Volpara™ as a measurement tool for breast volume☆

Dear sir,

Mammography has been a standard form of imaging the breast in the United Kingdom since 1988. With the advent of full-field digital mammography, software tools designed to provide automated breast density assessment are now available. These tools have emerged because mammographic breast density is an important risk factor for breast cancer.[1] The two commercially available systems are Quantra™ (Hologic Inc., Bedford, MA, USA) and Volpara™ (Matakina, Wellington, New Zealand). They calculate breast volume and density based on area and thickness measurements derived from the raw versions of the two-view digital mammograms. The overall breast volume is then used as the denominator for the volumetric percentage of fibroglandular tissue.[2] We aim to assess the validity of Volpara™ as a breast volume measurement tool by comparing Volpara™ volume measurements to actual skin sparing mastectomy (SSM) specimen volumes obtained intra-operatively.

A prospective database of 43 SSM specimens in 39 women were analysed. Immediately following SSM, direct volume measurements were performed intra-operatively using a water displacement technique. The excised breast tissue was placed in a cylinder of water and the volume of displaced water measured. Intraoperative volumes were compared to the Volpara™ volumes using the Pearson's coefficient test and intraclass correlation coefficient (ICC). Analysis was performed using SPSS v21 by the authors following advice from a trust statistician.

The mean Volpara™ volume measurement was 660 cc (range 285—1270 cc) and the mean mastectomy volume measured intra-operatively 393 cc (range 50—900 cc). Pearson's correlation test showed a statistically significant correlation of 0.81, $p < 0.01$ ($R^2 = 0.657$). ICC established moderate agreement with $n^b = 0.67$ for mean values and $n^b = 0.51$ for single measures, 95% CI.

Breast density measurements in radiological investigations have been widely researched, with papers substantiating the correlation of density with the risk of malignancy. It is only in the last decade that interest in volume has grown. In breast conservation surgery, the ratio of parenchyma removed has been shown to greatly affect cosmetic outcome and patient satisfaction. In mastectomies, pre-operative knowledge of breast volume can guide the surgeon in estimating what is required to be replaced, either in the form of flaps, implants or a combination of both.

There are many merits to using mammography to calculate breast volumes. It is almost invariable that any patient who undergoes a mastectomy for oncological therapeutic or prophylactic indications would have had a mammogram. Digital volume measurements from mammograms are simple, fully automated and can be performed retrospectively without the patient being present. Wang et al.[3] compared Volpara™ volume measurements with MRI measurements in 99 patients, and concluded that Volpara™ and MRI volumes were in 'substantial agreement' with an $R^2 = 0.91$. Highnam et al.[4] compared breast density using Volpara™ to MRI and found a high correlation ($R^2 = 0.94$), but made no analysis of volume. Brand JS et al.[5] analysed Volpara's™ performance in density analysis in 41,102 women and found this software performed well and in accordance with established density measures. Again, this study did not analyse volumes. To date, this is the first study comparing Volpara™ volumes with actual mastectomy specimens.

We have found a strong correlation of Volpara™ readings to actual mastectomy volume measurements, with a Pearson's correlation coefficient of 0.81, $p < 0.01$. Within a 95% confidence interval, the limits of agreement were −580 cc to 48 cc. This interval is wide, reflecting the small sample size and great variation of differences. ICC test showed only reasonable agreement, with a value of $n^b = 0.67$ for average measures and $n^b = 0.51$ for single measures. This can be clinically interpreted to be a concordance of 0.67 for Volpara™ measures and SSM measures on average, but only 0.51 for any single, given SSM measurement to be concordant with its Volpara™ measurement.

Not surprising, the Volpara™ breast volumes were consistently higher than mastectomy volumes (266 cc greater on average). We hypothesize that this was because the mastectomies were skin sparing, removing the nipple areolar complex (NAC) and breast parenchyma for measurement, whilst leaving the breast skin and subcutaneous envelope in situ.

There are limitations to our study. Due to the small sample size, our analysis cannot be adjusted for possible confounders. Traditional mastectomy (where the NAC and an ellipse of breast skin and fat is removed) volume measurements would more accurately represent the true breast volume, however this also leaves a portion of breast envelope in situ, rendering Volpara™ readings to still be intrinsically higher than specimen measurements. To reduce this variability, a method of digitally calculating the breast parenchyma without the skin envelope would be useful.

In summary, we believe that Volpara™ is a simple, objective and cost effective method of estimating breast volume. This can guide the surgeon in deciding the most suitable oncological procedure, and guide implant and/or flap reconstructive surgery in mastectomy.

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Conflict of interest statement

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Ethical approval

N/A.

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References

1. McCormack V, dos Santos Silva I. Breast density and parenchymal patterns as markers of breast cancer risk: a meta-analysis. *Cancer Epidemiol Biomarkers* 2006;**15**:1159–69.
2. Aitken Z, McCormack VA, Highnam RP, et al. Screen-film mammographic density and breast cancer risk: a comparison of the volumetric standard mammogram form and the interactive threshold measurement methods. *Cancer Epidemiol Biomarkers Prev* 2010;**19**(2):418–28.
3. Wang J, Azziz A, Fan B, et al. Agreement of mammographic measures of volumetric breast density to MRI. *PLoS ONE* 2013; **8**(12):e81653. Doi:10.137.
4. Highnam R, Brady S, Yaffe M et al. Robust breast composition measurement-Volpara. In: Marti J, Oliver A, Freixenet J, Marti R. Editors. Digital mammography: Springer Berlin/Heidelberg. Pp. 342–349.
5. Brand JS, Czene K, Sheperd J, et al. Automated measurement of volumetric mammographic density: a tool for widespread breast cancer risk assessment. *Cancer Epidermiol Biomarkers Prev* 2014;**23**(9):1764–72.

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Reply: Treatment of hydrofluoric acid burns of the fingers

Dear Sir,

We would like express our appreciation to Dr. Zhang and coauthors for their comments on our recently-published article entitled "Early Surgical Treatment by Free Flap Reconstruction of Hydrofluoric Acid Burn Injury".[1] We are grateful to them for bringing further attention to the appropriate treatment of hydrofluoric acid (HFA) burn injuries. We thank them for recognizing the importance of early surgical intervention and the suitable restoration of HFA burn wounds as introduced in our article. We agree with them that risks and benefits should be carefully weighed in the management of HFA burn injury. We welcome this opportunity to further discuss this interesting case.

Zhang et al. raise several valuable points. First, they emphasize the significance of the initial management of the HFA burn blister. We agree that it is necessary to remove the blister fluid to reduce local tension and thus relieve the pain. Consistent with their comments, our patient underwent an initial unroofing after magnetic resonance imaging (MRI) in the emergency department, and then the wound was treated topically with 10% calcium gluconate solution.[2] However, our treatment approach was not only addressed at the pain due to blistering, which can be managed conservatively, but also at the deep, penetrating, and progressive damage to HFA-injured soft tissue. The patient's MRI showed that HFA had already penetrated the skin barrier and reached the soft tissue integument. The characteristic throbbing pain of an HFA burn injury comes primarily from the reaction of fluoride ions with the soft tissue deep to the dermis.[3] This is probably more significant than the superficially-located blister above the dermis, which contains serous plasma fluid.[4]

Secondly, they assert that the subcutaneous injection of calcium gluconate for this finger HFA burn was inappropriate, and that this measure likely exacerbated the patient's pain. We disagree with this view for three reasons. First, the criteria for subcutaneous injections on extremities include injury by highly concentrated (>20%) HFA, central necrosis with a gray area, and throbbing pain. In our case, the wound induced by 54% HFA developed progressive discoloration, and initial treatment failed to control the pain. Second, digital nerve block can be performed cautiously before subcutaneous injection, although there is controversy regarding the use of local anesthetics for subcutaneous injection in fingers with HFA burns.[5] Third, the distal circulation of the patient's thumb was not compromised after subcutaneous injection on the first visit to the emergency department.

We agree with the finding of Zhang et al. that if the patient's pain fails to be relieved after early topical intervention, other treatment options need to be selected. They demonstrated excellent results in managing HFA-induced pain with the intra-arterial or intravenous perfusion of calcium gluconate.[6,7] However, this approach does have limitations. It should be noted that there is no established protocol for these methods.[6,8] Inappropriate