BREAST IMAGING

Could the coronal view in automated breast ultrasound help in the breast cancer screening of women with dense breasts?

By Dr. Simone Schiaffino, Dr. Gianmarco Della Pepa and Dr. Andrea Cozzi

In this article we describe an evaluation of the use of the coronal view of the Automated Breast Ultrasound (ABUS) technology. Coronal view is a unique feature of the ultrasound-based imaging technique, and yields higher specificity compared to a complete multiplanar assessment. In addition, coronal view ABUS has faster reading times, albeit at lower sensitivity.

Breast cancer is still the most frequent oncologic cause of death in women worldwide [1, 2], despite the spread of screening programs aimed at reducing mortality and morbidity associated with advanced stages of disease [3, 4]. Digital mammography is the main screening tool, offered in organized screening programs and also used in opportunistic screening, i.e. when a woman spontaneously requests to have the examination carried out or at the suggestion of her own family doctor or gynecologist [5].

Since the 1970s, dense breast tissue has been associated with a higher independent risk of breast cancer [6–8] and, more recently, has been demonstrated to be the "Achille's heel" of mammography [9, 10]. However, no agreement has ever been reached on selecting the best adjunct screening tool to supplement mammography in women with dense breasts. Handheld ultrasound (HHUS), automated breast ultrasound (ABUS) and digital breast tomosynthesis (DBT) are the main options [11, 12]. Key milestones in the development of ABUS in this context were the results of two prospective observational studies, in which the authors found that 1.9 to 2.4 additional breast cancers were detected per 1000 screened women, compared to screening with digital mammography alone [13, 14]. These findings were recently confirmed by newly published data [15, 16]. Screening of women with dense breasts is therefore the current main indication of ABUS [13, 14]. However other applications such as lesion characterization, targeted second look, preoperative staging, and assessment of response to neoadjuvant therapy, have also been progressively explored [17].

HOW DOES ABUS WORK?
ABUS is an ultrasound-based technique, able to scan the whole breast volume in a 3-dimensional approach [18]. Technically, the breast volume is acquired through a wide ultrasound probe with automated shifting, obtaining an almost isotropic voxel that can be reconstructed in all planes (including the coronal one) in which the breast is displayed from the nipple to the ribcage [Fig. 1-2]. The radiologist then reads the exam on a separate dedicated workstation [19].

PROS AND CONS OF ABUS
Despite its almost fifty years history [20, 21], clinical applications of ABUS have only recently been explored. The main advantages of the technology are the absence of ionizing radiation, the reduced operator dependency compared to HHUS, and the reduction of the overall workload of highly-specialized medical personnel [22]. Other major technical advantages of ABUS are the standardized and reproducible acquisition and the consequent double-reading option. The main technical drawback of ABUS is its limited assessment of the axilla, because of the

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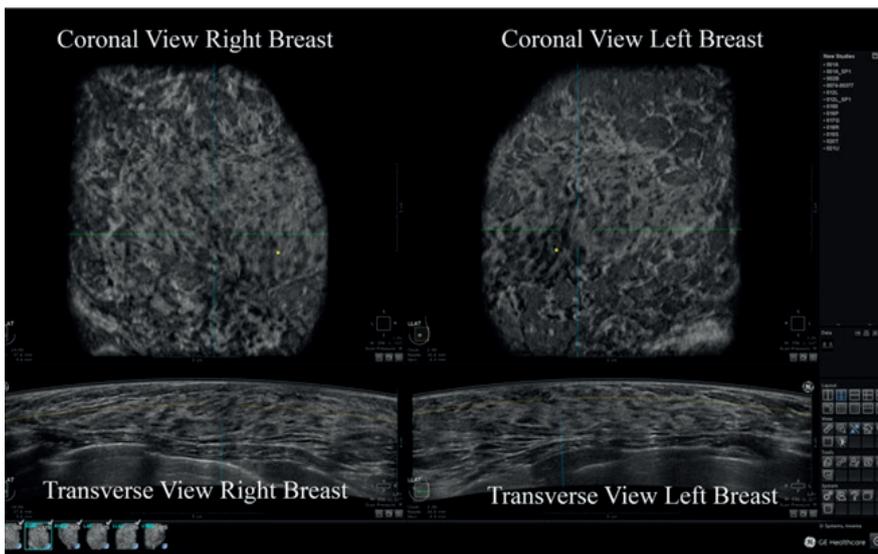Dr. Simone Schiaffino,
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Figure 1. Coronal (upper) and transverse (lower) ABUS views of the right and left breast in a normal case. This is one of the available layouts to assess ABUS examinations. The yellow dot in the centre of the coronal view shows the nipple position (from Schiaffino *et al.* [18]).

shape of the probe [23, 24]. To date, currently available ABUS machines are not able to provide color Doppler nor elastography-based tools, and ABUS-guided biopsy is still not available. The potential spread of ABUS as an adjunct screening tool can also be limited by longer reading times [25–28], when compared, for example, with tomosynthesis [29]. However, alternative and less taxing reading approaches are being explored, including the coronal view approach we have proposed and recently described in La Radiologia Medica [18]. The details of this approach are summarized below.

A NEW PERSPECTIVE: CORONAL VIEW READING AS A STAND-ALONE APPROACH

When all multiplanar views are used in ABUS the mean reading time is reported as being about seven minutes [25–28]. As already mentioned, this aspect considerably hinders the expanded use ABUS as a screening tool, given the need for reliable but fast reports in a high patient volume setting such as in screening. Alternative reading strategies, for example the assessment of the coronal view, could reduce the overall ABUS reading time, both as a brief preliminary evaluation and, theoretically, even as a single-plane reading.

Coronal view-centered assessment has been proposed by Chae and colleagues [30] as a "fly through" reading method, and it is the plane we normally assess first during ABUS reading, since it can provide a brief panoramic view of the acquisition. We therefore aimed to ascertain the value of stand-alone coronal view ABUS reading in women with dense breasts, in terms of reading times, diagnostic performance, and interobserver agreement, compared to the complete assessment of multiplanar (MPR) views [18].

THE VALUE OF STAND-ALONE CORONAL VIEW READING IN WOMEN UNDERGOING AUTOMATED BREAST ULTRASOUND

In a single-centre study [18], we prospectively enrolled consecutive women with dense breasts, i.e. heterogeneously dense or extremely dense breasts (breast density C or D according to the American College of Radiology BI-RADS classification). The women were referred to our Department for HHUS examinations for one of several indications: post-mammography ultrasound assessment, pre-operative assessment, follow-up of known benign lesions. The women were invited to undergo ABUS examination after standard HHUS. Of 256 patients, 188 were enrolled, with a total of 67 breast lesions, 25 of which (37%) were malignant and 42 (63%) benign, using histopathology as the reference standard (or at least two years of negative follow-up for benign lesions without histopathology). Three radiologists, (with respectively 5, 15 and 25 years of experience in breast imaging), reviewed the exams in two different sessions spaced by at least a one-month interval. During the first session, only the coronal view was provided to the reader, while
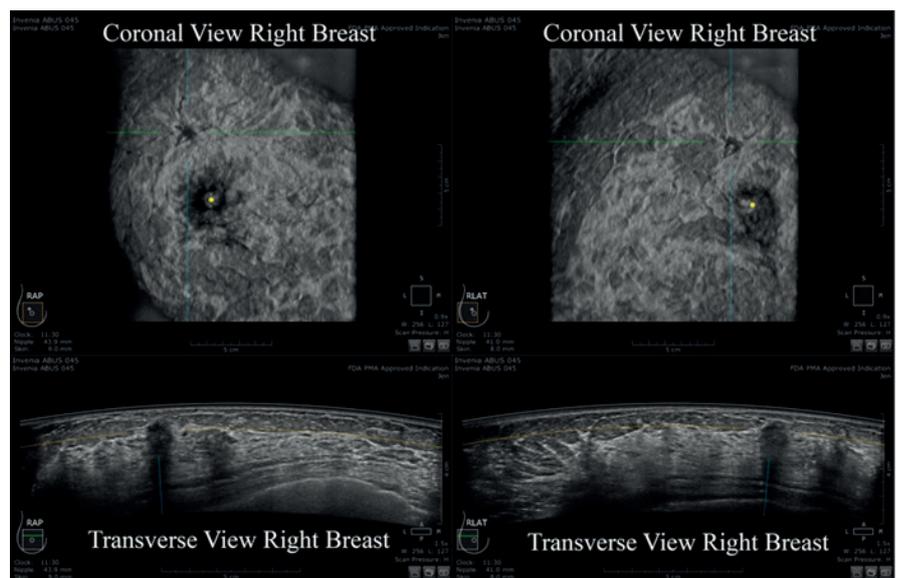

Figure 2. Coronal (upper) and transverse (lower) ABUS views of two different acquisition showing the right breast of a woman with a diagnosis of invasive ductal carcinoma. The distorted peripheral breast tissue around the cancer enhances its detection in the coronal view. The yellow dot in the centre of the coronal view shows the nipple position (from Schiaffino *et al.* [18])

in the second session all the different MPR views were available; all readers were blinded to the patients' clinical, radiological and pathology data. Finally we recorded and compared reading times in both reading sessions; each reader's diagnostic performance for each session; and interobserver agreement comparing the most and least experienced reader.

In terms of reading times, the first reading session using the coronal view alone showed a mean time per patient ranging from 76 to 84 seconds per reader, i.e. significantly faster than the complete MPR assessment of the second session. In the second session we found, indeed, a mean increase in reading time of 215% for Reader 1, 140% for Reader 2, and 157% for Reader 3, even if the mean reading time in this second session never exceeded three minutes.

The coronal view approach was associated with higher specificity and lower sensitivity for all readers, compared to the MPR approach. This is an interesting result if we consider the potential application of this technique in a screening setting, where high specificity is a desirable and valuable feature of a diagnostic tool.

Fair to moderate agreement between the most and least experienced reader was found for lesion features analysis, i.e. for the evaluation of lesion echogenicity, lesion shape, type of margins, and comprehensive BI-RADS assessment.

CONCLUSIONS

In our small group of patients, the coronal view approach showed significantly lower reading times and yielded high specificity. These two features would prove crucial if ABUS were to be applied in a screening setting. A major limitation of our study was the need to include women from various clinical and diagnostic settings in order to reach a sizable population. However we consider that our findings warrant further targeted investigations and discussion especially as a far as the screening context is concerned. At present however, suboptimal sensitivity values still make the complete MPR reading preferable.

TAKE HOME MESSAGE

The coronal view approach can be considered as a quick preliminary approach for ABUS reading and, in case of detection of a potential lesion, the reader can proceed to analyze all the different planes to confirm or rule out the presence of the suspected lesion. However, based on our results, the diagnostic performance of the coronal view stand-alone approach is still suboptimal. A complete assessment involving all available planes is still needed.

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