

Successful Treatment of Chytridiomycosis

By Donald K. Nichols and Elaine W. Lamirande

Batrachochytrium dendrobatidis is a recently discovered species of chytridiomycete (chytrid) fungus (Longcore et al., 1999) that has been isolated from many different amphibian species with fatal skin infections (Longcore, 2000). In experimental studies with dendrobatid frogs (*Dendrobates tinctorius* and *D. auratus*), we showed that *B. dendrobatidis* can be a primary pathogen (Nichols et al., 2001). The earliest clinical sign of chytridiomycosis in dendrobatid frogs is excessive shedding of skin; ante mortem diagnosis of chytrid infection can often be made through microscopic examination of shed skin and/or skin imprints (Nichols et al, 2001).

In another study, we experimentally infected juvenile *D. tinctorius* and then, once excessive skin shedding had begun, we treated them topically with one of three antimicrobial drugs: trimethoprim-sulfadiazine (TMS), miconazole, or itraconazole (Nichols et al., 2000). A powdered form of itraconazole was suspended in 1% methyl cellulose to make a 1% suspension of itraconazole; this was then diluted with 0.6% saline to a final concentration of 0.01% itraconazole in suspension. A 1% solution of miconazole was diluted with 0.6% saline to a final concentration of 0.01% miconazole. A 48% solution of TMS was diluted with saline to a final concentration of 0.1%. Infected frogs were treated by immersion in one of the three solutions or suspensions for five minutes per day for either eight (miconazole) or 11 (itraconazole and TMS) consecutive days. At the end of the study, all frogs were euthanized and examined histologically.

Although treatment with TMS prolonged the frogs' lives compared to untreated controls, it did not eliminate the chytrids from the frogs. All frogs treated with either miconazole or itraconazole were cured of chytrid infection. However, the miconazole treatments were poorly tolerated by the frogs which caused us to end that part of the experiment earlier than planned; in retrospect, this was probably due to ethyl alcohol in the original 1% stock solution.

We have subsequently used topical baths in 0.01% suspensions of itraconazole to successfully treat other experimentally infected *D. tinctorius* (Nichols and Lamirande, 2000) and naturally infected *Litoria caerulea* (unpublished data). This appears to be a highly effective treatment for chytridiomycosis in captive juvenile and adult anuran amphibians. Further studies are needed to determine if this treatment is efficacious and safe to use in tadpoles and caudates.

Itraconazole is a potent drug with fungicidal activity against a wide spectrum of fungal organisms. Therefore, it should not be indiscriminately used to treat wild populations of amphibians or to prophylactically treat captive animals.

Itraconazole is commercially available as a 1% solution (Sporanox, Janssen Pharmaceutica, Inc.), rather than the suspension that we formulated. This solution contains hydrochloric acid and propylene glycol as solvents and has a pH of 2; we do not know if this solution is safe to use on amphibians. Our experience with the frogs' reactions to the diluted miconazole solution clearly illustrates that caution must be exercised when attempting to use various drug formulations to treat amphibians.

References

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