Electronic letter

The importance of good images in using hair to screen for breast cancer

Veronica James

In reference to the Letter to the Editor "Can hair be used to screen for breast cancer?" (*J Med Genet* 2000;37:297-8), I must bring attention to a fatal flaw in the experimental data and hence the conclusions reached by Howell *et al.*¹ If their figure is a representative example of a typical image used in their analyses, I must conclude that there is no way that this group could test our assertion that there appears to be a strong correlation between a change in the x ray diffraction pattern of hair and the onset of breast cancer.²

The image shown by Howell *et al.*¹ contains none of the features that must be present in a diffraction pattern of hair if any meaningful analysis is to be performed. Specifically, in even a rudimentary image of a single hair or bunch of hairs the strongest meridional reflections should be very obvious at the 6.71 nm and 2.47 nm positions. In all of our studies (including a number done subsequent to the publication of the *Nature* paper), we found that the ring corresponding to breast cancer was less intense than these 7th and 19th meridionals. Furthermore, when we did measure an anomalously intense diffuse ring, it was found to lie at a slightly different position (clearly not resolvable with the images used by Howell *et al.*¹) and invariably disappeared when the sample alignment was improved and the hair put under an appropriate amount of tension. A diffraction image of a properly aligned and tensioned single hair with all the appropriate meridional reflections clearly visible can be seen in Wilk *et al.*³ The section of interest in the diffraction pattern for a normal hair sample is shown in fig 1A and that for the hair of a breast cancer patient is shown in fig 1B.

In conclusion, I must state that poor alignment, poor signal to noise, and poor resolution rendered the diffraction images of Howell *et al.*¹ useless for this type of analysis. As a final note, I would like to emphasise that our *Nature* paper was based on a study of 56 samples including both scalp and pubic hair and not just on 12 samples as asserted by Howell *et al.*

Figure 1 (A) A fibre diffraction intensity pattern for hair taken from a control showing the very strong 7th, 19th, and 38th orders of the 47 nm meridional lattice. (B) A fibre diffraction intensity pattern for hair taken from a breast cancer patient showing that the intensity of the diffuse ring reported as associated with all breast cancer patients is less intense than the three strong meridional reflections.

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1 Howell A, Grossmann G, Cheung KC, Kanbi L, Evans DGR, Hasnain SS. Can hair be used to screen for breast cancer?. *J Med Genet* 2000;37:297-8.

2 James V, Kearsley J, Irving T, Amemiya Y, Cookson D. Using hair to screen for breast cancer. *Nature* 1999;398:33-34.

3 Wilk K, James V, Amemiya Y. The intermediate filament structure of human hair. *Biochim Biophys Acta* 1995;1245:392-6.

Science or black magic?

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In reply to the comment by Veronica James, we are concerned that using hair for breast cancer diagnosis is still an issue! This comes as a surprise not only with respect to Dr James's response, but also in view of the subsequently accumulated experimental evidence, which clearly speaks against it. Apart from our report,¹ further studies⁴⁻⁵ (carried out by experienced research teams at different synchrotron radiation sources around the world) have not been able to confirm the correlation between *x* ray diffraction images of hair and breast cancer. Even though the original paper of James *et al*² was based on a total of 56 hair samples, only 12 pubic hair samples were used with the balance being scalp hair, which suffers from problems associated with hair treatment, etc.

We strongly disagree with Dr James's claims that our results suffer from poor experimental practice and that we do not have good images. Firstly, looking at the diffraction images of hair samples (that is, the same as presented in our report¹) collected with the experimental set up as recommended and used in the study by Wilk *et al*,³ it is immediately obvious that neither signal to noise nor resolution effects would render our results useless. The diffraction patterns displayed in fig 2 were recorded on image plate at the Photon Factory in Japan by Professor Amemiya, a co-author of James *et al*,² and are of similar quality to the ones recorded on a multi-wire detector at the Daresbury SRS in our original paper.¹ The two halves show diffraction patterns from samples of two women both diagnosed with breast cancer. There can be no doubt that one of these shows clear rings while the other does not. In the light of such clear experimental evidence from our work and that of others,⁴⁻⁵ it is astonishing that Dr James wishes to persuade the medical and diffraction communities that diffraction from hair can be used for diagnostic purposes. We hope that we

Figure 2 X ray diffraction images from the pubic hair of women diagnosed with breast cancer. (Right) Diffraction pattern displaying clear rings. (Left) Pattern with no clear rings. We are very grateful to Professor Amemiya for running the hair samples on BL15 at the Photon Factory, an instrument which was used by Dr James.¹

are dealing with science and not black magic; science requires reproducibility. Her assertions for differences in results because of "appropriate amount of tension" without quantification is unscientific and subjective. If the sample preparation requires the "magical touch" of Dr James then it can be hardly be argued as a straightforward and routine screening method.

In our opinion, there is no experimental scientific evidence which supports the assertion that diffraction from hair can be used to screen for breast cancer.

4 Briki F, Busson B, Salicru B, Estève F, Doucet J. Breast-cancer diagnosis using hair. *Nature* 1999;400:226.

5 Hart M (and three independent research groups). Using hair to screen for breast cancer. *Synchrotron Radiation News* 1999;12:31-6.

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