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Advanced ocular heterotopic bone formation in a guinea pig

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Eyes, Guinea pigs, Intraocular pressure, Heterotopic bone formation

Heterotopic bone formation (HBF) of the ciliary body is most often reported in the guinea pig (*Cavia porcellus*), with a prevalence of eight of 1000.[1] The most common treatment for ocular HBF is observation without any interventions, and the prognosis is generally considered favourable.[2,3] However, given this case report, once HBF is diagnosed with the lesion

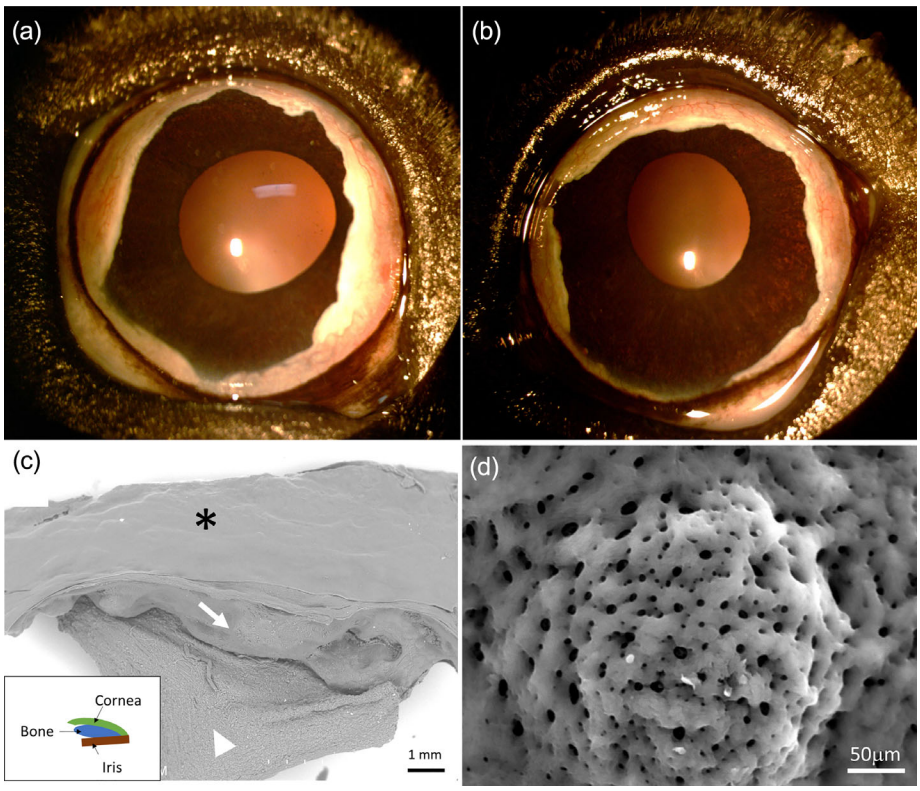

FIGURE 1 Heterotopic bone formation in a 5-year-old male pigmented guinea pig (Elm Hill strain): Slit-lamp biomicroscopy image of the white lesions in the right eye (a) and left eye (b). Scanning electron microscopy (SEM) image of the lesion in the right eye (c), showing bone lesion (white arrow), with adjacent cornea,* and iris (white arrowhead) as reference landmarks. High-magnification SEM image revealed numerous small holes (pores) in the bone deposits (d).

covering the entire angle, attention should be paid to glaucoma. Although a possible association between HBF and glaucoma has been raised,[4] to date this possibility has received relatively little attention, based on published reports. Normal IOPs for the guinea pig are reported to be 18.3 ± 4.6 mmHg.[5] The case described here involves a 5-year-old guinea pig (Elm Hill pigmented strain), which was diagnosed with bilateral HBF approximately 1.5 years ago. Its first 7-month follow-up history has been reported.[6] The lesions and intraocular pressures (IOPs) of both eyes were monitored regularly. One year after initial detection, the lesion was most advanced in the right eye, encompassing 360 degrees of the iridocorneal angle (Figure 1a,b). Vitamin C can lead to calcium deposition, which causes HBF.[7] Consistent with the latter interocular difference, the IOP of the right eye measured by rebound tonometry (iCare; Tonolab) was initially found to be higher than that of the left eye, although IOPs of both eyes were within the normal range (e.g., 15.3 ± 0.6 vs. 10.3 ± 1.5 mmHg) during the first year. Follow-up IOP recordings revealed significant fluctuations, with IOPs of the right eye being frequently outside the normal range from time to time (e.g., 48.3 ± 0.58 vs. 15.0 ± 1.0 mmHg), and IOPs of the left eye showing a similar, albeit, delayed trajectory. Subsequent electron microscopy analysis of the lesions revealed numerous small holes (pores) in the bone deposits (Figure 1c,d), which hint at bone remodelling[8] and may underlie the IOP fluctuations. Although posterior subcapsular cataracts impaired the quality of optical coherence tomography (OCT) images (Figure 2), there is an apparent peripapillary depression adjacent to the optic nerve head, which together with the progressive elevation in IOP, compared to initial OCT images and IOP,[6] is consistent with a diagnosis of glaucoma. In conclusion, periodic measurement of IOP is recommended after a diagnosis of HBF, due to the high risk of obstruction of the iridocorneal angle with disease progression.

LEARNING POINTS/TAKE-HOME MESSAGE

As advanced ocular heterotopic bone formation has the potential to increase intraocular pressure and ultimately cause glaucoma, periodic intraocular pressure monitoring is recommended.

AUTHOR CONTRIBUTIONS

So Goto and Christine F. Wildsoet conceived and designed the project. So Goto and Qiurong Zhu acquired the data. SG analysed and interpreted the data. So Goto and Christine F. Wildsoet wrote the paper. So Goto, Qiurong Zhu and Christine F. Wildsoet reviewed the paper.

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CONFLICTS OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ETHICS STATEMENT

All animal care and treatments used in this study conform to the ARVO Statement for the Use of Animals in Ophthalmic

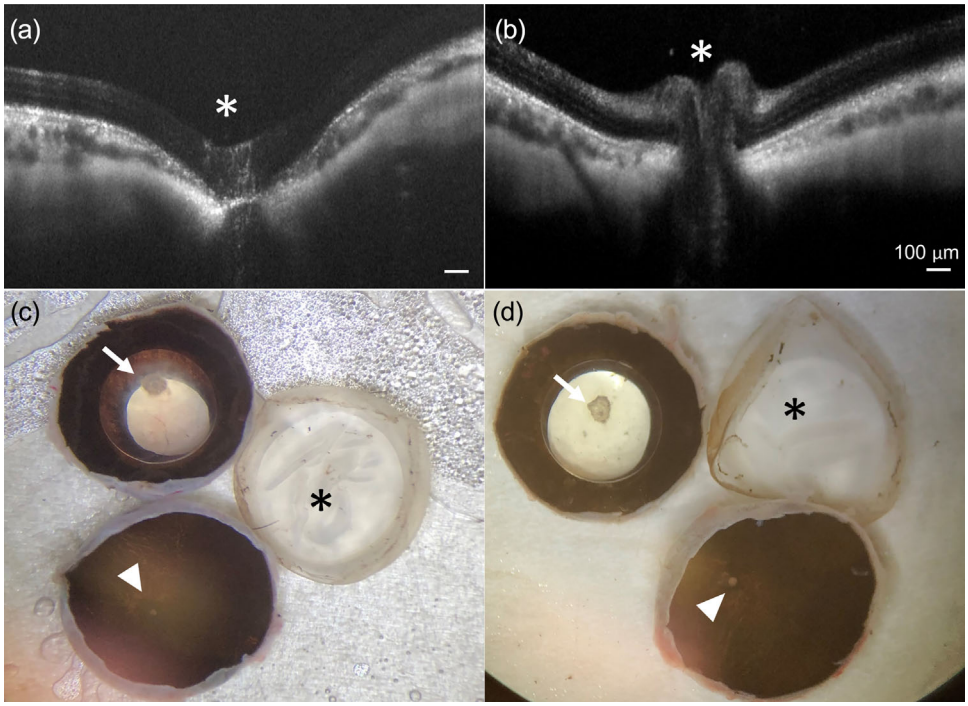

FIGURE 2 Cross-sectional posterior segment SD-optical coherence tomography images centred on the optic nerve head (white asterisk) of right (a) and left (b) eyes. Dissected enucleated eyes showing retina*, and remaining posterior poles (white arrowhead) comprising choroid and sclera. Posterior subcapsular cataracts in both eyes were observed from the back of the anterior segments (white arrow) of right (c) and left (d) eyes. Scale bar = 100 µm.

and Vision Research. Experimental protocols were approved by the Animal Care and Use Committee of the University of California, Berkeley.

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IMAGE QUIZ

What is your diagnosis, based on the ocular anterior segment changes evident in this guinea pig (Figure 1)?

ANSWER: Ocular heterotopic bone formation.

MULTIPLE-CHOICE QUESTION

How do you think intraocular pressure (IOP) is likely to change if the iridocorneal angle, which is the site of a major drainage channel for aqueous humor, is fully occupied, that is, around its circumference by bony deposits, as in this case?

POSSIBLE ANSWERS TO MULTIPLE-CHOICE QUESTION

A. Elevate
B. Decrease
C. No change

CORRECT ANSWER

Answer: A

Located in the angular recess where the peripheral posterior corneal and anterior surface of the iris meet, known as the iridocorneal angle, are drainage structures, including the trabecular meshwork, through which aqueous humor escapes from the eye into episcleral veins and beyond. The importance of this drainage route for regulating IOP is demonstrated by the elevation in the latter, resulting from the injection of microbeads or oil into the iridocorneal angle, as used in animal models of glaucoma, while in humans, accumulation of pigment granules in the iridocorneal angle is also known to elevate IOP. In the current case, bony lesions/deposits appear to almost fully occupy the iridocorneal angles of both eyes, that is encompassing 360 degrees, offering a likely explanation for the observed elevated IOPs, with dynamic remodelling of the bone deposits suggested by observed fluctuations in IOP.