

Draft Guidance on Loteprednol Etabonate; Tobramycin

This draft guidance, when finalized, will represent the current thinking of the Food and Drug Administration (FDA, or the Agency) on this topic. It does not establish any rights for any person and is not binding on FDA or the public. You can use an alternative approach if it satisfies the requirements of the applicable statutes and regulations. To discuss an alternative approach, contact the Office of Generic Drugs.

Active Ingredient: Loteprednol etabonate; Tobramycin

Dosage Form; Route: Suspension/drops; ophthalmic

Strength: 0.5%; 0.3%

Recommended Study: Two options

I. Option one: In vitro studies

To qualify for the in vitro option for this drug product (Loteprednol etabonate; Tobramycin 0.5%;0.3%) all of the following criteria should be met:

- i. The test and reference listed drug (RLD) formulations are qualitatively¹ and quantitatively² the same (Q1/Q2)³
- ii. Acceptable comparative physicochemical characterizations of the test and the designated reference standard (RS) product. The comparative characterization study should be performed on at least three batches of both the test⁴ and RS products and should include:
 - Appearance, pH, specific gravity, osmolality, surface tension, and viscosity
 - Soluble fraction of loteprednol etabonate in the final drug product
 - Drug particle size distribution. The particle size distribution should be compared using population bioequivalence (PBE) (95% upper confidence bound) based on D₅₀ and SPAN [i.e. (D₉₀-D₁₀)/D₅₀]. The applicant should provide no fewer than ten data sets from three different batches of both the test and RS products for PBE analysis. Full profiles of the particle size distribution should also be submitted for all samples tested. Refer to the *Guidance on Budesonide* inhalation suspension for additional information regarding PBE.

¹ Q1 (qualitative sameness) means that the test product uses the same inactive ingredient(s) as the RLD product.

² Q2 (quantitative sameness) means that the concentrations of the inactive ingredient(s) used in the test product are within ±5% of those used in the RLD product.

³ For ophthalmic drug products, FDA has determined that, as a scientific matter, any qualitative or quantitative deviations from the RLD, even in inactive ingredients listed in 21 CFR 314.94(a)(9)(iv), should be accompanied by an appropriate in vivo BE study or studies. *ANDA Submissions –Refuse-to-Receive Standards: Guidance for Industry*

⁴ The manufacturing process for exhibit batches should be reflective of the process used for the commercial batches.

- iii. Acceptable comparative in vitro drug release of loteprednol etabonate from the test and RS products⁵.
 - iv. Acceptable comparative in vitro antimicrobial kill rates of the test and RS products (Specific recommendations are provided below).
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II. Option Two: In vivo and in vitro studies

1. Type of study: Bioequivalence study with pharmacokinetic (PK) endpoints
Design: Single-dose, crossover or parallel design, in vivo in aqueous humor
Strength: 0.5%; 0.3%
Subjects: Patients undergoing indicated cataract surgery
Additional Comments: Specific recommendations are provided below.
 2. Type of study: In vitro bioequivalence study
Design: In vitro microbial kill rate study
Strength: 0.5%; 0.3%
Subjects: Not applicable
Additional Comments: Specific recommendations are provided below.
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In vivo pharmacokinetic study in aqueous humor: This study should be conducted in order to evaluate the steroid component (Loteprednol etabonate) of the fixed dose combination product.

Analyte to measure: Loteprednol etabonate in aqueous humor

Bioequivalence based on (90% CI): Loteprednol etabonate

Additional Comments Regarding the In Vivo Pharmacokinetic Study in Aqueous Humor:

1. An in vivo bioequivalence study is recommended for any loteprednol etabonate; tobramycin 0.5%;0.3% ophthalmic suspension test product that has a different inactive ingredient from the RLD, a difference of more than 5% in the amount of any inactive ingredient compared to that of the RLD, or differences in comparative physicochemical characterization data. In addition, the applicant should identify and characterize the differences and provide information demonstrating that the differences do not affect the safety or efficacy of the proposed drug product.
2. The study is conducted in patients undergoing indicated cataract surgery and scheduled to receive ophthalmic corticosteroids just prior to their eye surgery. A single dose of the test or reference product is instilled into the inferior cul de sac of the eye prior to cataract extraction. Only one single sample of aqueous humor is collected from one eye from each patient, at one

⁵ Note that, if determined to be warranted, an in vitro release test (IVRT) method used as part of the quality control specifications may and/or can ultimately be different than the IVRT method developed to support bioequivalence determination, and will be assessed at the time of review of the ANDA.

assigned sampling time point.

Applicant may consider a parallel design for the bioequivalence study. If using a parallel study design, note that each patient should receive only one treatment, test or reference, but not both. Alternatively, a crossover study design may be used in patients undergoing indicated cataract surgery for both eyes. When crossover study design is used, each patient should receive both of test and reference treatments. The wash-out period for the crossover study should not exceed 35 days.

3. In order to demonstrate bioequivalence, an adequate estimation of the rate (Cmax) and extent (AUC) of loteprednol etabonate absorption is needed.

The following statistical model is recommended:

The mean AUC_t for each product and time point t of measurement is calculated by using the mean concentrations (\overline{C}_t) at each time point t to derive the mean profile for each product. On the basis of the trapezoid rule, mean AUC_t is computed as the weighted linear combination of these mean concentrations at each time point through time t . The AUC_t is the area under the concentration - time curve from zero to the time t . Generally, we have j concentration measurements at times $t_1 < t_2 < t_3 \dots < t_j$ ($t_1 > 0$).

AUC_{t_j} is calculated for time from 0 to t_j as:

$$AUC_{t_j} = t_1 \times \overline{C}_{t_1} / 2 + \sum_{i=1}^{j-1} (\overline{C}_{t_i} + \overline{C}_{t_{i+1}}) \times (t_{i+1} - t_i) / 2$$

The ratio (R_t) of AUC_t from the test product to AUC_t from the reference product is used to assess bioequivalence for each time t of interest. Estimation of the standard deviation(s) of R_t may be done via the bootstrapping technique or a parametric method.

Bioequivalence is supported if the 90% confidence interval for R_t ($R_t \pm 1.645 s_t$) lies within (0.8, 1.25). The bootstrapping technique or a parametric method can be used to determine Cmax and Tmax and assess bioequivalence for Cmax.

4. The study design and statistical analysis plan should be specified *a priori* in the protocol. All details of the computations, including computation code should be submitted in the application.

Additional Comments Regarding the In Vitro Microbial Kill Rate Study:

1. An in vitro microbial kill rate study should be conducted in order to evaluate the antibiotic portion (tobramycin) of the combination product. The study should compare the antimicrobial activity of tobramycin in the test and reference product against the following:

- All organisms listed in the USP Preservative Effectiveness Test
- All organisms listed in the “Indications” section of the reference product labeling

The antimicrobial activity of tobramycin in the test and reference products should be compared in the in vitro BE study, at a minimum, against the following 17 organisms: *Candida albicans*, *Aspergillus niger*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Staphylococci epidermidis*, *Streptococcus pneumoniae*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Proteus mirabilis*, *Morganella morganii*, *Proteus vulgaris*, *Haemophilus influenzae*, *Haemophilus aegyptius*, *Moraxella lacunata*, *Acinetobacter calcoaceticus*, *Neisseria perflava* or *Neisseria sicca*.

The in vitro microbial kill rate study should be conducted by using at least 12 replicates for each kill rate study of each organism to demonstrate bioequivalence (BE) between the test and reference products.

2. The test and reference formulations, along with a negative control, should be compared in vitro for bacterial kill rates. Kill rates should be determined for each product and equivalence declared if both the test and reference products produce the same in vitro kill rates on all organisms tested. The following are additional recommendations regarding the study design:
 - a. The solution in which the testing for activity of the antibacterial agent in the test product is done should mimic as closely as possible the lacrimal fluid of the eye in composition, molarity, pH, etc.
 - b. The testing procedure should include some way for the antimicrobial agent to be inactivated at the time samples are withdrawn to perform colony counts for surviving organisms (e.g. filtration, dilution, chemical).
 - c. The time at which samples are withdrawn to determine organism survival should be: 0, 7.5, 15, 30 and 60 minutes. The two one-sided test procedure is recommended to determine the 90% confidence interval for the test/reference ratios of average kill rate for each sampling time point.
 - d. The organisms to be tested are those listed in USP <51> Antimicrobial Effectiveness Testing and organisms to be listed in the package insert for the product.
 - e. The final inoculum concentration of bacteria, yeast or spores that are tested should be at least 5×10^5 CFU/mL.
 - f. Media used to determine the organism survival should be appropriate to allow for recovery of surviving organisms.
 - g. The temperature at which organism recovery media are incubated should be the temperature of the eye.
 - h. All recovery media should be incubated for the appropriate amount of time to allow for the growth of the organism for which recovery is being attempted.
 - i. Recovery of organism testing should be done in triplicate at each dilution of test material.
 - j. The method of determining the colony counts of organism on survival media should be described in the protocol (e.g. counted under magnification).
 - k. The test methodology will need to be validated prior to using it to determine activity of the product against the organisms. It is suggested that at the time a test method is being written that a validation protocol be written.