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Different Distribution of Ca and Oxidative Damage in Human Hair from Patients Suffering from Breast Cancer

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1 Introduction

Applicability of Ca content in human hair to forecasting human breast cancer has been proposed [1], while hair Ca content was known to be largely affected by external oxidative damage such as bleach treatment [2]. In order to discriminate Ca accumulation by external stimuli from that provided by blood flow around hair matrix cells at the hair root, we have applied X-ray contact microscopy to imaging Ca content and oxidative damage in bleached hair from healthy female control group, and found that Ca increase by oxidative damage mainly distributes in outer region called cuticle and cortex, in contrast to Ca distribution in medulla, a central part of hair, which does not seem to be related to oxidative damage [3]. This observation suggests that Ca content in medulla may be critical for the medical application. In the present study, we applied Ca and oxidative damage mapping to hair specimens of a patient suffering from breast cancer.

2 Materials and Methods

X-ray contact microscopy was used for imaging cysteic acid, an oxidation product of cystine, at the S-K edge and for imaging Ca at the Ca-K edge at BL-11B with a spatial resolution of about 0.5 μm. Ca mapping of high sensitivity was also performed by detecting X-ray fluorescence (XRF) upon X-ray microbeam at BL-4A with a spatial resolution of around 5 μm. The hair specimens were obtained from women with breast cancer based on informed consent at Tokai University Hospital. The hair was cut in a thickness of about 20 μm, and put on SiN membrane as described previously [3].

3 Results and Discussion

Figure 1 shows Ca content (a) and oxidative damage (b) plotted against distance from the hair root. The contents were the average in several areas of 1.4-5 μm square for cuticle, cortex and medulla region. The increase of Ca content in cuticle area with increasing distance was nearly parallel with the increase of oxidative damage. In contrast, the Ca content in medulla does not seem to depend on the distance. Note that the very high content at around 29cm was observed as seen from panel a. The result was also confirmed by XRF in the panel a of Fig. 2. The oxidation was significant in cortex and cuticle area (Fig. 2, panel b). These results indicated that the marked increase of Ca in medulla may be related to the incidence of breast cancer. On the other hand Ca increase in cuticle probably result from oxidative damage.

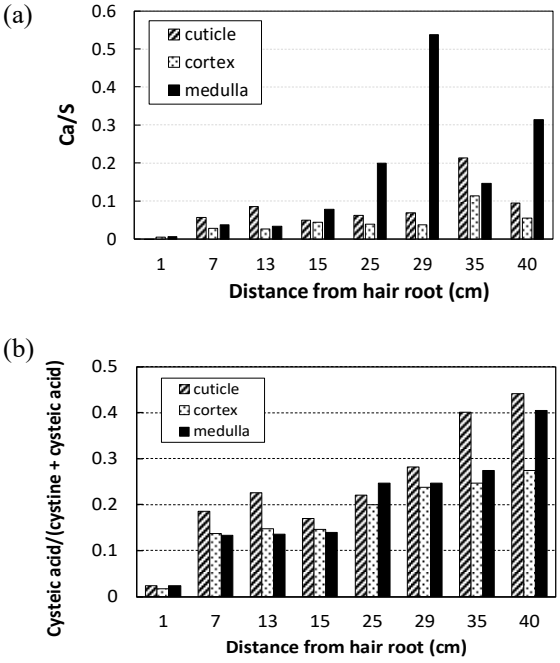

Fig. 1. Contents of Ca and oxidative damage in three regions of human hair with breast cancer from root to tip. (a) Ca, (b) oxidative damage.

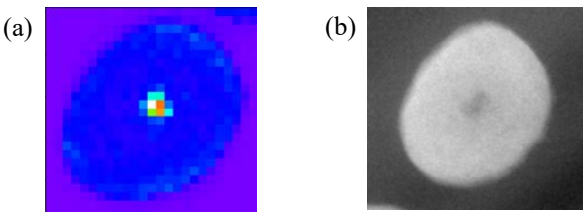

Fig. 2. Distribution of Ca and oxidative damage in the cross-section of human hair at 29cm from the root. (a) Ca by XRF (BL4A), (b) oxidative damage by contact microscopy (BL11B).

References

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