BREAST VOLUME MEASUREMENT BY MAMMOGRAPHY: IT'S ACCURACY AND APPLICATION

Surgery

Dr. R. G. Naniwadekar	MBBS, MS, Professor in Department of Surgery, KIMS, Karad
Dr. Pratik D. Ajagekar*	MBBS, Senior Resident in Department of Surgery, KIMS, Karad *Corresponding Author

ABSTRACT

AIM & OBJECTIVE: To have a pre-operative breast volume measurement by Mammography, its application and accuracy.

METHODS: Measurements of breast volumes of 43 patients who were scheduled to undergo mastectomy in Krishna Hospital and Medical Research Centre, Karad, were taken preoperatively by using Mammography. Volume of the specimen after the mastectomy was measured in each patient with the water displacement method (Archimedes). The results were compared statistically with the values obtained preoperatively.

RESULTS: The mean mastectomy specimen volume was 650.8 ± 315.6 mL. The breast volume values were established to be 644.7 ± 308.8 mL ($r = 0.997$) with the mammographic method. Examination revealed that the accuracy of mammography for measurement of breast volume for all volume ranges was significant.

CONCLUSION: The present study demonstrated that the breast volume measurement by mammography was significantly accurate in order to plan for corrective and reconstructive mammoplasty surgeries after mastectomy. However, when patient comfort, ease of application, and cost were taken into consideration, Mammography is easy application and comfortable for the patient with cost effectiveness, and an easier method with an acceptable degree of accuracy.

KEYWORDS

breast volume; breast density; macromastia; oncoplastic surgery; reduction mammaplasty; breast conservative surgery.

INTRODUCTION

Breast is a modified sweat gland derived from the ectodermal layer and situated on the anterior chest wall from the second to sixth rib. It is separated from the underlying pectoralis major muscle by the pectoral fascia. The normal breast profile is in a gently downward vertical direction from the clavicle to the nipple-areola and a mildly convex from the nipple-areola to the infra-mammary crease bilaterally symmetrical. The shape and size of the breast varies according to the Age, Race and Physiology of the mankind. The aim of a breast surgeon in corrective and reconstructive surgeries is to have pleasingly symmetrical breasts. Many attempts and methods have been derived and invented for the accurate measurement of the breast volume since the past. What is the significance of breast volume measurement?

It helps to establish a diagnosis and classify Macromastia[1].

This measurement is of a great value in the preoperative evaluation including implant size determination if at all augmentation is required.

In order to decide the indication for breast reduction surgery in macromastia[1,2] and to decide the amount of breast tissue to be removed, which is essential information required for insurance and social security companies.

Measurement is required for determining the approach in all kinds of breast surgeries viz., reduction, augmentation, reconstruction and oncoplasty to achieve bilaterally symmetrical breasts.[3,4]

Breast volume measurement preoperatively in Carcinoma cases should be done to determine the tumor and breast ratio for breast conservative surgeries. Since, a 5cm tumor is big for a small breast or in lean women whereas, it is small for a voluminous breast or obese patients. Breast conservation surgeries are easier as we get a good margin of clearance in a large volume breast, but patients with small breasts have to undergo mastectomy for the tumor of the same size.

Even though breast volume measurement is particularly important in so many aspects, it is not routinely done due to lack of a standard measurement method. Still there is no commonly accepted method all around the globe. There are six main methods to breast volume measurements among the other lesser known methods.

Several methods have claimed to measure the volume of the breast accurately, still there is a debate over which is the most accurate and feasible with minimal expences i.e. the ideal method for breast volume measurement. All these methods have also failed to gain reputation and acceptance due to the cost, patient discomfort and technical difficulties. Previously there have been only fewer studies with control groups to compare the various modalities for breast volume measurement. The various methods of measurement are enlisted in the table below :

Table1. Main methods of Breast volume measurement

Archimedes principle (displacement of water) measurement
Anthropometry (anatomical) measurement
Imaging (Mammography, CT, MRI) measurement8
Casting method of measurement
Grossman- Rounder Device method of measurement7
Biostereometrics measurement (3D surface scanning)

However in this study we have used Mammography as a standard method for preoperative breast volume measurement as study group and considered the postoperative measurement as a standard control group using Archimedes method. We have compared the readings/values with preoperative values.

METHODS & MATERIALS

Forty-three females were enrolled in this prospective study, who were scheduled to undergo mastectomy for various reasons in Krishna Hospital and Medical Research Centre, Karad from January 2017 to December 2017. The females participated voluntarily with a signed informed consent.

Mammography was used for the breast volume measurement in our study.

When the patients presented to the outpatient department they were informed about the study and voluntarily enrolled. Mammographic readings were obtained preoperatively before patient being admitted or on the day of admission in the hospital. The mammographic technician was given prior information about the measurement and compression thickness. All readings were taken only once in each patient.

Mammographic measurements

All the measurements were performed on the craniocaudal mammograms using ruler, and the volume calculated using the formula5,11:

Breast Volume = $\frac{\pi}{4} \times (H \times W \times C)$

[W = breast width, H = breast height, C = compression thickness]

$$V_{MMG}=(\pi/4) \times H \times W \times C$$
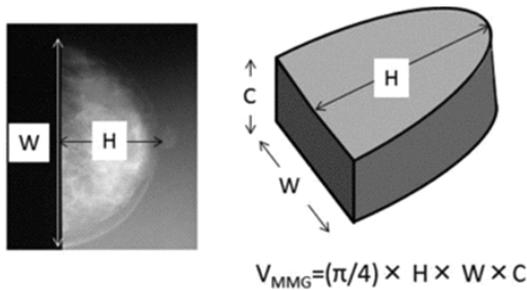
Fig1. Mammographic breast volume measurement method.

Specimen Volume Measurement

After the specimen was removed, it was measured in a graduated container. Simple mastectomy specimen were directly measured, whereas, the specimen of MRM were separated from the Axillary tissue by the surgeon and then measured to rule out the error in the readings. The amount of water displaced was measured as the volume of the specimen. In short, Archimedes principle was used here to measure the specimen volume.

STATISTICS

The breast volume by Mammography and specimen were compared with each other and the accuracy of the Mammography method was compared. The significance level was accepted as the p values lower than 0.05 at a 95% confidence interval.

RESULTS

In our study the mean age of the patients was found to be 47.8 years (range 31 – 78). The mean BMI was found to be 23.6kg/m2. The mean mastectomy specimen volume was 650.8 ± 315.6 ml. The mean breast volume calculated by Mammography was 644.7 ± 308.8 ml. We evaluated all the values and calculations; Mammography has turned out to be a very accurate method.

Table no. 1 Reliability of Mammographic breast volume measurements according to specimen volume.

Method	Mean Volume	Range (r)
Specimen Volume	650.8 ± 315.6 ml	--
Mammography	644.7 ± 308.8 ml	0.992 – 0.998

DISCUSSION

Although breast volume measurement is of a great value, in the diagnosis, management and reconstruction of the breast and breast disease, it has not been fully appreciated by the surgeons al over the globe. The main reason for it being, absence of a standard method for measurement, which is simple and accurate. In the present study, the approach was planned to provide with a answer to this problem. We have referred to many studies in the past and come across a similar pattern; i.e. the two or more methods were compared to each other and there was no standard control group. In our study, we have kept excised specimen as a control and compared our mammography findings with the specimen volume.

\In our study the mathematical calculations were made using a conical formula instead of a standard half-elliptical cylinder, which is why the results are not debatable11. In the study performed by Bulstrode et al.4, they reported that anthropometric and casting device method had results similar to that of mammographic findings, even then mammography remained the apt method for measurements. As compared to the other imaging techniques like MRI and 3D imaging, Mammography was found to be easier and simple. Kovacs et al5 demonstrated that MRI to be more reproducible that 3D imaging and Anthropometry. Mammography however holds an upper hand over MRI.

Mammography also requires less amount of time and data compiling is easy as everything is computerized and calculations are easy. In this era of technological advancement, Mammography certainly holds its ground when compared to MRI and 3D imaging in terms of availability, ease of measurement, cost effectiveness10 and reproducibility9. Mammography is also a routine investigation done in all breast lump cases as recommended by the American Society.

Casting and water displacement methods have not become a routine because of low patient comfort and complications in their application as well as relatively low level of accuracy. We further conclude that, Mammography is by far the most accurate method available for the breast volume measurement as compared to other available methods. We however suggest that further prospective studies to be conducted to compare the various methods of breast volume measurement, with a standard control group.

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