

Abstract

Bipolar cells play major roles in visual signal transmission from photoreceptors to ganglion cells, and can be further subdivided into at least 13 distinct types based on their morphology and physiology. Particularly, identification of the blue cone bipolar cell is an important work in color vision research. Color pathway has been studied for a long time in the primate, but the circuit for color processing in other mammals is still obscure, especially in the bipolar cell level. In this study, I was aiming to morphologically identify blue cone bipolar cells in the rabbit retina. For efficiently finding the blue cone bipolar cells, I used microinjection to mark bipolar cells, peanut agglutinin to label all cone cells, and anti-S cone opsin antibody to label S cone outer segments in the whole mount rabbit retina. I then superimposed the images to verify the cone selectivity in different injected bipolar cells. From the results of my experiments, each narrow-field and mediate-field type bipolar cells were showed to have no cone selectivity. However, there is one type of wide-field bipolar cells with S cone selectivity identified in my study. This type of cells gives rise 4-5 branchless primary dendrites to specifically contact S cone pedicles. In addition, there were also two other types of wide-field bipolar cells identified in my study, which have no S cone selectivity. In conclusion, the color encoding bipolar cells in rabbit retina are different from the ones found in primate retina. Therefore, the color information processing pathway of non-primate retina may be different from primate retina.

摘要

雙極細胞在從光感受器到節細胞的視覺訊號傳遞途徑上，一直扮演著重要的角色，而雙極細胞可依其形態及生理反應區分為十三種以上不同類別，所以在色彩視覺研究上，辨別出對不同視錐細胞具有專一性之雙極細胞是很重要的一個工作。而目前對於靈長類動物的色彩視覺傳遞途徑之研究比較透徹，但是在其他哺乳動物上，對於色彩視覺傳遞途徑的了解卻相當缺乏。

在本研究中，我們利用微注射的方式以標定兔子視網膜上的雙極細胞；藉由花生凝集素來標定視錐細胞；使用抗藍色視錐視紫蛋白之抗體來標定藍色視錐的感光區域，最後，利用影像重疊法以檢查所標定不同類別的雙極細胞是否對不同視錐細胞具有選擇性。

實驗結果顯示，無論哪一種小軸突面積及中等軸突面積的雙極細胞都不具有視錐的選擇性；同時，實驗結果亦發現一種大軸突面積的雙極細胞對藍色視錐細胞具有選擇性。這種雙極細胞具有四到五個未分岔的主樹突，並且會與藍色視錐的足狀節有特定的接觸。除此之外，我們還觀察到另外兩種大軸突面積的雙極細胞。

本研究顯示，兔子視網膜上關於色彩的雙極細胞與靈長類的雙極細胞有著明顯的形態差異。因此，在非靈長類動物的色彩訊息處理及傳遞功能上，極可能與靈長動物所知的情形有所不同。