were similar on days 7 and 14 at approximately 0.08 ng/mL and 0.09 ng•hr/mL respectively, indicating that a steady bimatoprost concentration was reached during the first week of ocular dosing.

Distribution

Bimatoprost is moderately distributed into body tissues and the systemic volume of distribution in humans at steady-state was 0.67 l/kg. In human blood, bimatoprost resides mainly in the plasma. The plasma protein binding of bimatoprost is approximately 88%.

Biotransformation

Bimatoprost is the major circulating species in the blood once it reaches the systemic circulation following ocular dosing. Bimatoprost then undergoes oxidation, N-deethylation and glucuronidation to form a diverse variety of metabolites.

Elimination

Bimatoprost is eliminated primarily by renal excretion, up to 67 % of an intravenous dose administered to healthy adult volunteers was excreted in the urine, 25% of the dose was excreted via the faeces. The elimination half-life, determined after intravenous administration, was approximately 45 minutes; the total blood clearance was 1.5 l/hr/kg.

Characteristics in elderly patients

After twice daily dosing with bimatoprost 0.3 mg/mL eye drops, solution, the mean $AUC_{0\text{-}24hr}$ value of 0.0634 ng•hr/mL bimatoprost in the elderly (subjects 65 years or older) were significantly higher than 0.0218 ng•hr/mL in young healthy adults. However, this finding is not clinically relevant as systemic exposure for both elderly and young subjects remained very low from ocular dosing. There was no accumulation of bimatoprost in the blood over time and the safety profile was similar in elderly and young patients.

12. PRECLINICAL SAFETY DATA

Effects in non-clinical studies were observed only at exposures considered sufficiently in excess of the maximum human exposure indicating little relevance to clinical use.

Monkeys administered ocular bimatoprost concentrations of ≥0.3 mg/mL daily for 1 year had an increase in iris pigmentation and reversible dose-related periocular effects characterised by a prominent upper and/or lower sulcus and widening of the palpebral fissure. The increased iris pigmentation appears to be caused by increased stimulation of melanin production in melanocytes and not by an increase in melanocyte number. No functional or microscopic changes related to the periocular effects have been observed, and the mechanism of action for the periocular changes is unknown.

Bimatoprost was not mutagenic or carcinogenic in a series of *in vitro* and *in vivo* studies.

Bimatoprost did not impair fertility in rats up to doses of 0.6 mg/kg/day (at least 103-times the intended human exposure). In embryo/foetal developmental studies abortion, but no developmental effects were seen in mice and rats at doses that were at least 860-times or 1700- times higher than the dose in humans, respectively. These doses resulted in systemic exposures of at least 33- or 97-times higher, respectively, than the intended human exposure. In rat peri/postnatal studies, maternal toxicity caused reduced gestation time, foetal death, and decreased pup body weights at ≥ 0.3 mg/kg/day (at least 41-times the intended human exposure). Neurobehavioural functions of offspring were not affected.

13. HOW SUPPLIED/STORAGE AND HANDLING

LUMIGAN® 0.01% (bimatoprost ophthalmic solution) is supplied sterile in opaque white low density polyethylene ophthalmic dispenser bottles and tips with turquoise polystyrene caps in the following sizes: 3 mL fill in a 5 mL container

Storage: LUMIGAN® 0.01% should be stored below 30°C. Discard unused contents 4 weeks after opening.

Manufactured by: Allergan Pharmaceuticals Ireland, Castlebar Road, Westport, County Mayo, Ireland

Date of revision: August 2023 (CCDS v13.0)

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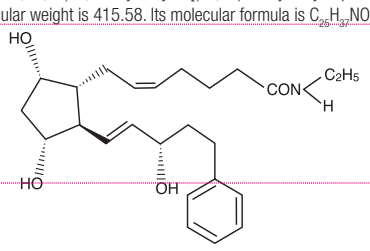
LUMIGAN® 0.01%

(bimatoprost ophthalmic solution)

1. DESCRIPTION

LUMIGAN® 0.01% (bimatoprost ophthalmic solution) is a synthetic prostamide analog with ocular hypotensive activity. Its chemical name is (Z)-7-[(1R,2R,3R,5S)-3,5-Dihydroxy-2-[(1E,3S)-3- hydroxy-5-phenyl-1-pentenyl]cyclopentyl]-5-N-ethylheptenamide, and its molecular weight is 415.58. Its molecular formula is $C_{25}H_{37}NO_4$. Its chemical structure is:



Bimatoprost is a powder, which is very soluble in ethyl alcohol and methyl alcohol and slightly soluble in water. LUMIGAN® 0.01% is a clear, isotonic, colorless, sterile ophthalmic solution with an osmolality of approximately 290 mOsmol/kg.

LUMIGAN® 0.01% contains Active: bimatoprost 0.1 mg/mL; Preservative: benzalkonium chloride 0.2 mg/mL; Inactives: sodium chloride; sodium phosphate, dibasic; citric acid; and purified water. Sodium hydroxide and/or hydrochloric acid may be added to adjust pH. The pH during its shelf life ranges from 6.8-7.8.

2. INDICATIONS AND USAGE

LUMIGAN® 0.01% (bimatoprost ophthalmic solution) is indicated for the reduction of elevated intraocular pressure in chronic open-angle glaucoma and ocular hypertension in adults (as monotherapy or as adjunctive therapy to beta-blockers).

3. DOSAGE AND ADMINISTRATION

Dosage

The recommended dosage is one drop in the affected eye(s) once daily, administered in the evening. The dose should not exceed once daily, as more frequent administration may lessen the intraocular pressure lowering effect.

Paediatric population:

The safety and efficacy of LUMIGAN® in children aged 0 to 18 years has not yet been established.

Patients with hepatic and renal impairment:

LUMIGAN® has not been studied in patients with renal or moderate to severe hepatic impairment and should therefore be used with caution in such patients. In patients with a history of mild liver disease or abnormal alanine aminotransferase (ALT), aspartate aminotransferase (AST) and/or bilirubin at baseline, bimatoprost 0.3 mg/mL eye drops, solution had no adverse effect on liver function over 24 months.

Method of administration

If more than one topical ophthalmic medicinal product is being used, each one should be administered at least 5 minutes apart.

4. DOSAGE FORMS AND STRENGTHS

Ophthalmic solution containing bimatoprost 0.1 mg/mL.

5. CONTRAINDICATIONS

LUMIGAN® 0.01% is contraindicated in patients with clinically significant hypersensitivity to bimatoprost or to any of the excipients.

LUMIGAN® 0.01% is contraindicated in patients who have had a suspected previous adverse reaction to benzalkonium chloride that has led to discontinuation.

6. WARNINGS AND PRECAUTIONS

Ocular

Before treatment is initiated, patients should be informed of the possibility of eyelash growth, darkening of the eyelid skin and increased iris pigmentation, since these have been observed during treatment with LUMIGAN®. Some of these changes may be permanent, and may lead to differences in appearance between the eyes when only one eye is treated. Increased iris pigmentation is likely to be permanent. The pigmentation change is due to increased melanin content in the melanocytes rather than to an increase in the number of melanocytes. The long term effects of increased iris pigmentation are not known. Iris colour changes seen with ophthalmic administration of bimatoprost may not be noticeable for several months to years. Typically, the brown pigmentation around the pupil spreads concentrically towards the periphery of the iris and the entire iris or parts become more brownish. Neither naevi nor freckles of the iris appear to be affected by the treatment. At 12 months, the incidence of iris hyperpigmentation with bimatoprost 0.01% eye drops, solution was 0.5%. At 12 months, the incidence with bimatoprost 0.03% eye drops, solution was 1.5% (see ADVERSE REACTIONS) and did not increase following 3 years treatment. Periorbital tissue pigmentation has been reported to be reversible in some patients.

Cystoid macular oedema has been uncommonly reported (≥1/1,000 to <1/100) following treatment with bimatoprost 0.3 mg/mL eye drops, solution. Therefore, LUMIGAN® should be used with caution in patients with known risk factors for macular oedema (e.g. aphakic patients, pseudophakic patients with a torn posterior lens capsule).

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ARTWORK TEMPLATE
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There have been rare spontaneous reports of reactivation of previous corneal infiltrates or ocular infections with bimatoprost 0.3 mg/mL eye drops, solution. LUMIGAN® should be used with caution in patients with a prior history of significant ocular viral infections (e.g. herpes simplex) or uveitis/iritis.

LUMIGAN® has not been studied in patients with inflammatory ocular conditions, neovascular, inflammatory, angle-closure glaucoma, congenital glaucoma or narrow-angle glaucoma.

Skin

There is a potential for hair growth to occur in areas where LUMIGAN® solution comes repeatedly in contact with the skin surface. Thus, it is important to apply LUMIGAN® as instructed and avoid it running onto the cheek or other skin areas.

Respiratory

LUMIGAN® has not been studied in patients with compromised respiratory function. While there is limited information available on patients with a history of asthma or COPD, there have been reports of exacerbation of asthma, dyspnoea and COPD, as well as reports of asthma, in post marketing experience. The frequency of these symptoms is not known. Patients with COPD, asthma or compromised respiratory function due to other conditions should be treated with caution.

Cardiovascular

LUMIGAN® has not been studied in patients with heart block more severe than first degree or uncontrolled congestive heart failure. There have been a limited number of spontaneous reports of bradycardia or hypotension with bimatoprost 0.03% eye drops, solution. LUMIGAN® should be used with caution in patients predisposed to low heart rate or low blood pressure.

Other Information

In studies of bimatoprost 0.03% in patients with glaucoma or ocular hypertension, it has been shown that the more frequent exposure of the eye to more than one dose of bimatoprost daily may decrease the IOP-lowering effect (see DRUG INTERACTIONS). Patients using LUMIGAN® with other prostaglandin analogues should be monitored for changes to their intraocular pressure.

LUMIGAN® 0.01% contains the preservative benzalkonium chloride (200 ppm), which may be absorbed by soft contact lenses. Eye irritation and discolouration of the soft contact lenses may also occur because of the presence of benzalkonium chloride. Contact lenses should be removed prior to instillation and may be reinserted 15 minutes following administration.

Benzalkonium chloride, which is commonly used as a preservative in ophthalmic products, has been reported to cause punctate keratopathy and/or toxic ulcerative keratopathy. Since LUMIGAN® 0.01% contains 200 ppm benzalkonium chloride (four times the concentration in bimatoprost 0.03% eye drops), it should be used with caution in dry eye patients, in patients where the cornea may be compromised and in patients taking multiple BAK-containing eye drops. In addition, monitoring is required with prolonged use in such patients.

There have been reports of bacterial keratitis associated with the use of multiple dose containers of topical ophthalmic products. These containers had been inadvertently contaminated by patients who, in most cases, had a concurrent ocular disease. Patients with a disruption of the ocular epithelial surface are at greater risk of developing bacterial keratitis.

Patients should be instructed to avoid allowing the tip of the dispensing container to contact the eye or surrounding structures, to avoid eye injury and contamination of the solution.

Effects on Ability to Drive and Use Machines

LUMIGAN® has negligible influence on the ability to drive and use machines. As with any ocular treatment, if transient blurred vision occurs at instillation, the patient should wait until the vision clears before driving or using machines.

7. Drug Interactions

No interaction studies have been performed.

No interactions are anticipated in humans, since systemic concentrations of bimatoprost are extremely low (less than 0.2 ng/mL) following ocular dosing with bimatoprost 0.03% eye drops.

Bimatoprost is biotransformed by any of multiple enzymes and pathways, and no effects on hepatic drug metabolising enzymes were observed in preclinical studies .

In clinical studies, LUMIGAN® 0.03% eye drops (multidose) was used concomitantly with a number of different ophthalmic beta blocking agents without evidence of interactions.

Concomitant use of LUMIGAN® and antiglaucomatous agents other than topical beta blockers has not been evaluated during adjunctive glaucoma therapy.

There is a potential for the IOP-lowering effect of prostaglandin analogs (e.g., LUMIGAN®) to be reduced in patients with glaucoma or ocular hypertension when used with other prostaglandin analogs (see WARNING AND PRECAUTIONS).

8. ADVERSE REACTIONS

In a 12-month Phase III clinical study approximately 38 % of patients treated with LUMIGAN® 0.01% eye drops, solution experienced adverse reactions. The most frequently reported adverse reaction was conjunctival hyperaemia (mostly trace to mild and of a non-inflammatory nature) occurring in 29% of patients. Approximately 4 % of patients discontinued due to any adverse event in the 12-month study.

The following adverse reactions were reported during clinical trials with LUMIGAN® 0.01% eye drops, solution or in the post-marketing period. Most were ocular, mild and none was serious.

Very common (≥1/10); common (≥1/100 to <1/10); uncommon (≥1/1,000 to <1/100); rare (≥1/10,000 to <1/1,000); very rare (<1/10,000); not known (cannot be estimated from available data) adverse reactions are presented according to System Organ Class in Table 1 in order of decreased seriousness within each frequency grouping.

Table 1.

System Organ class	Frequency	Adverse reaction
Nervous system disorders	uncommon	headache
	not known	dizziness
Eye disorders	very common	conjunctival hyperaemia
	common	punctate keratitis, eye irritation, eye pruritus, growth of eyelashes, eye pain, erythema of eyelid, eyelid pruritus
	uncommon	asthenopia, blurred vision, conjunctival disorder, conjunctival oedema, iris hyperpigmentation, madarosis, eyelid oedema
	not known	blepharal pigmentation, macular oedema, periorbital and lid changes associated with periorbital fat atrophy and skin tightness resulting in deepening of eyelid sulcus, eyelid ptosis, enophthalmos and eyelid retraction, dry eye, eye discharge, eye edema, lacrimation increased, foreign body sensation in eyes, ocular discomfort, photophobia
Respiratory, thoracic and mediastinal disorders	not known	asthma, asthma exacerbation, COPD exacerbation and dyspnoea
Gastrointestinal disorders	uncommon	nausea
Skin and subcutaneous tissue disorders	common	skin hyperpigmentation, hypertrichosis
	uncommon	dry skin, eyelid margin crusting, pruritus
General disorders and administration site conditions	common	instillation site irritation
Immune system disorders	not known	hypersensitivity reaction including signs and symptoms of eye allergy and allergic dermatitis
Vascular disorders	not known	hypertension

Adverse reactions reported in phosphate containing eye drops:

Cases of corneal calcification have been reported very rarely in association with the use of phosphate containing eye drops in some patients with significantly damaged corneas.

9. USE IN SPECIFIC POPULATIONS

9.1 Pregnancy

There are no adequate data from the use of bimatoprost in pregnant women. Animal studies have shown reproductive toxicity at high maternotoxic doses.

LUMIGAN® should not be used during pregnancy unless clearly necessary.

There are no data on the effects of bimatoprost on human fertility.

9.2 Nursing Mothers

It is unknown whether bimatoprost is excreted in human milk. Animal studies have shown excretion of bimatoprost in breast milk. A decision must be made whether to discontinue breast- feeding or to discontinue from LUMIGAN® therapy taking into account the benefit of breast- feeding for the child and the benefit of therapy for the woman.

10. OVERDOSAGE

No case of overdose has been reported, and is unlikely to occur after ocular administration. If overdose occurs, treatment should be symptomatic and supportive. If LUMIGAN® is accidentally ingested, the following information may be useful: in two-week oral mouse and rat studies, doses up to 100 mg/kg/day did not produce any toxicity. This dose expressed as mg/m^2 is at least 210 times higher than the accidental dose of one bottle of LUMIGAN® 0.01% for a 10 kg child.

11. CLINICAL PHARMACOLOGY

Pharmacotherapeutic group: Ophthalmologicals, prostaglandin analogues, ATC code: S01EE03.

11.1 Mechanism of Action

The mechanism of action by which bimatoprost reduces intraocular pressure in humans is by increasing aqueous humour outflow through the trabecular meshwork and enhancing uveoscleral outflow. Reduction of the intraocular pressure starts approximately 4 hours after the first administration and maximum effect is reached within approximately 8 to 12 hours. The duration of effect is maintained for at least 24 hours.

Bimatoprost is a potent ocular hypotensive agent. It is a synthetic prostamide, structurally related to prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$), that does not act through any known prostaglandin receptors. Bimatoprost selectively mimics the effects of newly discovered biosynthesised substances called prostamides. The prostamide receptor, however, has not yet been structurally identified.

During a 12-month pivotal study in adults with LUMIGAN® 0.01% eye drops, the mean diurnal IOP values measured at any visit over the 12-month study period differed by no more than 1.1 mmHg throughout the day and were never greater than 17.7 mmHg.

LUMIGAN® 0.01% eye drops contains BAK in a concentration of 200 ppm.

Limited experience is available with the use of LUMIGAN® in patients with open-angle glaucoma with pseudoexfoliative and pigmentary glaucoma, and chronic angle-closure glaucoma with patent iridotomy.

No clinically relevant effects on heart rate and blood pressure have been observed in clinical trials.

Paediatric population

The safety and efficacy of LUMIGAN® in children aged 0 to less than 18 years has not been established.

11.2 Pharmacokinetics

Absorption

Bimatoprost penetrates the human cornea and sclera well *in vitro*. After ocular administration in adults, the systemic exposure of bimatoprost is very low with no accumulation over time. After once daily ocular administration of one drop of 0.3 mg/mL bimatoprost to both eyes for two weeks, blood concentrations peaked within 10 minutes after dosing and declined to below the lower limit of detection (0.025 ng/mL) within 1.5 hours after dosing. Mean C_{max} and $AUC_{0\text{-}24hrs}$ values

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