Ontogeny of steroid hormone metabolism gene transcription during embryo-larval development of the zebrafish

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Zebrafish is widely accepted as an ideal model for studying vertebrate development and impairment of normal development. Early life stages of the zebrafish have been well described morphologically, but little is known about the role of the endocrine system in early development. Although some studies have shown that hormones are involved in various stages of development, available information is still limited.

In this study we described the transcriptional dynamics of key genes involved in the steroid hormone system during normal zebrafish development, which has never been done so far. We isolated RNA at 25 time points between 0 and 32 days of development. We selected genes coding for the key enzymes involved in steroid hormones biosynthesis (cyp11a1, cyp11a2, cyp17a1, cyp11c1, cyp19a1a, cyp19a1b, hsd17b3, hsd11b2 and hsd17b), the estrogen and androgen receptors (esr1, esr2a, esr2b, gper and ar), enzymes involved in cholesterol biosynthesis (hmgcrα, hmgcrβ) and vitellogenin (vtg1), a widely used biomarker for toxicological experiments. mRNA levels of these genes were measured using QPCR.

Our results show that some genes, like hsd17b3, esr2a and ar, are maternally transferred. This suggests an important role of steroid hormones in programming the earliest stages of zebrafish development before the embryo's genome is activated around 3hpf. Further, we observed that the nuclear estrogen receptors have very different transcriptional patterns during development. Around the time of embryonic genome activation, esr1 is abundantly transcribed by the embryo itself and the level of transcription remains high during the entire larval period. After the first day, transcription of esr2b gradually increases and peaks during the formation of the immature gonad (around day 10). Interestingly, transcription of the enzyme hsd17b3, which is important to both estrogen and androgen synthesis, shows an early peak, suggesting that hsd17b3 may be essential to steroid synthesis during early development. During the formation of the immature gonad, transcription of brain aromatase cyp19a1b and esr2a increases, and during gonad differentiation both genes are abundantly transcribed. These results will improve our fundamental understanding of how steroid hormones contribute to the coordination of embryonic and larval development and will be broadly applicable to the zebrafish research community.

keywords: zebrafish early life stages, steroid hormone system, enzymes, receptors, gene transcription

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