4

Overview of monotreme nervous system structure and evolution

Ken W. S. Ashwell

Summary

Although the brains of the modern platypus and echidnas have very distinctive features, they can be readily subdivided according to the schema applied to therian brains. The mammalian brain is derived developmentally from a segmentally organised neural tube, with distinct segments for the hindbrain (rhombomeres 1 to 11, and an isthmic segment), midbrain (two mesomeric segments) and forebrain (three prosomeres and a proneuromere region). Although the gene expression patterns that underlie these subdivisions have not been studied in monotremes, the anatomical features of internal ridges and depressions that reflect the segmentation can be identified at some stage in the developing monotreme brain.

All the modern monotremes (and also extinct members of the group) have larger brains than many modern and extinct marsupials and some placentals, although this large brain size is achieved by rather different patterns of developmental growth in the platypus and echidnas (extensive growth in cortical thickness in the former and an emphasis on cortical folding in the latter). Analysis of mammalian phylogeny on the basis of neural characters emphasises the abundance of plesiomorphic or primitive features in the monotreme central nervous system, but this analysis does not give due consideration to the sensory specialisations of the group (see Chapter 14).

Deducing the timing of monotreme brain evolution and the sequence of emergence of the distinctive neurological features of the platypus and echidnas is a frustratingly difficult task, because of the paucity of the fossil record. Nevertheless, many of the distinctive neurological features that characterise the