False-Positive Results in Studies of Changes in Fiber Diffraction of Hair From Patients With Breast Cancer May Not Be False

Previous reports of the changes in the structure of hair in women with breast cancer (1,2) have shown no false-negative results but have reported a number of false-positive results. We present updated reports of two patients that indicate that the changes in the fiber diffraction patterns from hair may reveal a very early stage of breast cancer not as yet visible by any other technique and, therefore, the false-positive results may not be false.

The synchrotron fiber diffraction experiments for these two patients were carried out or repeated on the ChemMatCARS and BioCAT facilities at the Advanced Photon Source (APS), Argonne National Laboratory (Argonne, IL). The experiments followed the protocol of James et al. (1,2), as reported earlier.

For patient 1, two samples of hair were examined. The first sample was a scalp hair taken when she was 38 years old and supposedly in perfect health. The second sample was a pubic hair taken when she was 43 years old and undergoing radiation therapy and chemotherapy treatments after surgery to remove an invasive ductal breast carcinoma. Results of these two experiments are illustrated in Fig. 1. The ring associated with breast cancer is clearly visible in both samples from this patient, indicating that the breast cancer-associated change in the hair was already present when she was 38 years old although the breast cancer was not detected by mammography until she was 43 years old.

For patient 2, three samples of hair were examined. The first sample, a scalp hair, was taken when she was 41 years old and clear of breast cancer as determined by mammography. Sixteen months later, she was diagnosed with ductal carcinoma by mammography. The second hair sample was a pubic hair that survived chemotherapy (four treatments of doxorubicin and cyclophosphamide and four treatments of paclitaxel). The change associated with breast cancer is clearly present in both diffraction patterns (Fig. 2, a and b). When informed about our earlier results, patient 2 presented a sample of hair taken when she was 6 months old that had been stored in a baby book. The change associated with breast cancer is not present in the baby hair (Fig. 2, c). This result clearly shows that the change associated with breast cancer was not present at birth.

When a person is undergoing chemotherapy treatment, the weakness of the ring reflects the condition of the hair at that time. Because many of the samples that have been studied have been collected during this period of treatment, extreme care must be exercised to eliminate the possibility of missing such extremely weak rings.

Fig. 1. a) Relevant section of the fiber diffraction pattern obtained from a scalp hair, 5 years prior to the tumor being observed by mammography when the patient was given a perfect bill of health. Arrow indicates the ring associated with the presence of breast cancer. b) Fiber diffraction of a pubic hair taken when the patient was 43 and undergoing chemotherapy following surgery to remove an invasive ductal tumor. The weakness of the ring indicates the condition of the hair at this point of treatment.
As yet, these are the only two proven instances of a false-positive result later being shown to be a true-positive result. However, a number of other false-positive results have come from women who have a strong family history of breast cancer for whom either the gene tests were positive or not carried out. Only time will tell how many of the false-positive results are truly false and how many are true indications that breast cancer can be seen at a much earlier stage by this technique.

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REFERENCES


NOTE

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Fig. 2. a and b) Relevant sections of the fiber diffraction patterns obtained for the second patient. In this case, (a) was the pattern obtained some 16 months prior to the tumor being observed by mammography. c) Pattern taken of the same patient’s scalp hair when she was 6 months of age. There is no breast cancer ring in this pattern. This woman did not have a family history of breast cancer.