EDITORIAL

Alternative Models in Neuropharmacology: The Zebrafish (*Danio rerio*)

Zebrafish (Danio rerio) has received attention as a powerful animal model for a range of human brain disorders [1]. Zebrafish is a small, low-cost, and genetically tractable aquatic vertebrate species with a high degree of morphological, physiological, and genetic homology to humans [2]. Although fish are considered primitive vertebrates because of their early evolutionarily appearance, their brain structure and function and rich behavioral repertoire are comparable to those of mammals [3]. Therefore, this fish is a powerful animal model for investigating mechanisms underlying complex behaviors, modeling neurological and neuropsychiatric disorders, and identifying molecular targets for drug treatment. The reviews in this thematic selection of articles updated insights on zebrafish as a model of translational neuroscience research.

The review by Costa *et al.* [4] discussed that zebrafish models can represent emergent tools to investigate pain-related behavioral responses and mood disorders and facilitate analgesic drug screening in translational pain research. The authors also highlight the advantages and limitations of the existing models to investigate the mechanisms involved in pain responses from an evolutionary perspective.

Bevenutti *et al.* [5] reviewed the findings related to the behavioral effects of NMDAR antagonists in zebrafish and discussed different experimental procedures, showing that zebrafish is an appropriate model to examine drug-induced behavioral phenotypes relevant to schizophrenia.

Regarding neurodegenerative diseases, Kiper and Freeman [6] discussed genetic editing technologies, which have been used to develop models in zebrafish to investigate mechanisms and targets of Alzheimer's disease. Although some neuropathological features of Alzheimer's disease are not seen in wild-type zebrafish, the genetic editing technologies have permitted the evaluation of the effects of amyloid and neurofibrillary tangles using zebrafish.

The review by Altenhofen and Bonan [7] discussed the use of zebrafish as a model to investigate sleep mechanisms and memory-related disorders. In addition, drugs are known to modulate sleep, such as melatonin, nootropics, and nicotine, demonstrating this species as a promising model for sleep research. In this context, Faillace and Bernabeu [8] discussed that epigenetic regulation participates in installing persistent adaptations and long-lasting synaptic plasticity generated by nicotine action on the mesolimbic dopaminergic neurons of zebrafish, and interventions in the epigenetic regulation have the potential to the therapeutics for nicotine addiction treatment.

Complementing rodent models, zebrafish is a promising organism in neuropharmacology research. In the review by De Abreu *et al.* [9], the increasing value of zebrafish for testing neurotropic effects of American Traditional Medicine was highlighted as well as their potential for the treatment of neurological disorders. In the review by Clayman and Connaughton [10], neuropharmacological and behavioral effects of caffeine and/or alcohol exposure in the zebrafish were explored, focusing on neurochemistry and behavioral analysis. The authors compared findings in zebrafish and rodent models, illuminating similarities across species and conservation of mechanisms that potentially reinforce ethanol and caffeine co-addiction. In this sense, the systematic review by Schaidhauer *et al.* [11] reported behavioral studies that focus on the impact of early alcohol exposure using zebrafish to observe if these models are similar to the behavioral effects of early alcohol exposure in humans.

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