Distribution of glycogen during the development of the organ of Corti

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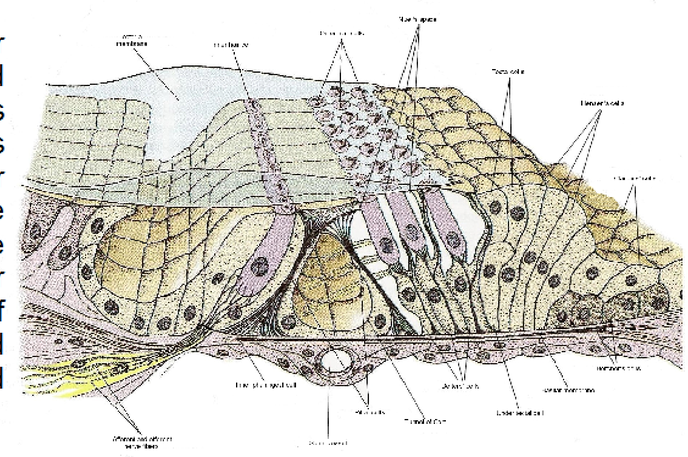
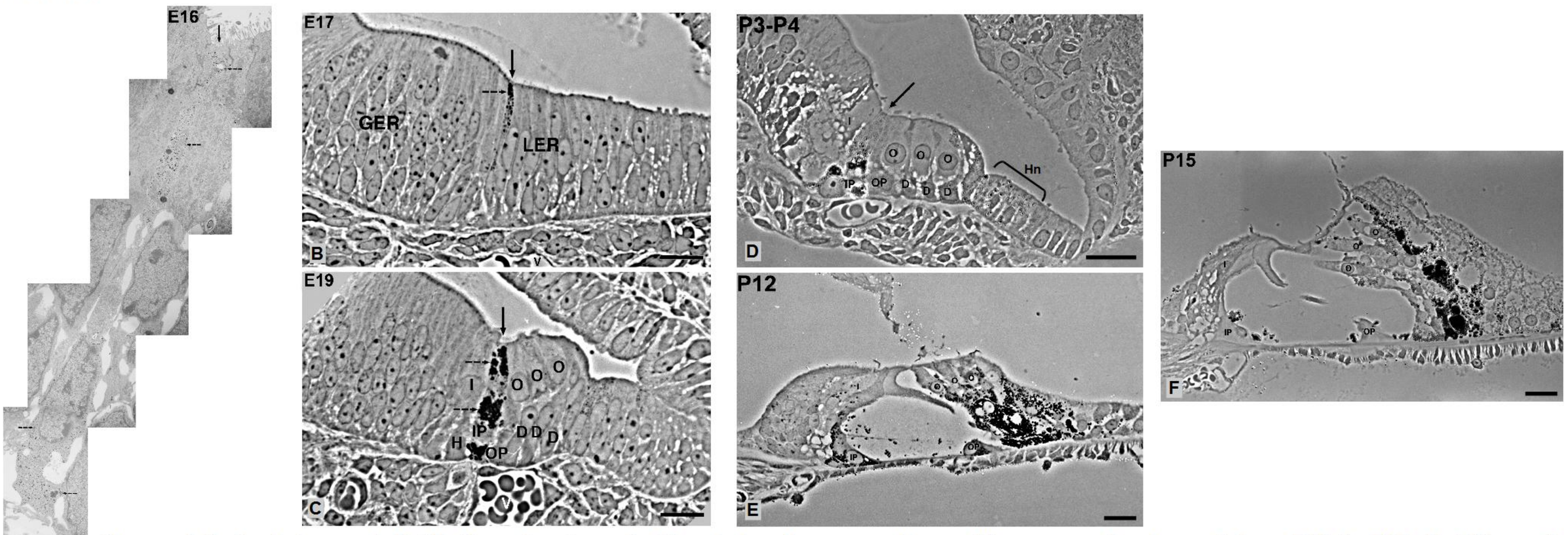
Introduction

In mammals, the perception of sound is mediated by an epithelial sensory patch located in the cochlear region of the inner ear named the organ of Corti (OC) [Kelley and Bianchi, 2002 ; Kelley, 2006]. The latter is componed of mechanosensory hair cells and nonsensory supporting cell types. The hair cells are modified epithelial cells that utilise a group of derived microvilli, referred to as stereocilia, to perceive pressure waves induced through sound. Based on their morphology and physiology, two types of hair cells can be distinguished: inner and outer hair cells. Likely, at least four types of supporting cells can be identified in the OC: inner pillar cell, outer pillar cell, inner phalangeal cell and Deiters' cells. These cells are arranged in a regular mosaic pattern running along the length of the snail-like cochlea from base to apex. One of the most striking aspects of this mosaic is that specific cell types are arranged in discreet rows. The edge of the OC located closest to the modiolus is composed of a single row of alternating inner hair cells and inner phalangeal cells. The edge of the Corti's organ located closest to the stria vascularis is composed of three rows of outer hair cells and Deiters'cells that are also arranged into a regular alternating mosaic. Finally, the single row of inner hair cells and the three rows of outer hair cells are separated by the tunnel of Corti that is a space delimited by a single row of inner pillar cells and a single row of outer pillar cells. The formation of Corti's tunnel appears after birth in rat [Roth and Bruns, 1992].



Although the structure of the auditory organ in mature mammals, the organ of Corti, is clearly established, its development is far to be elucidated. Using the periodic acid-thiocarbohydrazide-silver proteinate method [Thiéry, 1967], a cytochemical technique known for detecting polysaccharides in biological material at the light and electron microscope levels, we examined the spatiotemporal distribution of polysaccharides during Corti organ development in rat from embryonic day 16 (E16) to postnatal day 15 (P15).

Results



Figures A-F: Spatiotemporal distribution of polysaccharides during the mammalian auditory organ development from E16 to P15. At E16, small polysaccharide inclusions could only be detected in the cytoplasm of future inner pillar cells by electron microscopy . These became obvious at the light microscope level at E17. At E19, the polysaccharide deposits were important within the inner pillar cells and they arose in the Hensen cell cytoplasm. Polysaccharide accumulations also appeared in the outer pillar cells and in the Deiters cells from P3-P4. As the organ of Corti developped, the amount of polysaccharide inclusions within the inner and the outer pillar cells decreased. At P15, large amount of polysaccharide deposits were visible in the Deiters cells whereas they had almost disappeared from the inner and outer pillar cells. A: ultrathin section of a developping inner pillar cell. Bar: 2µm. B-F: semithin section of the developping OC from E17 to P15. Bar:16µm. The polysaccharides are detected with the periodic-acid thiocarbohydrazide silver proteinate method. Arrow: depression of the dorsal epithelium; dotted line arrow: silver precipitates; GER: greater epithelial ridge; LER: lesser epithelial ridge; I: inner hair cell; O: outer hair cell; H: phalangeal cell; D: Deiters' cell; IP: inner pillar cell; OP: outer pillar cell; V: spiral vessel; Hn: Hensen's cells.

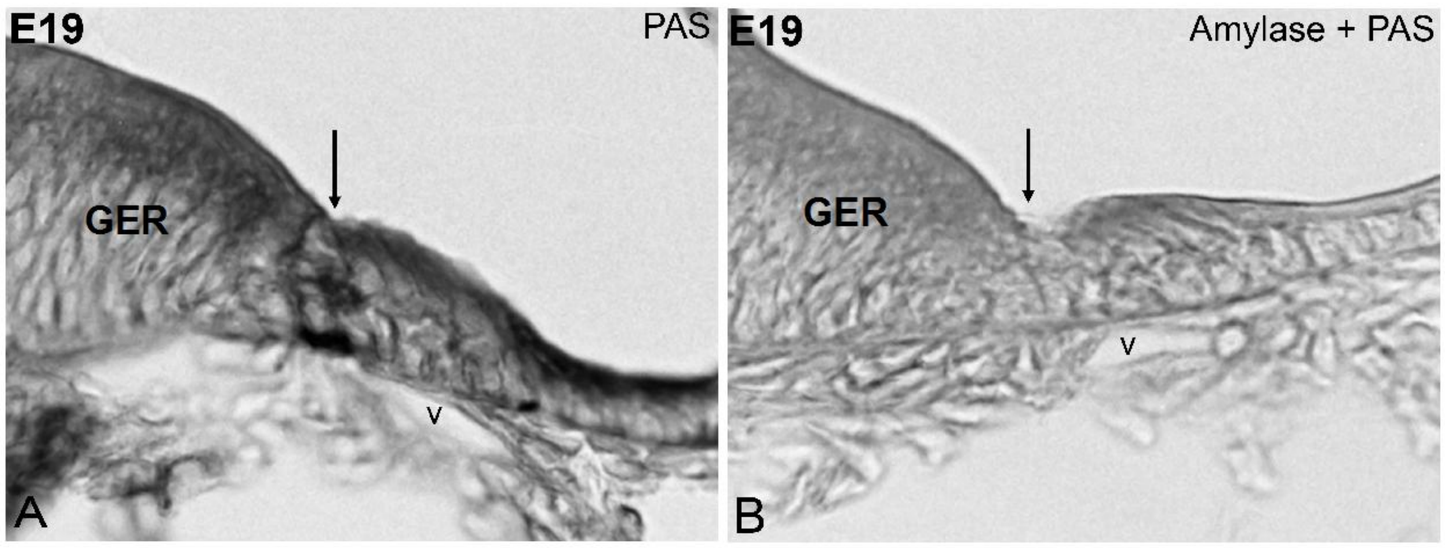


Figure A-B: The polysaccharide deposits are constituted by glycogen. Here, we showed that the polysaccharide deposits present in the developing organ of Corti were a PAS-positive material and can be digested with a salivary amylase suggesting that they are essentially constituted of glycogen. A: cryosection of OC at E19. The polysaccharides deposit are detected with the Periodic acid-Schiff (PAS) method. B: cryosection of OC at E19. After a salivary amylase digestion, the polysaccharides deposit aren't detected with the Periodic acid-Schiff method. Arrow: depression of the dorsal epithelium; dotted line arrow: glycogen stained with PAS method; GER: greater epithelial ridge; V: spiral vessel. Bar: 16µm.

Conclusions

In this study, we show that during the rat organ of Corti development, glycogen particules appear first in the cytoplasm of the future inner pillar cell at E16. Glycogen particules also appear in the Hensen's cells at E19 and in the Deiters' cell around P4. As development proceed, the density of glycogen particules decrease in the inner pillar cells while they increase in the Deiters' cells.
The next step of our work will be to determine the role of the important deposits of glycogen during the development of the organ of Corti.

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