DEVELOPMENT

Put a lid on it!

The roof plate is a specialized population of non-neural cells that provides vital signals for dorsal spinal cord patterning. It is induced at the junction between neural and non-neural ectoderm — a region that also generates neural crest and dI1 sensory interneurons. So how does the roof plate acquire its unique molecular and cellular characteristics? Reporting in *Development*, Chizhikov and Millen show that the LIM homeodomain transcription factor Lmx1a is both necessary and sufficient to induce roof plate formation. The *Lmx1a* gene is inactivated in the *dreher* mouse mutant, which fails to develop a roof plate.

Chizhikov and Millen showed that in chick and mouse embryos, Lmx1a protein is initially expressed in progenitors that give rise to roof plate and neural crest. Later in development, it becomes restricted to cells that express roof plate-specific markers such as MafB. The authors found that if they electroporated an *Lmx1a*-expressing construct into one side of the chick neural tube, the MafB-expressing domain was expanded. Roof plate marker expression could also be induced by Lmx1a in explants of naive neural tissue. In both cases, the ectopic MafB-expressing tissue exerted a roof plate-like patterning influence on adjacent tissue.

In the electroporated embryos, the *Lmx1a*-expressing cells were concentrated in the mantle zone of the neural tube, which consists largely of differentiated neurons. Also, there was a marked decrease in cell proliferation in the electroporated regions. Together, these findings indicate that Lmx1a causes neural progenitor cells to withdraw from the cell cycle, an idea that was supported by the finding that the *Lmx1a*-expressing domain is expanded in *dreher* mutant mouse embryos.

Interestingly, although the electroporated embryos expressed *Lmx1a* throughout the dorsoventral axis of the neural tube, only dorsal cells acquired a roof plate identity. Therefore, additional factors are probably required to make cells competent to respond to the roof plate-inducing activity of Lmx1a. Bone morphogenetic protein (Bmp) signals from the epidermal ectoderm are likely candidates — Chizhikov and Millen found that the Bmp inhibitor Noggin also inhibits the expression of Lmx1a and roof plate markers, and ectopic Bmp signalling induces both Lmx1a and MafB expression along the dorsoventral axis of the neural tube.

Lmx1a suppresses the specification of dI1 interneurons, but neural crest progenitors seem to be refractory to its effects. Therefore, although Lmx1a can account for the segregation of roof plate and dI1 lineages, further investigations will be required to find out how different lineages are generated from a progenitor population that is competent to generate both roof plate and neural crest.

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References and links

ORIGINAL RESEARCH PAPER Chizhikov, V. V. & Millen, K. Control of roof plate formation by Lmx1a in the developing spinal cord. *Development* **131**, 2693–2705 (2004)

FURTHER READING Caspary, T. & Anderson, K. V. Patterning cell types in the dorsal neural tube: what the mouse mutants say. *Nature Rev. Neurosci.* **4**, 290–298 (2003)

IN BRIEF

SLEEP

Local sleep and learning.

Huber, R. *et al. Nature* 6 June 2004 (10.1038/nature02663)

After performing a motor learning task that activates the right parietal cortex, subjects slept while their electroencephalogram was recorded. Slow-wave activity showed a local increase over the right parietal cortex in those subjects who had undergone the learning task. The local increase in slow-wave activity resembled the more global increase that is seen after prolonged wakefulness and is thought to represent sleep pressure, and also correlated with a subsequent improvement in performance.

FUNCTIONAL IMAGING

The hippocampal system mediates logical reasoning about familiar spatial environments.

Goel, V. *et al. J. Cogn. Neurosci.* **16**, 654–664 (2004)

Logical reasoning about familiar situations engages a different brain network from logical reasoning about unfamiliar situations. Goel *et al.* show that this dissociation also holds for logical reasoning about spatial environments. A reasoning task that involved familiar spatial environments, such as countries, activated a hippocampal network, whereas one that involved unfamiliar spatial environments, such as fictitious labs, activated areas that are associated with visuospatial processing.

DEVELOPMENT

The prepattern transcription factor Irx2, a target of the FGF8/MAP kinase cascade, is involved in cerebellum formation.

Matsumoto, K. *et al. Nature Neurosci.* **7**, 605–612 (2004)

Matsumoto and colleagues characterise *Irx2*, a homeobox gene that is expressed in the rhombic lip of the rostral hindbrain, which develops into the cerebellum. FGF8, expressed by the isthmus, organizes the developing cerebellum. The activation of Irx2 is modulated by the FGF8 and mitogen-activated protein kinase signalling pathway. When *Irx2* and *Fgf8a* are coexpressed in the chick midbrain, this area develops into cerebellum, showing the importance of Irx2 as a prepattern transcription factor.

CELL BIOLOGY OF THE NEURON

Intraflagellar transport genes are essential for differentiation and survival of vertebrate sensory neurons.

Tsujikawa, M. & Malicki, J. *Neuron* **42**, 703–716 (2004)

Many sensory neurons have cilia, and these tiny structures have important roles. Tsujikawa and Malicki show that, in the zebrafish, mutation of the *ovl* gene causes a deficit in ciliary transport that prevents photoreceptors, auditory hair cells and olfactory neurons from being able to maintain their cilia. Loss of cilia is followed by degeneration of the sensory cells.