VISION

First light

Writing in *Current Biology*, Sekaran and colleagues show that, in mice, the photopigment melanopsin is expressed in intrinsic photoreceptive retinal ganglion cells (ipRGCs) at birth, and provides the earliest light detection in the mammalian retina — almost two weeks before rod and cone cells become sensitive to light.

The visual system is composed of image-forming pathways, which are mediated by rod and cone cells, and non-image-forming pathways, which involve rod and cone cells and the ipRGCs. Although functional maturation of rod and cone cells is well characterized, information about the development of ipRGCs has been lacking. To bridge this gap, the authors studied the photosensitivity of retinae during a period in which rod and cone cells are not yet mature. Retinae from mice at various postnatal stages were exposed to light, and neuronal responses were measured using a fluorescent imaging technique.

At postnatal day (P) 0–1, 13.7% of the neurons in the ganglion cell layer of the retina show a significant increase in intracellular calcium after exposure to light, and this percentage decreases with age to 5.4% at P4–5 and 2.7% in the adult retina. The photosensitivity of neonatal retinae is absent in melanopsin-knockout mice, which indicates that the light response at early postnatal stages might originate from melanopsin-expressing ipRGCs.

The increased percentage of light-responsive cells in the inner retina at birth could either be due to greater electrical coupling between cells in the retina at this stage, or result from a higher number of melanopsin-expressing ipRGCs. Application of a gap-junction blocker, which abolished electrical coupling between cells, reduced the numer of light-responsive cells in the retina at all ages, but the percentage of photosensitive cells was still highest at P0–1. By contrast, the number of melanopsin-expressing cells in the newborn retina is three times that in the adult counterpart, which indicates that overproduction of melanopsin-expressing ipRGCs might be responsible for the higher light sensitivity of the retina during early development.

The ipRGCs project mainly to the suprachiasmatic nucleus (SCN), the central circardian pacemaker, and provide a measurement of environmental brightness at dawn and dusk, allowing circadian time to be aligned with environmental time. Sekaran *et al.* showed that, at P0, light pulses induced the expression of c-Fos — a marker of light-induced neuronal activity — in the SCN. Therefore, the SCN receives functional retinal connections from melanopsin-expressing ipRGCs at birth.

What is the significance of a functional non-image-forming pathway at birth? It will be interesting to determine whether ipRGCs are important in coordinating the timing of the neonatal clock, and whether they are involved in driving the activity-dependent maturation of the image-forming visual pathway in the neonate.

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References and links

ORIGINAL RESEARCH PAPER Sekaran, S. *et al.* Melanopsin-dependent photoreception provides earliest light detection in the mammalian retina. *Curr. Biol.* **15**, 1099–1107 (2005)

FURTHER READING He, S. *et al.* Seeing more clearly: recent advances in understanding retinal circuitry. *Science* **302**, 408–411 (2003)

WEB SITE

Hankins' laboratory: http://www1.imperial.ac.uk/medicine/people/m.hankins.html