Predictive value of SPECT/CT after radioiodine therapy in differentiated thyroid cancer

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Introduction

- The worldwide incidence of thyroid cancer has continuously increased.

- Patients with differentiated thyroid cancer (DTC) usually have a favourable prognosis with high cure rates; however, lifelong follow-up is required as potentially curable local recurrences and distant metastases may occur even decades later.

- Risk stratification systems help to categorize patients into different risk groups based on cancer related factors, clinical features, results of first WBS after radioiodine therapy and serum thyroglobulin (Tg) level.

- planar whole-body scan (WBS) ⇔ single photon emission computed tomography/computed tomography (SPECT/CT)

Objectives

- Aim of this study was to evaluate the separate role of SPECT/CT after radioiodine treatment of patients with DTC

  ✓ in early risk classification
  ✓ in prediction of late prognosis
  ✓ in comparison to
    – ATA risk classification
    – ETA risk classification
    – predictive value of postoperative stimulated thyroglobuline level

Methods

- **Characteristics of the patients**

Age (years)		T stage	% (n)
Median (range)	47 (15-86)	T1	35,2 (64)
Gender	% (n)	T2	25,1 (45)
Female	75 (136)	T3	30,2 (55)
Male	25 (45)	T4	9,5 (17)
Tumor histology		N stage	
Papillary (PTC)	77,3 (140)	N0	66,9 (121)
Classical	73,5 (103)	N1	33,1 (60)
Follicular	23,5 (33)	M stage	% (n)
Sclerosing	2,1 (3)	M0	95 (172)
Tall cell	0,7 (1)	M1	5 (9)
Follicular (FTC)	22,7 (41)	pTNM staging	
Classical	80,5 (33)	I	60,8 (110)
Hürthle cell	17,1 (7)	II	7,7 (14)
Trabecular	2,4 (1)	III	11,6 (21)
TgAb		IV	19,9 (36)
Negative	68,5 (124)		
Positive	31,5 (57)		

- **Radioiodine ablation**
  - 131I dose was 1100 MBq - 3700 MBq depending on the stage of disease
  - thyroid hormone withdrawal or recombinant human thyrotropin (rhTSH)

- **Laboratory measurements**
  - TSH (Elecsys® TSH assay, Roche, measuring range: 0.005-100 μIU/mL)
  - Tg (Elecsys® TG II assay, Roche, measuring range of 0.04 - 500 ng/mL)
  - TgAb (Elecsys® anti-TG assay, Roche, measuring range of 10.0-4000IU/ml).

- **SPECT/CT**
  - SPECT: dual head, 50 sec/frame, 64 frames
  - CT: low dose, 16 slices spiral CT, 120 KeV, 50 mAs
  - from the neck and chest 4-6 days after oral administration of 1100-3700 MBq radioiodine
  - additional SPECT/CT scans of the abdomen and pelvis were acquired if suspicious isotope accumulations were detected on the whole body scan
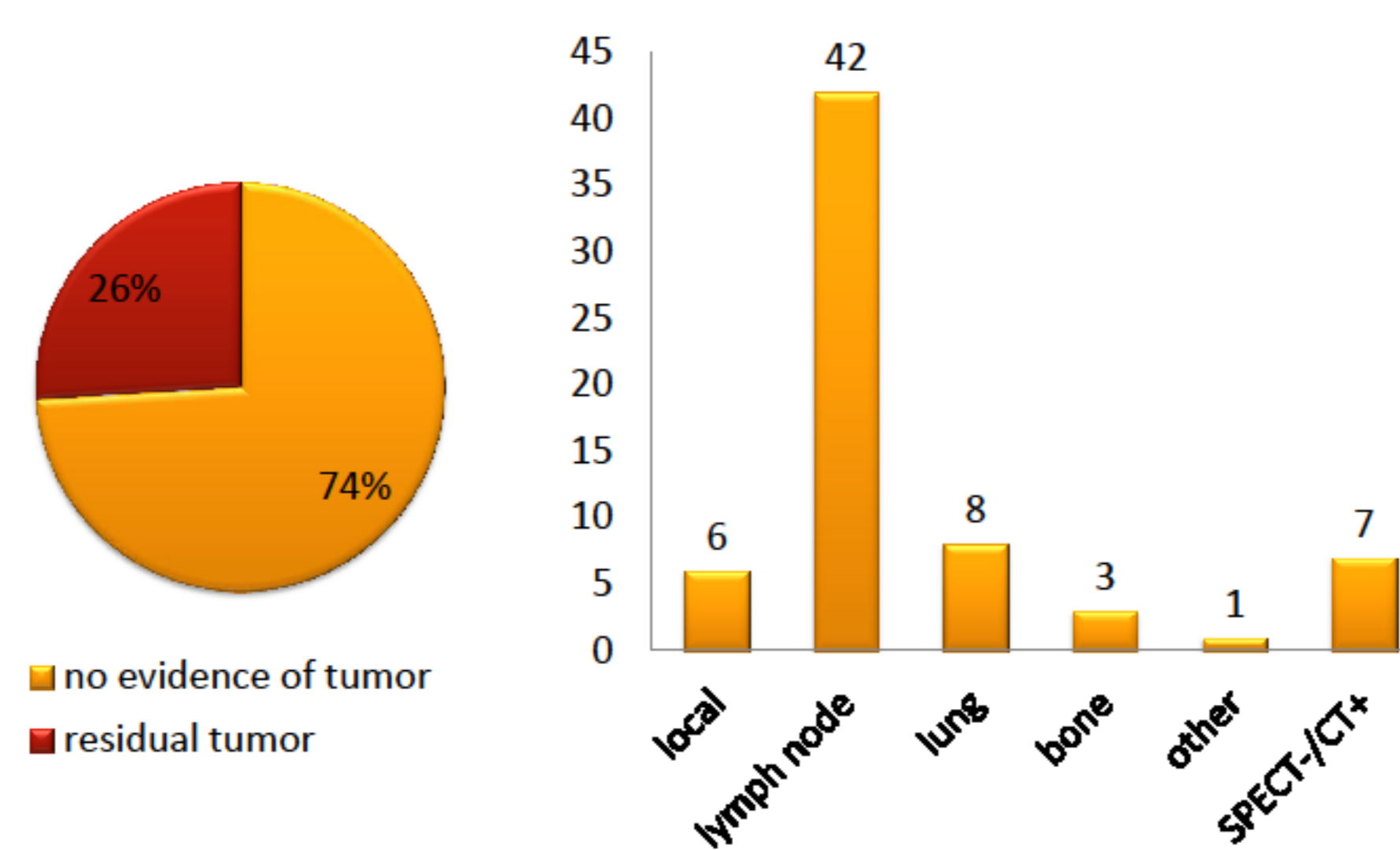
- **Risk classification systems**
  - American Thyroid Association (ATA) 2009
  - European Thyroid Association (ETA) 2006

- **Data analysis**
  - Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, USA), version 22.0.

Results

- **SPECT/CT after the first 131I treatment**

- **Change in risk classification and clinical stage based on SPECT/CT**

Patients with detectable residual disease were upgraded based on SPECT/CT results: patients with lymph node metastases had intermediate risk for recurrence; incomplete tumor resection or distant metastases classified the cases to high risk category. Patients without RAI uptake outside the thyroid bed previously categorized having intermediate or high risk were downgraded to low risk category except aggressive histology.

ATA risk classification

		Before SPECT/CT			
		low	intermediate	high	TOTAL
After SPECT/CT	low	61	37	3	101
	intermediate	6	52	6	64
	high	0	4	12	16
	TOTAL	67	93	21	181

Change: 57 (31%)
Cohen's kappa:0.486, p<0.001

Changes in clinical staging were not so profound, since the stage of young patients was not changed even if they had lymph node metastases.

Clinical stage

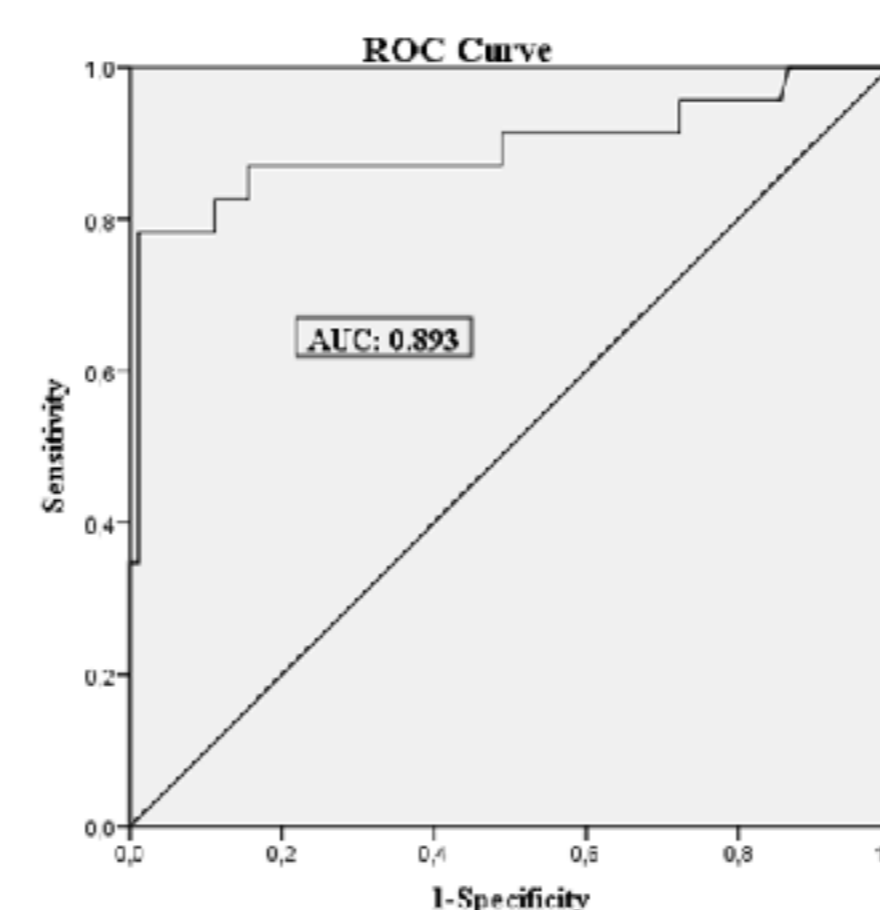|		Before SPECT/CT				
		I	II	III	IV	TOTAL
After SPECT/CT	I	104	0	0	0	104
	II	1	14	0	0	15
	III	1	0	19	0	20
	IV	4	0	2	36	42
	TOTAL	110	14	21	36	181

Change in stage IV: 6 (17%)
Cohen's kappa: 0.925, p<0.001

- **Follow-up (N=173, median 55 months)**
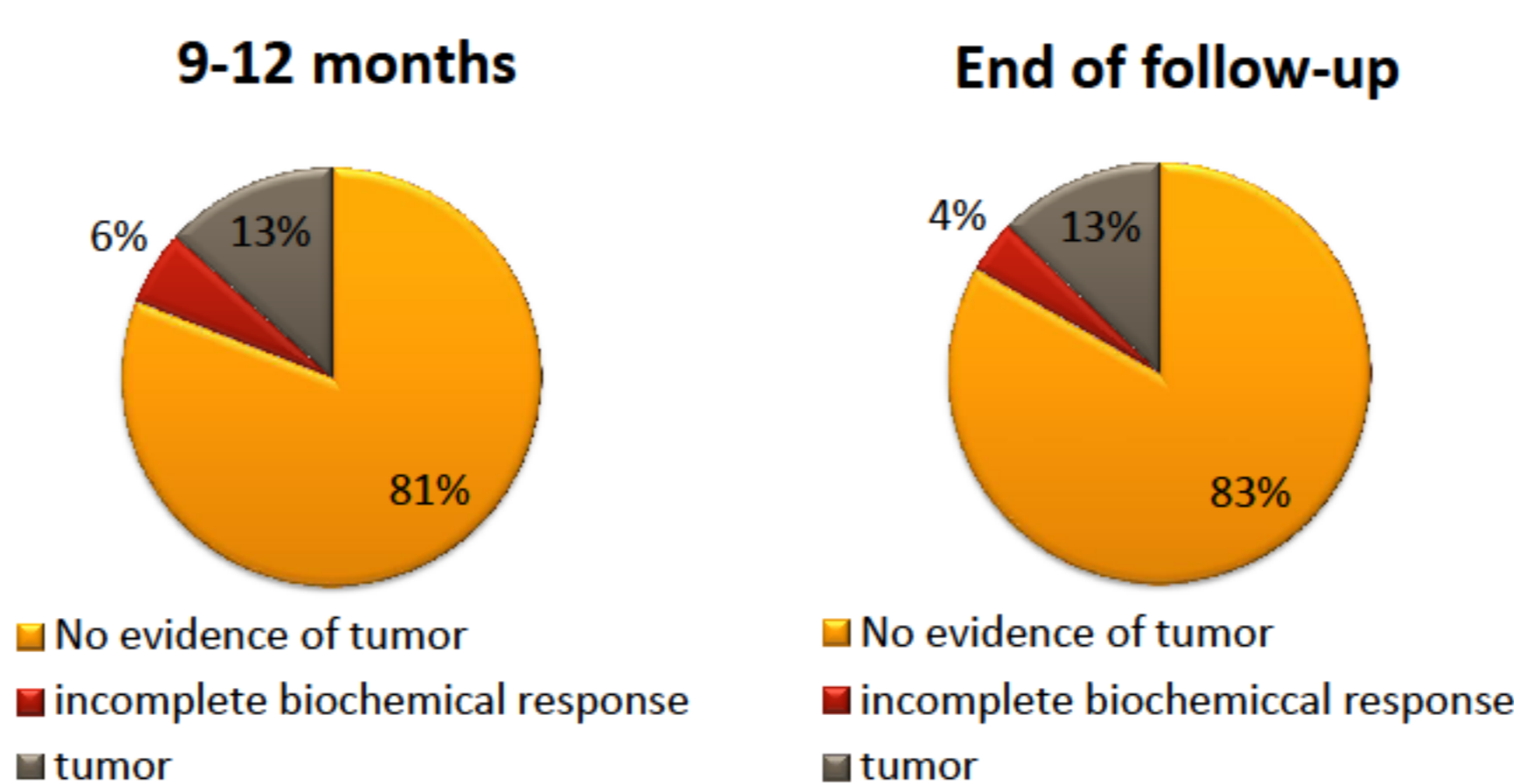
- **Diagnostic value of risk stratification systems, Tg and SPECT/CT**

The diagnostic value of stimulated Tg at the time of RAI treatment to predict residual tumor at the end of follow-up.

Results

Sensitivity, specificity, positive (PPV) and negative predictive values (NPV) and diagnostic accuracy of risk classification systems, stimulated Tg before the radioiodine treatment at 2 ng/mL cut-off level and SPECT/CT based on follow-up data at 9-12 months.
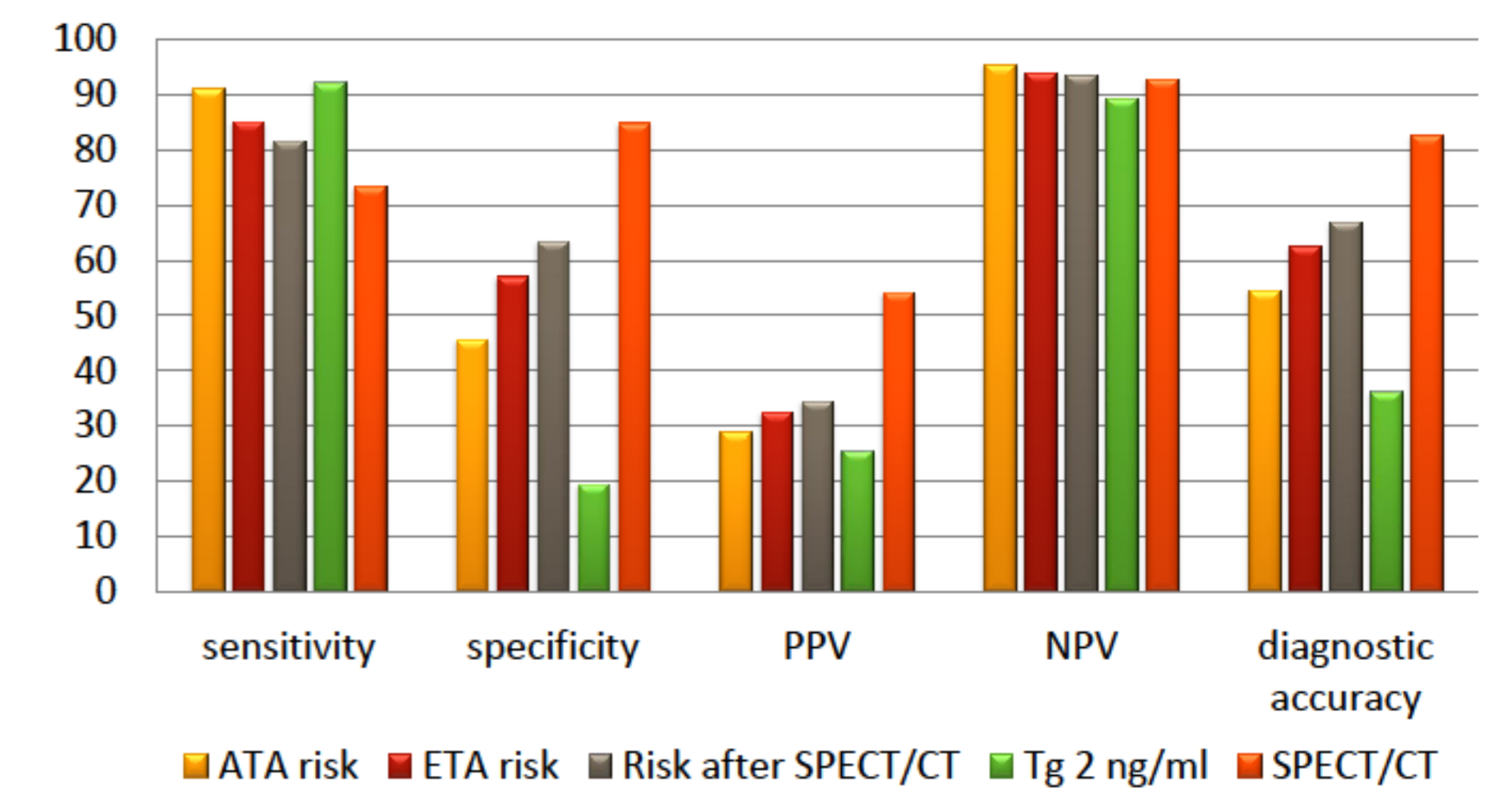

Tg at 2 ng/mL cut-off level had the lowest specificity and diagnostic accuracy (19.5% and 36.3%). The next was the ATA classification with a specificity of 45.7%, significantly lower than the specificity of ETA risk classification or the ATA classification modified based on the SPECT/CT results (p <0.001). The results of SPECT/CT without any other data had the highest specificity (85.0%) and diagnostic accuracy (82.8%, p <0.001).

The usefulness of risk classification systems and SPECT/CT to predict the presence of thyroid cancer at the end of follow-up.
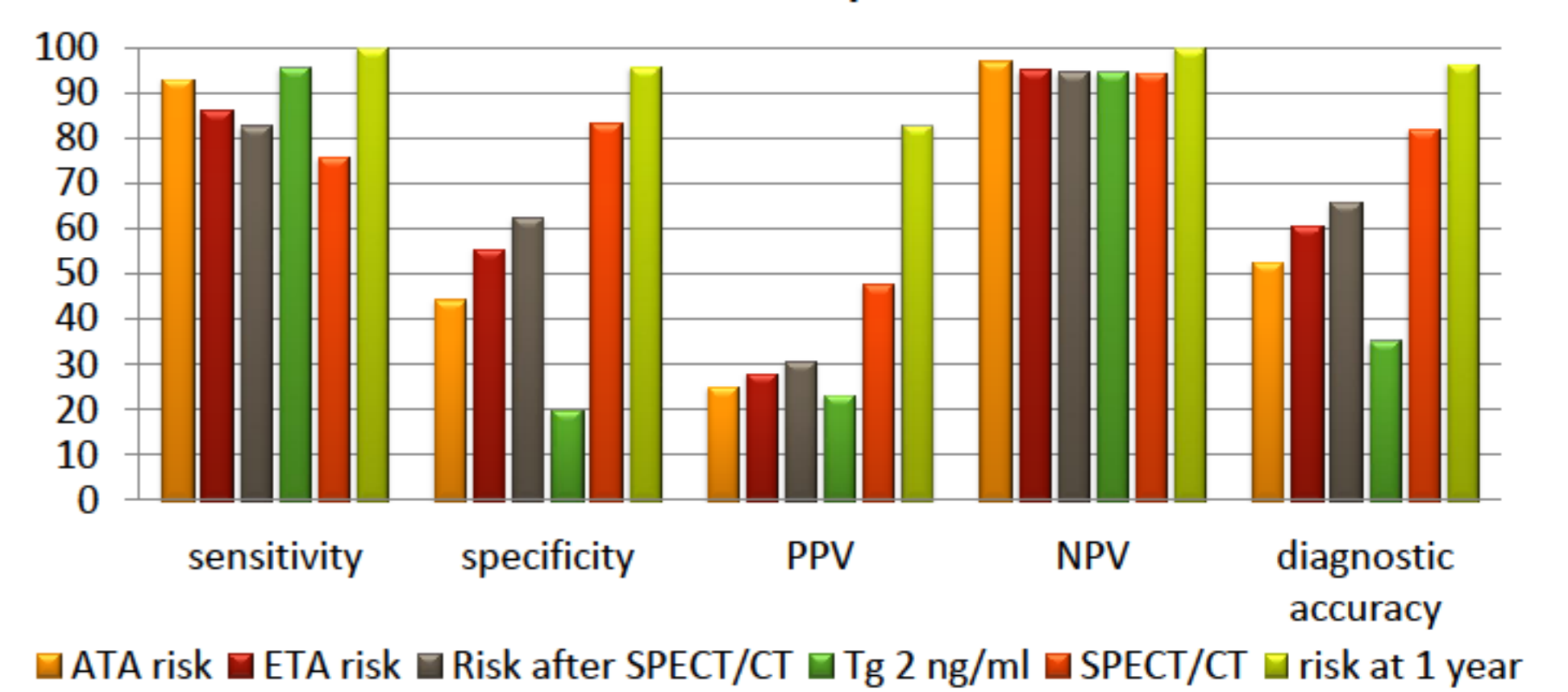
Reclassification of patients at one-year resulted in excellent diagnostic accuracy (96.5%). The specificity and the diagnostic accuracy of SPECT/CT were also high, being significantly better than the values of risk stratification systems (83.3%, 82.1%; p<0.001) and did not differ significantly from the results of one-year reclassification.

Conclusions

- SPECT/CT after radioiodine treatment is useful in the early classification of patients
- It influences the therapeutic strategy
- ATA and ETA risk classification systems are sensitive and have high negative predictive values but not specific
- Stimulated postoperative thyroglobulin <2 ng/ml is sensitive but the specificity is very low - its use is restricted by the high percentage of anti-Tg positivity
- SPECT/CT results after the first radioiodine treatment have higher specificity and diagnostic accuracy than ATA and ETA classification
- Reevaluation of patients for risk of relapse is required at one-year follow-up

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