Characterization of the Tissue Dielectric Constant of Skin Basal Cell Carcinoma

HN Mayrovitz1 Ph.D., P Spagna2 OMS-II, L Killpack3 D.O., Resident, PGY- III, S Gildenberg,4 M.D., Faculty, D Altman5 M.D., Faculty
1College of Medical Science, 2KPCOM 3-5St Josephs Mercy Livingston Dermatology Residency Training Program, Detroit MI

Background

Skin cancer is the most common cancer in the US. It is estimated that one in every five Americans will develop it in their lifetime. Florida has the second highest rate of melanoma in the nation, just behind California. Basal cell carcinoma (BCC) is the most common skin cancer worldwide. Each year, more than four million cases are diagnosed in the US. While BCC can occur in association with other clinical syndromes, it is most commonly caused by a combination of cumulative ultraviolet (UV) light exposure, intense occasional UV exposure, and overexposure to X-rays or other forms of radiation. The tumor of BCC results when cells in the deepest, or basal layer of the epidermis become cancerous. Overexposure to UV results in the formation of thymine dimers, damaging DNA. While DNA repair removes most UV-induced damage, not all cross-links are successfully excised. Overtime, the cumulative DNA damage leads to cellular mutation. The tumors of BCC are primarily distributed over photo-exposed surfaces of skin, occurring in head and neck in 75-85% of cases. Classically, BCC lesions present as a raised nodule, with a pearly and translucent margin and telangiectasia. Although BCC rarely metastasize, on rare occasion BCC can spread to lymph nodes, lungs or bones. Thus, if not dealt with promptly, it can lead to disfiguring lesions of the face.

Methods

PATIENTS: A convenience sample of 30 patients (19 males/11 females) undergoing biopsy for suspect lesions. Ages were 35-95 years (71.9 ± 15.5). MEASUREMENTS: Prior to biopsy, TDC, which is strongly dependent on tissue water, was measured by touching the lesion with a non-invasive handheld device (Figure 1). The device operates at 300 MHz using the open-ended coaxial line method and measures to a depth of about 0.5 mm. TDC was measured in triplicate on the lesion (L), and on normal control skin (N) usually on non-affected skin contralateral to the tumor site. Tissue biopsies were all done by the in-office pathologist, and were transcribed to the data form upon becoming available. Photographs of each lesion were also recorded at the time of measurement (Figure 2).

Biopsy results showed BCC for all 30 lesions, of which 2/3 were classified as nodular and 1/3 as infiltrative. TDC values (mean ± SD), measured at the lesion were significantly less than were measured at control site 22.1 ± 15.7 vs 37.4 ± 14.3, p < 0.0001 as shown in Figure 3. However, in four cases TDC values were greater on the lesions. These lesions tended to be either ulcerated or edematous. Initial preliminary comparisons of measurements on non-cancerous lesions (n=10) indicate that average percentage differences between lesions and control skin are about 40% for both cancerous and non-cancerous lesions.

Conclusions

Although significant differences in TDC values are found between BCC skin lesions and non-affected skin, the fact that there is so far, no clear separation between cancerous and non-cancerous differences, cautions that TDC may have inadequate selectivity to be a useful detection method. However, the current data describing, for the first time. TDC values for BCC lesions may be useful as reference values in extensions of this research.

References