

Sensitivity and Specificity of Combined Perimetric and Volumetric Evaluations in the Diagnosis of Arm Lymphedema

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Abstract: The objective of the current study was to evaluate the sensitivity and the specificity of perimetry combined with volumetry in the treatment of lymphedema. Ninety women, who had been submitted to breast cancer surgery, were randomly selected in the Government Healthcare Clinic for this study. Only patients who underwent surgical treatment of breast cancer with some degree of lymphadenectomy were included in the study cohort. Individuals with active disease, whether local or otherwise, functional alterations of the upper limbs before breast cancer surgery were not included. The following possibilities were considered: 1 – the perimetry evaluation was considered positive when the difference between the affected and unaffected sides was ≥ 2 cm for any one of the seven measurements and volumetry was ≥ 100 mL; 2 – perimetry ≥ 2 cm and volumetry ≥ 200 mL; 3 – a difference $> 10\%$ between the two limbs in volumetry and perimetry. Prevalence, sensitivity, specificity, positive predictive value, negative predictive value and accuracy were evaluated statistically with an alpha error of 5% considered acceptable (p -value < 0.05). The mean age of the women was 54.8 ± 11.7 years. The sensitivity, negative predictive value and accuracy were higher using perimetry when a volume ≥ 2 cm were considered. The specificity and positive predictive values were better when the difference was greater than 10% between the two limbs by both perimetry and volumetry. Perimetry is a reliable method in the diagnosis of lymphedema when differences > 2 cm between the two limbs should be considered.

Introduction

The evaluation of lymphedema after breast cancer treatment is one of the problems faced both in the diagnosis and in the follow up of these patients [1]. Different studies use different methods, such as volumetry, perimetry, description of the signs and symptoms, bioimpedance and volume by geometric measurements [1–5]. Volumetry is the Gold Standard for evaluation [5–7]. However, this technique is not always routinely used [7], and perimetry is more commonly employed both in the follow up and in the diagnosis of lymphedema [2–4].

In respect to perimetry, the volumes calculated using perimetric data from anatomic marks are safe, valid and more precise than when obtained by circumferential measurements based on the distance between fingertips [1]. Armer & Stewart [2] reported that there is no exact definition of the Gold Standard and that all lymphedemas are not equal, but suggested that differences higher than 10% between the affected and contralateral limbs should be considered corresponding to a more conservative definition and a difference of 2 cm corresponding to a more liberal definition. Bioimpedance is suggested as an alternative in the diagnosis of lymphedema and for the follow up of these patients [2]. Changes in feeling have been described as indicators of early sequels of lymphedema, where combining the evaluation of symptoms and measurements of the volume of the limb may prove to be the best data in the clinical follow up to

identify lymphedema [8]. Volumetric measurement, calculated by geometric formulas, strongly correlated with the volume determined by water displacement [4]. The difficulties to define evaluation parameters in respect to the diagnosis of lymphedema are highlighted by these citations, thereby suggesting the necessity of further studies. The objective of the current study was to evaluate the sensitivity and specificity of perimetry combined with volumetry in the treatment of lymphedema.

Method

Perimetry was combined with volumetry in the diagnosis of lymphedema of the upper limbs of 90 women after the surgical treatment of breast cancer. The women were randomly selected from women treated for breast cancer registered in a Government Healthcare Clinic and in the Physiotherapy Teaching College in Catanduva, Brazil. The norms of ethics were followed and the project was approved by the local Research Ethics Committee. Only patients who underwent surgical treatment of breast cancer with some degree of lymphadenectomy were included in the study cohort. Patients with active disease, whether local or otherwise, functional alterations of the upper limbs before breast cancer surgery and women unable to complete the questionnaire were not included in the study. The following possibilities were considered: 1 – the perimetry evaluation was considered positive when the difference between the affected and unaffected arms was ≥ 2 cm for any one of the seven measurements and volumetry was ≥ 100 mL; 2 – perimetry ≥ 2 cm and volumetry > 200 mL; 3 – a difference $> 10\%$ between the two limbs in volumetry and perimetry.

The volumetry was based on the displacement of water – the technique similar to the method used by the ancient Greeks. The perimetry was done in 5 cm steps of the member starting from the pleat of the elbow was evaluated.

The statistical analysis evaluated the prevalence, sensitivity, specificity, positive and negative predictive values and accuracy with an alpha error of 5% considered as acceptable (p -value < 0.05).

Table 1 – Variations in the sensitivity, specificity, positive and negative predictive values and the accuracy of the perimetric and volumetric combinations

	Volumetry ≥ 200 mL & perimetry ≥ 2 cm	Volumetry ≥ 100 mL & perimetry ≥ 2 cm	Volumetry $\geq 10\%$ & perimetry $\geq 10\%$
Sensitivity	90.0%	86.7%	73.3%
Specificity	71.7%	69.4%	78.3%
Positive predictive value	61.4%	57.8%	62.9%
Negative predictive value	93.5%	91.5%	85.5%
Accuracy	77.8%	74.4%	76.7%

Results

The mean age of the patients was 54.8 ± 11.7 years. Table 1 shows the evaluation of perimetry combined with volumetry (Gold Standard) in the different evaluations. When a difference of 2000 mL was considered, two patients with contralateral limbs difference larger than 200 mL that had been considered as having lymphedema were no longer considered as such. On the other hand, when a 10% difference in volume was considered, two patients with limbs of less than 2000 mL, who had been considered as without lymphedema, apparently were lymphedematous and so the prevalence was the same in both cases.

Discussion

The current study evaluated perimetry combined with volumetry in the diagnosis of lymphedema after breast cancer surgery showing variations in the prevalence, sensitivity, specificity, predictive values and accuracy using different combinations of measurements. The literature cites volumetry as the Gold Standard in the diagnosis of lymphedema [5–7], but without stating the standard volume to be considered. However, perimetry is the most commonly used examination in the diagnosis and follow up of the treatment of lymphedema [2–4].

In this study, the sensitivity of perimetry is higher when a volume of 200 mL for volumetry is considered and the specificity is higher when a difference of 10% compared to the contralateral limb in both volumetry and perimetry is considered.

The variation in the accuracy is small comparing the three conditions with the lowest accuracy being 74.4%. The negative predictive value was greatest when the volume was ≥ 200 mL in 93.5% of cases showing a high exclusion rate of patients who really do not have lymphedema.

When a volumetric difference of 10% is considered, two patients with contralateral limbs larger than 2000 mL, who were thought to have lymphedema, were reclassified as normal, but two limbs that were less than 2000 mL were recategorized as lymphedematous. These data are important when considering the volume of the limb to be considered during volumetry.

There are suggestions that with perimetry a difference of 2 cm should be considered for the diagnosis of lymphedema instead of 10% compared to the contralateral limb. This is because in some situations these limbs can have volumes of less than 2000 mL and thus the accuracy of the examination is lost. However, possible mistakes are not statistically significant.

Although there is no consensus in respect to the difference in size to be considered in lymphedema, volumetry is the Gold Standard in evaluations. Now it is necessary to establish the volume to be considered remembering that the size of the limb can influence the diagnosis. The ideal assessment would be to perform volumetry in the preoperative period and from this to establish the diagnosis of lymphedema for each individual. Perimetry should consider

alterations of more than 2 cm in respect to the contra-lateral extremity. The evaluations both in the diagnosis and treatment of lymphedema should be attained by safe and simple methods [10].

Conclusion

Perimetry is a reliable method for the diagnosis of lymphedema considering differences greater than 2 cm compared to the contra-lateral limb.

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