



MODERN TREATMENT STRATEGY FOR OVERACTIVE BLADDER SYNDROME: FROM STEP THERAPY TO A PERSONALIZED APPROACH

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Abstract

Overactive bladder syndrome (OAB) is one of the most common functional lower urinary tract disorders and is characterized by a significant impact on quality of life, sleep, social activity, and work capacity. In recent years, the concept of OAB treatment has undergone significant changes. The traditional stepwise model, based on a sequential transition from behavioral therapy to pharmacotherapy and then to invasive methods, is gradually being transformed into an individualized strategy that takes into account the clinical phenotype, age, comorbidities, cognitive risks, treatment adherence, and patient preferences.

This review analyzed the most relevant publications, including AUA/SUFU guidelines, systematic reviews, randomized clinical trials, and large cohort studies published in European Urology, European Urology Focus, Journal of Urology, BJU International, JAMA Network Open, Pharmacological Reviews, and other reputable journals.

The current model of OAB treatment is characterized by a shift from a one-size-fits-all approach to personalized therapy. Of particular importance are minimizing medication burden, reducing anticholinergic risks, early use of minimally invasive techniques, developing noninvasive neuromodulation, and using digital technologies. A promising strategy involves a combination of behavioral, pharmacological, and neuromodulatory interventions, followed by treatment adaptation based on the patient's response. **The scientific novelty of the proposed analytical approach**

The scientific novelty of this review lies not in the description of individual OAB treatment methods, but in **the conceptual integration of modern approaches**



into a single adaptive model . An analysis of the most recent and relevant research publications allows us to identify four interrelated trends:

from universal treatment to personalization - the choice of therapy is determined by the individual patient profile;

from assessing efficacy alone to assessing efficacy and safety , especially in long-term anticholinergic therapy;

from gradual escalation to early discussion of alternative methods - in case of ineffectiveness or intolerance to drug therapy;

From clinical procedure to home digital therapy - the development of wearable tibial neuromodulation systems.

Thus, modern OAB therapy can be presented not as a treatment ladder, but as **an adaptive choice system** , in which the patient's clinical phenotype determines the direction of therapeutic intervention, and the treatment outcome determines the subsequent correction of the strategy.

Keywords: Overactive bladder, urology, urgency, urge urinary incontinence, pharmacotherapy, β 3-agonists, anticholinergic drugs, botulinum toxin, neuromodulation, tibial stimulation, personalized treatment.

Introduction

Overactive bladder syndrome is a clinical syndrome characterized by urinary urgency, typically characterized by increased frequency and nocturia, with or without urge incontinence, in the absence of urinary tract infection or other obvious pathology. Despite its relatively simple clinical definition, OAB is a heterogeneous condition, encompassing patients with different mechanisms of symptom onset and varying treatment responses.

The relevance of this problem is determined not only by the high prevalence of the disease but also by the significant impact of its symptoms on quality of life. Urgency and nocturia disrupt sleep, limit social and professional activity, increase anxiety, and can contribute to social isolation. Moreover, the effectiveness of individual treatments varies significantly among patients.



In 2024, updated guidelines from the American Urological Association/Society of Urodynamics, Female Pelvic Medicine & Urogenital Reconstruction (AUA/SUFU) were published, based on a systematic review of 159 studies. They presented 33 clinical guidelines covering diagnostics, behavioral methods, pharmacotherapy, minimally invasive and invasive interventions, and the management of patients with a combination of OAB and symptoms of benign prostatic obstruction [1].

We are currently witnessing a shift from the traditional model of "drug therapy followed by invasive treatment" to a more flexible system of treatment selection. At the same time, there is increasing attention to long-term drug safety, the cognitive consequences of anticholinergic therapy, patient adherence, home neuromodulation techniques, and shared decision-making.

Changing the treatment concept for overactive bladder. Traditionally, OAB treatment was based on a stepwise approach. The first stage recommended lifestyle changes, fluid intake adjustments, and behavioral interventions. If these were insufficient, pharmacotherapy was prescribed, primarily anticholinergics or β_3 -adrenergic agonists. If drug therapy was ineffective, intravesical botulinum toxin injections or neuromodulation were used. However, this model has a fundamental limitation: it assumes that most patients must undergo the same sequence of therapeutic stages.

Current guidelines offer a more flexible approach. Once a diagnosis is established, the patient and physician should jointly determine the most appropriate strategy, taking into account the severity of symptoms, expected efficacy, potential adverse events, cost and availability of treatment, and individual patient preferences [1]. This represents a fundamental shift in therapeutic logic:

Not "what's the next step in treatment?" but "what method is optimal for this patient?" This transition is especially important in chronic OAB, when treatment must not only be initiated but also maintained over a long period.

Behavioral therapy as the foundation of treatment. Despite the rapid advancement of pharmacological and technological methods, behavioral therapy remains fundamental. It includes patient education, bladder training, fluid intake



adjustments, reduction of urgency factors, and, if necessary, pelvic floor muscle training. Of particular importance is the shift from viewing behavioral therapy as a simple “first step” to viewing it as a component of comprehensive long-term treatment.

A randomized clinical trial published in *JAMA Network Open* in 2024 evaluated a multicomponent treatment program for women with OAB, including behavioral and psychological components. The study demonstrates the potential of integrated non-pharmacological interventions, particularly in situations where symptoms are associated not only with physiological mechanisms but also with the patient's behavior and response to urgency [4].

Thus, modern behavioral therapy should not be viewed as a short-term recommendation, but as a structured program that involves patient education and regular evaluation of the results.

Pharmacotherapy: Efficacy should be assessed alongside safety. Pharmacotherapy remains a key component of OAB treatment. The main classes include anticholinergics and β 3-adrenergic agonists.

A comprehensive pharmacological analysis published in *Pharmacological Reviews* in 2023 shows that the modern pharmacology of OAB includes not only traditional targets but also a number of new potential mechanisms aimed at regulating bladder sensory function and signaling involved in the formation of urgency [3]. Moreover, the problem of pharmacotherapy is not so much the lack of effective drugs, but the need for long-term maintenance of the effect with an acceptable safety profile.

A particularly important area of research has been the comparison of anticholinergic and β 3-adrenergic therapy in terms of long-term risks. A large national cohort study published in *European Urology Focus* in 2024 compared the risk of dementia in patients with OAB treated with anticholinergic drugs, a β 3-agonist, or a combination of both. The authors emphasize the need to consider potential cognitive consequences when choosing long-term therapy, especially in elderly patients and in the presence of other risk factors [7].



This is of fundamental importance for modern urology. While previously the effectiveness of reducing urgency was considered the primary criterion for drug selection, now it is necessary to simultaneously evaluate:

- efficiency;
- portability;
- impact on cognitive function;
- drug load;
- concomitant therapy;
- likelihood of long-term commitment.

Therefore, the concept of “effective drug” should be expanded to the concept of **“optimal drug for a specific patient”**.

The problem of long-term anticholinergic therapy. One of the most significant changes in recent years has been the reassessment of long-term anticholinergic therapy. Anticholinergic medications have been proven to reduce urinary urgency, frequency, and episodes of urge incontinence. However, their use may be accompanied by dry mouth, constipation, visual impairment, urinary retention, and other side effects.

In the elderly population, the total anticholinergic load is particularly important. The presence of multiple medications with anticholinergic properties can increase the potential risk of adverse cognitive effects.

A large Korean cohort study conducted in 2024 reinforced the need to consider this aspect in long-term treatment of OAB [7]. As a result, patient age and the presence of polypharmacy are no longer secondary characteristics, but rather part of the treatment selection algorithm.

β3-Agonists and the Shift to More Individualized Pharmacotherapy. β3-Adrenergic agonists have become an important alternative to anticholinergic medications. According to the 2024 AUA/SUFU guidelines, both pharmacological groups can be used to reduce urgency, urinary frequency, and urge incontinence [1]. An important trend is the attempt to determine in advance the likelihood of a particular patient's response to treatment. This approach gradually moves drug therapy from an empirical prescription to **a predictive**



model in which the patient's clinical characteristics can potentially be used to select the most likely effective treatment.

However, the evidence base for personalized drug prescription is still insufficient. Therefore, modern practice should combine objective symptom assessment with regular reassessment of therapeutic response.

The problem of "cyclical" prescription of anticholinergic drugs. One indicator of the imperfections of traditional pharmacotherapy is the frequent change of drugs within a single class. The CYCLAMEN study, published in *European Urology Focus* in 2024, analyzed sequential anticholinergic drug regimens and their associated healthcare resource costs. The authors note that frequent drug changes are not always based on compelling evidence and may increase the burden on the healthcare system [8].

This fact has broader implications. If a patient repeatedly switches medications due to insufficient efficacy or adverse effects, this may indicate not only the need to select a different drug but also the advisability of changing **the class of therapy itself**.

Thus, the failure of several successive pharmacological interventions should be considered as a basis for an earlier transition to alternative methods, and not necessarily for further continuation of drug escalation.

New pharmacological targets: prospects and limitations. The development of new drugs for the treatment of OAB is aimed at identifying mechanisms other than classical cholinergic regulation and β_3 -adrenergic stimulation. Of interest is purinergic transmission, in particular P2X3 receptors involved in the transmission of sensory signals from the bladder.

The OVADER study, published in *European Urology Focus* in 2024, evaluated the P2X3 receptor antagonist eliapixant. The randomized, placebo-controlled phase IIa trial examined the efficacy and safety of the drug in patients with OAB and urge incontinence [9].

Although the results of early studies do not immediately translate into a new standard of treatment, the concept itself is significant. It demonstrates that future pharmacotherapy may be aimed not only at reducing detrusor activity but also at **modulating the sensory mechanisms underlying urgency**. This could



potentially allow for the development of different therapeutic strategies for patients with different pathophysiological phenotypes of OAB.

Botulinum toxin: effective when risk management is needed.

OnabotulinumtoxinA injections are one of the most proven treatments for refractory OAB. The method provides a significant reduction in symptoms, but requires consideration of a possible increase in residual urine and the need for temporary catheterization.

A study published in *European Urology Open Science* in 2023, based on a pooled analysis of data from four placebo-controlled randomised trials, examined the influence of age, gender and maximum residual urine volume on the likelihood of initiating clean intermittent catheterisation after the first injection of onabotulinumtoxinA [10].

Thus, botulinum toxin should not be considered simply as a "next step" after medication failure, but rather as a method that requires prior assessment of the patient's ability to independently control urination and potential catheterization. This is another example of the shift from a sequential to a personalized therapy model.

Neuromodulation: From a specialized procedure to a more accessible treatment. Neuromodulation is one of the most promising areas of modern functional urology. Sacral neuromodulation has already proven effective in treating refractory OAB. Obtaining data on long-term outcomes is crucial.

The SOUNDS study, published in *European Urology Focus* in 2023, presented approximately five-year results of the sacral neuromodulation system in 291 patients with OAB. The study confirmed the maintenance of clinical effect and improvement in quality of life in a significant proportion of patients in a real-world clinical setting [6].

However, implantable systems have limitations related to invasiveness, cost, and the need for surgical intervention. Therefore, the development of non-invasive tibial neuromodulation has recently attracted particular interest.

Wearable tibial neuromodulation as a new approach. In 2024, *BJU International* published a randomized clinical trial of a wearable device for transcutaneous tibial neurostimulation controlled by a smartphone. In the study,



stimulation resulted in a more significant reduction in urinary frequency compared to sham treatment: the change in urinary frequency was -3.5 versus -0.6 episodes per day. No serious device-related adverse events were observed [5]. Not only the clinical effect but also the treatment organization itself are crucial. A wearable device potentially allows for therapy to be administered at home, reducing the patient's dependence on regular medical visits. Thus, a new model is emerging:

Outpatient neuromodulation → self-administration → digital control → regular monitoring of results. This approach is particularly promising for patients who are undesirable for long-term drug therapy or who have difficulty tolerating its side effects.

From invasive to non-invasive neuromodulation. The development of neuromodulation reflects a general trend in modern urology. Initially, the focus was on implantable systems. Less invasive methods then gained popularity, and today wearable and potentially completely home-based devices are being developed.

A review of tibial neuromodulation published in 2024 found that PTNS and TTNS can reduce the severity of OAB symptoms, and implantable tibial stimulation systems also show promising results. The authors emphasize the potential advantages of home-based technologies in terms of convenience and treatment adherence [11]. Thus, a consistent technological transformation can be identified:

Clinic → outpatient procedure → minimally invasive procedure → home therapy → digital control. This transition could become one of the main directions of development in functional urology in the coming years.

A modern model of personalized treatment for OAB. It is advisable to view OAB treatment not as a fixed sequence, but as a decision-making system.

The first step is **to confirm the clinical syndrome and exclude obvious causes of the symptoms**.

The second stage is **the determination of the patient's clinical phenotype**: the prevalence of urgency, frequent urination, nocturia or urge incontinence.

The third stage is **an assessment of the factors determining the choice of treatment** :

- age;
- concomitant diseases;
- cognitive status and potential anticholinergic load;
- residual urine;
- previous treatment;
- drug tolerance;
- patient's ability to comply with therapy;
- financial and technological accessibility of methods.

The fourth stage is **the choice of initial therapy** . For some patients, a behavioral program is most appropriate, for others, pharmacotherapy, and for some patients with severe symptoms, an earlier discussion of minimally invasive treatments may be warranted.

The fifth stage is **evaluation of the response** .

Sixth - **adaptation of treatment** .

It is this last component that is crucial. Ineffective therapy should not lead to indefinite continuation of one strategy, but to a transition to a different mechanism of action. Based on the studies reviewed, the following model can be proposed:

**Концептуальная модель персонализированного
лечения гиперактивного мочевого пузыря**





However, the transition between stages does not have to be strictly linear. Patients can transition from pharmacotherapy to neuromodulation, return to combination therapy, or use several methods simultaneously. This approach can be defined as **an adaptive model of OAB treatment**.

Conclusion

Despite significant progress, the evidence base for modern OAB therapy has several limitations. First, many studies have relatively short follow-up periods. This is especially significant for new devices and non-invasive neuromodulation. Secondly, the problem of comparability between different methods remains. Differences in inclusion criteria, endpoint definitions, and the scales used make direct comparison of therapeutic strategies difficult.

Thirdly, biomarkers that would allow the most effective method to be determined in advance for a particular patient have not been sufficiently developed.

Fourth, the long-term effectiveness-safety-cost ratio needs to be better assessed.

Fifth, digitalization of treatment requires addressing issues of adherence, data protection, and clinical interpretation of information obtained from wearable devices.

The traditional model, in which treatment sequentially progressed from behavioral interventions to drug therapy and then to invasive methods, is gradually being replaced by a more flexible, personalized strategy. Pharmacotherapy remains central, but drug choice is increasingly determined not only by its ability to reduce symptoms but also by its long-term safety profile. Limiting unnecessary anticholinergic stress and considering potential cognitive risks are becoming particularly important.

At the same time, a new class of minimally invasive and non-invasive methods is developing. Botulinum toxin remains an effective option for refractory OAB, but requires an individual assessment of the risk of residual urine and the need for catheterization. Sacral neuromodulation demonstrates stable long-term results, while tibial neuromodulation is developing into home and wearable technologies. The most promising direction appears to be the combination of these methods into **an adaptive treatment model** based on initial patient stratification, shared



decision-making, assessment of efficacy and safety, and timely change of the therapeutic mechanism.

In the future, the development of biomarkers, digital symptom monitoring, wearable devices, and new pharmacological targets may lead to a further transition from syndrome-oriented treatment to truly personalized functional urology.

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