A Comparative Review of Oxybutynin Chloride Formulations: Pharmacokinetics and Therapeutic Efficacy in Overactive Bladder

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Antimuscarinic agents remain the mainstay of treatment of overactive bladder. However, the utility of some of these agents is limited due to tolerability concerns, multiple daily dosage regimens, lack of formulary coverage, and high cost. This can lead to problems with long-term compliance and may preclude optimal management. Oxybutynin has been the most widely prescribed antimuscarinic agent for more than 30 years. To meet the needs of tolerability and compliance, oxybutynin has evolved from an immediate-release pill to a once-daily oral dose and is now available as a topical gel. This review compares the various oxybutynin formulations in terms of pharmacokinetics, efficacy, and tolerability issues.
[Rev Urol. *2010;12(1):12-19 doi: 10.3909/riu0484*]

Key words: Oxybutynin • Overactive bladder • Urge incontinence • *N*-desethyloxybutynin

Overactive bladder (OAB) is a condition involving complex symptoms of urgency and frequency, with or without incontinence, that often has a negative impact on daily quality of life.[1] The approach to treating OAB is multimodal and includes both pharmacologic and nonpharmacologic treatment options. Initially, nonpharmacologic treatments are explored. In many cases, however, conservative management does not achieve the desired outcome and pharmacologic medications are used as an adjunct to behavioral therapy. Antimuscarinic drugs make up the majority of prescriptive medications used to control the symptoms of OAB.[2]

Oxybutynin is an antimuscarinic agent that has been available for more than 30 years, with a proven record of safety and efficacy in the treatment of OAB patients who require pharmacotherapy.[1,3] Striving for improved tolerability and efficacy, oxybutynin has evolved into newer formulations to treat OAB. US Food and Drug Administration (FDA)-approved formulations of oxybutynin include an oral immediate-release pill (OXY-IR), a once daily oral preparation (OXY-ER), a transdermal patch (OXY-TDS), and a topical gel (OXY-OTG). In addition, off-label formulations used in clinical practice include rectal suppositories and intravesical instillation of oxybutynin. This article compares the various oxybutynin formulations in terms of pharmacokinetics, efficacy, and tolerability issues.

General Pharmacodynamic Profile

Chemically, oxybutynin chloride is d,l (racemic) 4-diethylamino-2-butynyl phenylcyclohexylglycolate hydrochloride. Oxybutynin is a racemic (50:50) mixture of *R*- and *S*-isomers; however, its antimuscarinic activity resides predominantly with the *R*-isomer.[4,5] The chemical structure of oxybutynin is identical across (OXY-IR and OXY-ER) formulations. Oxybutynin chloride is lipophilic with a molecular weight of 393.95 and is readily soluble in water. Oxybutynin exerts mixed action on detrusor muscle by way of its direct smooth muscle antispasmodic effect, competitive antagonist of acetylcholine at postganglionic muscarinic receptors, and local anesthetic actions. However, the spasmolytic and local anesthetic effects of oxybutynin on bladder smooth muscle are approximately 500 times weaker than the antimuscarinic effects.[4]

Oxybutynin is metabolized primarily by the cytochrome P4503A4 (CYP3A4) enzyme system in the liver and intestinal wall. Upon first-pass of gastric and hepatic metabolism, oxybutynin and its primary active metabolite, *N*-desethyloxybutynin (DEO), move through the body and have been shown to be active at the muscarinic receptor sites in the bladder and the salivary gland. Although 5 muscarinic receptors have been identified (M1-M5), oxybutynin has antimuscarinic selectivity for the muscarinic receptor subtypes M1 and M3.[5] Following oral ingestion, the absolute bioavailability of oxybutynin is about 6% and the DEO plasma levels are 5 to 12 times greater than oxybutynin. Recent research has proposed that this is primarily responsible for the anticholinergic side effects of oxybutynin.[6]

Comparing Delivery Mechanism and Pharmacokinetics

Various delivery mechanisms are available for oxybutynin delivery including OXY-IR, OXY-ER, OXY-TDS, and OXY-OTG. One of the key differences distinguishing the delivery methods appears to be in the ratio of parent compound (oxybutynin) to metabolite (DEO) (Table 1). This has clinical relevance because DEO is metabolically active and has been thought to be responsible for many of the anticholinergic side effects associated with oxybutynin. The oral delivery systems (OXY-IR and OXY-ER) all go through presystemic metabolism in hepatic and intestinal enzyme systems. OXY-IR undergoes extensive upper gastrointestinal first-pass metabolism leading to high DEO:OXY ratios (4-10:1).[7] OXY-ER bypasses the upper gastrointestinal first-pass metabolism system by delaying the

Table 1
Pharmacokinetic Profiles of Oxybutynin Formulations

	Oxybutynin IR	Oxybutynin ER	Oxybutynin TDS	Oxybutynin OTG
Chemical structure	Oxybutynin	Oxybutynin	Oxybutynin	Oxybutynin
Primary metabolite	DEO	DEO	DEO	DEO
DEO:OXY ratio	5.5:1	4.3:1	1.3:1	0.8:1
Time to C_{max} (h)	~ 1	~ 4-6	~ 24-48	~ 26
Time to steady state (d)	3	3	4	7
Half-life (h)	~ 2-3	~ 12.4-13.2	~ 2	~ 62-84
Delivery system	None	Oral osmotic/matrix	Transdermal patch	Transdermal gel
Dose regimen	5 mg PO bid-qid	5-30 mg PO qd	3.9 mg (patch) q 3 days	1 g (gel) apply qd
First-pass metabolism	Bowel/liver	Bowel/liver	None	None

DEO, *N*-desethyloxybutynin; ER, extended release; IR, immediate release; OTG, transdermal gel; TDS, transdermal patch.

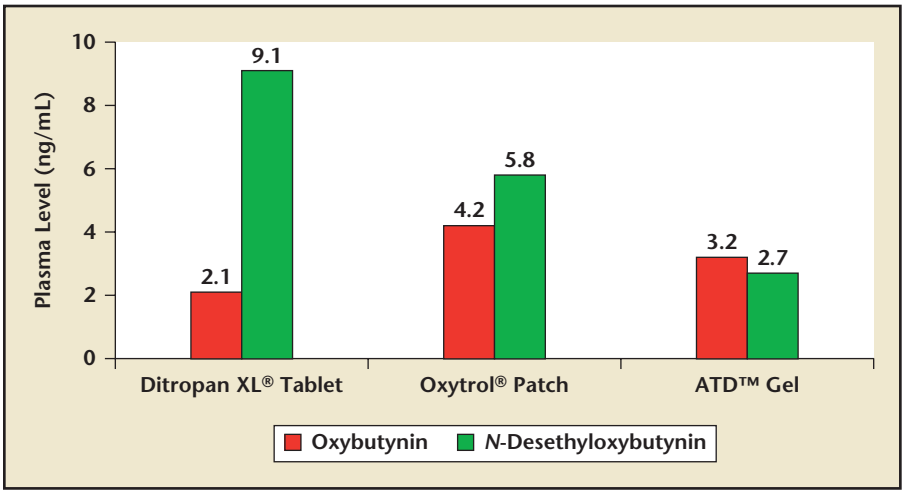

Figure 1. *Oxybutynin and* N*-desethyloxybutynin levels based on route of administration. ATD™, Advanced Transdermal Delivery Systems {Antares Pharma Inc., Ewing, NJ; Ditropan XL (Alza Corp. [a Johnson & Johson Company]); Oxytrol (Watson Pharmaceuticals, Corona, CA)}. Reproduced with permission from Alberti I et al.*[8]

release of oxybutynin and delivers it throughout the intestine in a controlled manner. Consequently, the DEO:OXY ratio (4.3:1) has been improved compared with OXY-IR (Figure 1).[8] Transdermal administration of oxybutynin essentially eliminates presystemic metabolism although a small amount of CYP3A4 is found in the skin. Consequently, OXY-TDS and OXY-OTG have the lowest DEO concentration and hence the best DEO:OXY ratios (1.3:1 OXY-TDS and 0.8:1 OXY-OTG).[8] Clinically, oxybutynin's therapeutic index of decreased anticholinergic side effects is best maximized by transdermal systems.

Comparison of Absorption and Steady State

Depending on the formulation chosen, oxybutynin absorption and eventual attainment of steady state are vastly different. As illustrated in Table 1, OXY-IR has the fastest absorption, achieving a C_{max} within an hour, whereas OXY-TDS has the longest absorption, achieving a C_{max} within 48 hours. Steady-state oxybutynin concentration is achieved first with OXY-ER and OXY-IR at 3 days followed by OXY-TDS at 4 days, and OXY-OTG at 7 days.[4,9-11] Understanding absorption characteristics and attainment of steady-state pharmacokinetics is important because patients on OXY-OTG should be counseled that they may see only minimal effects during the first week, whereas OXY-IR or OXY-ER should be effective within 3 days. Half-life is also different based on formulation, with OXY-IR and OXY-TDS having 2-hour half-lives, whereas OXY-OTG has the longest half-life at 62 to 84 hours. Formulations with a prolonged half-life allow maintenance of steady-state concentrations without daily dosing. Understanding these intricacies may be advantageous for some patients. For example, if a patient forgets to take daily OXY-OTG, serum steady-state concentrations are maintained, whereas a patient who forgets to take OXY-IR will lose steady-state concentration as well as therapeutic benefit.

Comparing Drug Interaction

Oxybutynin is metabolized via CYP3A4 enzyme, which is part of the cytochrome P450 enzyme system. Drugs that induce the CYP3A4 enzyme reduce serum concentration of oxybutynin or interacting drug, whereas drugs that inhibit CYP3A4 increase serum concentration of either drug. When OXY-IR and OXY-ER were administered with ketoconazole, a potent CYP3A4 inhibitor, mean oxybutynin plasma concentrations were approximately 3- to 4-fold higher and approximately 2-fold higher, respectively.[4,9] Although no specific drug-drug integration studies have been performed with OXY-TDS or OXY-OTG, caution should be used when prescribing oxybutynin with patients concomitantly receiving CYP3A4 inhibitors.

Comparing Food Effects

Oral drug delivery of medication has the potential for altered absorption and pharmacokinetic effect when combined with food or antacids. Data in the literature suggest that OXY-IR solution coadministered with food resulted in a slight delay in absorption and an increase in its bioavailability by 25% (n = 18).[12] The other oral agent, OXY-ER, had similar absorption and bioavailability under both fed and fasted conditions.[9] OXY-TDS and OXY-OTG do not have any issues with food interactions.

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Comparisons in Special Populations

Pediatric

Currently, only the oral formulations (OXY-IR and OXY-ER) have FDA indications for pediatric patients.

Both OXY-IR and OXY-ER were studied in children aged 5 to 15 years with neurogenic OAB who managed their bladders with intermittent catheterization and oxybutynin. OXY-IR was studied in 30 children and OXY-ER was studied in 19 children. In addition to safety, both studies demonstrated efficacy improvements in clinical and urodynamic parameters.[9,13] OXY-IR is indicated for pediatric patients with neurogenic OAB aged ≥ 5 years, whereas OXY-ER is indicated for patients aged ≥ 6 years due to the noncrushable nature of the OXY-ER formulation. The usual pediatric dose of OXY-IR is 1 5-mg tablet 2 times a day with the maximum recommended dose of 1 5-mg tablet 3 times a day (15 mg/d). OXY-ER has a recommended pediatric starting dose of 5 mg once daily at approximately the same time each day. Dosage may be adjusted in 5-mg increments to achieve a balance of efficacy and tolerability (up to a maximum of 20 mg/d). Although clinically appealing, the safety and efficacy of OXY-TDS and OXY-OTG in pediatric patients have not been established.

Geriatric

Interestingly, when OXY-IR was approved in 1975, the studies did not include sufficient numbers of subjects aged ≥ 65 years to determine whether they respond differently than do younger patients. Pharmacologically, OXY-IR's elimination half-life is prolonged from 2 to 3 hours to 5 hours in elderly patients.[4,7] Consequently, dosage with OXY-IR in the elderly should be cautiously selected. Generally, a lower initial starting dose of OXY-IR, 2.5 mg, given 2 or 3 times per day, has been recommended for elderly patients.[14]

No overall differences in pharmacokinetics, safety, or effectiveness were observed between older patients and younger patients in the OXY-ER, OXY-TDS, or OXY-OTG trials. In the registration trials, the mean age was 59 years (range, 18-98 years), 61 years (range, 20-88 years), and 59.4 years (range, 18-88 years) for OXY-ER, OXY-TDS, and OXY-OTG, respectively. Forty-nine percent of the OXY-TDS and 38% of the OXY-OTG study patients were aged ≥ 65 years.[9-11]

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Comparing Dosage and Administration

The usual adult dose for OXY-IR is 1 5-mg tablet 2 to 3 times per day with the maximum recommended dose of 1 5-mg tablet 4 times per day (20 mg/d). A lower starting dose of 2.5 mg 2 or 3 times per day is recommended for the frail elderly.[13] Unlike OXY-IR, OXY-ER must be swallowed whole with the aid of liquids, and must not be chewed, divided, or crushed. The recommended starting dose of OXY-ER is 5 to 10 mg once daily at approximately the same time each day. Dosage may be adjusted in 5-mg increments to achieve a balance of efficacy and tolerability (up to a maximum of 30 mg/d).[9] OXY-TDS and OXY-OTG should be applied to dry, intact skin on the abdomen, hip, or buttock. Rotating the application site with each new application is recommended to minimize dermatitis reactions. The dose of OXY-TDS is 1 3.9 mg/d system applied twice weekly (every 3-4 days).[10] OXY-OTG is packaged in a heat-sealed sachet that contains a 1-g unit dose (1.14 mL) of 100 mg/g oxybutynin chloride gel. The contents of 1 sachet are applied daily. Person-to-person transference of OXY-OTG is a potential issue. To minimize exposure, the application site should be covered with clothing.[11]

Comparing Efficacy Profiles

A comparison of the efficacy and tolerability profiles of oxybutynin is of clinical interest. Several head-to-head, randomized, double-blind trials comparing OXY-IR and OXY-ER have demonstrated that they are similarly effective at equivalent doses.[15-17] Continence rates are similar, as are reductions in urge incontinence and micturition frequency; however, tolerability (namely dry mouth) was much improved in favor of OXY-ER. In a titration dose study, OXY-TDS resulted in comparable clinical efficacy and urodynamic parameters to OXY-IR.[18] The daily incontinent episodes decreased 66% in the OXY-TDS groups and 72% in the OXY-IR groups. OXY-TDS, however, demonstrated a significant improved anticholinergic tolerability profile compared with OXY-IR.

Several head-to-head, randomized, double-blind trials comparing OXY-IR and OXY-ER have demonstrated that they are similarly effective at equivalent doses.

To date there have been no clinical head-to-head studies of OXY-ER, OXY-TDS, or OXY-OTG. However, both OXY-ER and OXY-TDS have been compared with tolterodine ER (TOL-ER) and have demonstrated similar efficacy.[19] In the Overactive Bladder: Performance of Extended Release

Agents (OPERA) trial, OXY-ER, 10 mg, and TOL-ER, 4 mg, were compared. Both agents reported similar decreases in urge incontinence reductions and incontinence episodes, whereas OXY-ER had a greater decrease in weekly micturition frequency (28.4 vs 25.2; $P = .003$) and overall dry rate (23% vs 16.8%; $P = .03$).

The comparative efficacy of OXY-TDS, TOL-ER (4 mg daily), and placebo were assessed in another double-blind, multicenter study.[20] There were no significant differences in any evaluated outcome parameters between OXY-TDS and TOL-ER. Both active treatments resulted in a 75% reduction in daily incontinence episodes compared with a 50% reduction with placebo (both $P < .05$ vs placebo). Upon completion of the study, 39% OXY-TDS, 38% TOL-ER, and 22% placebo patients were continent (both $P = .014$ vs placebo). OXY-OTG has not been compared with any other agent; however, its pharmacokinetics is very similar to OXY-TDS.

To truly compare efficacy of the various oxybutynin formulations, direct head-to-head trials of all agents would need to be performed. Using direct comparisons based on previous studies is fraught with criticism due to study design and methodology issues. Given the limitations noted and the data just summarized, an attempt at comparison of the efficacy of the various oxybutynin formulations can be suggested: OXY-IR, 10 mg = OXY-ER, 10 mg = TOL-ER, 4 mg = OXY-TDS = OXY-OTG.

Comparing the Tolerability Profiles

A head-to-head study has not been performed between the different new formulations of oxybutynin, which makes tolerability comparisons difficult. One method is to compare the adverse-event profiles of the various formulations. When a pooled analysis of adverse events from phase III clinical trials is performed, there is an overall lower frequency of dry mouth (6.9 vs 29 vs 71.4), constipation (1.3 vs 7 vs 13), and somnolence (0.3 vs 2 vs 14) with OXY-TDS/OTG versus OXY-ER (10 mg) versus OXY-IR.[9-11,13] (Table 2). Overall tolerability to adverse events from best to worst appears to be OXY-OTG > OXY-TDS > OXY-ER > OXY-IR. Clinical data support the concept that the therapeutic index of oxybutynin can be improved by avoiding presystemic metabolism and reducing the DEO concentration.

Central nervous system (CNS) safety has been a recent area of focus for all antimuscarinic agents. Oxybutynin and its metabolite (DEO) have characteristics (small size, neutral charge, and highly lipophilic) that potentially allow penetration into the CNS. In addition to somnolence and dizziness reported in the OXY-IR (14.9% and 16.6%, respectively) and OXY-ER (12% and 6%, respectively) trials, postmarket reports have included agitation, hallucinations, and memory impairment.[9,13] There is a paucity of quantitative electroencephalographic or CNS drug concentration data specifically evaluating oxybutynin and cognitive function. Most trials reporting on cognitive function measure via indirect methods. Katz and colleagues studied the differential effects of OXY-IR versus placebo on memory.[21] In a double-blind study, OXY-IR (5-10 mg) caused significant cognitive decrements on 7 of 15 cognitive measures. In a 3-week, randomized, double-blind study, Kay and colleagues noted that OXY-ER resulted in significant memory deterioration compared with placebo, as measured by delayed recall on the Name-Face Association Test at week 3 (mean differences, −1.30; $P = .011$).[22] The dose of OXY-ER used was 10 mg once daily at week 1, increased to 15 mg daily at week 2, and 20 mg daily by week 3. The drop in cognitive function was first measured as early as 1 week on the 10-mg dose. In contrast to the high-dose OXY-ER, Lackner and associates studied low-dose OXY-ER 5 mg in a randomized, placebo-controlled trial in cognitively impaired female nursing home residents.[23] Low-dose OXY-ER was well tolerated and was found to have no significant change in cognitive function scores at all time points between OXY-ER and placebo.

Recently, OXY-IR, OXY-OTG, and placebo were evaluated in a short comparative study using cognitive and psychomotor testing.[24] OXY-IR demonstrated evidence of impairment on specific measures of recent memory versus placebo, whereas OXY-OTG and placebo were similar. Despite its limitations, this trial raises the question of whether the CNS effects of oxybutynin could be related to the oxybutynin serum concentration and/or the metabolite DEO.[25,26] Clinical trial data support this concept in that transdermal delivery of oxybutynin has the lowest somnolent (0.3%) and dizziness (1.5%) rate of all delivery methods. Until future research is completed to further substantiate this notion, patients at risk for cognitive impairment should be monitored closely with all forms of oxybutynin.

Alternative Non–FDA-Approved Delivery Methods

In an effort to reduce the side effects of oral oxybutynin, rectal suppositories and direct bladder instillation of oxybutynin have been studied.[27-29] These nontraditional delivery methods also avoid the presystemic metabolism of oxybutynin and consequently reduce the plasma concentration of DEO. Most of the intravesical oxybutynin trials have involved adults and children with neurogenic OAB who were using intermittent

Table 2
Adverse Event Profiles of Oxybutynin Formulations (%)

Body System	Adverse Event	Oxybutynin IR	Oxybutynin XL	Oxybutynin XL	Oxybutynin TDS	Oxybutynin OTG
		5-20 mg/d (n = 199)	5-30 mg/d (n = 429)	10 mg/d (n = 576)	3.9 mg/d (n = 246)	1 g/d (n = 389)
General	Headache	7.5	10	6	> 1	1.5
	Asthenia		7	3		
	Pain		7	4		
Digestive	Dry mouth	71.4	61	29	6.9	6.9
	Constipation	15.1	13	7	1.6	1.3
	Diarrhea		9	7	1.2	
	Nausea	11.6	9	2	> 1	0.3
	Dyspepsia	6	7	5		
Nervous	Somnolence	14	12	2	> 1	0.3
	Nervousness	6.5				
	Insomnia	5.5				
	Dizziness	16.6	6	4		1.5
Respiratory	Rhinitis		6	2		2.8
Special senses	Blurred vision	9.6	8	1	1.2	
	Dry eyes		6	3		0.5
Urogenital	Urinary tract infection	6.5	5	5		6.9
	Urinary hesitation	8.5				
	Dysuria				1.2	0.3
	Urinary retention	6				
Skin	Pruritis				15.4	1.3
	Dermatitis					1.8
	Application site reaction[a]				26.8	5.4

ER, extended release; IR, immediate release; OTG, transdermal gel; TDS, transdermal patch.

[a]Includes application site pruritus, dermatitis, papules, anesthesia, erythema, irritation, and pain.

catheterization. Several clinical studies have demonstrated significant clinical urodynamic effects including decreased detrusor hyper-reflexia, increased maximum bladder capacity, and decreased detrusor pressure at bladder capacity in neurogenic OAB.[30-33] Although the optimum dose for intravesical instillation has not been determined, published studies suggest that an oral dose of 0.2 mg/kg daily (average, 10 mg daily) can be safely used intravesically.[29,31] Crushed OXY-IR pills are dissolved in sterile water or saline in concentrations of 5 mg/mL. Similar to transdermal delivery, intravesical oxybutynin avoids intestinal and hepatic first-pass metabolism (oxybutynin's presystemic metabolism) and results in a lower concentration of metabolite DEO. Buyse and colleagues demonstrated that DEO concentrations after intravesical instillation were similar to oxybutynin, whereas oral therapy produced metabolite concentrations that were, on average, 7 times higher than those of oxybutynin.[28] Although very effective in treating neurogenic OAB with minimal adverse effects, the inconvenience of the instillation procedure is often the reason for discontinuation of intravesical therapy.

Rectal suppositories may represent an interesting option for OAB treatment,

especially in patients who have an aversion to oral medication or develop allergic contact sensitivity to transdermal oxybutynin. Rectal oxybutynin suppositories minimize presystemic metabolism by avoiding the hepatic first-pass effect. Despite the lower DEO levels, Winkler and Sand reported the anticholinergic adverse events of dry mouth (48%) and constipation (14.3%), which were comparable to OXY-IR.[27] Although not commercially manufactured, oxybutynin suppositories are often obtained from compounding pharmacies that specialize in customizing medications to meet the needs and preferences of each individual client.

Conclusions

Oxybutynin has been the most prescribed agent for the treatment of OAB. Initially limited by its tolerability and poor patient compliance, oxybutynin's transformation into alternative delivery systems has improved its tolerability while maintaining its effectiveness. The newer delivery systems maintain steady-state characteristics and, most importantly, avoid the presystemic metabolism of oxybutynin. This reduction in DEO levels appears to improve the therapeutic tolerability of oxybutynin. Although no head-to-head trials have been performed comparing extended-release and transdermal preparations, the various oxybutynin formulations (OXY-IR, 10 mg, OXY-ER, 10 mg, OXY-TDS, and OXY-OTG) appear to have similar efficacy based on available clinical information. OXY-IR and OXY-ER have the distinct advantage of being FDA approved for use in the pediatric population. The use of oxybutynin in the elderly remains a concern. OXY-IR was not studied in geriatric patients and has had the most reported problems with CNS, memory, and cognition side effects. Early data on transdermal formulations appear to demonstrate improved cognitive tolerability in the elderly, possibly related to the DEO concentration. Generally, transdermal delivery of oxybutynin provides significant anticholinergic tolerability advantages over the oral preparations. Of the 2 transdermal preparations, OXY-OTG has fewer dermatitis reactions and may be the optimal route of administration for this safe and effective drug in properly selected patients. Knowledge of the unique attributes of the various oxybutynin delivery systems can enhance a provider's skill set in selecting the most appropriate oxybutynin formulation for patients. ■

Early data on transdermal formulations appear to demonstrate improved cognitive tolerability in the elderly, possibly related to the DEO concentration.

Generally, transdermal delivery of oxybutynin provides significant anticholinergic tolerability advantages over the oral preparations. Of the 2 transdermal preparations, OXY-OTG has fewer dermatitis reactions and may be the optimal route of administration for this safe and effective drug in properly selected patients.

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Main Points

- Oxybutynin is an antimuscarinic agent available for the treatment of overactive bladder (OAB) with a proven record of safety and efficacy in the treatment of patients who require pharmacotherapy. It has evolved into newer US Food and Drug Administration (FDA)–approved formulations including an oral immediate-release pill (OXY-IR), a once-daily oral preparation (OXY-ER), a transdermal patch (OXY-TDS), and a topical gel (OXY-OTG).
- No clinical head-to-head studies have been completed as yet comparing OXY-ER, OXY-TDS, and OXY-OTG; however, both OXY-ER and OXY-TDS have been compared with tolterodine ER (TOL-ER) and have demonstrated similar efficacy. In the Overactive Bladder: Performance of Extended Release Agents (OPERA) trial, OXY-ER, 10 mg, and TOL-ER, 4 mg, were compared, with both agents reporting similar decreases in urge incontinence reductions and incontinence episodes, whereas OXY-ER had a greater decrease in weekly micturition frequency (28.4 vs 25.2; $P = .003$) and overall dry rate (23% vs 16.8%; $P = .03$).
- OXY-IR, OXY-OTG, and placebo were evaluated in a short comparative study using cognitive and psychomotor testing. OXY-IR demonstrated evidence of impairment on specific measures of recent memory versus placebo, whereas OXY-OTG and placebo were similar. This trial raises the question of whether the central nervous system (CNS) effects of oxybutynin could be related to the oxybutynin serum concentration and/or the metabolite *N*-desethyloxybutynin (DEO).
- Oxybutynin has been the most prescribed agent for the treatment of OAB. Initially limited by its tolerability and poor patient compliance, oxybutynin's transformation into alternative delivery systems has improved its tolerability and maintained its effectiveness. The newer delivery systems maintain steady-state characteristics and avoid the presystemic metabolism of oxybutynin.
- OXY-IR, 10 mg, OXY-ER, 10 mg, OXY-TDS, and OXY-OTG appear to have similar efficacy based on available clinical information. OXY-IR and OXY-ER have the advantage of being FDA approved for use with pediatric patients, although the use of oxybutynin in the elderly, remains a concern. OXY-IR was not studied in geriatric patients and has had the most reported problems with CNS, memory, and cognition side effects. Early data on transdermal formulations appear to demonstrate improved cognitive tolerability in the elderly possibly related to the DEO concentration.