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METHODOLOGY

Audit of ultrasound measurement of invasive breast cancers compared with histological size

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Abstract: An accurate measure of breast cancer size is important since it influences therapy choice and can be used to monitor response to treatment. Ultrasound is known to underestimate tumor size, but experienced operators should achieve a good correlation between measurements and histological size. There is a wide range of published correlation coefficients with a mean of 0.74 and range of 0.45 to 0.92. Tumor type can influence the correlation with lobular carcinomas, in particular, being more difficult to visualize and measure on imaging. A minimum correlation of 0.6 with a desirable target of 0.75 seems achievable. This short report demonstrates how readily available software can be used to calculate and graphically display a correlation coefficient of ultrasound and histological tumor measurements. Using our results for one year, we illustrate the use of this software as an auditing tool.

Keywords: breast, ultrasound, audit, cancer

Introduction

Measurement of breast cancer size by ultrasound is important. Size can influence therapy plans for the patient and is also important for measuring response to adjuvant therapy. Ultrasound assessment is known to underestimate tumor dimensions compared to histology,[1] but experienced operators should aim to achieve a good correlation between ultrasound measurement and histological size. Correlation refers to the departure of two random variables from independence. Ultrasound does not give exact histological size and tends to underestimate tumor dimensions. However, the relationship should be linear and ultrasound is widely used to approximate tumor size and monitor therapy in the clinical situation.[1] For this reason, a parametric measure of correlation (Pearson's coefficient) has been applied in a number of publications. Its use was reviewed and tabulated by Pritt et al in 2004.[2] Spearman's coefficient can be applied, but its use is best when the relationship between the factors is not linear. Previous publications have assumed a linear relationship and chosen Pearson's coefficient. Many software packages will allow simultaneous calculation of both figures. Radiologists measuring cancers aim for a correlation with histological size as close to 1.0 as possible. The correlation coefficient alone is not enough since viewing the distribution of data plots allows us to visually asses the linearity of the relationship and identify outliers. Correlation can be calculated and plotted easily using widely available software.

Methods

A standard correlation coefficient for which to aim must first be set. The goal is for a good linear correlation between tumor size by ultrasound and microscopic size.

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The literature shows a wide range of published Pearson's correlation coefficients. These were tabulated by Pritt et al[2] who compared their results of 0.79 with 11 prior studies finding an overall mean of 0.74 and range of 0.45 to 0.92. Tumor types can influence the correlation, with lobular carcinomas being more difficult to quantify.[1,2] A large United Kingdom (UK) series[4] established a correlation coefficient of 0.63. It is therefore difficult to set targets with such a varied range of published data, but a minimum of 0.6 with a desirable target of 0.75 would seem achievable.

One year (2007) of new invasive breast cancer cases at Glasgow Southern General Hospital were identified from histology records and histological size of the lesion at microscopy documented. We obtained ultrasound measurement at diagnosis from the radiologists' reports. The correlation coefficient was assessed using Microsoft Excel® (2003, Microsoft Inc, Redmond, WA) and *Statistics with Confidence* software.[3]

Results

Sixty-two new breast cancers were identified at Glasgow Southern General Hospital in 2007. In 16 cases, the diagnosis had been made either by wide-bore needle biopsy only, or with adjuvant therapy administered before excision. Other cases were excluded if there was multifocality, no ultrasound performed, or if they were preinvasive only.

Twenty-seven invasive cancers were eligible and had a histological excision size recorded. These measurements and their comparative ultrasound sizes are shown in Table 1. Pearson's correlation coefficient was calculated at $r = 0.73$ by both Microsoft and *Statistics with Confidence* software packages. The plot graph (Figure 1) shows a somewhat linear relationship and allows for easy identification of outliers.

Table 1 Ultrasound and comparative histological size of invasive breast cancer cases at Glasgow Southern General hospital in 2007 (n = 27)

Case	Ultrasound size (mm)	Histological size (mm)
1	11	17
2	14	15
3	20	40
4	30	35
5	23	29
6	30	20
7	11	13
8	20	27
9	7	9
10	16	22
11	11	8
12	17	18
13	13	25
14	17	15
15	17	15
16	25	30
17	24	20
18	22	23
19	23	22
20	8	10
21	28	36
22	11	15
23	25	22
24	18	20
25	11	15
26	15	20
27	15	15

Discussion

It is generally understood that ultrasound will tend to underestimate tumor size and will not equal histological measurement; however, there should be a good linear correlation between our measurements and histological size.

Although targets such as being within 1 cm in a certain percentage of cases have been used in some papers,[5] we suggest that a meaningful audit is best done by measuring and plotting correlation coefficients. We have used both Microsoft Excel® and software from Altman et al[3] to calculate correlation coefficient in 27 cases. The latter software allows simultaneous calculation of Pearson's and Spearman's correlation coefficients to be calculated. In our small sample there was no significant difference found; the Pearson correlation was 0.73 (95% confidence interval [CI]: 0.476–0.866) and the Spearman correlation was 0.77 (95% CI: 0.549–0.889).

While Pearson's correlation coefficient is a good statistical indicator of the linear correlation of measurements, widely differing plots graphs can arise from the same numerical figure. As seen in an example from Anscombe,[6] all 4 plot diagrams can lead to the same figure for r of 0.816 (Figure 2). For this reason, and to identify outliers, the plot graph is a valuable addition to r value alone.

Individuals can calculate and plot correlation by using readily available software, with very little technical skill required. We have used both Microsoft Excel® and *Statistics with Confidence* software,[3] but other programs, including free web-based software, are available. The *Statistics with Confidence* package allows easy calculation of CI[5] for the Pearson's coefficient and gives a good indication of the statistical

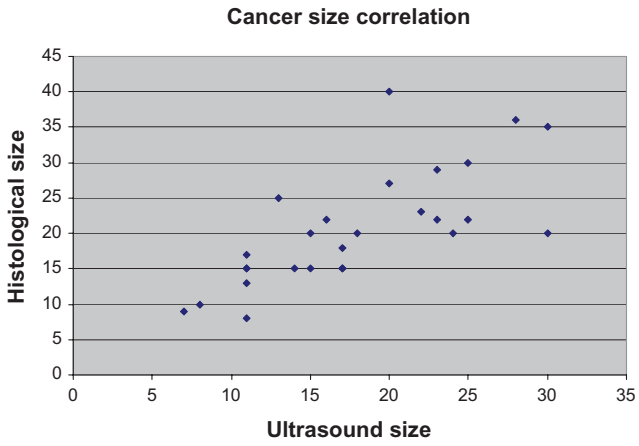

Figure 1 Plot of histological size compared to ultrasound measurement.

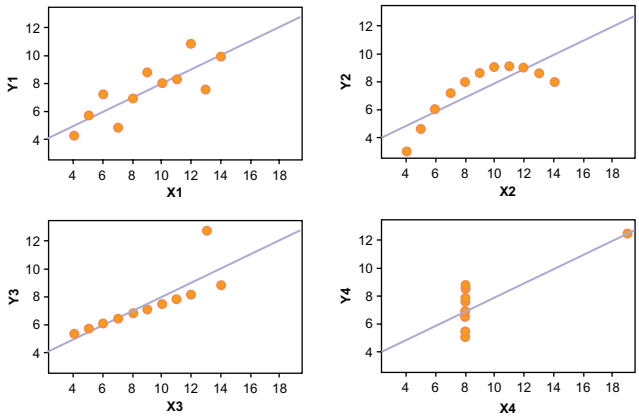

Figure 2 Correlation plot diagrams from Anscombe.[6] Copyright © 1973, American Statistical Association. All rights reserved. Reprinted with permission from Anscombe FJ. Graphs in statistical analysis. *Am Staf.* 1973;27:17–21.
Note: All four plots have an *r* value of 0.816 for correlation.

significance of the calculated figure. For our small sample, the 95% CI was 0.48–0.73. A reasonable sample size is needed since many cancers need to be excluded (ie, multicentric lesions, neoadjuvant treatment cases etc). In this report, the CI of our result was broad. It is partly because of this that we consider the plot diagram to be of value as it can portray the linearity of a relationship and identify outlying measurements for review, rather than just viewing a numerical figure for correlation coefficient alone.

We suggest the following targets based on published reviews: a minimum correlation coefficient 0.6 and an achievable goal of 0.75. We advocate the use of this measure as a routine audit tool.

Disclosure

The authors report no conflicts of interest in this work.

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