Abstract

Neural crest (NC) cells play a crucial role in vertebrate development and evolution. This cell population contributes to many new cell types such as chondrocytes and osteocytes of the head skeleton, neurons, pigment cells, cardiomyocytes, and many others. As such the neural crest is often considered as the fourth germ layer. This vertebrate-specific cell population emerges during formation of the neural tube. Whereas in the trunk region NC cells migrate as separate cells, cranial neural crest (CNC) cells extensively migrate in three discrete streams forming most of the head mesenchyme. In all vertebrates, CNC stereotypically follows the tripartite pattern of migration along the anteroposterior axis so that the most anterior (trigeminal) stream emerges first, followed by the hyoid and branchial CNC streams. In this work, I have studied representatives of all three lineages of non-teleost fishes (bichir, sturgeon, and gar) and also one species from the crown group of ray-finned fishes, the pike. The main question I addressed in my project was whether the CNC cells stereotypically follow a tripartite pattern of migration along the anteroposterior axis as is seen throughout vertebrates. Surprisingly, I found several alterations in the emergence of CNC cells and their migratory pattern in the studied species. I showed that in bichir, gar, and pike embryos, the emigration of the hyoid CNC appears to be accelerated when compared to the first stream. Interestingly, this heterochronic shift in migration is developmentally associated with the early formation of their key hyoid structures, namely the external gills (bichir), large operculum (gar), and the first formed head cartilage in pike - *hyosymplectic*. Using a multiorganismal comparative approach, I was able to discern a possible shared character for all ray-finned fishes. I also revealed that the hyoid and branchial CNC cells initially constitute a single hyo-branchial sheet, which becomes separated only later in concert with the second pharyngeal pouch morphogenesis. Moreover, in all non-teleost fish embryos, I showed that the most anterior CNC cells interact with a unique rostral domain, the preoral gut, and that this rostral endodermal domain appears to provide a key patterning influence on the CNC streams.

Keywords: cranial neural crest, ray-finned fishes, hyoid stream, heterochrony, preoral gut