

Utility of ultrasound shear wave elastography for diagnosis of malignant thyroid nodules: efficacy of standard deviation elasticity values

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INTRODUCTION

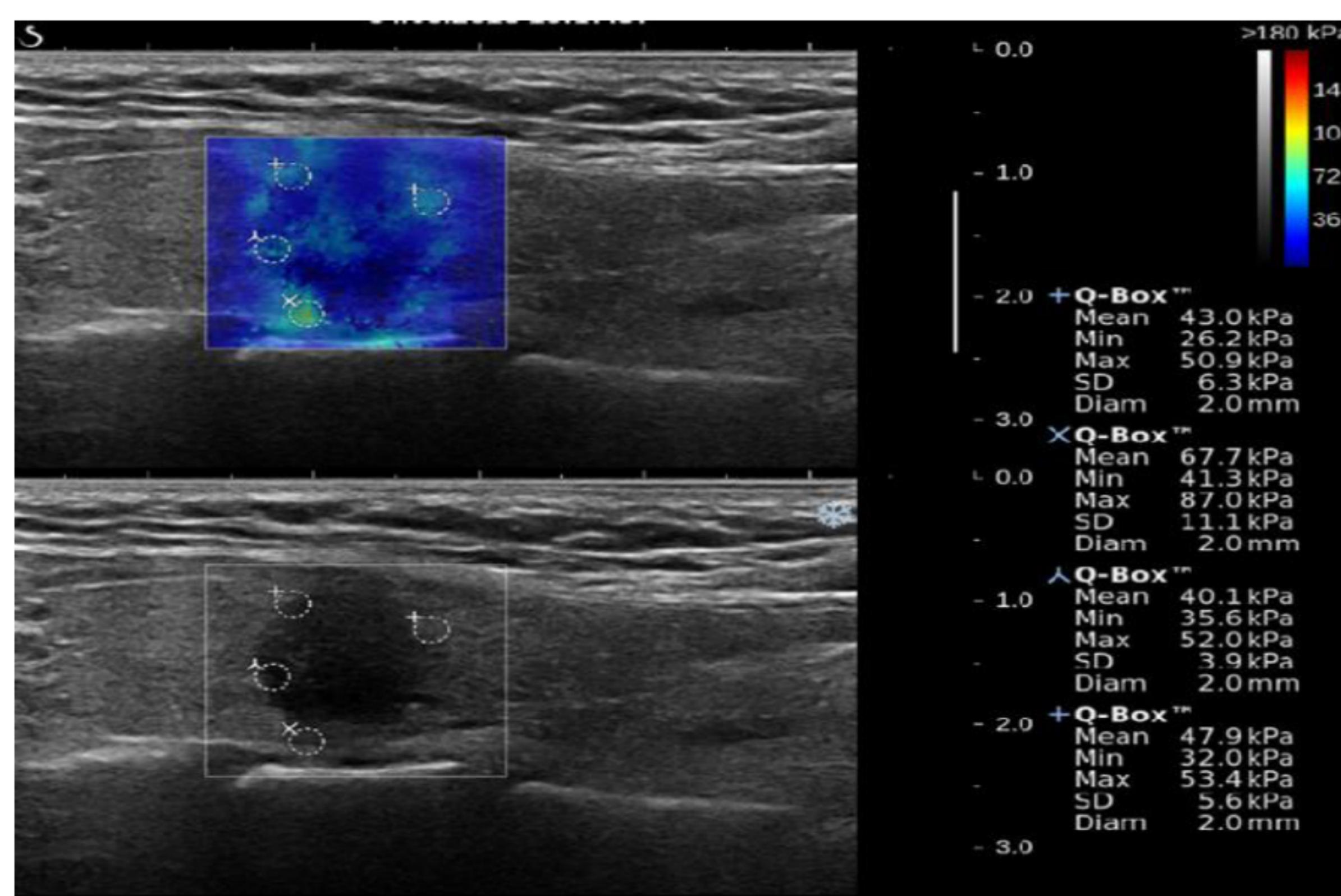
Shear wave elastography (SWE) is an emerging technique that can be used to evaluate malignancy in many organs. Recently, some studies have focused on providing the efficacy and diagnostic accuracy of SWE in the differential diagnosis of benign and malignant thyroid nodules, but the results showed different SWE parameters with different cut-off values. The aim of this study was to address the role of elasticity indices as a possible predictive marker for detecting papillary thyroid carcinoma (PTC) and quantitative assessment of SWE for differential diagnosis of benign and malignant thyroid nodules.

METHODS

Retrospective analysis of patients with thyroid nodules undergoing SWE before ultrasound (US)-fine needle aspiration (FNA) were analyzed. The SWE elasticity indices of mean (E_{Mean}), minimum (E_{Min}), maximum (E_{Max}) and its standard deviation (E_{SD}) of nodules were measured.

RESULTS

Shear wave elastography (upper image) and gray-scale ultrasound (lower image) of a papillary thyroid carcinoma.

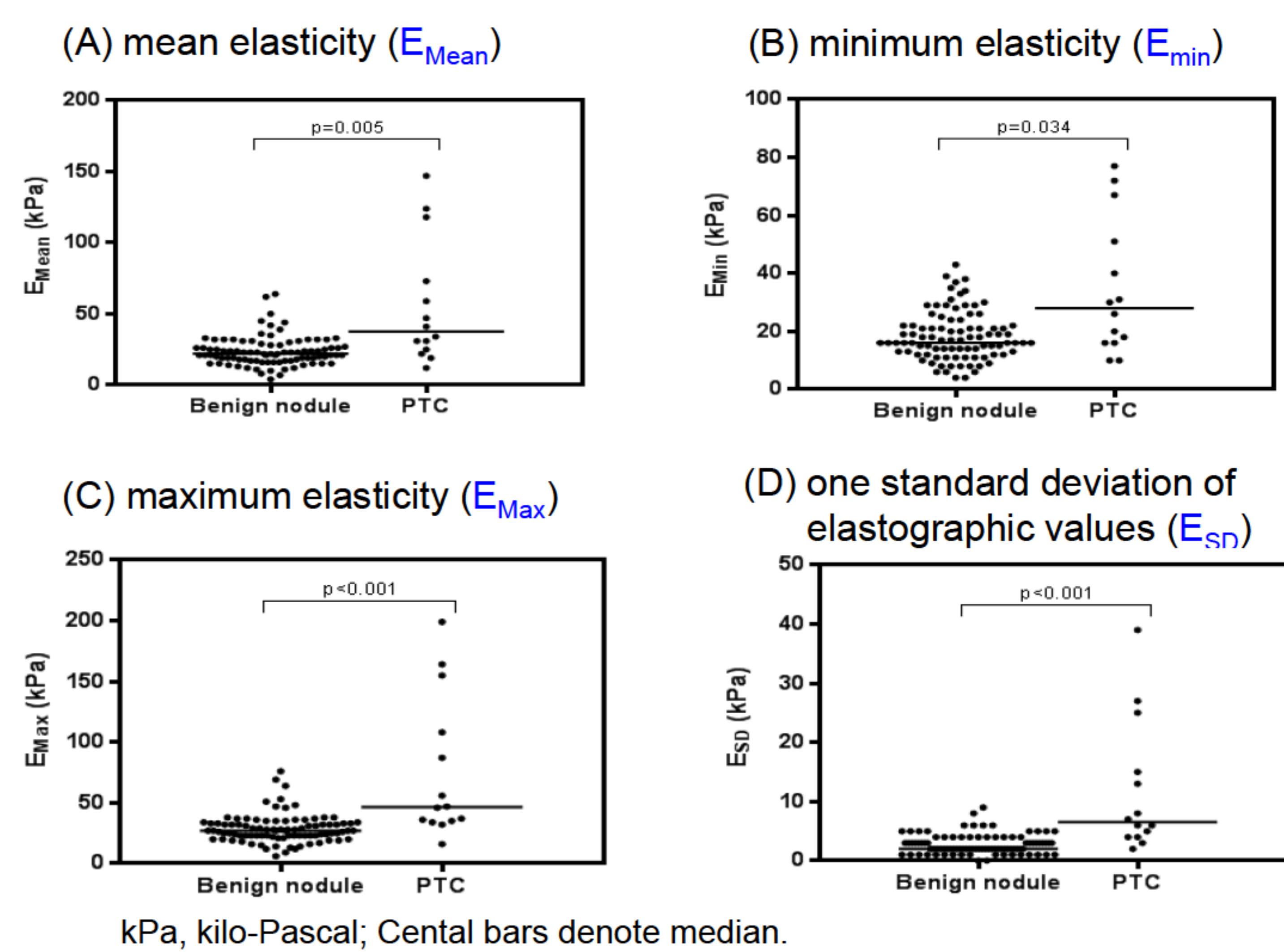


Comparison of baseline characteristics between benign nodule and papillary thyroid carcinoma (N=105)

Characteristic	Benign nodule (n=91)	PTC (n=14)	p value
Female	68 (75%)	10 (71%)	0.752
Age (years)	55 (44, 65)	51 (49, 55)	0.177
Hypoechoogenicity	34 (37%)	12 (86%)	0.001
Non-parallel orientation	5 (5%)	6 (43%)	0.001
Irregular margin	15 (17%)	10 (71%)	<0.001
Microcalcification	4 (4%)	4 (29%)	0.038
Elasticity indices (kPa)			
E_{Mean}	23.7 (16.9, 31.5)	37.4 (24.1, 84.7)	0.005
E_{Min}	17.8 (13.4, 26.4)	27.9 (15.9, 55.1)	0.034
E_{Max}	31.5 (23.0, 36.3)	46.7 (35.0, 119.7)	<0.001
E_{SD}	2.6 (1.8, 4.1)	6.3 (4.1, 17.3)	<0.001
TSH at baseline (mU/L)	1.4 (0.8, 2.4)	1.8 (1.7, 2.8)	0.241

PTC, papillary thyroid carcinoma; kPa, kilo-Pascal; E_{Mean} , mean elasticity; E_{Min} , minimum elasticity; E_{Max} , maximum elasticity; E_{SD} , one standard deviation of elastographic values.

Scatter dot plots of shear wave elastography measurements for benign nodules (n=91) and papillary thyroid carcinomas (n=14).



ROC results and diagnostic performance of elasticity indices for predicting papillary thyroid carcinoma.

Elasticity indices	Cut-off (kPa)	AUC (95% CI)	Sensitivity (%)	Specificity (%)	Accuracy (%)	PLR (%)	NLR (%)	Diagnostic odds ratio (95% CI)
E_{Mean}	33.3	0.743 (0.582-0.904)	57.1	86.4	80.8	4.21	0.50	8.50 (2.33-31.02)
E_{Min}	29.7	0.683 (0.508-0.858)	50.0	86.4	79.5	3.69	0.57	6.74 (1.76-23.06)
E_{Max}	45.9	0.803 (0.664-0.942)	57.1	88.1	82.2	4.82	0.49	9.91 (2.65-37.09)
E_{SD}	6.5	0.849 (0.723-0.975)	50.0	96.6	87.7	14.75	0.52	28.50 (4.92-165.09)

kPa, kilo-Pascal; AUC, area under the ROC curves; CI, confidence intervals; PLR, positive likelihood ratio; NLR, negative likelihood ratio; E_{Mean} , mean elasticity index; E_{Min} , minimum elasticity index; E_{Max} , maximum elasticity index; E_{SD} , standard deviation of elastographic values.

Discrimination of papillary thyroid carcinoma from benign nodules using different cut-offs.

Elasticity indices	Cut-off (kPa)	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	PLR	NLR
E_{SD}	1.4	100.0 (78.5-100.0)	18.6 (10.7-30.4)	1.23	0.00
	2.7	92.8 (68.5-98.7)	52.5 (40.4-63.9)	1.96	0.14
	5.0	71.4 (45.4-88.3)	88.1 (75.0-94.8)	6.02	0.32
	6.5 ^a	50.0 (26.8-73.2)	96.6 (88.5-99.1)	14.75	0.52
	10.8	35.7 (16.3-61.2)	100.0 (93.9-100.0)	-	0.64

^aThreshold with highest accuracy.

CONCLUSION

The shear elasticity index of E_{SD} with higher likelihood ratios of PTC will probably identify nodules with an increased risk for malignancy. It may help identify and select malignant nodules and also reduce unnecessary FNA of benign nodules.

REFERENCES

- Sebag F et al. 2010 J Clin Endocrinol Metab 95:5281-5288.
- Veyrieres JB et al. 2012 Eur J Radiol 81:3965-3972.
- Bhatia KS et al. 2012 Eur Radiol 22:2397-2406.

