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乳腺三维断层技术结合乳腺超声对致密型乳腺病变的诊断价值*

蒋尧西 彭松[△] 牟灿 杨巧丽 田伟

(重庆市妇幼保健院放射科 重庆 401147)

摘要 目的:探讨乳腺三维断层技术(DBT)结合乳腺超声(BUS)对致密型乳腺病变的诊断价值。**方法:**回顾分析 2018 年 6 月至 2019 年 4 月在我院就诊且有完整病理结果的 149 例致密型乳腺病变患者的影像资料,对比 DBT、BUS 两种检查方法的检出率;以病理结果为金标准,分析 DBT、BUS、DBT 联合 BUS 三种检查模式的诊断效能。**结果:**BUS 对良性病变的检出率(97.87%)高于 DBT(89.36%),差异有统计学意义($\chi^2=5.697, P<0.05$);DBT 与 BUS 对恶性病变的检出率分别为 98.44%、95.31%,差异无统计学意义($\chi^2=1.032, P>0.05$)。DBT 诊断致密型乳腺病变的敏感度为 90.61%、特异度为 93.55%、准确率为 91.77%,BUS 诊断致密型乳腺病变的敏感度为 78.13%、特异度为 89.36%、准确率为 84.81%,DBT 联合 BUS 诊断致密型乳腺病变的敏感度为 95.31%、特异度为 95.74%、准确率为 95.57%。DBT 联合 BUS 诊断致密型乳腺恶性病变的受试者工作特征曲线(ROC)的曲线下面积(AUC)为 0.977,稍高于 DBT 的 AUC(0.951),明显高于 BUS 的 AUC(0.885)。**结论:**BUS 对良性病变的检出率显著高于 DBT,DBT 对致密型乳腺病变的诊断效能高于 BUS,二者结合能提高病变的检出率与诊断效能。

关键词:数字乳腺三维断层技术;乳腺超声;乳腺病变;诊断

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Diagnostic Value of Digital Breast Tomosynthesis Combined with Breast Ultrasonography in Dense Breast Lesions*

JIANG Yao-xi, PENG Song[△], MU Can, YANG Qiao-li, TIAN Wei

(Department of Radiology, Chongqing Health Center for Women and Children, Chongqing, 401147, China)

ABSTRACT Objective: To investigate the diagnostic value of digital breast tomosynthesis (DBT) combined with breast ultrasonography (BUS) in dense breast lesions. **Methods:** The imaging data of 149 patients with dense breast lesions with complete pathological findings who were admitted to our hospital from June 2018 to April 2019 were retrospectively analyzed, and the detection rates of DBT and BUS of two inspection methods were compared. The pathological results were taken as the gold standard, the diagnostic efficiency of DBT, BUS and DBT combined BUS were analyzed. **Results:** The detection rate of BUS in benign lesions (97.87%) was higher than DBT (89.36%), the difference was statistically significant ($\chi^2=5.697, P<0.05$). The detection rates of DBT and BUS for malignant lesions were 98.44% and 95.31%, respectively, and the differences were not statistically significant ($\chi^2=1.032, P>0.05$). The sensitivity of DBT in diagnosis of dense breast lesions was 90.61%, the specificity was 93.55%, the accuracy rate was 91.77%. The sensitivity of BUS in diagnosis of dense breast lesions was 78.13%, the specificity was 89.36%, the accuracy rate was 84.81%. The sensitivity of DBT combined with BUS in diagnosis of dense breast lesions was 95.31%, the specificity was 95.74%, the accuracy rate was 95.57%. The area under the receiver operating characteristic curve (ROC) of DBT combined with BUS for diagnosis of dense breast lesions was 0.977, which was slightly higher than that of DBT (0.951), and significantly higher than that of BUS (0.885). **Conclusion:** The detection rate of BUS for benign lesions is significantly higher than that of DBT, and the diagnosis efficiency of DBT for dense breast lesions is higher than that of BUS, the combined application of the two methods can improve the detection rate and diagnostic efficiency of lesions.

Key words: Digital breast tomosynthesis; Breast ultrasonography; Breast lesions; Diagnosis

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前言

乳腺癌作为发病率高居女性恶性肿瘤首位的疾病,危害着广大女性的身心健康^[1]。全数字化乳腺摄影(FFDM)是目前国际

认可的检查乳腺疾病的首选方法^[2],但中国女性的乳腺以致密型居多,这在一定程度上降低了该检查的准确性^[3]。乳腺三维断层技术(DBT)及乳腺超声(BUS)均能减少组织重叠的干扰,更加清晰地显示致密型乳腺中的病灶,是适用于中国女性的乳腺

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作者简介:蒋尧西(1983-),女,本科,主治医师,研究方向:乳腺疾病影像诊断,E-mail: jiangyaoxixi@163.com

[△] 通讯作者:彭松(1979-),男,博士,主任医师,研究方向:妇儿影像诊断,E-mail: 945261860@qq.com

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检查方法^[4,5]。DBT 不能鉴别病变的囊实性,对于病变内血流情况的检查也不如 BUS 直观。BUS 对于乳房观测的整体感不如 DBT,而且对于钙化灶也不敏感,如果将二者结合则有可能互补缺点,提高病变的检出率和诊断准确率。本文通过比较 DBT 及 BUS 对致密型乳腺病变的检出率,分析 DBT、BUS、DBT 联合 BUS 三种诊断模式的诊断效能,评估三者在致密型乳腺疾病诊断中的应用价值,现报道如下。

1 资料与方法

1.1 一般资料

回顾分析 2018 年 6 月至 2019 年 4 月期间在我院就诊的 149 例致密型乳腺病变患者的影像资料,纳入标准:(1)有完整的 DBT 和 BUS 影像资料;(2)病理结果齐全;(3)乳腺腺体类型为不均匀致密型(c 型)或极度致密型(d 型)的病例。排除标准:(1) 备孕期或妊娠期女性;(2) 有过乳腺手术或治疗史者;(3)乳腺腺体类型为脂肪型(a 型)或散在纤维腺体型(b 型)的病例。

1.2 检查方法

DBT 检查:使用 Hologic Selenia Dimensions DM 机,对患者的双侧乳房分别拍摄标准头尾位及内外斜位片,X 线球管于乳房上方 15° 内旋转,每 1° 曝光 1 次,曝光获得的低剂量二维图像经后处理重建多幅断层图像。

BUS 检查:使用 Philips EPIQ5 彩色超声诊断仪,探头频率为 10~14 Hz,先用常规超声检查双侧乳房的各个象限及双侧腋窝,然后用彩色多普勒成像判断病变血流情况。

1.3 评价方法

由 2 位高年资放射科医师和 2 位高年资超声科医师分别对患者的 DBT 和 BUS 图像进行分析,有分歧的地方经讨论后取得一致结论,最终由资深专家对二者的结论综合评估,得出

DBT、BUS 的诊断结果。所有结果均依据美国放射学会乳腺报告和数据库系统(ACR BI-RADS)标准分类,4a 以上归为阳性,4a 及以下归为阴性^[6]。

1.4 统计学方法

采用 SPSS 25.0 统计软件对数据进行统计分析,计算各种诊断模式下所得诊断结果的敏感度、特异度、准确率,采用 χ^2 检验对计数资料进行两两比较,制定各诊断模式的受试者工作特征曲线(ROC)。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 检查结果

本组 149 例患者共检出病变 158 例,包括 94 例良性病变和 64 例恶性病变。9 例患者双乳均发现病变,余 140 例患者均为单侧乳腺病变。

2.2 DBT 及 BUS 对致密型乳腺良、恶性病变检出率的比较

根据病理结果对两种检查方法检出的病变进行分类,如表 1、2 所示。DBT 未检出的 10 例良性病变包括腺病和囊肿各 1 例、导管内乳头状瘤 3 例、纤维腺瘤 5 例,未检出的 1 例恶性病变为浸润性癌,总共 11 例病变未被 DBT 检出,其最大径平均值为 (0.68 ± 0.32) cm。BUS 未检出的 2 例良性病变为纤维囊性乳腺病和硬化性腺病各 1 例,有 3 例恶性病变没有被检测出,分别为导管内癌、浸润性癌及浸润性癌伴 PAGET 病各 1 例,总共 5 例病变未被 BUS 检出,其最大径平均值为 (1.57 ± 0.54) cm。DBT 及 BUS 对乳腺良性病变的检出率分别为 89.36% $(84/94)$ 、97.87% $(92/94)$,差异有统计学意义 $(\chi^2=5.697, P=0.017)$ 。DBT 及 BUS 对恶性病变的检出率分别为 98.44% $(63/64)$ 、95.31% $(61/64)$,差异无统计学意义 $(\chi^2=1.032, P=0.310)$ 。BUS 对良性病变的检出能力优于 DBT,二者对恶性病变的检出能力相近。

表 1 DBT 及 BUS 对致密型乳腺良性病变的检出率 [n(%)]

Table 1 The detection rate of DBT and BUS for dense benign breast lesions [n(%)]

Benign lesions	DBT	BUS
Mammary gland fibroma	44(46.80%)	49(52.13%)
Adenosis	9(9.47%)	10(10.64%)
Adenosis with fibroadenoma Forming tendency	6(6.38%)	6(6.38%)
Fibrocystic disease of breast	2(2.13%)	1(1.09%)
Sclerosing adenosis	5(5.32%)	4(4.26%)
Duct papilloma	2(2.13%)	5(5.32%)
Benign phyllodes tumour	3(3.19%)	3(3.19%)
Non-puerperal mastitis	7(7.45%)	7(7.45%)
Cyst	6(6.38%)	7(7.45%)
Total	84(89.36%)	92(97.87%)
χ^2 value	5.697	
P value	0.017	

2.3 三种诊断模式对致密型乳腺病变诊断效能的比较

DBT 联合 BUS 的敏感度、特异度、准确率分别为 95.31%

$(61/64)$ 、95.74% $(90/94)$ 、95.57% $(151/158)$,高于其它两种诊断模式。三种诊断模式的诊断结果与病理结果对照见表 3,三种诊

断模式的敏感度、特异度、准确率结果见表 4。

表 2 DBT 及 BUS 对致密型乳腺恶性病变的检出率 [n(%)]

Table 2 The detection rate of DBT and BUS for malignant lesions in dense breast [n(%)]

Malignant lesions	DBT	BUS
Infiltrating ductal carcinoma	41 (64.06%)	42 (65.63%)
Ductal carcinoma in situ(DCIS)	12 (18.75%)	11 (17.19%)
Infiltrating ductal carcinoma with ductal carcinoma in situ	4 (6.25%)	3 (4.69%)
Neuroendocrine carcinoma	2 (3.13%)	2 (3.13%)
Infiltrating ductal carcinoma with paget's disease	2 (3.13%)	1 (1.56%)
Papillary carcinoma	2 (3.13%)	2 (3.13%)
Total	63 (98.44%)	61 (95.31%)
χ^2 value	1.032	
P value	0.310	

表 3 不同诊断模式的诊断结果与病理结果比较

Table 3 Comparison of diagnostic results and pathological results of different diagnostic modes

Diagnostic modes	Diagnosis	Pathological results	
		Malignant	Benign
DBT	Malignant	58	7
	Benign	6	87
BUS	Malignant	50	10
	Benign	14	84
DBT combine with BUS	Malignant	61	4
	Benign	3	90

表 4 不同诊断模式的诊断效能比较

Table 4 Comparison of diagnostic efficacy of different diagnostic modes

Diagnostic modes	Sensitivity	Specificity	Accuracy
BUS	78.13%(50/64)	89.36%(84/94)	84.81%(134/158)
DBT	90.61%(58/64)	93.55%(87/94)	91.77%(145/158)
DBTcombine with BUS	95.31%(61/64)	95.74%(90/94)	95.57%(151/158)

2.4 三种诊断模式对恶性病变诊断效能的 ROC 曲线分析

DBT、BUS、DBT 联合 BUS 的曲线下面积(AUC)分别为：0.951、0.885、0.977，即 DBT 联合 BUS 诊断的 AUC 稍高于 DBT，明显高于 BUS，三种诊断模式诊断恶性病变的 ROC 曲线见图 1。

2.5 恶性病变影像特征与诊断分析

本组病例中 5 个恶性病变被 DBT 误诊为良性，这 5 个病例都缺乏恶性病变 X 线特征，其中 2 个因被 BUS 检出异常血流信号、边缘成角或模糊等恶性病变征象而被 BUS 校正结果(图 2)。11 个恶性病变被 BUS 误诊为良性，其中 8 个病灶因被 DBT 检出不规则形肿块、微钙化或结构扭曲等恶性病变征象而被 DBT 校正结果(图 3)。3 个病例在 DBT 和 BUS 上的影像表现都不典型而被两种检查都误诊为良性。

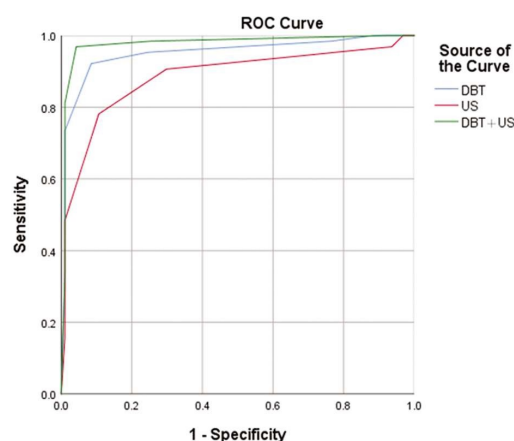


图 1 三种诊断模式对恶性病变的诊断效能的 ROC 曲线

Fig.1 The ROC curve of the diagnostic efficacy of the three diagnostic modes for malignant lesions

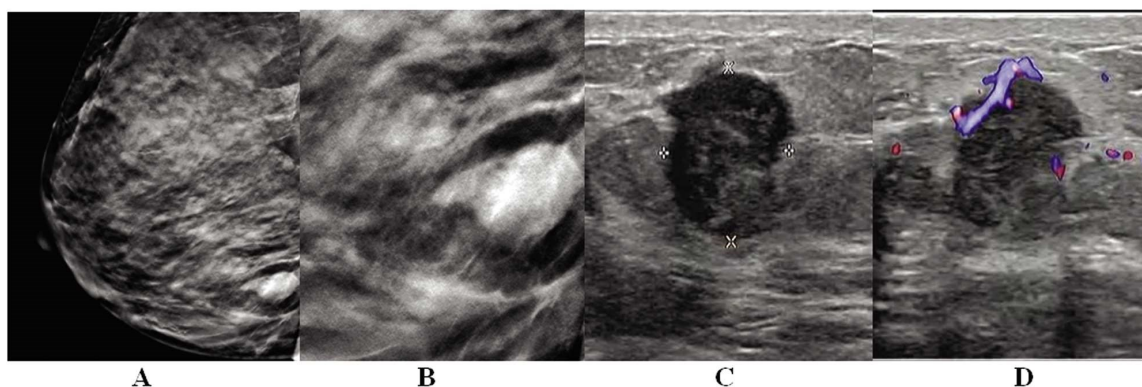


图2 恶性病变被 DBT 误诊为良性

Fig.2 Malignant lesions misdiagnosed as benign by DBT

Note: A, B: DBT showed an irregular high-density mass under the right breast, with a clear margin, considering the possibility of fibroadenoma, BI-RADS 4a type. C: BUS showed irregular and abnormal echo at 6 o'clock in the right breast, with angular edges, and uneven internal echo, aspect ratio >1; D: Color Doppler flow imaging showed perforator blood flow signal in the mass, suggesting the possibility of right breast cancer, BI-RADS 4b type.

Pathological findings: right breast infiltrating carcinoma.

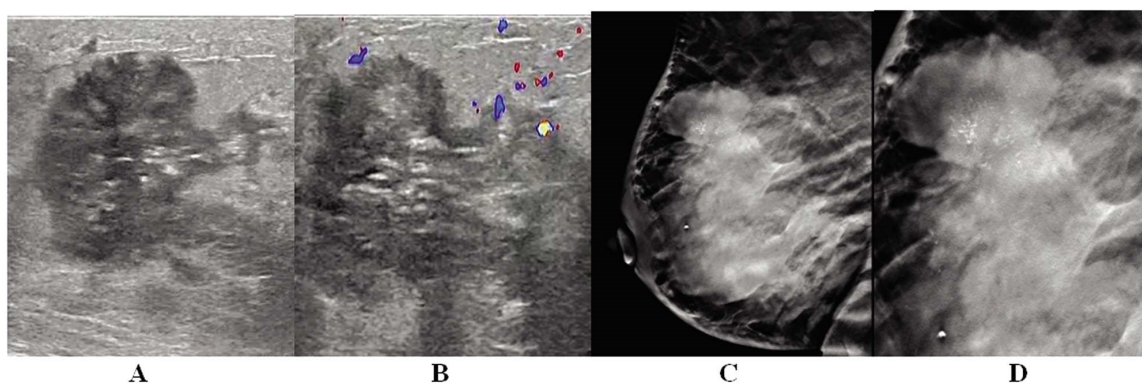


图3 恶性病变被 BUS 误诊为良性

Fig.3 Malignant lesions misdiagnosed as benign by BUS

Note: A: BUS showed abnormal echo in the outer upper quadrant of the right breast, with unclear edge, uneven echo and poor sound transmission. B: Color Doppler flow imaging showed blood flow signal in the mass, suggesting inflammatory changes in the right breast, BI-RADS 3 type; C and D: DBT showed an irregular isodense mass in the 1/3 of the outer upper quadrant of the right breast, with fuzzy edges, and a large number of linear branching calcifications in it, which was considered to be breast cancer, BI-RADS 5 type. Pathological findings: right breast infiltrating carcinoma.

3 讨论

DBT 是在传统 FFDM 基础上发展起来的新技术,它从多个角度对乳腺进行投照,再将获得的数据重建成多幅断层图像,克服了传统 FFDM 对致密型乳腺不敏感的缺点,能够更加清晰地显示病变的形状及边缘,对于结构扭曲、非对称致密影的检出率较传统 FFDM 有明显提高^[7-9]。BUS 的特点是无辐射、可重复性强、不受腺体密度的影响,对于微小病变、导管内病变、特别是囊性病变的检出具有较大优势^[10-12]。本研究表明 BUS 对良性病变的检出优于 DBT,主要体现在微小良性病变的检出方面。本组病例中被 DBT 遗漏的病变普遍较小,最大径约 (0.68 ± 0.32) cm。尽管大量文献研究证实 DBT 较 FFDM 在病变的检出率方面有显著优势^[13,14],但与 BUS 对于微小良性病变的检出能力相比,DBT 仍然有差距。本研究发现 DBT 与 BUS 对恶性病变的检出略有差异,但不显著,仅有 3 例以恶性钙化灶为唯一表现的乳腺癌未能被 BUS 检出,1 例被致密腺体掩盖的微小乳腺癌未能被 DBT 检出。尽管本组病例中有部分恶性

病变很小,且与正常腺体没有明显的密度差异,但恶性病变常合并微钙化或结构扭曲,有助于 DBT 对微小恶性病变的检出。

DBT 及 BUS 的成像原理不同,判断病变性质所依据的影像学表现也有一些差异。提示病变可能为恶性的 DBT 影像学表现包括:形状不规则形、边缘模糊或呈毛刺状、高密度、微钙化、结构扭曲等;可疑恶性的 BUS 影像学表现包括:形状不规则、边缘不清晰、低回声、纵横比>1、异常血流信号、微小钙化灶等。DBT 相较于 BUS 最大的优势是对钙化灶的检出及钙化性质的判定,这也是本研究中 DBT 的诊断效能高于 BUS 的最主要原因。钙化灶的形态、分布特点是评估其良、恶性的两个重要因素。恶性钙化灶常为细小密集的钙化灶,为“微钙化”^[15,16]。本研究组在工作中发现,DBT 与传统 FFDM 相比能提高部分微钙化的检出率,但对钙化灶的形态、分布特点的显示并无明显优势,这与其它学者的研究结果一致^[17,18]。虽然 BUS 也能检出一部分微小钙化灶,但其检出钙化灶与实际钙化灶往往不相符^[9],且无法通过钙化灶的形态、分布特征对其良、恶性做出精确的判定。除钙化灶之外,结构扭曲、非对称致密影的检出及

性质的判定也是 DBT 相较于 BUS 的一个重要优势。BUS 对乳房观测的整体感较差,对于结构扭曲及非对称致密影的显示往往不如 DBT,且 DBT 相较于传统的 FFD 对结构扭曲及非对称致密影的诊断有更高的敏感度和准确率^[20-22]。

BUS 相较于 DBT 的优势在于能够准确地鉴别病变的囊、实性,可清晰直观地显示导管内病变,可简单高效地观测病变内及周围的血流信号,特别对富血供的恶性病变有较大敏感性^[23-25],但部分恶性病变的血流不丰富,而某些良性病变如乳头状瘤和炎性病变却可能有丰富的血供,这也是 BUS 鉴别诊断的一个难点^[26,27]。近年来超声增强造影、弹性成像等技术的发展使得超声不再仅依靠回声差别来鉴别病变的性质,有助于提高诊断的准确率^[28-30]。本研究证实 DBT 联合 BUS 的诊断效能高于 DBT 和 BUS,这与其它类似文献的结论相一致^[31]。本研究中 DBT 与 BUS 相结合后诊断效能的提升体现在敏感度(95.31%)和准确率(95.57%)的提高,ROC 曲线下面积(AUC)也提高到了 0.977。

综上所述,BUS 对良性病变的检出率显著高于 DBT,DBT 对致密性乳腺病变的诊断效能高于 BUS,二者结合能提高病变的诊断效能。本研究具有一定的局限性,我们选取的病例为 DBT 或 BUS 检出病变的患者,但这两种检查仍有各自的缺陷,就算结合运用也仍有少数病变被漏诊的可能性;虽然 DBT 与 BUS 相结合能提高诊断的敏感度、准确率,但仍有一部分病变因缺乏典型的影像学征象或具有混淆性的影像学征象而被误诊。如何更准确的检出病变、更精确的对病变的性质做出诊断是我们在今后的工作中需要努力的方向。

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