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Original Article

Assessment of the breast volume by a new simple formula

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ABSTRACT

Background: With the recent introduction of improved techniques for plastic surgery of the breast and increased public awareness toward these procedures, plastic surgeons are continuously trying to improve their methods and results to reach perfection. Assessment of the breast volume is an important issue prior to the use of breast implants in any aesthetic or reconstructive breast surgery. Previous methods to measure breast volume have included use of a simple bra and breast cup size, cumbersome fluid displacement, appliances and approximate visual estimation.
Objectives: In this work we have tried to develop an easy method for assessment of the breast volume for both the patient and the the surgeon through a simple mathematical formula.
Materials and Methods: Fifty two volunteers were included in this study. For every one, general parameters including age, weight and height were recorded. Local breast measurements and water volume displacement were also recorded.
Results: The collected data were statistically correlated. Using the analyzed data, the breast volume was calculated through a simple and direct formula on the basis of the breast circumference.
Conclusion: Our method has, as its principle, the use of an accurate and simple formula, which is based only on one measurement. This is easy for both the patient and the plastic surgeon. This equation is not only a significant technical advantage for the surgeon, but also provides a universal standardization of the breast volume.

KEY WORDS

Breast, formula, volume

INTRODUCTION

Attractive breasts are symetrically situated on the anterolateral chest wall and have soft but defined junctures with the chest, upper abdomen and the axillae. The breast profile is a gentle downward vertical flow from the clavicle to the nipple-areola and a mildly convex from the nipple-areaola to the infra-mammary crease.[1] The goal of the breast surgeon in aesthetic and reconstructive breast surgeries is always to create the appearance of pleasant symmetrical breasts. For this purpose, a method of measurement is presented allowing an objective and accurate calculation of the breast volume. This measurement is of a great value in the preoperative evaluation including implant size determination in cases needing augmentation and assessment of how much should be excised in cases of breast reduction. Many of the breast implant companies supply intraoperative sizers of the created pocket for proper selection of the ideal size of the needed implant. As it is not logical to have a breast implant sizer for every patient, the repeated usage of these sizers, although sterlizable, is fraught with risks. In the absence of theses breast sizers, more than one implant may be used, as a trial and error, in the operative theater to achieve the ideal volume. Consequently, the preoperative volume assessment will assist the surgeon to calculate the ideal volume of the operated breast according to the patient's anthropometrical measurements. This will also assist the patient to preoperatively, decide the size of her proposed implant or to decide how much tissue she wants to remove from her breast in cases of augmentation and reduction respectively. The hypothesis, this study tries to answer: is it possible through only one of the variables of breast measurements to calculate the breast volume?

MATERIALS AND METHODS

Fifty two nulliparous volunteers were included in this study. They were students of the Faculty of Nursing who were not complaining of any of the breast conditions and in whom no major aesthetic procedure would be considered appropriate to enhance the breast's form. Age, weight, height and chest circumference of each participant was recorded. Linear measurements of both breasts of every volunteer were calculated, once in the upright position and once more in the supine position, including mid-clavicular to nipple and to infra-mammary crease, projection, lateral breast crease to nipple, midline to nipple and breast circumference. The contact area of the breast on the chest wall in the upright position was also measured [Figure 1]. The standard water volume displacement was also recorded for every breast. The collected data was entered and statistically correlated

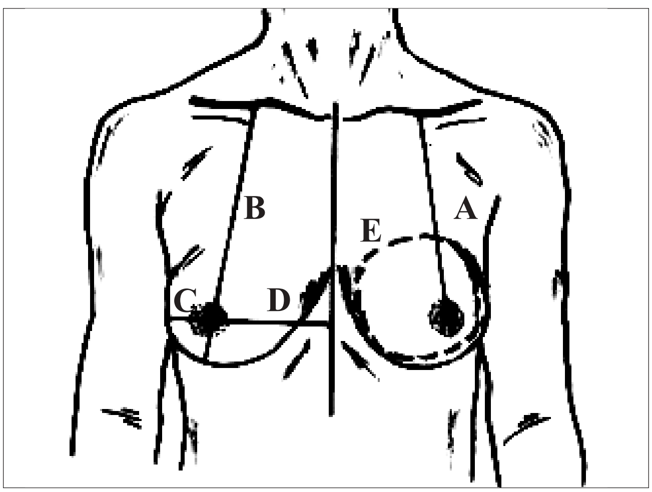

Figure 1: Linear breast measurements: (A) mid-calvicular to nipple, (B) mid-clavicular to infra-mammary crease, (C) lateral breast crease to nipple, (D) midline to nipple and (E) breast circumference

using EPI info version 5. The minimum, maximum, mean and standard deviation of each of the general parameters, the linear measurements and breast volume were calculated.

RESULTS

One hundred and four breasts were included in this work. Fifty six breasts (53.8%) were of the cone-shaped variety, while the other 48 (46.2%) were of the rounded form. Table 1 shows that their age ranged from 18 to 25 years with a mean age of 20.5±1.7 years. The mean weight, height and chest circumference were 61.6±10.1 kg, 159±5.5 cm and 73.3±9.1 cm respectively. Table 2 shows that the water volume displacement of right breasts ranged from 100 to 800 cm^3 (mean 288.8±130.5) with minimal variation from left breasts which ranged from 80 to 850 cm^3 (mean 289.7±131.1). In the upright position the right breast circumference ranged from 28 to 49 cm (mean 38.5±4.1) nearly without variation from left breasts which ranged from 28 to 50 cm (mean 38.6±4.0). In the supine position the right breast circumference ranged from 33 to 54 cm (mean 41.5±4.2) nearly without variation from left breasts which ranged from 33 to 55 cm (mean 41.4±4.1).

It has been already proved that the volume of a sphere could be simply calculated through a direct formula.[2] This well established equation can calculate the sphere volume as equal to $4/3\ \pi$ x (half diameter)^3 ["$\pi = 3.14$"] If we assume that the breast is half a sphere, its volume could be calculated as: $2/3\ \pi$ x (half diameter).[3]

However, breast shape, consistency, weight fluctuations, menstrual and hormonal influences and position of the breast on the chest wall are some of the factors that affect the accurate and reproducible breast volume measurement. These factors preclude the absolute consideration of the breast as a half of a sphere. Consequently, finding a fixed factor instead of the ($2/3\ \pi$) would enable us to use a similar equation of that of the half sphere volume for the breast volume assessment. Although this factor would be a fixed one in our formula,

Table 1: General parameters of the studied group. N = 52 females (104 breasts)

Variable	*Min*	*Max*	*Mean*	*St. deviation*
Age/years	18	25	20.5	1.73
Weight/kg	47	89	61.6	10.14
Height/cm	148	175	159.0	5.5
Chest circumference/cm	58	90	73.3	9.1

Table 2: Linear breast measurements. The measurements are for 104 breasts

Measurements	*Min*	*Max*	*Mean*	*St. deviation*
Water volume displacement of rt. breasts/cm³	100	800	288.8	130.48
Water volume displacement of lt. breast/cm³	80	850	289.7	131.14
Upright right breast circumference/cm	28	49	38.5	4.1
Upright left breast circumference/cm	28	50	38.6	4.0
Supine right breast circumference/cm	33	54	41.5	4.2
Supine left breast circumference/cm	33	55	41.4	4.1

it is compatible with the human breast, as it comes from the previously mentioned live variables.

Hence, the breast volume = (Factor) $\pi \times$ (half diameter).^{3}
As the half diameter could be simply calculated by the equation of;
Half diameter = breast circumference $\div$ 2 π = circumference/6.28
and the breast volume is known through the water volume displacement, this unknown factor can be calculated as:
Factor = Breast water volume displacement $\div$ π (half diameter)[3]
Consequently, the volume could be calculated as:
Breast volume = Factor π x (half diameter)^3
In the upright position, the calculated mean value of the half diameter of the right breast of the studied sample was 6.12 cm, while that of the left breast was 6.14 cm. Applying these values in the last mentioned formula, the factor will be 0.38. So, we can now simply calculate the breast volume by the equation:
Breast volume = 0.38 $\pi \times$ (half diameter)^3
Breast volume = 0.38 x 3.14 $\times$ (half diameter)^3
Breast volume = 1.193 $\times$ (half diameter)^3
Breast volume = 1.193 $\times$ (breast circumference/6.28)^3

In the supine position, the calculated mean value of the half diameter of the right breast was 6.6 cm, while that of the left breast was 6.59 cm. Applying these values in the last mentioned formula, the factor was 0.31. So, the breast volume can be calculated by the equation:
Breast volume = 0.31 $\pi \times$ (half diameter)^3
Breast volume = 0.31 $\times$ 3.14 $\times$ (half diameter)^3
Breast volume = 0.973 $\times$ (half diameter)^3
Breast volume = 0.973 $\times$ (breast circumference/6.28)^3

DISCUSSION

Many authors have previously tried to determine the breast volume. Smith performed volumetric analysis by making a plaster cast of the subject's chest and then measuring the amount of sand needed to fill the mold.[3] The Grossman-Rounder device utilized a variable cone which did not measure all the breast tissue, since the tip of the cone is not always filled when a firm or a very small breast is measured.[4] The water displacement method also does not adequately measure the tissue lateral to the pectoral folds. The common drawbacks of these methods are that they need a special apparatus and the application is cumbersome for both the patient and the surgeon.

Presenting a simple and direct equation to calculate the breast volume was our aim. Westreich[5] in 1997 has suggested a formula in an attempt to determine the ideal breast volume:
Volume = (M-Ni)$^{1.103}$ x (N-Ni)$^{0.811}$ or log (volume) = 1.103 x log (M-Ni) + 0.811 x log (N-Ni), as M-Ni is the manubrium to nipple and N-Ni is the nipple to nipple distance. Although he stated that none of the measurements could supply the actual breast volume, we also find his formula a very complicated one, depending on two variables, with many logs and multiplications.

Our equation presents its simplicity in two points; the first of which is the use of only one variable which is the breast circumference, the second is the possibility to calculate the breast volume through a simple and direct mathematical step. The half diameter could be simply calculated as: Half diameter = circumference / 6.28, then we can get the breast volume through the equation of:

Breast volume = 0.973 x (half diameter)^3 in supine position
Breast volume = 1.193 x (half diameter)^3 in upright position

Although we have now two equations for two positions, if we actually consider that the supine position is the ideal position to measure the breast circumference as resting of the breast tissue by its weight on the chest wall will cancel the other differentiation criteria of the breasts as shape, consistency and position which may accompany the physiological and anthropometric changes of aging and pregnancy. However, we have measured the main variable in our method which is the half diameter (by measuring the breast circumference) in two positions; the supine and the up-right positions in a trial to achieve the highest degree of accuracy. We have found that the factor difference between the two positions is not significant and minimal (0.06). Multiplying the higher half diameter of the supine position with the less factor will be merely equal to the multiplication of the shorter diameter of the upright position with the more factor value.

There has been little discussion with almost no known studies in the published literature documenting breast shape preferences. A recent study suggests that both the plastic surgeons and the patients may have drastically different images in their minds regarding what constitutes an attractive, natural and ideal breast shape.[6] However, there may be a general consensus that the nice breast has a round shape and look like a juvenile breast.[7] In our study, we have measured the factor value in both the circular and rounded form breasts in either position; supine and upright. The value in the cone shaped breasts was 0.39+0.10 and 0.31+0.07 during the upright and supine positions respectively. For the circular breasts the value was 0.38+0.09 and 0.30+0.08 during the upright and supine positions respectively. Although there was no significant difference between the two conditions, we consider this negativity as a highly significant finding meaning that the used factor in our formula is absolutely accurate and reliable for all breasts.

CONCLUSION

Our method has, as its principle, the use of an accurate and simple formula, based only on one measurement which is also very easy for both the patient and the plastic surgeon. This equation is not only a significant technical advantage for the surgeon, but also provides a universal standardization of the breast volume. In our opinion, it is ideal in its volume determination for all normal breasts which would be a useful adjunct to assist the breast surgeon to achieve the desired aesthetic goals.

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