the most frequently used substances in medical practice, therefore the following subsections are devoted to these preparations.

1. Metoprolol

Chinese researchers assessed the influence of metoprolol on the occurrence of depressive symptoms in a group of women and men (154 patients) with chronic heart failure in class III and IV of the NYHA (New York Heart Association) scale [40]. Metoprolol slow-release tablets at a dose of 23.74 mg or 47.5 mg every 7 days were used. Assessment was performed using the HADS every 3 months from the beginning of treatment for a period of one year. Interestingly, men had higher scores on the HADS compared to women for the depression subscale in the first measurement. After just 3 months, an increase in depressive symptoms was observed, while the feeling of anxiety decreased regardless of gender. An increase in the HADS over time compared to the mean baseline values was found in the context of the occurrence of depressive symptoms from 9.32 ± 2.95 to 10.27 ± 2.82 in men and from 7.87 ± 2.15 to 8.83 ± 2.67 in women. In the same study, the effect of metoprolol on depressive symptoms was significantly higher in men after 3 months compared to the baseline value (62.58 ± 8.92 to 60.19 ± 6.50). From the above data, it can be concluded that metoprolol has a positive effect on the induction of depression, but to a different extent depending on gender. It has been observed that psychologically men and women react differently to metoprolol [40]. In turn, the results of a previously published study indicated that metoprolol treatment significantly deepens the symptoms of depression and burnout, but reduces the intensity of anxiety independent of the reduction in heart rate in patients with chronic heart failure and clinically diagnosed mood disorders [41]. In the Chinese studies presented above, it was noted that metoprolol increases the incidence of depression because it increases depressive symptoms regardless of gender, and reduces the level of anxiety, which should have important clinical implications when deciding on the use of this drug in people with existing depression or predisposed to it.

2. Bisoprolol

In the neurology department of Seoul National University Hospital, studies were conducted on 59 patients with orthostatic tachycardia who were classified into the bisoprolol or propranolol groups, respectively [42]. The patients were not taking antidepressants. Follow-up tests performed after 1 and 3 months showed lower intensity of depressive symptoms measured on the Beck scale in both study groups and no significant differences between these groups in the intensity of depressive symptoms. There was no statistically significant difference in the reduced incidence of depression depending on the use of propranolol and bisoprolol [42].

Another analysis conducted in patients with heart failure examined the effect of bisoprolol and carvedilol on the severity of depressive symptoms in these people. The study group included people over 65 years of age. 292 people took bisoprolol and 297 carvedilol. It was observed that there was a significant reduction in the severity of depressive symptoms after using these preparations in all elderly patients participating in the project [43]. The above analysis indicates a reduction in the incidence of depression when using bisoprolol and carvedilol.

There are few studies in the literature relating to the effect of bisoprolol on the induction of depression, but all these publications clearly confirm the beneficial effect of the drug on the reduced incidence of depressive episodes.

3. Carvedilol

One of the most important studies on the effect of carvedilol on depressive disorders was a study on mice that assessed the effect of carvedilol on the risk of developing depression. The animals were subjected to chronic, unpredictable stress for 21 days. Between days 15 and 22 of the experiment, 5 or 10 mg/kg of carvedilol was administered orally. On day 22, the mice's behavior was assessed, paying particular attention to locomotion, the presence of depressive behavior, as well as social interactions and working memory. The level of depressive symptoms in mice is tested by the tail hanging test, in which the immobility time of animals suspended by the tail is measured. A correlation is observed between the increase in the time of immobility of a suspended individual and the advanced level of depression. The prefrontal cortex and hippocampus of mice were dissected to assess oxidative factor and brain-derived neurotrophic factor [44]. Before drug administration, a reduction in the number of hygiene activities and their delay were observed. There were noticeable deficits in memory and social behavior, which disappeared after administration of the drug. Chronic stress decreased the concentration of glutathione in the hippocampus, while the administration of carvedilol resulted in an increase in glutathione. A similar relationship was also observed regarding brain-derived neurotrophic factor and oxidative factor. On this basis, the antidepressant and antioxidant effects of carvedilol in mice were confirmed [45].

In the study below carvedilol used in patients with erythema in the course of rosacea, by significantly reducing the level of anxiety and depressive symptoms, contributed to the alleviation of skin symptoms, especially in people under 30 years of age. The study involved 156 patients taking 5 mg of the drug for 10 weeks, and the parameters of depression and anxiety were assessed using the PSA (Patient Self-Assessment) scale and the GAD-7 generalized anxiety questionnaire [46].

Recapitulation

The largest group of patients taking β-blockers are patients treated for cardiovascular diseases. This group of patients has a higher prevalence of depressive disorders than the general population. The above-mentioned research results on the effect of these drugs on depressive symptoms were often ambiguous and varied depending on the study group and the pharmacokinetic properties of the beta-blocker drug used in the study. Those belonging to the lipophilic group, with the exception of propranolol, showed a greater likelihood of depression in most of the presented studies.

Drugs such as bisoprolol and carvedilol did not have a negative effect on mood. Moreover, studies on bisoprolol ambiguously indicated its effect in reducing the intensity of depressive symptoms. In turn, metoprolol, despite its hydrophilic nature, is considered, in most recent studies, to be a drug that may cause symptoms of depression.

Depressive disorders are diagnosed through a clinical examination, and psychopathological scales complement a medical examination, therefore it is extremely difficult to assess the symptoms of depression objectively based only on psychopathological scales. Moreover, an additional difficulty in comparing studies is the multitude of available scales used in scientific works, which sometimes differ significantly, making it impossible to conduct reliable analyzes of data from different sources.

Based on all the literature discussed above, it should be assumed that the authors of this study tend to believe that beta-blockers mostly have no effect on inducing depressive symptoms or this effect is insignificant from a clinical point of view. They reduce the level of anxiety, akathisia and tremors, but may cause fatigue and contribute to sleep disorders.

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