

# Study on female breast cancer imaging screening consultation network in Guangdong Province, China

Q. Hong<sup>1</sup>, Q. Guo<sup>1</sup>, W. Wang<sup>1</sup>, Y. Zhang<sup>1</sup>, Q. Wang<sup>2</sup>, Z. Lai<sup>3</sup>

<sup>1</sup> Department of Radiological Diagnosis, Guangdong Women and Children Hospital, Guangzhou

<sup>2</sup> Department of Breast Surgery, Guangdong Women and Children Hospital, Guangzhou

<sup>3</sup> Department of Information, Guangdong Women and Children Hospital, Guangzhou (China)

## Summary

**Objective:** This study aimed to construct breast cancer image screening consultation network (BISCN) that connects all levels of medical institutions in Guangdong Province. **Materials and Methods:** Fourteen hospitals in different cities and counties (districts) of Guangdong were selected for breast cancer screening with imaging (breast X-ray, ultrasound, and MRI). “Breast Imaging Reporting and Data System (BI-RADS)” was taken as reference to build up image data base of breast cancer screening and BISCN that is an internet-based network platform. BISCN quality control was performed to improve the diagnostic accuracy and collaboration of members. In 2011, the BISCN members underwent breast imaging diagnosis training and conducted a questionnaire survey. **Results:** BISCN allowed quick, synchronous, and accurate communication and feedback of diagnostic imaging in breast cancer among all levels of medical institutions and improved the ability of breast cancer screening in the province, as well as the detection rate of early breast cancer throughout the province, especially in the grassroot units. The survey results showed that the trainees’ understanding situation of the training contents before training was  $2.02 \pm 1.75$  points. Through the study, the participants considered that the teaching contents could solve the daily diagnose problems ( $2.91 \pm 0.70$  points), the post-training scores were improved ( $2.88 \pm 1.23$  points), and highly satisfactory with the teaching contents ( $2.81 \pm 0.53$  points). All students passed the examination and were qualified for the future. **Conclusions:** BISCN is of good feasibility in construction and applicability in management by raising diagnosis level of breast cancer in Guangdong Province.

**Key words:** Breast cancer; Imaging; Screening; Consultation; Network.

## Introduction

Breast cancer has become the most threatening disease to the female health and the second female malignant tumor with a morbidity of 70 per 100,000 in large Chinese cities [1]. Therefore, early diagnosis of breast cancer is quite important, which enhances cure rate, reduces mortality, improves life quality of patients, and prolongs their survival time. At present, early detection rate of female breast cancer is still low [2], thus many patients cannot be treated early.

Although hospitals in Guangdong have been equipped with molybdenum target X-ray, color Doppler ultrasound, and MRI, etc., the imaging technique is still in the exploratory stage compared with that in developed countries. Some researchers attempt to establish connections for breast cancer screening [3] and explore the mode of female breast cancer screening in countries [4]. However, bottlenecks still exist, such as prevalently improper screening techniques, uneven distribution of high-end imaging diagnostic resources, and isolated resources in each institution [5, 6]. Therefore, standardization of breast cancer screening with imaging and network consultation are two important issues that urgently need to be resolved.

The present research group has gained abundant experience during previous breast cancer screening with imag-

ing, including the successful improvement of the detection rate of early atypical breast cancer through the combination of molybdenum target X-ray and ultrasound screening [7], application of new imaging technique such as MRI in clinical research [8], and establishment of medical imaging databases based on the internet [9]. In 2003, the American College of Radiology (ACR) published the fourth edition of Breast Imaging Reporting and Data System (BI-RADS), which standardized the breast cancer image screening techniques [10]. However, how to establish the consultation network of breast cancer image screening based on existing internet is still an issue to be resolved.

The present research aimed to integrate the resources of breast cancer imaging diagnosis in all medical institutions in Guangdong, screen the breast cancer images, build up the breast cancer imaging screening consultation network (BISCN) with complementary advantages, and evaluate the effect of BISCN on the detection rate of early breast cancer.

## Materials and Methods

### General information

Institute of mammary gland disease prevention and control in the Maternity and Child Care Center in Guangdong Province and the sub-institutes in Yingde, Xinhui, Zhaoqing, Jiangmen, Boluo,

Revised manuscript accepted for publication December 10, 2014

Table 1. — Screening consultation situations of female breast cancer ultrasound of Guangdong Province from 2011-2012.

Treatment-transferring hospital	N	Cases of ultrasonic BI-RADS Grade 4-5 (positive rate)	Cases of molybdenum target BI-RADS Grade 4-5 (positive rate)	Surgical cases	Breast cancer percentage
Yingde Municipal Hospital of Maternal and Child Health	437	43 (9.8%)	24 (5.5%)	Invasive breast cancer 5; fibroadenoma 6; papilloma 2	1.14% (5/437)
Xinhui Municipal Hospital of Maternal and Child Health	221	41 (18.6%)	30 (13.6%)	Invasive breast cancer 4; fibroadenoma 4; papilloma 2	1.8% (4/221)
Zhaoqing Municipal Duanhiu Dist. Hospital of Maternal and Child Health	201	42 (20.9%)	9 (4.5%)	Intraductal carcinoma 1; fibroadenoma 4; papilloma 1; mastitis 1; canal saccular ectasia 1	0.5% (1/201)
Jiangmen Municipal Hospital of Maternal and Child Health	66	33 (50.0%)	11 (16.7%)	Invasive breast cancer 1; fibroadenoma 3; papilloma 1	1.5% (1/66)
Boluo Municipal Hospital of Maternal and Child Health	84	20 (23.8%)	10 (11.9%)	Invasive breast cancer 1; fibroadenoma 1; papilloma 1	1.2% (1/84)
Guangzhou Red Cross Hospital	67	9 (13.4%)	3 (4.4%)	fibroadenoma 1; papilloma 1	0% (0/67)
Guangzhou Baiyun Dist. 2 <sup>nd</sup> Hospital	164	35 (21.3%)	20 (12.1%)	Invasive breast cancer 2; fibroadenoma 6; papilloma 1	1.2% (2/164)

etc., were selected as pilot hospitals, where about 2,000 female patients were screened for breast cancer. This study was conducted in accordance with the declaration of Helsinki and with approval from the Ethics Committee of Women and Children's Hospital, Guangdong Province. Written informed consent was also obtained from all participants.

#### Clinical screening

Specialized doctors inquired the patients about the medical history and filled in uniform questionnaire forms. Specialized breast examination was performed, which started from the observation of abnormal changes in breast shape and skin, and then the palpation to their mammary gland, areola, and axillary lymph nodes to screen lump. If the lump was observed, its shape, size, location, hardness, edge, and the lump activity were recorded.

#### Image screening

All the patients were routinely examined by breast X-ray and ultrasound, while part of them underwent MRI. 1) Breast X-ray photographing: axial and lateral oblique position were selected as routine photographing and symptoms such as morphology and distribution of gland calcification, lump shape, size and edge, structure distortion, sagging skin, and inverted nipple were observed and recorded in the breast images. The risk ratios of breast cancer were evaluated according to the fourth edition of BI-RADS grading criterion published by ACR in 2003. 2) Breast ultrasound examination: Breast lump morphology, edge, internal echo, posterior acoustic shadowing, vertical and horizontal diameter, the tumor blood supply, morphology and distribution of calcification, structure disorder, and ultrasound imaging time-intensity curve were observed, recorded, and evaluated according to the BI-RADS grading criterion as well [11]. 3) MRI examination: lump morphology, edge and enhancement pattern, the enhancement distribution pattern of non-mass-like lesion and internal enhancement pattern, early enhancement rate, time-signal curve, and apparent diffusion coefficient (ADC) values were also evaluated according to the BI-RADS classification.

#### Surgical resection and followed up

The patients under BI-RADS classification IV were regularly followed up; cases at BI-RADS IV, breast aspiration biopsy, duc-

toscopy or surgical resection were performed to obtain pathological result, which was taken as diagnostic gold standard together with the results of follow-up over three years.

#### Breast cancer imaging database and the establishment of BISCN

The database was constructed based on the above screening results. The databases of all levels of medical institutions in the province were connected via internet platforms, including Shida PACS remote consultation system and Tencent video software, to establish BISCN in Guangdong Province. BISCN quality control was performed to improve the diagnostic accuracy and collaboration of members. In 2011, the BISCN members underwent breast imaging diagnosis training and conducted a questionnaire survey.

## Results

#### Breast cancer imaging database

According to female breast cancer screening results in Guangdong, system software of breast cancer screening database was programmed. Input information included general information (name, age, occupation, educational level and history of marriage, childbearing, menstruation, family, and other diseases, etc.), specialized examination of breast, breast X-ray, ultrasound and MRI results, follow-up results, etc.

#### BISCN establishment

BISCN established via internet platform in Guangdong is now stably running, which performed a systematical, ordered, and informationized management of data resources from all medical institutions in the province. It achieved remote consultation and education, raised the level of breast cancer diagnosis, and the detection rate of early cancer all over the province, especially in the grassroot units. The screening consultation situations, as well as the surgical and pathological results of female breast cancer ultrasound and molybdenum target of Guangdong Province from 2011-2012 are shown in Table 1.

Table 2. — Questionnaire results of the BISCN training in 2011.

Survey items	N	Full distance (points)	Results (points)
Contents taught could solve the daily diagnostic problems	64	1-3	2.91 ± 0.70
Post-training scores	64	1-3	2.88 ± 1.23
Satisfaction about the training contents	64	1-3	2.81 ± 0.53
Satisfaction about the teaching schedule	64	1-3	2.75 ± 0.81
Sanctification about the teaching material	64	1-3	2.66 ± 0.91
Understanding situation of the training contents before training	64	1-3	2.02 ± 1.75

### Quality control

Breast cancer imaging data from each pilot hospital was regularly gathered, analyzed, and evaluated and feedback reports were produced. In order to enhance the diagnostic level, workshops about breast cancer image diagnosis, advanced studies for breast imaging physicians, guest lectures, and consultation in the grassroot units given by senior experts were regularly carried out. In 2011, the BISCN members performed the breast imaging diagnosis training, and conducted a questionnaire survey (Table 2). The survey results showed that the trainees' understanding situation of the training contents before training was  $2.02 \pm 1.75$  points. Through the study, the participants considered that the teaching contents could solve the daily diagnostic problems ( $2.91 \pm 0.70$  points), the post-training scores were improved ( $2.88 \pm 1.23$  points), and highly satisfactory with the teaching contents ( $2.81 \pm 0.53$  points). All students passed the examination and were qualified for the future (Table 3).

### Discussion

Recently epidemiological data has confirmed decreased mortality of breast cancer in developed countries mainly due to effective screening system. Breast cancer screening in China began in 1987; Xu Guang-wei *et al.* screened 106,385 women in Beijing within three years and 87 were diagnosed with breast cancer (82/100000). Screening of one million citizens from urban area in Tianjin discovered 470 patients with five-year survival rate of 75.5%. Similar investigations were carried out all over China, which played a positive role in early diagnosis and treatment of breast cancer. However, such screening lacks standardized methods, modern techniques, long-term plan, and follow-up data.

Nowadays, breast cancer screening includes X-ray photograph, B ultrasound, and MRI, while large radioactive damage and expensive expense respectively rule out CT

Table 3. — Training situation of BISCN members in breast imaging diagnosis.

Unit	Number of participating people	Exam qualification
Guangdong Provincial Hospital of Maternal and Child Health	13	13
Qingyuan Municipal Hospital of Maternal and Child Health	4	4
Shaoguan Municipal Hospital of Maternal and Child Health	4	4
Shenzhen Municipal hospital of Maternal and Child Health	5	5
Xinhui Municipal Hospital of Maternal and Child Health	3	3
Puning Municipal Hospital of Maternal and Child Health	3	3
Shaoguan Municipal Hospital of Maternal and Child Health	3	3
Xinfeng County Hospital of Maternal and Child Health	2	2
Meizhou Municipal Hospital of Maternal and Child Health	3	3
Zhanjiang Municipal Hospital of Maternal and Child Health	2	2
Jiangmen Municipal Hospital of Maternal and Child Health	4	4
Heyuan Municipal Hospital of Maternal and Child Health	3	3
Dongguan Municipal Hospital of Maternal and Child Health	4	4
Chaozhou Municipal Hospital of Maternal and Child Health	3	3
Nanhai Dist. Hospital of Maternal and Child Health	3	3
Maoming Municipal Hospital of Maternal and Child Health	3	3
Zhaoqing Municipal Hospital of Maternal and Child Health	2	2
Sum	64	64 (100%)

and PET-CT as routines. X-ray photograph is internationally recognized screening method for early breast cancer, but its sensitivity and specificity are affected by mammary gland density and the age of patients. Reference reported 5~15% of breast cancer images were false negative even under the optimal imaging and diagnostic conditions [12]. Recently, full field digital mammography has been applied, in which the X-ray exposure was reduced by 25~75% compared with traditional imaging [13]. The detection rate of breast cancer symptoms also increased significantly [14]. Breast ultrasound is the primary choice for adolescent, pregnant, and lactating patients with breast lesions [15]. However, the accuracy of ultrasound diagnosis mainly depends on the equipment and doctor's experience, and it is not sensitive to tiny calcifications [16]. MRI: the diagnosis of breast lump is ac-

According to the pathological morphology, signal characteristics, enhancement pattern, and time-signal intensity curve [17]. Studies showed that the ADC value in malignant carcinoma group was significantly lower than that of benign lesion and normal groups [18], and the sensitivity and specificity of ADC diagnosis were 92.3% and 96.2%, respectively [19]. MRI examination of breast has been performed overseas, but only in some developed regions of Guangdong due to the complicated and expensive equipment [20].

Breast cancer screening in all medical institutions in Guangdong lacks standardized screening techniques, diagnostic imaging criterion, and comparability among institutions, resulting in reduced working efficiency and many misdiagnoses. The fourth edition of BI-RADS in 2003, firstly put forward by ACR in 1992, has been extensively adopted [21]. BI-RADS classification in screening standardizes breast X-ray report, reduces confusion of image description, and monitors general investigation [22]. Accepted by all medical institutions in the province, the fourth edition of BI-RADS classification was employed for breast cancer report in the present research to standardizing the breast cancer image screening techniques.

Compared with foreign advanced imaging diagnostic resources, the domestic high-end image diagnosis resources are unevenly distributed without sharing. Senior hospitals own advanced imaging equipment and diagnosis talents, while primary hospitals have more patients, but outdated imaging equipments and few diagnosis talents without effective training. Moreover, imaging diagnosis of breast cancer started late in China; experts specialized in breast are scarce; breast image consultation based on internet is not established, which are bottlenecks for breast cancer screening. Being the foundation of establishing BISCN, the present author group belongs to the Maternity and Child Care Centers of Guangdong, which is the highest among the centers in the province and the leading institution of national breast cancer screening with abundant network resources and experience of breast cancer screening. In 2011, the BISCN members performed the breast imaging diagnosis training and conducted a questionnaire survey (Table 2). The survey results showed that the trainees' understanding situation of the training contents before training was  $2.02 \pm 1.75$  points, indicating that the trainees' master degrees regarding breast imaging diagnosis were low and uneven.

Networked consultation effectively integrates the resources of breast imaging diagnosis from all medical institutions in the province. According to the results of female breast cancer screening in the pilot hospitals, system software of breast image screening database was programmed and the database was preliminarily established in this research. Based on the database, breast image screening databases in all medical institutions of the en-

tire province were connected via internet platform and BISCN was established in Guangdong Province. In 2011, the BISCN members performed the breast imaging diagnosis training and the participants considered that the teaching contents could solve the daily diagnose problems ( $2.91 \pm 0.70$  points), the post-training scores were improved ( $2.88 \pm 1.23$  points), and highly satisfactory with the teaching contents ( $2.81 \pm 0.53$  points). All students passed the examination and were qualified for the future. The BISCN preliminary operation result showed that the platform performed a systematical, ordered, and informationized management of data resources from all medical institutions in the province. It achieved remote consultation and education, allowed consulting and cognizing the database at any time, facilitated the communication among institutions and the training of image diagnosing doctors, which raised diagnosis level of breast cancer in Guangdong Province.

### Acknowledgements

This study was supported by Science and Technology Planning Project of Guangdong Province, 2010 (SN: 3034235).

### References

- [1] Li L., Yang W.P., Chen L.: "Analysis on 4710 poor woman cervical and breast cancer screening". *China Women and Children Health Care*, 2013, 28, 223.
- [2] Xu J.L.: "Analysis on screening results of cervical cancer and breast cancer among 24099 rural women". *China Maternal and Child Health Care*, 2012, 16, 2427.
- [3] Yang R., Fu Z.H., Zhang B., Yang S.P., Zhang D., Li Y.X.: "Establishment of breast cancer screening mechanism relied on service System for women and children health care". *Cancer Research on Prevention and Treatment*, 2012, 39, 582.
- [4] Wang H.M.: "Exploration of rural woman breast cancer screening mode". *China Med. Innov.*, 2012, 9, 151.
- [5] Kong L.H.: "Analysis on 85710 rural woman cervical and breast cancer screening data". *Med. Innovat. China*, 2011, 20, 119.
- [6] Zhao F.H.: "Analysis on Yunnan Province rural woman cervical cancer screening data". *China Women and Children Health Care*, 2012, 27, 34.
- [7] Guo Q.L., Ye Z.Q., Liu Q.Y.: "Diagnosis evaluation of mammography, Doppler ultrasonic and 3D oriented puncture for breast cancer". *J. China Radiology*, 2001, 35, 782.
- [8] Hong Q.S., Shen J., Xue Y.M.: "MRI application on thyroid associated ophthalmopathy grading and staging". *J. Chinese Endocrinology and Metabolism*, 2010, 26, 35.
- [9] Hong Q.S., Li Z.P., Liu S.B.: "Establishment of medical imaging databases basing on web storage". *J. Diagnostic Imaging and Interventional Radiology*, 2002, 11, 186.
- [10] Timmers J.M., van Doorne-Nagtegaal H.J., Zonderland H.M., van Tinteren H., Visser O., Verbeek A.L. *et al.*: "The breast imaging reporting and data system (BI-RADS) in the Dutch breast cancer screening programme: its role as an assessment and stratification tool". *Eur. Radiol.*, 2012, 22, 1717.
- [11] Qiu J.M., Hu J.Z., Zhu B., Li Y.Y., Ouyang Y.Y.: "The Role of Ultrasonic BI-RADS Classification in breast cancer screening". *J. China Medicine Guideline*, 2012, 10, 1.

- [12] Smith-Bindman R., Chu P., Miglioretti D.L., Quale C., Rosenberg R.D., Cutter G. *et al.*: "Physician predictors of mammographic accuracy". *J. Natl. Cancer Inst.*, 2005, 97, 358.
- [13] Skaane P.: "Studies comparing screen-film mammography and full-field digital mammography in breast cancer screening: updated". *Acta Radiol.*, 2009, 50, 3.
- [14] Kallenberg M., Karssemeijer N.: "Computer-aided detection of lumps in full-field digital mammography using screen-film mammograms for training". *Phys. Med. Biol.*, 2008, 53, 6879.
- [15] Qian J.L.: "Application of doppler ultrasonic on breast disease screening". *China Medicine Guideline*, 2012, 10, 213.
- [16] Sehgal C.M., Arger P.H., Rowling S.E., Conant E.F., Reynolds C., Patton J.A.: "Quantitative vascularity of breast lumps by Doppler imaging: regional variations and diagnostic implications". *J. Ultrasound Med.*, 2000, 19, 427.
- [17] Kvistad K.A., Rydland J., Vainio J., Smethurst H.B., Lundgren S., Fjøsne H.E. *et al.*: "Breast lesions: evaluation with dynamic contrast-enhanced T1-weighted MR imaging and with T2\*-weighted first-pass perfusion MR imaging". *Radiology*, 2000, 216, 545.
- [18] Partridge S.C., DeMartini W.B., Kurland B.F., Eby P.R., White S.W., Lehman C.D.: "Quantitative diffusion-weighted imaging as an adjunct to conventional breast MRI for improved positive predictive value". *AJR Am. J. Roentgenol.*, 2009, 193, 1716.
- [19] Pereira F.P., Martins G., Figueiredo E., Domingues M.N., Domingues R.C., da Fonseca L.M. *et al.*: "Assessment of breast lesions with diffusion-weighted MRI: comparing the use of different b values". *AJR Am. J. Roentgenol.*, 2009, 193, 1030.
- [20] American College of Radiology.: "Breast imaging reporting and data system (BI-RADS). 4<sup>th</sup> ed. Reston (VA): American College of Radiology, 2003.
- [21] Burnside E.S., Ochsner J.E., Fowler K.J., Fine J.P., Salkowski L.R., Rubin D.L. *et al.*: "Use of microcalcification descriptors in BI-RADS 4th edition to stratify risk of malignancy". *Radiology*, 2007, 242, 388.
- [22] Kong A.P., Zhou M.T., Liu J., Shi B.B.: "Diagnosis value of digital mammography combined with MRI on breast cancer". *Baotou Medicine*, 2012, 36, 203.

Address reprint requests to:

Q. GUO, M.D.

Department of Radiology

Guangdong Women and Children Hospital

No. 13 Guangyuan West Road

Guangzhou 510010, (China)

e-mail: qinglugou@126.com