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Diagnostic efficiency of mammogram in breast cancer patients: Complementary breast ultrasound improves cancer detection in young women with dense breasts

Editor's message

This issue intends to complement the "Hong Kong Breast Cancer Registry Report No. 12" on the diagnostic aspects in breast cancer detection and characteristics among local breast cancer patients. Our findings supported that the combination of mammography and ultrasonography may benefit relatively younger women with dense breasts. Our study aims at encouraging women to undertake breast imaging as a regular checkup or as first diagnostic tool towards suspicious breast symptoms. The findings encourage more research and discussion on improving the diagnosis of breast cancer.

Introduction

Mammography (MMG) especially through regular screening is the gobal gold standard of diagnosing breast cancer early (1). Detection of breast cancer at an early stage and small sizes is associated with better prognosis and hence reduces mortality. It is well understood that breast cancer can be discovered in preclinical phase, when ductal carcinoma in situ (DCIS) detected through regular breast screening can reduce the occurrence of invasive cancer (2). Therefore, MMG guidelines are established worldwide and these screening programmes have been reviewed in the literature, in which mortality reduction ranges from 20% to 43%, indicating that regular screening saves lives (3-7).

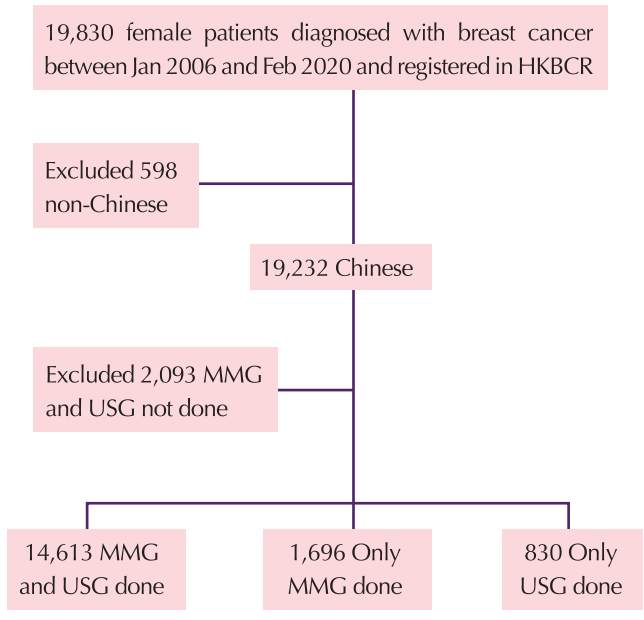
Despite scientific evidence showed that the advantages of MMG outweigh its disadvantages across all age groups (8-10), Hong Kong has not adopted any regular screening programmes. Without any guidelines of breast screening in the past decade, it is not surprising that the uptake of MMG is low among women in Hong Kong. Given that the incidence of breast cancer has been increasing in the past decade, the government has recently amended their recommendation for breast screening to include not only the high risk breast cancer individuals but also women in the general public bearing certain personal risk factors. The current study aims at providing information regarding the imaging diagnosis of breast cancer by examining the diagnostic accuracy associated with MMG and the additional benefit of ultrasound (USG) in different circumstances (11).

Method of study

Records on 17,139 female patients who had undergone MMG and/or USG and were diagnosed with breast cancer in or after 2006 were retrieved from the Hong Kong Breast Cancer Registry (HKBCR) (Figure 1). Results of MMG and USG are graded by Breast Imaging-Reporting and Data System (BI-RADS), with scores of 4-5 indicating positive for diagnosis of breast cancer. Based on the BI-RADS scheme, breast densities are divided into four categories–(a) almost entirely fat, (b) scattered fibro-glandular tissue, (c) heterogeneously dense, (d) extremely dense, with increasing proportion of fibro-glandular tissue from category a to category d. The overall diagnostic accuracy of each modality was assessed and evaluated by different age groups and breast density categories.

For those who have both MMG and USG performed, they were stratified into four groups based on the MMG/USG results. The cancer detection sensitivity of each group was calculated. A p-value of less than 0.05 was considered statistically significant by chi-square test.

Figure 1: **Flowchart of recruitment**



Results and Discussion

Table 1 presents the characteristics of the patients. The majority of patients had heterogeneously dense breasts. Near 80% of the women had radiological dense breasts (i.e., with heterogeneous and extreme density) in the current study. The majority (61.5%) of patients showed opacity on mammogram.

Table 1: **Age and breast screening findings of patients**

		N	%
Age group	<40	1,520	9.0
(N=16,948)	40-49	5,366	31.7
	50-59	5,606	33.1
	60-69	3,208	18.9
	≥70	1,248	7.4
Breast density	Fatty	1,516	13.5
(N=11,232)	Scattered density	993	8.8
	Heterogeneous density	7,890	70.2
	Extreme density	833	7.4
MMG features	Opacity only	5,201	33.4
(N=15,569)	Microcalcifications only	3,163	20.3
	Opacity and microcalcifications	2,889	18.6
	Architectural distortion only	266	1.7
	Asymmetric density only	532	3.4
	Other findings	3,518	22.6

To examine the cancer detection rates, the sensitivity among patients who had undergone MMG and/or USG is presented in Table 2. While MMG or USG alone could detect most (85.2% and 91.9%, respectively) of the cancer, the cancer detection rate was higher (up to 94.3%) when both imaging modalities were used. This finding suggested that USG was complementary to MMG by increasing the cancer detection rate.

Table 2: **Accuracy of MMG and USG**

	N	Accuracy (%)
MMG (N=16,309)	13,899	85.2
USG (N=15,443)	14,198	91.9
MMG & USG (N=14,613)	13,777	94.3

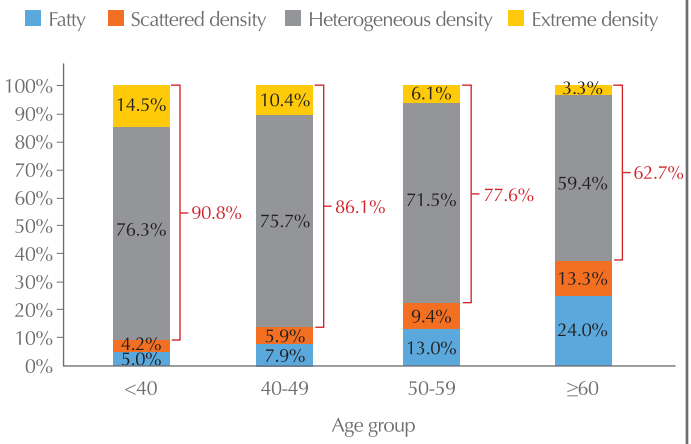
A. MMG findings with relation to age and breast density

The accuracy of MMG increased with age, and decreased with breast density (Table 3), as young patients had denser breasts (Figure 2). The majority (90.8%) of young patients aged below 40 had dense breasts, compared to 62.7% of old patients aged 60 and above. The accuracy of MMG was significantly different between patients at age below 40 (79.2%) and those aged 60 and above (90.7%; p<0.001). Such discrepancies between age groups were highly related to radiological breast densities, which are higher in young women, and in Asia countries (12). Although malignant opacities could be obscured in dense breast, suspicious microcalcifications (present in 35.2% of symptomatic patients undergoing MMG), could be visualized clearly, making it an important feature of breast cancer diagnosis in dense breasts on MMG (Table 4).

Table 3: **Age and breast density among patients undergone MMG**

		N	MMG+	MMG-	Accuracy (%)
Age group	<40	1,360	1,077	283	79.2
(N=16,127)	40-49	5,122	4,102	1,020	80.1
	50-59	5,364	4,689	675	87.4
	60-69	3,085	2,791	294	90.5 } 90.7%
	≥70	1,196	1,090	106	91.1
Breast density	Fatty	1,516	1,367	149	90.2
(N=11,232)	Scattered density	993	875	118	88.1
	Heterogeneous density	7,890	6,642	1,248	84.2
	Extreme density	833	673	160	80.8

Figure 2: **The relation between age and breast density**



According to how the patients firstly discovered their disease, 14,039 of them could be further divided into symptomatic and asymptomatic groups. While the symptomatic group refers to patients who consulted doctor on self-discovered breast symptoms relevant to cancer, the asymptomatic group refers to patients who were not aware of any breast changes, and their tumours were picked up by MMG, USG, clinical breast examination, other tests (such as CT scan and MRI), or incidental finding during breast surgery. Table 4 presents the MMG features observed in the two groups. Microcalcifications alone were significantly higher in the asymptomatic group (p<0.001) whereas significantly more patients with opacity and/or microcalcifications were seen in the symptomatic group (p<0.001). While microcalcifications are common in in situ cancer, it is hardly self-detectable without other symptoms of breast cancer (13, 14). Having microcalcifications detected implied earlier breast cancer diagnosis, particularly of stage 0. That could be one of the reasons that undergoing regular MMG screening has been proven as the only cost-beneficial modality to reduce breast cancer mortality (15).

B. USG findings

Table 5 shows the diagnostic performance of USG in all patients. Cancer detection rate with USG was high, ranging from 82.8% to 95.5%. Unlike MMG, the accuracy did not increase with age. It is, however, increased with tumour size from less than 1 cm to 5 cm. When a tumour is bigger, it is easier to be characterised by benign or malignant features on USG. In MMG occult cancer, USG detected additional cases, which were 9.0% of all cancer cases, improving cancer detection rate to 94.3% (Table 6). While the majority (78.2%) of patients with USG detected but MMG occult cancer presented with symptoms, only 21.8% of them were asymptomatic. In our subanalysis between the symptomatic and asymptomatic patients, USG picked up additional 12.6% of tumours in the asymptomatic group (Table 7).

Similar findings were shown in the Western societies. The combination of MMG and USG detected 27% more cancer than MMG alone in women presenting with breast symptoms (16). In a prospective cross-sectional study, USG detected an additional 3.7 malignant lesions per 1000 women per year in a three-year setting with 2,714 American women (17). The sensitivity increased from 55.6%, with MMG alone, to 94.4% with USG as a supplementary imaging modality (17). The results from these studies taken with those in the current study suggested USG as a useful adjunct screening tool as it is not hindered by breast density. When there is suspicion of multifocal or multi-centric disease in dense breasts, further assessment by magnetic resonance imaging (MRI) of breasts could reach a near 100% cancer detection rate (18).

Table 4: **MMG features observed in the symptomatic and asymptomatic groups**

	Symptomatic (N=12,310)		Asymptomatic (N=2,640)		P value
	N	%	N	%	
Opacity only	4,474	36.3	556	21.1	<0.001
Microcalcifications only	1,931	15.7 } 35.2%	1,080	40.9	<0.001
Opacity & microcalcifications	2,405	19.5	352	13.3	<0.001
Architectural distortion only	195	1.6	61	2.3	0.009
Asymmetric density only	441	3.6	69	2.6	0.013
Other findings	2,864	23.3	522	19.8	<0.001

Table 5: **Age and tumour size found in USG results**

		N	USG+	USG-	Accuracy (%)
Age group	<40	1,393	1,229	164	88.2
(N=15,264)	40-49	4,846	4,350	496	89.8
	50-59	4,998	4,636	362	82.8
	60-69	2,881	2,729	152	94.7
	≥70	1,146	1,094	52	95.5
Tumour size	≤1.00cm	1,723	1,450	273	84.2
(N=11,486)	1.01-2.00cm	4,245	3,988	257	93.9
	2.01-5.00cm	5,101	4,932	169	96.7
	>5.00cm	417	402	15	96.4

Table 6: **Diagnostic accuracy of breast imaging for patients who have done both MMG and USG**

	USG+	USG-	Overall
MMG+	12,131 (83.0%)	335 (2.3%)	12,466 (85.3%)
MMG-	1,311 (9.0%)	836 (5.7%)	2,147 (14.7%)

Table 7: **Diagnostic accuracy of breast imaging for patients who have done both MMG and USG in the symptomatic and asymptomatic groups**

	Symptomatic (N=11,848)	Asymptomatic (N=2,191)
MMG+ USG+	10,081 (85.1%)	1,557 (71.1%)
MMG+ USG-	127 (1.1%)	199 (9.1%)
MMG- USG+	990 (8.4%)	276 (12.6%)
MMG- USG-	650 (5.5%)	159 (7.3%)

Conclusion

The current study showed that MMG had a high diagnostic accuracy in Hong Kong Chinese population, despite a high proportion of patients with heterogeneous and extreme breast density. For those with dense breasts, additional USG could increase cancer detection rate by 9.0%. Therefore, MMG and USG has complementary role in achieving a high cancer detection especially for young women with dense breasts. The current study supported the combined use of mammogram and ultrasound in breast cancer diagnosis.

References

(Please refer to Chinese version)

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