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How does multi-frequency bioelectrical impedance analysis compare to gold standard Computed Tomography assessment of body composition in a cancer population?

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Computed Tomography (CT) is a gold standard method of body composition analysis. In cancer populations CT scans are readily available as they form an important part of the staging of cancer. However due to the exposure to radiation their use in body composition assessment is limited to those scans that are already available. Multi-frequency bioelectrical impedance analysis (BIA) is a cheap, portable method of body composition analysis in widespread use. However, to our knowledge BIA has not been compared to CT assessment of body composition in the scientific literature.

The aim of this study was to compare multi-frequency BIA to the gold standard method of body composition by CT in a cohort of oesophageal cancer patients scheduled for major surgery. All patients scheduled for oesophagectomy for cancer underwent body composition assessment by multi-frequency BIA (BCM- Body Composition Monitor, Fresenius Medical Care AG & Co. KGaA, Germany). Results of the BIA were compared to CT assessment of body composition (performed as part of routine medical care). Body composition was assessed at the level of the 3rd lumbar vertebra using OsiriX software (Pixmeo, Geneva, Switzerland). Hand outlining of the regions of interest and specific tissue demarcation using Hounsfield units thresholds for different tissue types (e.g. skeletal muscle, visceral and subcutaneous adipose tissue) was performed and the cross sectional area (cm^2) of each compartment was calculated. Cut off points for sarcopenia were set at 55·4 cm^2/m^2 for men and 38·9cm^2/m^2 for women[1]. Estimates of whole body fat free mass (FFM) were calculated using regression equations[1]; whole-body fat-free mass (kg) = 0·3 x skeletal muscle at L3 (cm^2) + 6·06; whole-body fat mass (FM) (kg)= 0·042 x fat tissue at L3 (cm^2) +11·2.

In total 49 patients (26 males, 13 females) participated in this study. The majority (76 %) had oesophageal adenocarcinoma and 72 % received neo-adjuvant chemo radiotherapy pre-operatively. All were scheduled to undergo oesophagectomy and were being treated with a curative intent. The average weight was 83 kg (SD 15) and the average BMI was in the overweight category 28·2 kg/m^2 (SD 5). In total 15 % had a normal BMI, 60 % were overweight and 21 % obese. Based on CT assessment of body composition 42 % (n = 20) of patients were sarcopenic. When the results of body composition by BIA were compared to CT it was found that BIA significantly underestimated fat mass % (30·5 % (SD8·6) versus 33·2 % (SD6), p = 0·000) and fat free mass %: 56 % (SD11·7) versus 63 % (SD13), p = 0·003, see table 1.

Table 1: Comparison of body composition by CT scan and BIA

	CT	*BIA*	*P*
Fat Mass (kg), mean (SD)	27·7 (7·7)	34·8 (13·4)	0·0001
Fat Mass (%), % (SD)	33·2 (6)	30·7 (8·6)	0·05
Fat Free Mass (kg), mean (SD)	52 (13)	45·8 (11·2)	0·001
Fat Free Mass (%), %(SD)	63 (13)	56 (11·7)	0·003

In conclusion multi-frequency BIA significantly underestimates body composition in terms of % fat and % FFM as compared to CT assessment of body composition. Although CT is the gold standard for body composition analysis, BIA is cost-effect and accessible and therefore has a role in clinical practice. The above findings need to be taken into account in the application of BIA, with further studies warranted to identify discrepancies that exist between CT and BIA among different patient cohorts.

1. Mourtzakis M, Prado CM, Lieffers JR, Reuman T, McCargar LJ, Baracos VE (2008). A practical and precise approach to quantification of body composition in cancer patients using computed tomography images acquired during routine care. *Appl Physiol Nutr Metab*, **33**, 997–1006.