Original Article

Evaluation of clinical risk factors for predicting insidious right central and posterior right recurrent laryngeal nerve lymph node metastasis in papillary thyroid microcarcinoma patients (cN0): experience of a single center

Fuqiang Li, Yijun Wu, Liang Chen, Liang Hu, Xiaosun Liu

Thyroid Disease Diagnosis and Treatment Center, the First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou 310003, China

Contributions: (I) Conception and design: F Li, Y Wu; (II) Administrative support: Y Wu; (III) Provision of study materials or patients: F Li, Y Wu, L Chen; (IV) Collection and assembly of data: Y Wu, L Chen, L Hu, X Liu; (V) Data analysis and interpretation: F Li, Y Wu, L Chen; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Fuqiang Li. Thyroid Disease Diagnosis and Treatment Center, the First Affiliated Hospital, School of Medicine, Zhejiang University, 79 Qingchun Road, Hangzhou 310003, China. Email: cd20070410@zju.edu.cn.

Background: Papillary thyroid microcarcinoma (PTMC), one specific subtype of papillary thyroid carcinoma (PTC) which measures less than 10 mm in maximum dimension, presents with a high risk of insidious lymph node metastasis escaping from preoperative examinations (cN0). Given the complications of lymph node dissection (LND) and metastasis risk, proper stratification of PTMC for performing prophylactic LND bears great importance.

Methods: From June 2015 to December 2017, 338 PTMC patients undergoing thyroidectomy were included in the present study. Potential risk factors, including age, gender, maximal tumor size, etc. were collected and analyzed for association with thyroid lymph node metastasis.

Results: Among the 338 patients, 87 patients (25.7%) presented with right central lymph node metastasis (CLNM) and 28 patients (8.3%) had posterior right recurrent laryngeal nerve lymph node metastasis (PRRLN-LNM). The maximal tumor was prone to occur at the middle part of the lower pole (35.3%) in patients with right CLNM, while the proportion of tumors located in the middle part of the upper pole (17.2%) was highest in PRRLN-LNM patients. Ages younger than 45 years old, male gender, and a tumor size of more than 0.5 cm were correlated independently with right CLNM and PRRLN-LNM. Presence of capsular invasion also had a significant association with the occurrence of PRRLN-LNM.

Conclusions: Ages younger than 45, male gender, and a maximal tumor size larger than 0.5 cm, in addition to capsular invasion, were independent risk factors for stratification of PTMC patients. PTMC patients with these clinical characteristics were suggested to receive prophylactic LND in their initial thyroid surgeries.

Keywords: Papillary thyroid microcarcinoma (PTMC); right central lymph node metastasis (right CLNM); posterior right recurrent laryngeal nerve lymph node metastasis (PRRLN-LNM); lymph node dissection (LND); cN0

Submitted Aug 16, 2018. Accepted for publication Nov 06, 2018.
doi: 10.21037/atm.2018.12.43
View this article at: http://dx.doi.org/10.21037/atm.2018.12.43

Introduction

As the most common malignant endocrine neoplasm, thyroid cancer manifests with an ever-increasing incidence of more than 14.3 per 100,000 individuals (1). Papillary thyroid carcinoma (PTC) accounts for almost 85% of all thyroid malignancies. Among them, one specific subtype of PTC that measures less than 10 mm in maximum dimension is defined as papillary thyroid microcarcinoma (PTMC). With universal uses of ultrasonography (US) and fine-needle aspiration biopsy, it was reported that the incidence of PTMC has increased to 441% within just two decades (2,3). Although PTMC was commonly recognized as an indolent tumor due to the fact that most patients diagnosed with it had favorable prognosis, pathological examination revealed that 40–60% of PTMC patients eventually demonstrated central lymph node metastasis (CLNM) or posterior right recurrent laryngeal nerve lymph node metastasis (PRRLN-LNM) (4,5), which are risk factors associated with tumor recurrence, metastasis, and elevated mortality (6). Moreover, some authors argued that sometimes preoperative examinations, such as neck US and contrast-enhanced computed tomography (CT), could be invalid for determining the status of CLNM or PRRLN-LNM in some PTMC patients (7). Therefore, as a result of the inaccurate preoperative assessment of neck lymph nodes, PTMC patients who were diagnosed with negative clinical lymph node metastasis (cN0) tended to undergo inadequate lymph node dissections (LND) in their first tailored surgeries (8).

Given the complications of LND and metastasis risk of this subtype of PTMC, the clinical significance of prophylactic LND for cN0 PTMC patients has remained controversial. According to the updated 2015 American thyroid association management guidelines for differentiated thyroid cancer, it was suggested that prophylactic LND was ineffective in significantly improving the long-term survival of cN0 PTMC patients (9). Moreover, it might even increase the risk of hypoparathyroidism or iatrogenic injury to the recurrent laryngeal nerve, especially when performed by more inexperienced surgeons (10). However, a more than 40% CLNM and PRRLN-LNM incidence cannot be overlooked for PTMC patients, either. For cN0 PTMC patients with high-risk characteristics, most of them can benefit from getting prophylactic LND in their initial surgeries because it can prevent the unnecessary reoperations needed to treat potential tumor recurrence in the future. For example, as one of the common PTMC lymphatic metastasis-related sites, lymph nodes posterior to the right recurrent laryngeal nerve (LN-PRRLN), located close to the esophagus, are deeply covered within the massive adipose tissue (11). As a result, it is sometimes relatively easy to evaluate PRRLN-LNM as a false negative in preoperative assessment. Moreover, due to tissue adhesion, surgical scarring and multiple metastatic lesions, reoperations of thyroid tumors tend to entail more difficulty in thoroughly removing lesions and controlling complications (12). Furthermore, the pathological examination results of LND can greatly enhance the accuracy of the TNM staging diagnosis, and thus aid in making postoperative individualized treatment schemes, including radioiodine (^{131}I) therapy and thyroid stimulating hormone (TSH) suppressive therapy, for each PTMC patient (9,13).

In fact, for the majority of cN0 PTMC patients, whether prophylactic LND should be performed is a decision mainly based on the corresponding individual's clinical features, including basic information and auxiliary examination data. Therefore, we aimed to evaluate the potential association between clinical features of cN0 PTMC patients and thyroid lymph node metastasis, and then specifically identify the risk factors for predicting right CLNM and PRRLN-LNM before operations.

Methods

Patients and data

In this retrospective research, we included qualified patients who accorded with the following criteria: patients were diagnosed with PTMC by final pathological examination results, individual clinical information was available and complete, and dissection of the right central and right posterior laryngeal nerve lymph nodes was performed. Meanwhile, we excluded the PTMC patients who presented with thyroid isthmus lesions or who had any previous history of thyroid-related operations.

From June 2015 to December 2017, 338 PTMC patients undergoing thyroidectomy at the First Affiliated Hospital, of the School of Medicine, at Zhejiang University were included in the present study. All perioperative data of patients were obtained by use of the hospital's clinical database system. For each inpatient, information regarding age, gender, tumor size, nodal involvement, multifocality, capsular and perithyroidal invasion were collected. After thyroidectomy and LND, the resected tissues were sent

for histological examination, and identically experienced pathology doctors reviewed the final reports.

Surgical procedures

Different PTMC patients underwent corresponding surgical procedures performed by experienced surgeons: ipsilateral lobectomy with isthmusectomy and ipsilateral central LND were performed for tumor lesions located in a single lobe; total thyroidectomy with bilateral central LND was performed for patients with any of the following conditions: (I) tumor invading the thyroid capsule, (II) contralateral central lymph nodes obviously enlarged in operations and (III) intraoperative frozen pathological examinations indicating pre-tracheal or pre-laryngeal lymph node metastasis. Additionally, all patients underwent dissection of the right central and right posterior laryngeal nerve lymph nodes.

Indications for surgery

The indications for surgery were the following: (I) family history of thyroid cancer or previous head and neck external beam radiation; (II) multinodular thyroid; (III) a strong patient demand for surgery due to an unbearable psychological burden; (IV) extrathyroid extension; (V) PTMC adjacent to recurrent laryngeal nerve or to trachea; (VI) metastatic lymph node on neck ultrasound. Otherwise, the surveillance was recommended.

Tumor locations and groups

In this study, with reference to the lesion status in the US examination, tumor locations were divided into the upper pole, middle third, and lower pole. In addition, each of these three locations was further subdivided into a ventral part, middle part, and dorsal part. If patients were detected with multiple lesions, the classification was mainly based on the largest dominant lesion. When the dominant lesion was located at the juncture of two adjacent parts, the tumor location was noted as the part which contained more volume of the lesion. Also, patients diagnosed with right central and right posterior laryngeal nerve lymph node metastasis were divided into corresponding groups.

Clinical feature assessment

In this study, we analyzed the associations between thyroid lymph node metastasis and the following potential risk factors: age (<45, 45–59 and ≥60 years old), gender (male and female), maximal tumor size (<0.5 and ≥0.5 cm), gland lobes of tumor (unilateral and bilateral), primary lesion number (solitary lesion and multifocal lesions), tumor invasion (capsular invasion and external gland invasion), and tumor locations by US examination.

Ethical statement

Written informed consent was obtained from all participants. Ethical approval was obtained from the Ethics Committee of the First Affiliated Hospital, of the School of Medicine, at Zhejiang University (reference number: 2018-722), and in accordance with the ethical guidelines of the 1975 Declaration of Helsinki. All data were analyzed anonymously and identified before analysis.

Statistical analysis

Generally, the continuous variables were expressed as median with standard deviation or number (percentage). We used statistical software package SPSS19.0 (SPSS Inc., Chicago, IL, USA) to accomplish all statistical analysis. $P<0.05$ was recognized to be statistically significant. Chi-square test and Fisher's exact test were performed to analyze qualitative variables. Based on existing analysis results, potential risk factors of thyroid LNM, which were found to be significantly different between groups, were assessed using logistic regression analysis.

Results

Demographic and clinical characteristics of patients

Among the 338 included PTMC patients in this study, there were 263 females (77.8%) and 75 males (22.2%) with a mean age of 44.2±11.0 years (range, 19–74 years). The mean size of maximal tumor lesion in PTMC patients was 0.54±0.19 cm (range, 0.1–0.9 cm). Eighty-seven patients (25.7%) presented with right CLNM and 28 patients (8.3%) had PRRLN-LNM. Additionally, 13 patients (3.8%) had multiple unilateral lesions while 36 patients (10.7%) had bilateral multiple lesions. Capsular invasion of PTMC was found in 55 patients (16.3%) while 53 patients (15.7%) presented with perithyroidal invasion induced by PTMC. The clinical characteristics of patients are summarized in *Table 1*.

Table 1 Demographic and clinical characteristics of included patients

Characteristics	Patients diagnosed with PTMC (n=338)
Age (years), mean ± SD [range]	44.2±11.0 [19–74]
<45	171 (50.6)
46–59	134 (39.6)
≥60	33 (9.8)
Gender, n (%)	
Female	263 (77.8)
Male	75 (22.2)
Maximal tumor size (cm), mean ± SD [range]	0.54±0.19 [0.1–0.9]
Nodal involvement	
Right CLNM	87 (25.7)
PRRLN-LNM	28 (8.3)
Multifocality, n (%)	
Unilateral multiple lesions	13 (3.8)
Bilateral multiple lesions	36 (10.7)
Capsular invasion	55 (16.3)
Perithyroidal invasion	53 (15.7)

PTMC, papillary thyroid microcarcinoma; CLNM, central lymph node metastasis; PRRLN-LNM, posterior right recurrent laryngeal nerve lymph node metastasis.

Tumor location and lymph node metastasis

To evaluate the potential correlations between tumor location and lymph node metastasis, we subdivided the thyroid into three coronal locations and three cross-sectional locations based on the anatomic thyroid structure. Subsequently, all 388 patients were divided into nine groups. In 87 patients (25.7%) presenting with right CLNM, the maximal tumor was prone to occur at the middle part of the lower pole (35.3%), followed by the middle part of the upper pole (31.0%), the dorsal part of the middle third (30.8%) and the ventral part of the lower pole (30.6%). As for PRRLN-LNM, the rate for a tumor in the middle part of the upper pole (17.2%) was the highest one. However, the difference between these nine locations had no statistical significance in either the right CLNM (P=0.509) group or the PRRLN-LNM (P=0.387) group (*Table 2*).

Table 2 Correlations between tumor location and lymph node metastasis for included PTMC patients

Tumor locations	Patients with right CLNM, n (%)	Patients with PRRLN-LNM, n (%)
Total number	87/338 (25.7)	28/338 (8.3)
Upper pole		
Ventral part	5/32 (15.6)	3/32 (9.4)
Middle part	9/29 (31.0)	5/29 (17.2)
Dorsal part	4/18 (22.2)	3/18 (16.7)
Middle third		
Ventral part	20/73 (27.4)	4/73 (5.5)
Middle part	12/67 (17.9)	5/67 (7.5)
Dorsal part	12/39 (30.8)	3/39 (7.7)
Lower pole		
Ventral part	11/36 (30.6)	1/36 (2.8)
Middle part	12/34 (35.3)	4/34 (11.8)
Dorsal part	2/10 (20.0)	0/10 (0.0)
P	0.509	0.387

PTMC, papillary thyroid microcarcinoma; CLNM, central lymph node metastasis; PRRLN-LNM, posterior right recurrent laryngeal nerve lymph node metastasis.

Risk factors for right CLNM and PRRLN-LNM

Apart from tumor location, we assessed other potential risk factors correlating with right CLNM and PRRLN-LNM in univariate analysis, which included basic individual information and characteristics of tumor lesions. With the help of the test results, we found that right CLNM was significantly associated with age, gender, maximal tumor size, and external gland invasion. In addition, age, gender, tumor size and capsular invasion were potentially linked to the incidence of PRRLN-LNM (*Table 3*). In the following multivariate analysis, ages younger than 45-year-old, male gender and a tumor size of more than 0.5 cm were correlated independently with right CLNM and PRRLN-LNM. Meanwhile, the presence of capsular invasion was also significantly related to the occurrence of PRRLN-LNM (*Table 4*).

Conclusions

Along with the popularization and advancement of the US and fine-needle aspiration biopsy, the incidence of PTC

Table 3 Univariate analyses of right CLNM† and PRRLN-LNM with potential risk factors

Characteristic	Patients with right CLNM		Patients with PRRLN-LNM	
	n (%)	P	n (%)	P
Age (years)		0.053		0.025*
<45	50/171 (29.2)		21/171 (12.3)	
46–59	34/134 (25.4)		6/134 (4.5)	
≥60	3/33 (9.1)	0.004	1/33 (3.0)	0.006**
Gender				
Female	58/263 (22.1)		16/263 (6.1)	
Male	29/75 (38.7)	<0.001	12/75 (16.0)	0.015*
Maximal tumor size, cm				
<0.5	13/105 (12.4)		3/105 (2.9)	
≥0.5	74/233 (31.8)	0.753	25/233 (10.7)	0.950
Gland lobes of tumor				
Unilateral lobe	69/264 (26.1)		22/264 (8.3)	
Bilateral lobes	18/74 (24.3)	0.829	6/74 (8.1)	0.598
Primary lesion number				
Solitary lesion	75/289 (26.0)		23/289 (8.0)	
Multifocal lesions	12/49 (24.5)	0.958	5/49 (10.2)	0.004**
Capsular invasion				
Present	14/55 (25.5)		10/55 (18.2)	
Absent	73/283 (25.8)	0.067	18/283 (6.4)	0.157
External gland invasion				
Present	19/53 (35.8)		7/53 (13.2)	
Absent	68/285 (23.9)		21/285 (7.4)	
Tumor coronal location		0.415		0.115
Upper pole	18/79 (22.8)		11/79 (13.9)	
Middle third	44/179 (24.6)		12/179 (6.7)	
Lower pole	25/80 (31.3)		5/80 (6.3)	
Tumor cross-sectional location		0.972		0.307
Ventral part	36/141 (25.5)		8/141 (5.7)	
Middle part	33/130 (25.4)		14/130 (10.8)	
Dorsal part	18/67 (26.9)		6/67 (9.0)	

*, P<0.05; **, P<0.01. CLNM, central lymph node metastasis; PRRLN-LNM, posterior right recurrent laryngeal nerve lymph node metastasis.

Table 4 Logistic regression analysis of right CLNM and PRRLN-LNM with high risk factors

Characteristic	HR	95% CI	P
Presence of right CLNM			
Age (years)			
<45	1	–	–
46–59	0.926	0.541–1.583	0.778
≥60	0.250	0.071–0.879	0.031*
Gender			
Male	1	–	–
Female	0.449	0.252–0.802	0.007**
Maximal tumor size, cm			
≥0.5	1	–	–
<0.5	0.312	0.163–0.600	<0.001***
Presence of PRRLN-LNM			
Age (years)			
<45	1	–	–
46–59	0.308	0.113–0.836	0.021*
≥60	0.164	0.020–1.366	0.095
Gender			
Male	1	–	–
Female	0.373	0.160–0.874	0.023*
Maximal tumor size, cm			
≥0.5	1	–	–
<0.5	0.287	0.082–1.001	0.050
Capsular invasion			
Present	1	–	–
Absent	0.240	0.096–0.601	0.002**

*, P<0.05; **, P<0.01; ***, P<0.001. HR, high risk; CI, confidence interval; CLNM, central lymph node metastasis; PRRLN-LNM, posterior right recurrent laryngeal nerve lymph node metastasis.

has elevated rapidly in the past 30 years, with PTMC accounting for the bulk of this incidence (14,15). All of our included patients had consistently been screened with a routine preoperative US examination. However, a significant amount of clinical research has indicated that PTMC patients often end up with insidious neck lymph node metastasis, with a high incidence of about 50% (16,17). Preoperative examinations of neck lymph nodes were at times reported to be insufficiently sensitive (18), and thus the significance and necessity of prophylactic LND for cN0 PTMC patients requires full consideration. Preoperative individual stratification is urgently needed to make adequate operative schedules for different PTMC patients.

In our study, different age ranges, which we divided into <45, 45–59 and ≥60 groups, could distinguish the potential risk of right CLNM and PRRLN-LNM before operations. We found that an age of 45 years old might be an effective cutoff because patients younger than 45 presented with higher HR (high risk) value of right CLNM and PRRLN-LNM. Many previous reports corroborate our

findings (19-21), confirming that the metastasis ability of PTMC decreased significantly when patient age increased. Meanwhile, considering that younger patients have a relatively long-life span and are in better physical condition, there is an inclination to recommend prophylactic LND for their initial operations.

Furthermore, gender also behaved as a strong potential risk factor for predicting lymph node metastasis. Zhang *et al.* demonstrated that male PTMC patients presented with a significantly higher risk of lymph node metastasis (22). In the present study, our data were consistent with these findings, showing that the HR value for males was about three times higher than females. It follows then that male PTMC patients need adequate assessment of their preoperative stratification, and that LND is accepted when needed.

Generally, maximal tumor size is widely used to reflect the malignancy and predict the progression in various tumors (9,23). As for PTMC, many guidelines and studies chose 0.5 cm as the threshold of tumor size in risk stratification (24,25). In the multivariate analysis, our findings revealed that a maximal tumor diameter of more than 0.5 cm had a significantly strong correlation with both right CLNM and PRRLN-LNM. This information can help surgeons to decide whether to perform prophylactic LND for cN0 PTMC patients during operations. Moreover, capsular invasion of tumor indicated a high risk of PRRLN-LNM, which was in line with the findings of a previous study (26).

In conclusion, ages younger than 45, male gender, and a maximal tumor size larger than 0.5 cm, along with capsular invasion, are all independent risk factors for stratification of PTMC patients. For PTMC patients possessing these clinical characteristics, it is suggested that they accept prophylactic LND in their initial thyroid surgeries.

Acknowledgements

Funding: This work was supported by the Health Department of Zhejiang Province (#2013KYA075).

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The study was approved by the Ethics Committee of the First Affiliated Hospital, of the School of Medicine, at Zhejiang University (reference number: 2018-722) and written informed consent was obtained from all patients.

References

1. Davies L, Welch HG. Current thyroid cancer trends in the United States. JAMA Otolaryngol Head Neck Surg 2014;140:317-22.
2. Simard EP, Ward EM, Siegel R, et al. Cancers with increasing incidence trends in the United States: 1999 through 2008. CA Cancer J Clin 2012;62:118-28.
3. Chen AY, Jemal A, Ward EM. Increasing incidence of differentiated thyroid cancer in the United States, 1988–2005. Cancer 2009;115:3801-7.
4. Ito Y, Uruno T, Nakano K, et al. An observation trial without surgical treatment in patients with papillary microcarcinoma of the thyroid. Thyroid 2003;13:381-7.
5. Luo DC, Xu XC, Ding JW, et al. Clinical value and indication for the dissection of lymph nodes posterior to the right recurrent laryngeal nerve in papillary thyroid carcinoma. Oncotarget 2017;8:79897-905.
6. Lundgren CI, Hall P, Dickman PW, et al. Clinically significant prognostic factors for differentiated thyroid carcinoma: a population-based, nested case-control study. Cancer 2006;106:524-31.
7. Hwang HS, Orloff LA. Efficacy of preoperative neck ultrasound in the detection of cervical lymph node metastasis from thyroid cancer. Laryngoscope 2011;121:487-91.
8. Li M, Zhu XY, Lv J, et al. Risk factors for predicting central lymph node metastasis in papillary thyroid microcarcinoma (CN0): a study of 273 resections. Eur Rev Med Pharmacol Sci 2017;21:3801-7.
9. Haugen BR, Alexander EK, Bible KC, et al. 2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer: The American Thyroid Association Guidelines Task Force on Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid 2016;26:1-133.
10. Cavicchi O, Piccin O, Caliceti U, et al. Transient hypoparathyroidism following thyroidectomy: a prospective study and multivariate analysis of 604 consecutive patients. Otolaryngol Head Neck Surg 2007;137:654-8.
11. Kim YS, Park WC. Clinical predictors of right upper paraesophageal lymph node metastasis from papillary thyroid carcinoma. World J Surg Oncol 2012;10:164.

12. Dobrinja C, Pastoricchio M, Troian M, et al. Partial thyroidectomy for papillary thyroid microcarcinoma: Is completion total thyroidectomy indicated? Int J Surg 2017;41 Suppl 1:S34-9.
13. Mazzaferri EL. Management of low-risk differentiated thyroid cancer. Endocr Pract 2007;13:498-512.
14. Burgess JR, Tucker P. Incidence trends for papillary thyroid carcinoma and their correlation with thyroid surgery and thyroid fine-needle aspirate cytology. Thyroid 2006;16:47-53.
15. Burgess JR. Temporal trends for thyroid carcinoma in Australia: an increasing incidence of papillary thyroid carcinoma (1982-1997). Thyroid 2002;12:141-9.
16. Yun JS, Lee YS, Jung JJ, et al. Central neck recurrence patterns and morbidity following reoperation for recurrent papillary thyroid carcinoma. J Korean Surg Soc 2008;74:42-7.
17. Roh JL, Kim JM, Park CI. Central lymph node metastasis of unilateral papillary thyroid carcinoma: patterns and factors predictive of nodal metastasis, morbidity, and recurrence. Ann Surg Oncol. Ann Surg Oncol 2011;18:2245-50.
18. Lee DW, Ji YB, Sung ES, et al. Roles of ultrasonography and computed tomography in the surgical management of cervicallymph node metastases in papillary thyroid carcinoma. Eur J Surg Oncol 2013;39:191-6.
19. Zhang DG, Gao L, Miao YW, et al. Risk factors for posterior to right recurrent laryngeal nerve lymph node metastasis in papillary thyroid carcinoma. Saudi Med J 2014;35:832-7.
20. Shaha AR, Loree TR, Shah JP. Intermediate-risk group for differentiated carcinoma of thyroid. Surgery 1994;116:1036-40.
21. Soylu L, Aydin OU, Ozbas S, et al. The impact of the multifocality and subtypes of papillary thyroid carcinoma on central compartment lymph node metastasis. Eur Rev Med Pharmacol Sci 2016;20:3972-9.
22. Zhang L, Wei WJ, Ji QH, et al. Risk factors for neck nodal metastasis in papillary thyroid microcarcinoma: a study of 1066 patients. J Clin Endocrinol Metab 2012;97:1250-7.
23. Stojiljkovic D, Santrac N, Stojiljkovic T, et al. Correlation of tumor size as independent factor and disease stage with local recurrence of non-small cell lung carcinoma and its operability. J BUON 2015;20:166-72.
24. Wang M, Wu WD, Chen GM, et al. Could Tumor Size Be A Predictor for Papillary Thyroid Microcarcinoma: a Retrospective Cohort Study. Asian Pac J Cancer Prev 2015;16:8625-8.
25. Lee KJ, Cho YJ, Kim SJ, et al. Analysis of the clinicopathologic features of papillary thyroid microcarcinoma based on 7-mm tumor size. World J Surg 2011;35:318-23.
26. Yang Y, Chen C, Chen Z, et al. Prediction of central compartment lymph node metastasis in papillary thyroid microcarcinoma. Clin Endocrinol (Oxf) 2014;81:282-8.

Cite this article as: Li F, Wu Y, Chen L, Hu L, Liu X. Evaluation of clinical risk factors for predicting insidious right central and posterior right recurrent laryngeal nerve lymph node metastasis in papillary thyroid microcarcinoma patients (cN0): experience of a single center. Ann Transl Med 2019;7(1):8. doi: 10.21037/atm.2018.12.43

