

doi: 10.13241/j.cnki.pmb.2021.10.035

高频超声与超声造影对甲状腺癌侵袭性的诊断价值*

王佳强¹ 李伟² 米佳¹ 张妮妮¹ 王胜利¹ 王巧云^{1Δ}

(延安大学附属医院 1 超声医学科; 2 内分泌科 陕西 延安 716000)

摘要 目的:探讨高频超声与超声造影对甲状腺癌侵袭性的诊断价值。方法:2016年2月至2019年10月选择在本院诊治的甲状腺癌患者88例作为研究对象,所有患者都给予高频超声与超声造影诊断,记录影像学特征。检测所有患者侵袭性指标表达情况并判断诊断价值。结果:在88例患者中,病理检出颈部转移性淋巴结22例(转移组),检出率为25.0%。转移组的病灶钙化、边界模糊、纵横比 ≥ 1 、内部血流信号、低回声等比例都显著高于非转移组($P<0.05$)。转移组的淋巴结长径、短径显长于非转移组($P<0.05$),两组长短径比值对比无差异($P>0.05$)。转移组的峰值强度(Peak intensity, PI)、平均通过时间(Mean transit time, MTT)、达峰时间(Peak time, TIP)值显著高于非转移组($P<0.05$)。转移组的ADAM9、Notch-1、CXCR4 mRNA相对表达水平都显著高于非转移组($P<0.05$)。高频超声与超声造影对甲状腺癌侵袭性的诊断敏感性为95.2%和95.5%,特异性为100.0%和100.0%。结论:高频超声与超声造影对甲状腺癌侵袭性都有很好的诊断敏感性与特异性,可为甲状腺癌颈部淋巴结转移的诊断提供补充性的定性和定量分析的方法。

关键词: 高频超声; 超声造影; 甲状腺癌; 侵袭性; 诊断价值

中图分类号: R736.1; R445.1 **文献标识码:** A **文章编号:** 1673-6273(2021)10-1963-05

The Diagnostic Value of High-frequency Ultrasound and Contrast-enhanced of Invasiveness of Thyroid Cancer*

WANG Jia-qiang¹, LI Wei², MI Jia¹, ZHANG Ni-ni¹, WANG Sheng-li¹, WANG Qiao-yun^{1Δ}

(1 Department of Ultrasound Medicine; 2 Department of Endocrinology, Affiliated Hospital of Yan'an University, Yan'an, Shaanxi, 716000, China)

ABSTRACT Objective: To explore the diagnostic values of high-frequency ultrasound and contrast-enhanced of invasiveness of thyroid cancer. **Methods:** From February 2016 to October 2019, 88 cases of patients with thyroid cancer diagnosed and treated in our hospital were selected as the research subjects. All patients were given high-frequency ultrasound and ultrasound contrast diagnosis, and the imaging characteristics were recorded. Detected the expression of aggressive indexes of all patients and were to judge the diagnostic values. **Results:** There were 22 patients with metastatic lymph nodes in the neck were detected by pathology (metastasis group), and the detection rates were 25.0%. The proportions of calcification, blurred border, aspect ratio ≥ 1 , internal blood flow signal, and low echo in the metastasis group were significantly higher than the non-metastatic group($P<0.05$). The long and short diameters of lymph nodes in the metastatic group were significantly higher than those in the non-metastatic group ($P<0.05$). There were no statistically significant difference compared between the two groups in the ratio of length to diameter($P>0.05$). The peak intensity (PI), mean transit time (MTT) and peak time (TIP) values of the metastasis group were significantly higher than those of the non-metastasis group($P<0.05$). The relative expression levels of ADAM9, Notch-1 and CXCR4 mRNA in the metastatic group were significantly higher than those in the non-metastatic group ($P<0.05$). The sensitivity of high-frequency ultrasound and ultrasound contrast to the diagnosis of thyroid cancer invasion were 95.2% and 95.5%, and the specificity were 100.0% and 100.0%. **Conclusion:** High-frequency ultrasound and contrast-enhanced ultrasound have good diagnostic sensitivity and specificity for the invasion of thyroid cancer, and can provide complementary qualitative, quantitative analysis methods for the diagnosis of cervical lymph node metastasis of thyroid cancer.

Key words: High-frequency ultrasound; Contrast-enhanced ultrasound; Thyroid cancer; Invasiveness; Diagnostic value

Chinese Library Classification(CLC): R736.1; R445.1 **Document code:** A

Article ID: 1673-6273(2021)10-1963-05

前言

甲状腺癌(Thyroid cancer)是内分泌科头颈部最常见的恶

性肿瘤,约占全身各个部位恶性肿瘤的2%左右,占各种恶性肿瘤死亡病例总数的0.5%左右^[1,2]。该病的组织学类型包括乳头状癌、髓样癌、滤泡状癌,但是多数患者起病隐匿,病程发展

* 基金项目:国家自然科学基金项目(81470140)

作者简介:王佳强(1985-),男,本科,主治医师,研究方向:腹部,浅表,超声介入,电话:18609290022, E-mail: wjq18609290022@163.com

Δ 通讯作者:王巧云(1982-),女,本科,主治医师,研究方向:妇产,腹部,浅表超声,电话:18791116581, E-mail: 541479718@qq.com

(收稿日期:2020-07-23 接受日期:2020-08-17)

慢,就诊时多伴随有侵袭性^[3,4]。颈部淋巴结转移表明甲状腺癌患者具有极强的侵袭性,导致预后比较差,为此早期诊断与鉴别甲状腺癌颈部转移性淋巴结具有重要价值^[5,6]。病理组织活检是公认的甲状腺癌颈部转移性淋巴结诊断金标准,但是对患者有一定的创伤^[7,8]。超声可较清晰地反映甲状腺癌病灶的数量、部位及其侵袭状况。特别是当前高频超声具有快捷、实时动态、无创伤性、无辐射性、可重复性等优点,已成为甲状腺癌的首选检查方法^[9,10]。超声造影(Contrast enhanced ultrasound, CEUS)是将微泡造影剂经外周静脉注射到靶组织,增加血流与周围组织回声的差异,提高诊断的准确性^[11,12]。本文具体探讨了高频超声与超声造影对甲状腺癌侵袭性的价值,以有助于促进早期检出颈部转移性淋巴结。

1 资料与方法

1.1 研究对象

选择 2016 年 2 月至 2019 年 10 月本院诊治的甲状腺癌患者 88 例,纳入标准:均经手术病理组织活检确诊;本院伦理委员会批准了此次研究;临床资料完整;年龄 20~80 岁;单侧发病;患者签署了知情同意书。排除标准:既往有甲状腺手术史者;合并其他恶性肿瘤疾病者;伴有颈部局部或全身感染性疾病者;临床资料缺乏者;妊娠与哺乳期妇女;正参与其他研究者;存在交流沟通障碍或精神疾病者。

1.2 超声方法

1.2.1 高频超声方法 选择飞利浦 iu Elite 超声仪器,患者取仰卧位,充分暴露颈部,嘱患者平静呼吸以保证图像质量,适当施压以获取最佳超声图像。记录病灶钙化、边界、纵横比、血流信号、低回声等状况,同时记录颈部淋巴结的长径、短径、长短径比值等指标。

1.2.2 超声造影方法 超声造影剂为微泡造影剂 SonoVue,造影机械指数 0.07,经肘静脉快速团注 1.2 mL,持续观察造影图像。选取病灶内造影最显著的区域为感兴趣区,记录 PI、MTT、TIP 等指标。

1.3 侵袭性转移指标检测

取所有患者的病灶组织标本,提取组织总 RNA,采用荧光定量 PCR 法检测 ADAM9、Notch-1、CXCR4 表达水平,获取 PCR 扩增曲线,计算 mRNA 相对表达量。

1.4 统计方法

应用 SPSS 20.00,计量资料用($\bar{x} \pm s$)示,行 t 检验,计数数据用%示,分析为 χ^2 分析, $P < 0.05$ 有统计学意义。

2 结果

2.1 颈部转移性淋巴结情况

在 88 例患者中,病理检出颈部转移性淋巴结 22 例(转移组),检出率为 25.0%。两组的一般资料对比无差异($P > 0.05$),见表 1。

表 1 两组一般资料对比

Table 1 Comparison of tgeneral information of two groups

Groups	n	Gender (male/female)	Average age (years)	Lesion location (left / right)	Pathological type (papillary carcinoma / medullary carcinoma / follicular carcinoma)	BMI(kg/m ²)
Transfer group	22	8/14	48.29± 2.15	11/11	13/7/2	22.84± 1.44
Non-transfer group	66	22/44	48.12± 1.77	34/32	34/22/10	22.19± 1.22

2.2 常规超声特征对比

转移组的病灶钙化、边界模糊、纵横比 ≥ 1 、内部血流信号、

低回声等比例都显著高于非转移组($P < 0.05$),见表 2。

表 2 两组常规超声特征对比(例,%)

Table 2 Comparison of conventional ultrasound characteristics between two groups (n,%)

Groups	n	Calcification	Boundary blur	Aspect ratio ≥ 1	Internal blood flow signal	Low echo
Transfer group	22	21(95.5)*	21(95.5)*	21(95.5)*	22(100.0)*	19(86.4)*
Non-transfer group	66	32(48.5)	28(42.4)	19(28.8)	31(47.0)	27(40.9)

Note: Compared with the non-transfer group, * $P < 0.05$.

2.3 颈部淋巴结超声指标对比

转移组的淋巴结长径、短径显著长于非转移组($P < 0.05$),两组长短径比值对比无差异($P > 0.05$),见表 3。

2.4 超声造影指标对比

转移组的 PI、TTP 与 MTT 值显著高于非转移组,经过对比差异均存在统计学意义($P < 0.05$),见表 4。

2.5 侵袭性指标对比

转移组的 ADAM9、Notch-1、CXCR4 mRNA 相对表达水平

都显著高于非转移组,经过对比差异均存在统计学意义($P < 0.05$),见表 5。

2.6 诊断价值对比

在 88 例患者中,高频超声与超声造影诊断颈部转移性淋巴结分别为 20 例与 21 例,为此两者对甲状腺癌侵袭性的诊断敏感性为 95.2%(20/22) 和 95.5%(21/22),特异性为 100.0%(66/66)和 100.0%(66/66),见表 6。

表 3 两组颈部淋巴结超声指标对比($\bar{x} \pm s$)Table 3 Comparison of ultrasound indexes of cervical lymph nodes between two groups ($\bar{x} \pm s$)

Groups	n	Long Trail (mm)	Short Trail(mm)	Length to short diameter ratio
Transfer group	22	27.62 $\pm$ 1.48*	14.57 $\pm$ 2.11*	1.88 $\pm$ 0.24
Non-transfer group	66	19.09 $\pm$ 2.14	10.42 $\pm$ 1.11	1.85 $\pm$ 0.18

Note: Compared with the non-transfer group, * $P < 0.05$.

表 4 两组超声造影指标对比($\bar{x} \pm s$)Table 4 Comparison of ultrasound contrast indexes between the two groups ($\bar{x} \pm s$)

Groups	n	PI	TTP(s)	MTT(s)
Transfer group	22	0.63 $\pm$ 0.08*	0.94 $\pm$ 0.11*	0.90 $\pm$ 0.07*
Non-transfer group	66	1.28 $\pm$ 0.11	1.18 $\pm$ 0.08	1.08 $\pm$ 0.06

Note: Compared with the non-transfer group, * $P < 0.05$.

表 5 两组侵袭性指标相对表达水平对比($\bar{x} \pm s$)Table 5 Comparison of relative expression levels of invasive indexes between the two groups ($\bar{x} \pm s$)

Groups	n	ADAM9	Notch-1	CXCR4
Transfer group	22	3.09 $\pm$ 0.11*	4.09 $\pm$ 0.12*	3.76 $\pm$ 0.21*
Non-transfer group	66	1.08 $\pm$ 0.12	1.32 $\pm$ 0.08	1.24 $\pm$ 0.09

Note: Compared with the non-transfer group, * $P < 0.05$.

表 6 高频超声与超声造影对甲状腺癌侵袭性的诊断价值(n=88)

Table 6 Diagnostic value of high-frequency ultrasound and contrast-enhanced thyroid cancer (n=88)

Pathology	High frequency ultrasound		Ultrasonography		Total
	Lymph node metastasis	Non-lymph node metastasis	Lymph node metastasis	Non-lymph node metastasis	
Lymph node metastasis	20	2	21	1	22
Non-transfer group	0	66	0	66	66
Total	20	68	21	67	88

3 讨论

甲状腺癌的病情发展中,颈部淋巴结转移是重要的病理特征,准确判断颈部淋巴结转移可为预后提供帮助^[13]。超声检查有便捷、经济性等特点,临床上已广泛应用。高频超声对甲状腺癌的显示非常敏感,能清楚显示病灶的形态、位置、大小、数目等特征,无论是对甲状腺癌的定位还是定性诊断均有优势^[14,15]。本研究显示在 88 例患者中,病理检出颈部转移性淋巴结 22 例(转移组),检出率为 25.0%;转移组的病灶钙化、边界模糊、纵横比 ≥ 1 、内部血流信号、低回声等比例都显著高于非转移组;转移组的淋巴结长径、短径显著长于非转移组,与刘利平^[16]等学者的研究类似,探讨甲状腺癌常规超声特征、超声造影定量参数与颈部淋巴结转移之间的关系,发现证实的甲状腺癌患者 89 例,淋巴结转移 49 例,转移率为 55.06%,淋巴转移组的癌结节大小、是否与被膜接触、钙化类型、回声质地、峰值强度与非转移组均存在显著差异。从机制上分析,其病灶纵横比是否 >1 、形态是否规则、内部是否有钙化及血流信号、边界是否清晰等诸因素均能够为甲状腺癌的诊断提供可靠的超声依据^[17,18]。

甲状腺是人体最大的内分泌腺,它具有合成、贮存与分泌甲状腺素的功能。流行病学显示随着人口的老龄化,其发生率也逐步增加^[19]。淋巴结由淋巴细胞集合而成,参与机体的免疫反应。甲状腺癌颈部淋巴结转移表明肿瘤的侵袭性比较强,也预示患者的预后比较差,为此加强早期诊断具有重要价值^[20]。超声造影是可实时动态检测造影剂在病灶内灌注的全过程,根据不同组织灌注时相的不同进行判断^[21,22]。超声造影中的时间-强度曲线分析能客观地评价不同病理类型病灶^[23,24]。本研究显示转移组的 PI、TTP 与 MTT 值显著高于非转移组,与王海燕^[25]等学者的研究类似,探究超声造影定量分析诊断乳头状甲状腺癌患者颈部淋巴结转移的效能,发现转移组癌结节大小显著高于无转移组,转移组边缘区 PI、TTP 与 MTT 值显著高于无转移组,表明转移性淋巴结内的病灶组织,常呈低灌注。从机制上分析,甲状腺癌颈部转移性淋巴结皮质内血供差,特别是部分患者可出现因坏死液化而导致的无灌注区^[26,27]。

早期对甲状腺癌淋巴结转移进行有效鉴别,有利于为临床治疗方案的制定提供指导。侵袭基因异常表达可参与肿瘤细胞的远处转移,也是甲状腺癌淋巴结转移的重要原因^[28]。本研究

显示转移组的 ADAM9、Notch-1、CXCR4 mRNA 相对表达水平都显著高于非转移组,与蒙秋凤^[29]等学者的研究类似,探讨甲状腺癌超声造影参数与病灶内增殖、侵袭、自噬基因表达的相关性,发现甲状腺癌组患者 PI、TTP、MTT 的水平低于甲状腺癌组患者,甲状腺癌组肿瘤组织中 ADAM9、CXCR4 mRNA 的表达量高于甲状腺腺瘤组,与本研究不同的是发现甲状腺癌组肿瘤组织中 Notch-1 的表达量低于甲状腺腺瘤组,可能与样本的来源有关。从机制上分析,ADAM9 属于金属蛋白酶解离素家族成员,通过使细胞接触、基质降解促进组织侵袭。Notch-1 在多种肿瘤发生发展过程中扮演调节癌基因作用,在恶性肿瘤组织中呈现高表达状况。CXCR4 可促进肿瘤细胞的克隆形成及侵袭转移活性。本研究显示转移组的 ADAM9、Notch-1、CXCR4 mRNA 相对表达水平都显著高于非转移组,表明甲状腺癌淋巴结转移多伴随有 ADAM9、Notch-1、CXCR4 的高表达^[30,31]。

超声可清楚显示甲状腺癌的性质及其周围组织的侵袭情况,病变检出敏感性高,有较好的图像分辨率,对颈部淋巴结转移的诊断起到重要作用^[32,33]。同时甲状腺位置表浅且随吞咽上下运动,也为超声诊断颈部淋巴结转移提供了良好的条件^[34]。本研究显示高频超声与超声造影对甲状腺癌侵袭性的诊断敏感性为 95.2 %和 95.5 %,特异性为 100.0 %和 100.0 %,表明两者诊断的敏感性与特异性都比较好。与于光辉^[35]的研究类似,探究超声造影和超声弹性成像对甲状腺良恶性结节的鉴别诊断价值,发现超声造影以及弹性成像在诊断甲状腺结节性质中,有着较高的价值,其准确性、特异性、敏感性分别为:89.7 %、90.3 %、88.2 %以及 87.9 %、89.0 %、89.7 %,与本研究不同的是该学者还进行了联合诊断,发现有效率最高,准确性、特异性以及敏感性分别为 97.2 %、96.6 %、98.5 %,和超声造影、弹性成像相比,联合检查的 ROC 曲线面积最大。本研究下一步将加大样本量进行分析,从而总结出超声诊断与超声造影诊断的实际价值,对比二者联合检测的价值。

总之,高频超声与超声造影对甲状腺癌侵袭性都有很好的诊断敏感性与特异性,可为甲状腺癌颈部淋巴结转移的诊断提供补充性的定性和定量分析的方法。

参考文献(References)

- [1] 周卫东,王贵民,金美善,等.乳腺癌甲状腺转移误诊为甲状腺癌 1 例[J].川北医学院学报,2018,33(2): 276-277
- [2] 陈小林,华清泉.自噬相关蛋白 Beclin1、LC3 在甲状腺癌合并颈部淋巴结转移中的表达及临床意义[J].川北医学院学报,2016,31(1): 84-87
- [3] Huang R, Jiang L, Xu Y, et al. Comparative Diagnostic Accuracy of Contrast-Enhanced Ultrasound and Shear Wave Elastography in Differentiating Benign and Malignant Lesions: A Network Meta-Analysis[J]. Front Oncol, 2019, 9: 102
- [4] Jiang W, Wei HY, Zhang HY, et al. Value of contrast-enhanced ultrasound combined with elastography in evaluating cervical lymph node metastasis in papillary thyroid carcinoma [J]. World J Clin Cases, 2019, 7(1): 49-57
- [5] Jin ZQ, Yu HZ, Mo CJ, et al. Clinical Study of the Prediction of Malignancy in Thyroid Nodules: Modified Score versus 2017 American College of Radiology's Thyroid Imaging Reporting and Data System Ultrasound Lexicon[J]. Ultrasound Med Biol, 2019, 45(7): 1627-1637
- [6] Ladrón-De-Guevara D, Pérez D, Núñez P, et al. [Synchronous tumors detected with contrast-enhanced F18-FDG positron emission tomography/computed tomography (PET/CTc) in colorectal cancer][J]. Rev Med Chil, 2019, 147(7): 828-835
- [7] Li C, Li X, Chen L, et al. The Association Among Quantitative Contrast-Enhanced Ultrasonography Features, Thyroid Imaging Reporting and Data System and BRAF V600E Mutation Status in Patients With Papillary Thyroid Microcarcinoma[J]. Comput Intell Neurosci, 2019, 35(3): 228-232
- [8] Zhang Y, Zhang MB, Luo YK. Effect of chronic lymphocytic thyroiditis on the efficacy and safety of ultrasound-guided radiofrequency ablation for papillary thyroid microcarcinoma [J]. Cancer Medicine, 2019, 8(12): 5450-5458
- [9] Zhao H, Liu X, Lei B, et al. Impact of thyroid nodule sizes on the diagnostic performance of Korean thyroid imaging reporting and data system and contrast-enhanced ultrasound[J]. Clin Hemorheol Microcirc, 2019, 72(3): 317-326
- [10] Zhao H, Liu X, Lei B, et al. Diagnostic performance of thyroid imaging reporting and data system (TI-RADS) alone and in combination with contrast-enhanced ultrasonography for the characterization of thyroid nodules[J]. Clin Hemorheol Microcirc, 2019, 72(1): 95-106
- [11] Deng D, Chen X, Wang H, et al. Typical manifestations of Hürthle cell adenoma of the thyroid on contrast-enhanced CT: A case report [J]. Medicine (Baltimore), 2019, 98(22): e15866
- [12] Fard N, Schlemmer H P, Raue F, et al. CT- and ultrasound-characteristics of hepatic lesions in patients with multiple endocrine neoplasia syndrome. A retrospective image review of 25 cases [J]. Plos One, 2019, 14(2): e0212865
- [13] Fukukura Y, Kumagai Y, Higashi R, et al. Extracellular volume fraction determined by equilibrium contrast-enhanced multidetector computed tomography as a prognostic factor in unresectable pancreatic adenocarcinoma treated with chemotherapy [J]. Eur Radiol, 2019, 29(1): 353-361
- [14] Li J, Zhang Y, Tang J, et al. Malignant peripheral nerve sheath tumor of the pancreas-A case report[J]. Cancer Med, 2019, 55: 239-242
- [15] Lin ZM, Yan CX, Song Y, et al. The features of contrast enhanced ultrasound and BRAF V600E in papillary thyroid carcinoma [J]. J Thorac Dis, 2019, 11(12): 5071-5078
- [16] 刘利平,崔荣荣,杨婧,等.甲状腺癌超声造影及二维超声特征与颈部淋巴结转移的关系探讨 [J]. 中华内分泌外科杂志, 2019, 13(1): 26-30
- [17] Liu Y, Lu Q, Wu XL, et al. Ultrasonographic imaging of calcifying fibrous tumor of cervical esophagus: A case report[J]. Medicine (Baltimore), 2019, 98(28): e16425
- [18] Cho SJ, Suh CH, Baek JH, et al. Diagnostic performance of CT in detection of metastatic cervical lymph nodes in patients with thyroid cancer: a systematic review and meta-analysis [J]. Eur Radiol, 2019, 29(9): 4635-4647
- [19] Connolly MJ, Lazinski D, Aoki KA, et al. Ectopic Parathyroid Adenoma in Piriform Sinus: Case Report and Review of the Literature[J]. PLoS One, 2019, 98(1): 14-17
- [20] Guang Y, He W, Luo Y, et al. Patient satisfaction of radiofrequency

- ablation for symptomatic benign solid thyroid nodules: our experience for 2-year follow up[J]. BMC Cancer, 2019, 19(1): 147
- [21] Lv Z, Bai X, Sheng Q, et al. A case report of a giant mature teratoma of the thyroid gland in a young girl [J]. Medicine (Baltimore), 2019, 98(9): e14703
- [22] Peng Q, Niu C. Mummified Thyroid Nodules: Conventional and Contrast-Enhanced Ultrasound Features [J]. J Ultrasound in Med, 2019, 38(2): 441-452
- [23] Zhao Z, Ye C. Cascade and Fusion of Multitask Convolutional Neural Networks for Detection of Thyroid Nodules in Contrast-Enhanced CT[J]. Medical Image Analysis, 2019, 2019: 7401235
- [24] Zhou J, Chen E, Xu H, et al. Feasibility and Diagnostic Performance of Voxelwise Computed Diffusion-Weighted Imaging in Breast Cancer[J]. J Magn Reson Imaging, 2019, 49(6): 1610-1616
- [25] 王海燕, 朱林林, 周如海, 等. 超声造影定量分析诊断乳头状甲状腺癌患者颈部淋巴结转移的效能分析 [J]. 中华全科医学, 2019, 17(12): 2079-208
- [26] Zhou J, Zhang Y, Chang KT, et al. Diagnosis of Benign and Malignant Breast Lesions on DCE-MRI by Using Radiomics and Deep Learning With Consideration of Peritumor Tissue[J]. Chinese J Medical Imaging Technology, 2020, 51(3): 798-809
- [27] Zhou W, Chen Y, Zhang L, et al. Percutaneous Microwave Ablation of Metastatic Lymph Nodes from Papillary Thyroid Carcinoma: Preliminary Results[J]. World J Surg, 2019, 43(4): 1029-1037
- [28] Peng Q, Niu C, Zhang M, et al. Sonographic Characteristics of Papillary Thyroid Carcinoma with Coexistent Hashimoto's Thyroiditis: Conventional Ultrasound, Acoustic Radiation Force Impulse Imaging and Contrast-Enhanced Ultrasound[J]. Ultrasound Med Biol, 2019, 45(2): 471-480
- [29] 蒙秋凤. 甲状腺癌超声造影参数与病灶内增殖、侵袭、自噬基因表达的相关性[J]. 海南医学院学报, 2018, 24(15): 1459-1462
- [30] Pühr-Westerheide D, Cyran CC, Sargsyan-Bergmann J, et al. The added diagnostic value of complementary gadoteric acid-enhanced MRI to F-DOPA-PET/CT for liver staging in medullary thyroid carcinoma[J]. Cancer Imaging, 2019, 19(1): E73
- [31] Wang H, Liu K, Ren J, et al. Magnetic Resonance Imaging Characteristics of Papillary Thyroid Carcinoma for the Prediction of Cervical Central Compartment Lymph Node Metastasis [J]. J Comput Assist Tomogr, 2019, 43(6): 963-969
- [32] Wang L, Xu D, Yang Y, et al. Safety and efficacy of ultrasound-guided percutaneous thermal ablation in treating low-risk papillary thyroid microcarcinoma: A pilot and feasibility study [J]. J Cancer Res Ther, 2019, 15(7): 1522-1529
- [33] Xu Y, Qi X, Zhao X, et al. Clinical diagnostic value of contrast-enhanced ultrasound and TI-RADS classification for benign and malignant thyroid tumors: One comparative cohort study[J]. Medicine (Baltimore), 2019, 98(4): e14051
- [34] Zhang Q, Zhang M, Chen S, et al. Predicting cervical lymph node metastasis in patients with papillary thyroid cancer (PTC) - Why contrast-enhanced ultrasound (CEUS) was performed before thyroidectomy [J]. J Ultrasound Med, 2019, 72(1): 61-73
- [35] 于凤辉. 探究超声造影和超声弹性成像对甲状腺良恶性结节的鉴别诊断价值[J]. 影像研究与医学应用, 2019, 3(7): 72-73

(上接第 1991 页)

- [23] Chen SP, Yang Q, Wang CJ, et al. Transducin β -like 1 X-linked receptor 1 suppresses cisplatin sensitivity in nasopharyngeal carcinoma via activation of NF- κ B pathway[J]. Mol Cancer, 2014, 13(1): 195
- [24] KUNITZ M. Crystalline inorganic pyrophosphatase isolated from baker's yeast[J]. J Gen Physiol, 1952, 35(3): 423-450
- [25] 张宁, 司怀军, 柳娜, 等. 马铃薯无机焦磷酸酶基因 cDNA 在大肠杆菌中的表达及蛋白质特征分析 [J]. 分子植物育种, 2008, 6(6): 1107-1110
- [26] Mishra DR, Chaudhary S, Krishna BM, et al. Identification of Critical Elements for Regulation of Inorganic Pyrophosphatase (PPA1) in MCF7 Breast Cancer Cells[J]. PLoS One, 2015, 10(4): e0124864
- [27] Ma M, Yu N. Over-Expression of TBL1XR1 Indicates Poor Prognosis of Serous Epithelial Ovarian Cancer[J]. Tohoku J Exp Med, 2017, 241(3): 239-247
- [28] Liu L, Lin C, Liang W, et al. TBL1XR1 promotes lymphangiogenesis and lymphatic metastasis in esophageal squamous cell carcinoma[J]. Gut, 2015, 64(1): 26-36
- [29] Wang P, Zhou Y, Mei Q, et al. PPA1 regulates tumor malignant potential and clinical outcome of colon adenocarcinoma through JNK pathways[J]. Oncotarget, 2017, 8(35): 58611-58624
- [30] Rosenbluh J, Wang X, Hahn WC. Genomic insights into WNT/ β -catenin signaling [J]. Trends Pharmacol Sci, 2014, 35(2): 103-109