

doi: 10.3978/j.issn.2095-6959.2022.11.009

View this article at: <https://dx.doi.org/10.3978/j.issn.2095-6959.2022.11.009>

# 声触诊组织量化成像技术联合血清 Ca153 对乳腺结节良恶性的诊断价值

祁汉中<sup>1,2</sup>, 倪雪君<sup>1</sup>, 陈希<sup>1</sup>

(1. 南通大学附属医院超声科, 南通大学医学院, 江苏 南通 226001; 2. 建湖县人民医院超声科, 江苏 盐城 224700)

**[摘要]** 目的: 探究声触诊组织量化成像(virtual touch tissue imaging quantification, VTIQ)技术联合血清抗 癌原153(carcinoma marker 153, Ca153)对乳腺结节良恶性的评价效果。方法: 回顾性选取2020年 1月至2021年12月在建湖县人民医院就诊的112例乳腺实质性结节患者为研究对象, 以术后病理结 果作为金标准, 将112例乳腺结节患者分为恶性组与良性组, 比较VTIQ技术测量结节剪切波速度 值(shear wave velocity, SWV)、血清Ca153与两者联合诊断乳腺结节良恶性的敏感度、预测值、准 确率、漏诊率、误诊率, 并比较三者诊断乳腺结节良恶性与病理结果的一致性。结果: 112例乳腺 结节经病理检查显示: 良性乳腺结节79例, 恶性乳腺结节33例。恶性乳腺结节组SWV值与Ca153 均显著高于良性乳腺结节组, 差异有统计学意义( $P<0.05$ )。受试者工作特征(receiver operating characteristic, ROC)曲线显示: SWV值与Ca153水平诊断乳腺结节良恶性最佳阈值为4.385 m/s与 31.465 U/mL, VTIQ技术SWV值诊断乳腺结节恶性的敏感度为78.79%(26/33), 诊断乳腺结节良 性的敏感度为96.20%(76/79); 血清Ca153诊断乳腺结节恶性的敏感度为72.73%(24/33), 诊断乳 腺结节良性的敏感度为98.73%(78/79); 联合诊断乳腺结节恶性的敏感度为93.94%(31/33), 诊断 乳腺结节良性的敏感度为100.00%(79/79)。VTIQ技术SWV值诊断乳腺结节良恶性与病理检查相 比, Kappa值为0.837, 两者一致性较好; 血清Ca153诊断乳腺结节良恶性与病理检查相比, Kappa 值为0.769, 两者一致性较好; 联合诊断乳腺结节良恶性与病理检查相比, Kappa值为0.956, 两 者一致性较好, 且联合诊断Kappa值显著高于VTIQ技术SWV值与血清Ca153单独诊断的Kappa值 ( $P<0.05$ )。VTIQ技术、血清Ca153及两者联合诊断的漏检率、误诊率差异无统计学意义( $P>0.05$ ), 但两者联合诊断乳腺结节良恶性的准确率高于VTIQ技术与血清Ca153( $P<0.05$ )。结论: VTIQ技术 联合血清Ca153诊断鉴别乳腺结节良恶性具有较高价值, 可有效提高诊断准确率。

**[关键词]** 乳腺结节; 良恶性; 声触诊组织量化成像技术; 血清Ca153; 联合诊断

## Diagnostic value of virtual touch tissue quantitative imaging quantification technique combined with serum Ca153 in benign and malignant breast nodules

QI Hanzhong<sup>1,2</sup>, NI Xuejun<sup>1</sup>, CHEN Xi<sup>1</sup>

(1. Department of Ultrasound, Affiliated Hospital of Nantong University, Medical School of Nantong University, Nantong Jiangsu 226001;

2. Department of Ultrasound, Jianhu County People's Hospital, Yancheng Jiangsu 224700, China)

收稿日期 (Date of reception): 2022-06-19

通信作者 (Corresponding author): 倪雪君, Email: lily0138@163.com

**Abstract** **Objective:** To explore the effect of virtual touch tissue imaging quantification (VTIQ) combined with serum carcinoma marker 153 (Ca153) on the evaluation of benign and malignant breast nodules. **Methods:** A total of 112 patients with breast parenchymal nodules who were treated in Jianhu County People's Hospital from January 2020 to December 2021 were retrospectively selected as research subjects. Using postoperative pathological results as the gold standard, 112 patients with breast nodules were divided into a malignant and a benign group. The sensitivity, predictive value, accuracy rate, missed diagnosis rate, misdiagnosis rate of nodule shear wave velocity (SWV), serum Ca153, and their combination in diagnosing benign and malignant breast nodules. The consistency of the diagnosis of benign and malignant breast nodules and the pathological results were compared among the 3 methods. **Results:** Pathological examination of 112 breast nodules showed that there were 79 benign breast nodules and 33 malignant breast nodules. The SWV value and Ca153 in the malignant breast nodule group were significantly higher than those in the benign breast nodule group, and the difference was statistically significant ( $P < 0.05$ ). The ROC curve shows that the optimal thresholds of SWV value and Ca153 level for the diagnosis of benign and malignant breast nodules were 4.385 m/s and 31.465 U/mL. The SWV value of VTIQ technique had a sensitivity of 78.79% (26/33) in diagnosing malignant breast nodules; the sensitivity of diagnosing benign breast nodules was 96.20% (76/79); the sensitivity of serum Ca153 in diagnosing breast nodule malignancy was 72.73% (24/33); the sensitivity of diagnosing benign breast nodules was 98.73% (78/79); the sensitivity of combined diagnosis of breast nodule malignancy was 93.94% (31/33); the sensitivity for diagnosing benign breast nodules was 100.00% (79/79). Compared with the pathological examination, the SWV value of VTIQ technology in the diagnosis of benign and malignant breast nodules had a Kappa value of 0.837, and the two were in good agreement. Compared with the pathological examination, the Kappa value of serum Ca153 in the diagnosis of benign and malignant breast nodules was 0.769, and the two were in good agreement. Compared with the pathological examination, the Kappa value of the joint diagnosis of benign and malignant breast nodules was 0.956, and the consistency between the two was good. The Kappa value of the combined diagnosis was significantly higher than the SWV value of VTIQ technology and serum Ca153 alone diagnosis Kappa value ( $P < 0.05$ ). There was no significant difference in missed detection rate and misdiagnosis rate among VTIQ technology, serum Ca153, and their combined diagnosis ( $P > 0.05$ ). However, the accuracy of the 2 combined diagnosis of benign and malignant breast nodules was higher than that of VTIQ technology and serum Ca153 ( $P < 0.05$ ). **Conclusion:** Virtual touch tissue imaging quantification technology combined with serum Ca153 has high value in the diagnosis and differentiation of benign and malignant breast nodules and can effectively improve the diagnostic accuracy.

**Keywords** breast nodules; benign and malignant; virtual touch tissue imaging quantification; serum Ca153; combined diagnosis

乳腺癌是常见女性恶性肿瘤,也是致死首位女性恶性肿瘤<sup>[1]</sup>。我国乳腺癌发病率呈逐年上升趋势,且发病日益年轻化。因而早期诊断并给予早期治疗是提高乳腺癌治疗效果,改善生存率的关键环节,提高乳腺癌恶性结节诊断准确率,降低漏诊是临床研究重点<sup>[2-3]</sup>。超声检查操作简单、无辐射且具有较好可重复性成为临床乳腺癌检查重要方式<sup>[4]</sup>,声触诊组织量化成像(virtual touch tissue imaging quantification, VTIQ)技术是一种近年来兴起的弹性技术,其前身为新一代

声辐射力脉冲成像技术,具有客观测量结果,且操作简便<sup>[5]</sup>。但既往研究<sup>[5]</sup>表明:VTIQ诊断乳腺癌临床存在误诊情况,具有一定局限性。血清肿瘤相关性抗原153(carcinoma marker 153, Ca153)诊断乳腺癌准确性较高,但存在单项指标漏诊情况<sup>[6]</sup>。因而,探索多项指标联合检测是现阶段提高乳腺恶性结节诊断准确率的研究新热点<sup>[7]</sup>。目前临床有关VTIQ技术联合血清Ca153诊断乳腺恶性结节研究较少,基于此,本研究探讨VTIQ联合血清Ca153对乳腺结节良恶性的评价效果。

## 1 对象与方法

### 1.1 对象

回顾性选取2020年1月至2021年12月在建湖县人民医院就诊的112例乳腺结节患者为研究对象年龄18~80(43±13)岁, 结节直径0.4~4(2.2±0.7) cm。纳入标准: 1)年龄≥18岁; 2)病灶未经任何相关处理与治疗; 3)临床表现为乳腺包块、乳头溢液与乳痛等症状; 4)均为女性; 5)患者及家属均知情同意并签署承诺书。排除标准: 1)乳腺肿块为明显囊性病灶; 2)存在乳腺植入体; 3)既往乳腺切除术或活检术; 4)未经病理检查确诊; 5)其他部位肿瘤转移; 6)认知障碍不能配合本研究。本研究方案经建湖县人民医院医学伦理委员会审查批准(审批号: 2020LC1108)。

### 1.2 方法

**VTIQ检查:** 仪器为西门子超声诊断仪(S3000型), 配备VTIQ技术。常规检查后采用高频线阵探头, 频率设置为5~14 MHz, 探头采用9L4。参照BI-RADS分类标准行常规超声检查, 观察结节新边界、形态、内部回声改变、纵横比、有无内部钙化情况、血流分布特征、后方回声衰减情况, 测量结节大小。然后进入VTIQ技术检查, 放置感兴趣区于结节中央, 注意避开可见钙化区, 测量剪切波速度值(shear wave velocity, SWV), 每个病灶测量与记录SWV值, 测7次, 除去最低值与最高值, 计算其5次测量结果的平均值, VTIQ技术测量范围设置为0.5~10.0 m/s, 范围外测值均显示为X.XX m/s, 本研究将囊性病灶排除, 因而仅代表硬质病灶SWV值。患者于入院时接受检查(图1、2)。

**血清Ca153检查:** 入院时收集2 mL肘静脉血,

采用免疫发光法检测血清Ca153水平。

### 1.3 观察指标

以术后病理结果作为金标准, 比较恶性组与良性组的SWV值、血清Ca153与两者联合诊断乳腺结节良恶性的敏感度、预测值、准确率、漏诊率、误诊率, 并比较三者诊断乳腺结节良恶性与病理结果的一致性。

### 1.4 统计学处理

采用SPSS 22.0统计学软件进行数据分析。计数资料用例(%)表示, 比较行 $\chi^2$ 检验、秩和检验; 正态分布的计量资料用均数±标准差( $\bar{x}\pm s$ )表示, 组间比较分别行独立样本 $t$ 检验, 使用Kappa检验比较两种方法检查一致性, 取值为0~1, Kappa值≥0.75为两者一致性较好, 0.4~<0.75为一般, <0.4为较差。 $P<0.05$ 为差异有统计学意义。

## 2 结果

### 2.1 病理结果

112例乳腺结节术后病理结果显示: 良性结节79例, 恶性结节33例。其中良性乳腺结节病理类型包括乳腺纤维腺瘤( $n=46$ )、乳腺腺病( $n=22$ )、导管内不典型增生( $n=8$ )、导管内乳头状瘤( $n=3$ ), 恶性乳腺结节病理类型包括浸润性导管癌( $n=27$ )、原位癌( $n=3$ )、浸润小叶癌( $n=2$ )、黏液癌( $n=1$ )。

### 2.2 两组 SWV 值与 Ca153 水平比较

恶性乳腺结节组SWV值与Ca153均显著高于良性乳腺结节组, 差异均有统计学意义(均 $P<0.05$ , 表1)。

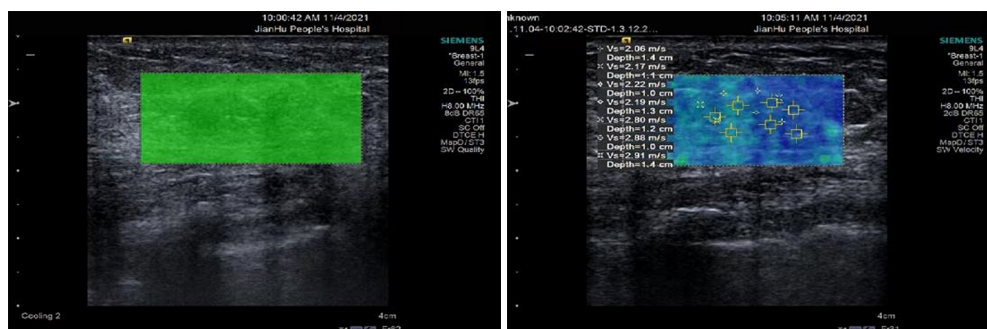


图1 乳腺纤维腺瘤, BI-RADS 3级

Figure 1 Fibroadenoma of the breast, BIRADS grade 3

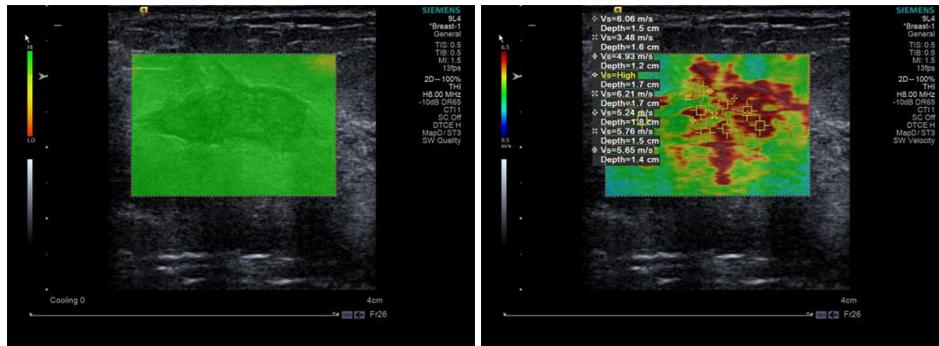


图2 浸润性导管癌，BI-RADS 4b级

Figure 2 Invasive ductal carcinoma, BI-RADS grade 4b

表1 两组SWV值与Ca153水平比较

Table 1 Comparison of SWV values and Ca153 levels between the 2 groups

组别	n	SWV值/ (m·s <sup>-1</sup> )	Ca153/ (U·mL <sup>-1</sup> )
良性乳腺结节组	79	3.13 ± 1.01	22.26 ± 4.86
恶性乳腺结节组	33	5.68 ± 1.71	43.29 ± 9.25
t		9.806	15.723
P		<0.001	<0.001

### 2.3 VTIQ 技术、血清 Ca153 及两者联合对乳腺结节良恶性的诊断价值

ROC曲线显示：VTIQ技术SWV值和Ca153水平诊断乳腺结节良恶性最佳阈值为4.385 m/s和31.465 U/mL(图3)。以SWV值>4.385 m/s视为乳腺结节恶性，≤4.385 m/s为乳腺结节良性；Ca153>31.465 U/mL为乳腺结节恶性，≤31.465 U/mL为乳腺结节良性；两者联合诊断中任何一项显示恶性则视为恶性，两者均显示为良性则视为良性，由临床两位经验丰富医师共同判断。

以病理检查作为金标准，VTIQ技术SWV值诊断乳腺结节恶性的敏感度为78.79%(26/33)，乳腺结节恶性预测值为89.66%(26/29)，诊断乳腺结节良性的敏感度为96.20%(76/79)，乳腺结节良性预测值为91.57%(76/83)；血清Ca153诊断乳腺结节恶性的敏感度为72.73%(24/33)，乳腺结节恶性预测值为96.00%(24/25)，诊断乳腺结节良性的敏感度为98.73%(78/79)，乳腺结节良性预测值为89.66%(78/87)；联合诊断乳腺结节恶性的敏感度为93.94%(31/33)，乳腺结节恶性预测值为100.00%(31/31)，诊断乳腺结节良性的敏

感度为100.00%(79/79)，乳腺结节良性预测值为97.53%(79/81)，表2)。

VTIQ技术SWV值诊断乳腺结节良恶性与病理检查相比，Kappa值为0.837，两者一致性较好；血清Ca153诊断乳腺结节良恶性与病理检查相比，Kappa值为0.769，两者一致性较好；联合诊断乳腺结节良恶性与病理检查相比，Kappa值为0.956，两者一致性较好。联合诊断Kappa值显著高于VTIQ技术SWV值与血清Ca153单独诊断(P<0.05，表3)。

### 2.4 VTIQ 技术、血清 Ca153 及两者联合对乳腺结节良恶性检出情况

VTIQ技术、血清Ca153及两者联合诊断的漏检率、误诊率比较差异无统计学意义(P>0.05)，但两者联合诊断乳腺结节良恶性的准确率高与VTIQ技术与血清Ca153(P<0.05，表4)。

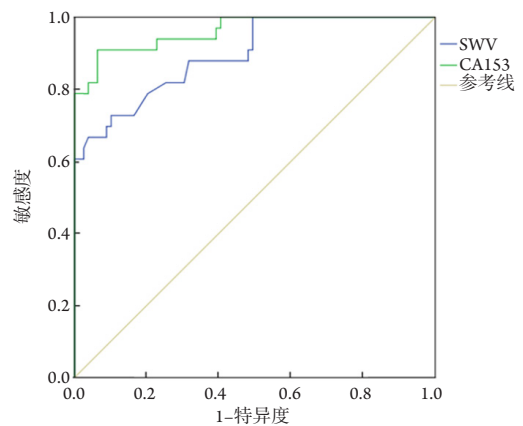


图3 VTIQ技术SWV值和Ca153诊断乳腺结节良恶性的ROC曲线

Figure 3 ROC curve of SWV value and Ca153 level of VTIQ technique in the diagnosis of benign and malignant breast nodules

表2 VTIQ技术、血清Ca153及两者联合对乳腺结节良恶性的诊断准确性

Table 2 Diagnostic accuracy of VTIQ technology, serum Ca153, and their combination in benign and malignant breast nodules

检查方式	病理检查		合计
	恶性乳腺结节	良性乳腺结节	
VTIQ技术			
恶性乳腺结节	26	3	29
良性乳腺结节	7	76	83
合计	33	79	112
血清Ca153			
恶性乳腺结节	24	1	25
良性乳腺结节	9	78	87
合计	33	79	112
联合诊断			
恶性乳腺结节	31	0	31
良性乳腺结节	2	79	81
合计	33	79	112

表3 VTIQ技术、血清Ca153及两者联合对乳腺结节良恶性与病理检查一致性

Table 3 Consistency of VTIQ technology, serum Ca153 and their combination in benign and malignant breast nodules and pathological examination

秩的测量	Kappa值	接近标准错误 <sup>a</sup>	大约T <sup>b</sup>	P
VTIQ技术	0.837	0.059	8.699	<0.001
血清Ca153	0.769	0.068	8.280	<0.001
联合诊断	0.956	0.031	10.13	<0.001

a: 未使用虚无假设; b: 正在使用具有虚无假设的渐近标准误。

a: no false hypothesis was used; b: an asymptotic standard error with false assumptions is being used.

表4 不同诊断方式检出情况比较(n=112)

Table 4 Comparison of detection status of different diagnostic methods (n=112)

不同检查方式	准确率/%	漏检率/%	误诊率/%
VTIQ技术	91.07*	6.25	2.68
血清Ca153	91.07*	8.04*	0.89
联合诊断	98.21	1.79	0.00
Z	6.207	4.565	3.532
P	0.045	0.126	0.329

与联合诊断比较, \*P<0.05。

Compared with combined diagnosis, \*P<0.05.

### 3 讨论

乳腺癌是由乳腺组织进展而来, 最初明显症状多为与乳房组织其余部位不同感觉的肿块, 此时乳腺癌确诊率可达80%<sup>[8]</sup>。通常乳腺癌患者生存率取决于患者年龄、癌症进程与癌症类型, 发达国家患者5年生存率为80%~90%, 发展中国家患者生存率较差<sup>[8]</sup>。乳腺癌是女性主要癌症类型, 在女性癌症中占25%<sup>[8]</sup>。既往研究<sup>[9]</sup>表明: 早期诊断并进行早期治疗对提高患者生存质量十分重要。

弹性超声成像是通过组织弹性系数差异性进行不同组织软硬程度评估。研究<sup>[10]</sup>表明: 乳腺良性结节硬度高于乳腺正常组织, 而乳腺恶性结节高于良性结节, 因而弹性成像可用于乳腺结节良恶性鉴别。声辐射脉冲力弹性成像通过探头发射聚焦声脉冲力施压组织<sup>[11]</sup>。既往声辐射脉冲力弹性成像包括声触诊组织定量技术与声触诊组织成像技术, 二者融合产生VTIQ技术, 可定量定性评估组织软硬程度<sup>[12-13]</sup>。VTIQ技术具有以下优势: 1)速度模式下通过红蓝绿色分别代表软硬程度, 有利于指导ROI放置在有效感兴趣区, 且可在同一帧图像中进行多点测量, 利于取得最有价值的SWV值; 2)可在获得高质量模式图切至速度模式, 弹性结果可信度更高; 3)VTIQ技术取样框范围克服了声触诊组织定量技术取样框超过肿块范围产生结果偏差的缺点, 获得的SWV值针对性更好; 4)量程范围可调节。因而VTIQ技术完善既往弹性成像定量诊断缺点, 最终反映组织硬度SWV值结果更为可靠、科学。本研究中恶性乳腺结节组SWV值显著高于良性乳腺结节组, 分析原因为组织弹性越好, 应变越大, SWV值越小, 反之则SWV值越高, 提示VTIQ技术对诊断乳腺结节良恶性具有一定可行性。ROC曲线显示: VTIQ技术SWV值诊断乳腺结节良恶性最佳阈值为4.385 m/s。以病理检查作为金标准, VTIQ技术SWV值诊断乳腺结节恶性的敏感度为78.79%, 诊断乳腺结节良性的敏感度为96.20%, 与既往研究<sup>[8]</sup>结果相似。VTIQ技术SWV值诊断乳腺结节良恶性与病理检查相比, Kappa值为0.837, 两者一致性较好, 提示VTIQ技术鉴别乳腺结节良恶性具有一定价值, 但其诊断乳腺结节恶性存在一定假阳性、假阴性与误诊率, 分析与不同病例病灶弹性存在重叠性相关, 良性病变若存在钙化、胶原化、纤维间质成分增加, 可增加组织硬度, 出现假阳性; 而恶性结节癌细胞成分高、间质成分低、合并坏死出血或类似黏液癌会致使病变硬度下降, 出现假阴性。

随着医学水平发展与对肿瘤的深入研究, 肿瘤患者体内细胞组织分化异常, 存在多种肿瘤标志物水平升高, 肿瘤标志物在肿瘤早期诊断中具有重要价值<sup>[14]</sup>。Ca153是乳腺癌诊断特异性肿瘤标志物, 可有效反映肿瘤转移与恢复效果<sup>[15]</sup>。本研究中恶性乳腺结节组Ca153均显著高于良性乳腺结节组, 提示Ca153鉴别乳腺结节良恶性具有一定可行性。ROC曲线分析显示: Ca153水平诊断乳腺结节良恶性最佳阈值为31.465 U/mL。以病理检查作为金标准, 血清Ca153诊断乳腺结节恶性的敏感度为72.73%, 诊断乳腺结节良性的敏感度为98.73%; 血清Ca153诊断乳腺结节良恶性与病理检查相比, Kappa值为0.769, 两者一致性较好; 具有一定价值。但其诊断乳腺结节恶性的敏感度不高, 且存在漏诊率, 与既往研究<sup>[15]</sup>观点一致。推测原因是乳腺结节良性患者存在炎症时, 血清Ca153水平亦会升高, 因此血清Ca153升高诊断乳腺结节良恶性准确性欠佳。

基于此, 本研究创新性将VTIQ技术联合血清Ca153诊断乳腺结节良恶性, 结果显示联合诊断乳腺结节恶性的敏感度为93.94%, 诊断乳腺结节良性的敏感度为100.00%, 提示联合诊断价值更高。与病理检查相比, Kappa值为0.956, 显著高于VTIQ技术SWV值与血清Ca153单独诊断的Kappa值, 且联合诊断乳腺结节良恶性的准确率高于VTIQ技术与血清Ca153, 提示联合诊断准确性高于单一诊断。

综上所述, VTIQ技术联合血清Ca153诊断鉴别乳腺结节良恶性具有较高价值, 可有效提高诊断准确率。本研究不足之处是研究为回顾性研究, 数据准确性欠佳, 且样本量较少, 期待后期深入研究验证。

### 参考文献

1. Andrade FO, Liu F, Zhang X, et al. Genistein reduces the risk of local mammary cancer recurrence and ameliorates alterations in the gut microbiota in the offspring of obese dams[J]. *Nutrients*, 2021, 13(1): 201.
2. Lally RM, Kupzyk KA, Bellavia G, et al. CaringGuidance™ after breast cancer diagnosis eHealth psychoeducational intervention to reduce early post-diagnosis distress[J]. *Support Care Cancer*, 2020, 28(5): 2163-2174.
3. Zhang Z, Zhang X, Lin X, et al. Ultrasonic diagnosis of breast nodules using modified faster R-CNN[J]. *Ultrason Imaging*, 2019, 41(6): 353-367.
4. Liang X, Yu J, Liao J, et al. Convolutional neural network for breast and

- thyroid nodules diagnosis in ultrasound imaging[J]. Biomed Res Int, 2020, 2020: 1763803.
5. Sun JW, Wang XL, Zhao Q, et al. Virtual touch tissue imaging and quantification (VTIQ) in the evaluation of breast lesions: The associated factors leading to misdiagnosis[J]. Eur J Radiol, 2019, 110: 97-104.
  6. 王丽, 马张艳, 朗晓林. 彩色多普勒超声联合血清CA199和CA153对乳腺癌的诊断价值[J]. 中国妇幼保健, 2021, 36(4): 964-966.  
WANG Li, MA Zhangyan, LANG Xiaolin. The diagnostic value of color Doppler ultrasonography combined with serum CA199 and CA153 in breast cancer[J]. Maternal & Child Health Care of China, 2021, 36(4): 964-966.
  7. Ou X, Wang J, Zhou R, et al. Ability of <sup>18</sup>F-FDG PET/CT radiomic features to distinguish breast carcinoma from breast lymphoma[J]. Contrast Media Mol Imaging, 2019, 2019: 4507694.
  8. 秦敏. VTIQ结合CDFI极大提高对乳腺BI-RADS4类良性病变的诊断效能[J]. 基因组学与应用生物学, 2019, 38(4): 1876-1882.  
QIN Min. VTIQ combined with CDFI could greatly improve the diagnostic efficacy of bi-rads 4 benign and malignant breast nodules[J]. Genomics and Applied Biology, 2019, 38(4): 1876-1882.
  9. Brahimetaj R, Willekens I, Massart A, et al. Improved automated early detection of breast cancer based on high resolution 3D micro-CT microcalcification images[J]. BMC Cancer, 2022, 22(1): 162.
  10. Gao LY, Gu Y, Xu W, et al. Can combined screening of ultrasound and elastography improve breast cancer identification compared with MRI in women with dense breasts-a multicenter prospective study[J]. J Cancer, 2020, 11(13): 3903-3909.
  11. Kaban S, Damar Ç. Interrelationship between liver T2\*-weighted magnetic resonance imaging and acoustic radiation force impulse elastography measurement results and plasma ferritin levels in children with  $\beta$ -thalassemia major[J]. J Clin Ultrasound, 2022, 50(1): 108-116.
  12. 冯景, 王洲, 李健, 等. 声触诊组织成像定量技术与声触诊定量技术对乳腺肿瘤诊断效能的比较[J]. 安徽医学, 2020, 41(2): 156-159.  
FENG Jing, WANG Zhou, LI Jian, et al. Comparison of acoustic palpation tissue imaging quantitative technology and acoustic palpation quantitative technology in the diagnosis of breast tumors[J]. Anhui Medical Journal, 2020, 41(2): 156-159.
  13. 张俊鹏, 夏燕飞, 韩雪, 等. 应变弹性成像与声触诊组织成像定量技术鉴别诊断颈部良、恶性淋巴结[J]. 中国医学影像技术, 2022, 38(1): 137-140.  
ZHANG Junpeng, XIA Yanfei, HAN Xue, et al. Strain elastography and virtual touch tissue imaging quantification technique for differential diagnosis of benign and malignant cervical lymph nodes[J]. Chinese Journal of Medical Imaging Technology, 2022, 38(1): 137-140.
  14. Zajkowska M, Gacuta E, Lubowicka E, et al. Can VEGFR-3 be a better tumor marker for breast cancer than CA 15-3?[J]. Acta Biochim Pol, 2020, 67(1): 25-29.
  15. 宣立功, 胡万宁. 钼靶X线片联合肿瘤血清标志物在乳腺结节诊断中的意义[J]. 中国临床研究, 2019, 32(9): 1261-1264.  
XUAN Ligong, HU Wanning. Mammogram combined with serum tumor marker in the diagnosis of breast nodules[J]. Chinese Journal of Clinical Research, 2019, 32(9): 1261-1264.

本文引用: 祁汉中, 倪雪君, 陈希. 声触诊组织量化成像技术联合血清Ca153对乳腺结节良恶性的诊断价值[J]. 临床与病理杂志, 2022, 42(11): 2654-2660. doi: 10.3978/j.issn.2095-6959.2022.11.009

**Cite this article as:** QI Hanzhong, NI Xuejun, CHEN Xi. Diagnostic value of virtual touch tissue quantitative imaging quantification technique combined with serum Ca153 in benign and malignant breast nodules[J]. Journal of Clinical and Pathological Research, 2022, 42(11): 2654-2660. doi: 10.3978/j.issn.2095-6959.2022.11.009