LOCAL TISSUE WATER MEASURED BY TISSUE DIELECTRIC CONSTANT: DEPENDENCE ON ANATOMICAL SITE AND DEPTH IN WOMEN PRIOR TO BREAST CANCER RELATED SURGERY

Background and Goals: Clinical assessment of limb edema can be done by girth, volume or electrical impedance methods. But, such methods are unsuitable to determine local edema or edema in areas other than limbs. Quantitative assessment of local edema could yield information not previously available to help detect, assess and track edema or lymphedema progression in any anatomical region. Recent work showed that local tissue water (LTW), assessed by a tissue dielectric constant (TDC) method, can quantify LTW in arms of patients with breast cancer treatment-related lymphedema. Since only forearms were studied, we believed that knowledge of anatomical site and tissue depth dependence of TDC values could provide comparative reference data and also help extend the method's utility. Thus our goal was to measure and compare TDC values at anatomically paired sites and study tissue depth dependence.

Methods: A total of 26 women with ages (mean±SD) of 56.3±16.4 years, were evaluated. Of the 26, 16 were patients recently diagnosed with breast cancer and awaiting surgery (age: 65.4±11.6 years), and 10 were healthy controls (age: 41.9±12.3 years). Patients, as compared to controls, had similar body mass indices (28.7±5.9 vs. 27.5 ± 5.8 Kg/m²) but were older (p<0.001). Four sites, (mid-forearm-F, mid-biceps-B, axilla-A, and lateral thorax-T), on both body sides were measured to an effective tissue depth of 2.5mm. Also, at F, four different probes with sampling depths of 0.5, 1.5, 2.5 and 5 mm were used.

Results: Groups: Patient TDC values at arm sites (F and B) were significantly greater than for controls (p<0.01) but not different at A or T.
Site: TDC values at A were greater than measured at all other sites (p<0.001). TDC values at B were less than at all other sites (p<0.001). There was no significant difference in TDC values between F and T.
Side: There were no significant differences in TDC values between paired dominant-nondominant body sides at any site.
Depth: TDC values decreased with increasing depth in patients and controls, with values at each depth being different from all others (p<0.001). Patient TDC values were greater than corresponding control values (p<0.05) for all depths except 5 mm.

Conclusions: The composite results have several potential clinical implications. Firstly, since TDC measurements can be tailored to reflect changes to a depth of between 0.5 to 5.0 mm, whereas standard indices of limb lymphedema based on limb volume or bioimpedance reflect conditions of the entire cross-section, it is likely that TDC assessments are more sensitive and flexible to detect early developing lymphedema. Secondly, since assessments can be made in any body area or part and is not limited to limbs, it should be possible to assess localized edema and its change in the hand, finger, head, neck and so on. Finally, the present data shows that any potential clinical assessment or research protocol should consider and take into account both the anatomical site and depth dependence features that might be expected when choosing a probe and site for use in any specific study.