Diagnostic Accuracy Study

Medicine®

OPEN

Cervical lymph node metastases in papillary thyroid cancer

Preoperative staging with ultrasound and/or computed tomography

Guiling Lu, MD*, Liang Chen, MD

Abstract

Preoperative screening of potential risk of lymph node metastasis is necessary for thyroidectomy plus lymph node dissection. The 2015 American thyroid association management guidelines do not recommend prophylactic cervical lymph node resection without clinical evidence of metastasis. Ultrasound is recommended imaging method and routine computed tomography is not recommended by the 2015 American thyroid association management guidelines for screening of lymph node metastasis. The objective of the study was to compare the diagnostic performance of ultrasound against that of computed tomography for screening cervical lymph node metastasis of patients with papillary thyroid cancer before thyroidectomy plus lymph node dissection.

Data regarding preoperative neck ultrasound, neck computed tomography, and physical examination of the head and neck and postoperative pathological results of a total of 185 patients (age > 18 years) with a diagnosis of papillary thyroid cancer who had suspicious lymph nodes on preoperative imaging and treated by thyroidectomy plus lymph node dissection for the therapeutic purpose were collected and analyzed.

Sensitivity (78.09% vs 75.28%, $P < .0001$) and accuracy (77.29% vs 75.13%, $P = .0004$) of neck computed tomography scanning to detect cervical lymph node metastasis were higher than those of neck ultrasound scanning. Sensitivity, accuracy, positive clinical utility, and negative clinical utility for neck ultrasound scanning plus neck computed tomography scanning to detect cervical lymph node metastasis were higher among all index tests ($P < .05$ for all) and were statistically the same as those of surgical pathology ($P > .05$ for all). The working areas for decision-making of thyroidectomy plus lymph node dissection of the physical examination, neck ultrasound, the neck computed tomography, and the neck ultrasound scanning plus the neck computed tomography scanning were 0 to 0.691 diagnostic confidence/lesion, 0 to 0.961 diagnostic confidence/lesion, 0 to 0.944 diagnostic confidence/lesion, and 0 to 0.981 diagnostic confidence/lesion, respectively.

Besides the neck ultrasound, the neck computed tomography scanning can be used as a complementary imaging method to detect cervical lymph node metastasis of patients with papillary thyroid cancer before thyroidectomy plus lymph node dissection.

Level of evidence: III.

Technical efficacy stage: 2.

Keywords: cervical lymph nodes metastasis, lymph node dissection, neck computed tomography, neck ultrasound, papillary thyroid cancer, thyroidectomy

1. Introduction

The incidence of thyroid cancer has increased in mainland China[1] particularly papillary thyroid carcinoma is more than 90% in the last few decades.[2] Lymph node metastasis has occurred in 60% to 70% of patients with papillary thyroid cancer[3] that is related to local recurrence and mortality.[4] There is the risk of loco-regional recurrence of about 15% to 30% in papillary thyroid cancer,[3] which needs appropriate preoperative screening of potential risk of lymph node metastasis for complete or partial thyroidectomy plus lymph node dissection.[5,6] Also, the 2015 American thyroid association management guidelines[7] do not recommend prophylactic cervical lymph node resection without clinical evidence of metastasis.

Ultrasound is recommended imaging method for screening of lymph node metastasis in patients with papillary thyroid cancer before thyroidectomy plus lymph node dissection.[7] Also, ultrasound is superior to computed tomography for screening of benign or malignant nature of thyroid nodules.[8,9] However, ultrasound is operator-dependent, and retropharyngeal, retrosternal, and mediastinal regions are difficult to evaluate through

Editor: Wen-Wei Sung.

The authors have no funding and conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

Department of Ultrasonography, Haian People's Hospital of Jiangsu Province, Haian, Jiangsu, China.

** Correspondence: Guiling Lu, Department of Ultrasonography, Haian People's Hospital of Jiangsu Province, No.17 Zhongba Middle Road, Haian, Jiangsu 226600, China (e-mail: 2444600202@qq.com).*

How to cite this article: Lu G, Chen L. Cervical lymph node metastases in papillary thyroid cancer: preoperative staging with ultrasound and/or computed tomography. Medicine 2022;101:9(e28909).

Received: 5 May 2021 / Received in final form: 22 January 2022 / Accepted: 31 January 2022

http://dx.doi.org/10.1097/MD.0000000000028909

ultrasound.[10,11] Also, the sensitivity of ultrasound is variable and low for central lymph node metastasis.[12] Routine computed tomography is not recommended by the 2015 American thyroid association management guidelines,[7] but computed tomography may use an adjunct to neck ultrasound to assess lymph node metastasis in patients with papillary thyroid cancer before thyroidectomy plus lymph node dissection.[8] Computed tomography plays a complementary role in the assessment of lymph node metastasis before the surgical procedure.[13] Unlike ultrasound, computed tomography is less operator-dependent and has a potential conclusion regarding lymph node metastasis around esophagus regions but has the risk of exposure to ionizing radiation and risk of future cancers is not addressed in available studies.[14] Also, computed tomography has acceptable diagnostic performance for screening cervical lymph nodes metastasis before thyroidectomy plus lymph node dissection.[15] Several pieces of research focused on the diagnostic value of computed tomography in cervical lymph nodes metastases in thyroid cancer and they also reported the sensitivity and specificity.[16] Therefore, it is controversial to select a diagnostic modality for screening of cervical lymph node metastasis of patients with papillary thyroid cancer before thyroidectomy plus lymph node dissection.

The objective of the retrospective analysis of the cross-sectional study was to compare the diagnostic performance of neck ultrasound against computed tomography for screening cervical lymph node metastasis of patients with papillary thyroid cancer before thyroidectomy plus lymph node dissection considering the results of surgical pathology as the reference standard.

2. Materials and methods

2.1. Ethics approval and consent to participate

The designed protocol (HaPH151421 dated March 1, 2021) was approved by the Haian People's Hospital of Jiangsu Province review board and the Chinese Society of Clinical Oncology. The study reporting has adhered to the v2008 Declarations of Helsinki and the law of China. Being a retrospective study the registration in the Chinese Clinical Trial Registry was waived by the institutional review board. Also, neither patient approval nor informed consent was required for the study.

2.2. Inclusion criteria

Patients (age > 18 years) with papillary thyroid cancer (positive in fine-needle aspiration cytopathology) underwent neck ultrasound and neck computed tomography scan before surgeries and who were treated by thyroidectomy plus lymph node dissection for treatment of cervical lymph nodes metastasis were included in the analysis. All patients of this study had suspicious lymph node metastasis on physical examination or imaging study. The authors did perform neck dissection for the therapeutic purpose in all.

2.3. Exclusion criteria

Patients whose complete data were not available at the patients' records of the institutes and who were not treated by thyroidectomy plus lymph node dissection for treatment of cervical lymph nodes metastasis (because neck ultrasound and neck computed tomography scans showed free from metastasis) were excluded from the analysis.

2.4. Index test

2.4.1. Physical examination of the head and neck. It includes examinations of the size and firmness of the thyroid and any enlarged lymph nodes in the neck. In addition, laryngoscopy was performed to assess vocal cord motility.

2.4.2. Neck ultrasound scanning. Neck ultrasound was performed using an 8 to 10 MHz linear transducer (GE Healthcare, Little Chalfont, England) by radiologists (minimum of 5-years' experience in thyroid imaging). The entire thyroid gland and cervical lymph node bearing area were examined. When the lymph node was reported enlarged, rounded, loss of fatty hilum, marked hypoechogenicity, abnormal vascularity, microcalcifications, or cystic change, then it was considered as cervical lymph nodes metastasis.[11] The representative figure of neck ultrasound scanning is presented in Figure 1.

2.4.3. Neck computed tomography scanning. Neck computed tomography scanning was performed by the 40-slice scanner (Siemens Somatom Sensation, Siemens AG, Berlin, Germany). A total of 65 mL iohexol (Omnipaque, GE Healthcare, Little Chalfont, England) was given at a rate of 1.2 mL/s. After 60 second, using a 1.2 mm collimator and at 0.75 pitch scanning was performed. Images were acquired at 120 kVp and 1.5 mm axial plane slice thickness, from the skull base to the upper mediastinum. The images were reconstructed into 3.0 mm axial × 3.0 coronal images. Neck computed tomography scanning was performed by radiologists (minimum of 5-years' experience in head and neck imaging). In computed tomography

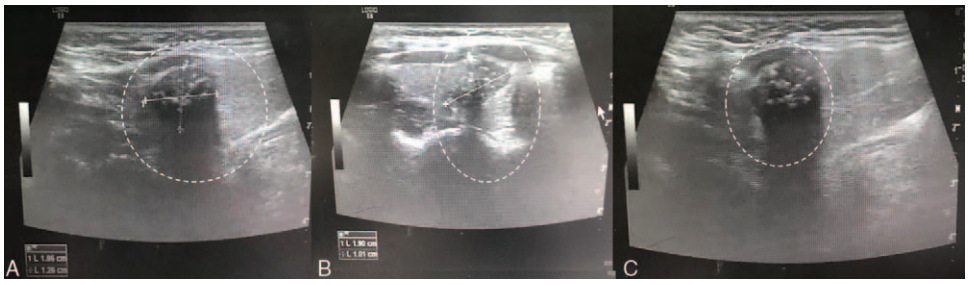

Figure 1. The representative figure of neck ultrasound scanning. A. Enlarged lymph node. A white circle indicates 1.06 cm of the lymph node in the axial plane. B. Marked hypoechogenicity. A white circle indicates hypoechogenicity of the lymph node. C. Microcalcifications. A white circle indicates calcification in the lymph node.

Figure 2. The representative figure of neck computed tomography scanning of 62 years old man. A white circle indicates enlarged (>1 cm in the transverse plane) cervical lymph node.

images, lymph nodes were examined for size, asymmetry, calcification, marked hypoattenuation, and cystic change, if it was reported any of suspicious parameter, then it was considered as cervical lymph nodes metastasis. The representative figure of neck computed tomography scanning is presented in Figure 2. The computed tomography was performed as a routine or after clinical findings.

The details of image analysis for cervical lymph nodes metastasis of neck ultrasound and computed tomography scans are presented in Table 1. All imaging studies were retrospectively reviewed. Images can meet only 1 of the criteria for cervical lymph node metastasis.

2.4.4. Surgery. Thyroidectomy plus lymph node dissection was performed within 6-months from diagnostic imaging if neck ultrasound and/or neck computed tomography scans showed lymph nodes metastasis in any 1 cervical compartment out of 4 compartments (2 the central neck nodal and 2 the lateral neck nodal compartments defined as per recent American Thyroid Association consensus statement).[17] Also, in a few cases, lymph nodes were removed for prophylactic purposes because patients may have changes of disease(s) progression (surgeons' opinion). The cytological detection of lymph node metastases outside the central compartment will imply total thyroidectomy and ipsilateral systematic lymph node dissection of the affected lateral cervical compartment, otherwise the preferred treatment for small cancers is hemithyroidectomy. The resected surgical specimen of the thyroid plus lymph node was sent to the pathological laboratory for analysis.

2.4.5. Diagnostic parameters. Sensitivities, specificities, accuracies, positive clinical utility, and negative clinical utility of index tests for detection of cervical lymph node metastasis were calculated as per Eqs. 1, 2, 3, 4, and 5, respectively.

$$\text{Sensitivity} = \frac{\text{Truepositives}}{\text{True positives} + \text{False negatives} + \text{Inconclusive results}} \times 100 \quad (1)$$

$$\text{Specificity} = \frac{\text{Truenegatives}}{\text{True negatives} + \text{False positives} + \text{Inconclusive results}} \times 100 \quad (2)$$

$$\text{Accuracy} = \frac{\text{Truepositives} + \text{True negatives}}{\text{True positives} + \text{True negatives} + \text{False positives} + \text{False negatives} + \text{Inconclusive results}} \times 100 \quad (3)$$

$$\text{Positive clinical utilitiy} = \text{Sensitivity} \times \text{Positive predictive value} \quad (4)$$

$$\text{Negative clinical utilitiy} = \text{Specificity} \times \text{Negative predictive value} \quad (5)$$

Where,

True positives: Detected by individual index test and detected by surgical pathology.

True negatives: Not detected by individual index test and not detected by surgical pathology.

False positives: Detected by individual index test but not detected by surgical pathology.

False negatives: Not detected by individual index test but detected by surgical pathology.[18]

Inconclusive results: No interpretation(s) due to poor image quality.

2.4.6. Clinical usefulness. The beneficial score was evaluated for each index test for decision-making of thyroidectomy plus lymph node dissection as per Eq. 6.[19]

$$\text{Beneficialscore} = \frac{\text{True positive cervical lymph node metastasis}}{\text{Total numbers of cervical lymph node evaluated}} - \left(\frac{\text{False}-\text{positive cervical lymph node metastasis}}{\text{Total numbers of cervical lymph node evaluated}}\right) \times \frac{\text{Level of diagnostic confidence above which the decision of thyroidectomy plus lymph node dissection was taken}}{1-\text{Level of diagnostic confidence above which the decision of thyroidectomy plus lymph node dissection was taken}} \quad (6)$$

Table 1

Criteria for cervical lymph node metastasis of neck ultrasound and computed tomography scans.

Neck ultrasound	Neck computed tomography
Enlarged (>1 cm in axial plane)	Enlarged (>1 cm in transverse plane)
Rounded	Rounded
Loss of fatty hilum	Loss of fatty hilum
Marked hypoechogenicity	Marked hypoattenuation
Microcalcifications	Microcalcifications
Cystic change	Cystic change

The size was not only used for decision-making of upper level 2 lymph node.

2.5. Statistical analysis

SPSS 26.0, IBM Corporation, Armonk, NY was used for statistical analysis purposes. A Chi-square test was performed between categorical variables. All results were considered significant at a 95% of confidence level.

3. Results

3.1. Study population

From January 15, 2018 to January 1, 2020, a total of 250 patients with papillary thyroid cancer (had positive results with fine-needle aspiration cytopathology; Bethesda V or VI) underwent preoperative neck ultrasound and neck computed tomography scan at the department of ultrasound of the Haian People's Hospital of Jiangsu Province, Haian, Jiangsu, China and the referring hospitals. Among them, neck ultrasound and neck computed tomography scans of 50 patients showed free from cervical lymph nodes metastasis and complete data of 15 patients were not available at the patients' records of the institutes. Therefore, data of 65 patients were excluded from the analysis. Data regarding preoperative neck ultrasound, neck computed tomography, and physical examination of the head and neck and postoperative pathological results of a total of 185 patients (age > 18 years) with papillary thyroid cancer whose neck ultrasound and/or neck computed tomography scans have shown cervical lymph node metastasis in any 1 cervical compartment out of 4 compartments and treated by thyroidectomy plus lymph node dissection were collected from the patients' records of the institutes and analyzed. The flow diagram of the retrospective analysis is reported in Figure 3. All of the 50 excluded scan negative cases were followed up clinically to show that there were no false negatives.

3.2. Characteristics of patients

Among enrolled patients 134 (72%) were female and 51 (28%) were male. Age and ethnicity of the enrolled patients are reported in Table 2.

3.3. Diagnostic parameters

True positive, false negative, inconclusive results, positive predictive value, and negative predictive value for physical

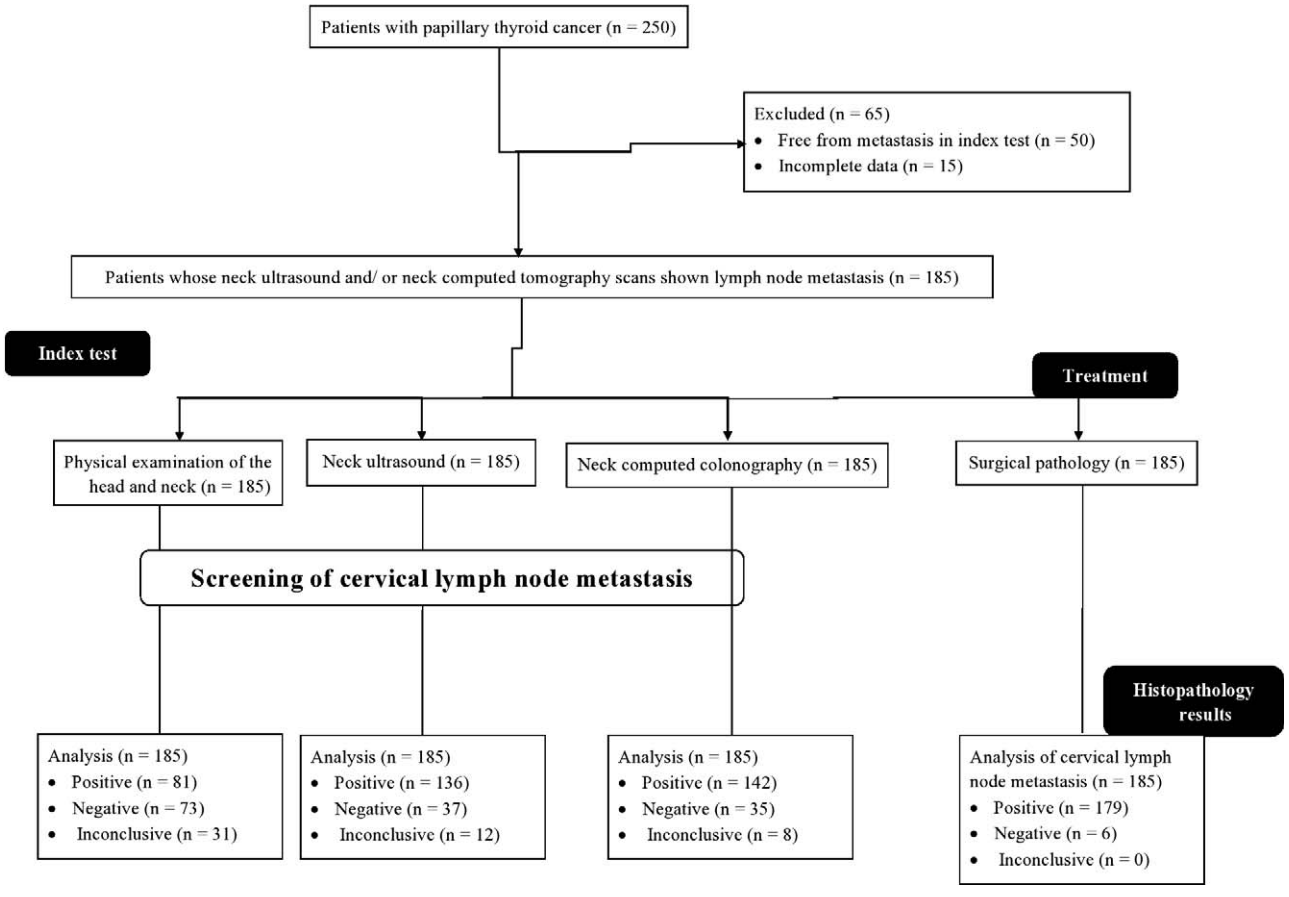

Figure 3. The flow diagram of the retrospective analysis.

Table 2

Demographical, anthropological, and surgical characteristics of patients.

Characteristics		Value
The numbers of patients included in the analysis		**185**
Sex	Male	51 (28)
	Female	134 (72)
Age (yrs)	Minimum	23
	Maximum	68
	Mean ± SD	42.15 ± 9.15
Ethnicity	Han Chinese	170 (92)
	Mongolian	13 (7)
	Tibetan	2 (1)
Family history of papillary thyroid cancer		45 (24)
The extent of lymph nodes dissection	One side of the central cervical compartment	143 (77)
	Both sides of the central cervical compartment	27 (15)
	Both sides of the central cervical compartment with the lateral cervical compartment	15 (8)

Categorical variables are demonstrated as frequency (percentages) and continuous variables are demonstrated as mean ± standard deviation (SD).

examination of the head and neck, neck ultrasound scanning, and neck computed tomography scanning to detect cervical lymph nodes metastasis were significantly fewer than those of surgical pathology ($P < .05$ for all). There were no significant differences between results of diagnostic parameters (true positive, false positive, true negative, false negative, inconclusive results, positive predictive value, and negative predictive value) for neck ultrasound scanning plus neck computed tomography scanning to detect cervical lymph nodes metastasis and those of surgical pathology ($P > .05$ for all). Also, there were no significant differences between the results of diagnostic parameters (true positive, false positive, true negative, false negative, inconclusive results, positive predictive value, and negative predictive value) for neck ultrasound scanning to detect cervical lymph nodes metastasis and those of neck computed tomography scanning ($P > .05$ for all). Inconclusive results (8 vs 12) and false negative values (31 vs 32) of neck computed tomography scanning to detect cervical lymph nodes metastasis were fewer than those of neck ultrasound but values were not statistically significant ($P > .05$ for both). The details of the diagnostic parameters of the index tests for detection of cervical lymph node metastasis are reported in Table 3.

Sensitivity, specificity, accuracy, and positive clinical utility for physical examination of the head and neck, neck ultrasound scanning, and neck computed tomography scanning to detect cervical lymph node metastasis were significantly fewer than those of surgical pathology ($P < .05$ for all). The sensitivity ($P < .0001$) and accuracy ($P = .0004$) of neck computed tomography scanning to detect cervical lymph node metastasis were significantly higher than those of neck ultrasound scanning. The specificity and positive clinical utility of neck computed tomography scanning to detect cervical lymph node metastasis were higher than those of neck ultrasound scanning but values were not statistically significant ($P > .05$ for both). The negative clinical utility of neck computed tomography scanning to detect cervical lymph node metastasis was the same as that of neck ultrasound scanning. Sensitivity, specificity, accuracy, positive clinical utility, and negative clinical utility for neck ultrasound scanning plus neck computed tomography scanning to detect cervical lymph node metastasis were higher among all index tests ($P < .05$ for all). Sensitivity, accuracy, positive clinical utility, and negative clinical utility for neck ultrasound scanning plus neck computed tomography scanning to detect cervical lymph node metastasis were statistically the same as those of surgical pathology ($P > .05$ for all). However, specificity for neck ultrasound scanning plus neck computed tomography scanning to detect cervical lymph node metastasis was fewer than that of

Table 3

Diagnostic parameters of the index tests for detection of cervical lymph node metastasis.

Parameters	Surgical pathology	Physical examination of the head and neck		Neck ultrasound scanning		Neck computed tomography scanning			Neck ultrasound scanning + Neck computed tomography scanning	
Patients	**185**	**185**	***P* value**	**185**	***P* value**	**185**	***P* value**	**†*P* value**	**185**	***P* value**
True positive	179 (97)	56 (30)	<.0001	134 (73)	<.0001	139 (75)	<.0001	.636	177 (96)	.785
False positive	0 (0)	25 (13)	<.0001	2 (1)	.478	3 (2)	.258	.653	2 (1)	.478
True negative	6 (3)	1 (1)	.127	5 (3)	.759	4 (2)	.749	.736	5 (2)	.759
False negative	0 (0)	72 (39)	<.0001	32 (17)	<.0001	31 (17)	<.0001	.890	1 (1)	.127
Inconclusive results	0 (0)	31 (17)	<.0001	12 (6)	.001	8 (4)	.012	.491	0 (0)	N/A
Positive predictive value	179 (97)	81 (43)	<.0001	136 (74)	<.0001	142 (77)	<.0001	.548	179 (97)	.999
Negative predictive value	6 (3)	73 (40)	<.0001	37 (20)	<.0001	35 (19)	<.0001	.896	6 (3)	.999

Data are presented as frequencies (percentages).

A Chi-square test was performed for statistical analysis.

A *P* value less than .05 was considered significant.

N/A = not applicable.

* Concerning surgical pathology.

† Concerning neck ultrasound scanning.

Table 4

Sensitivity, specificity, accuracy, positive clinical utility, and negative clinical utility of the index tests for detection of cervical lymph node metastasis.

	Surgical pathology	Physical examination of the head and neck		Neck ultrasound scanning		Neck computed tomography scanning			Neck ultrasound scanning + neck computed tomography scanning	
Diagnostic parameters	Value	Value	*P value	Value	*P value	Value	*P value	†P value	Value	*P value
Sensitivity	100%	35.22%	<.0001	75.28%	<.0001	78.09%	<.0001	<.0001	99.44%	.316
Specificity	100%	1.75%	<.0001	26.31%	<.0001	26.67%	<.0001	.575	71.43%	<.0001
Accuracy	100%	37.01%	<.0001	75.13%	<.0001	77.29%	<.0001	.0004	98.38%	.477
Positive clinical utility	0.97	0.15	<.0001	0.56	<.0001	0.60	<.0001	.667	0.96	.701
Negative clinical utility	0.03	0.007	.0003	0.05	.718	0.05	.718	N/A	0.02	.651

A Chi-square test was performed for statistical analysis.
A *P* value less than .05 was considered significant.
N/A = not applicable.
* Concerning surgical pathology.
† Concerning neck ultrasound scanning.

surgical pathology ($P < .0001$). The details of sensitivity, specificity, accuracy, positive clinical utility, and negative clinical utility to detect cervical lymph node metastasis of different index tests are reported in Table 4.

3.4. Clinical usefulness

The working area for decision-making of thyroidectomy plus lymph node dissection for surgical pathology was 0 to 1 diagnostic confidence/lesion. That for the physical examination of the head and neck was 0 to 0.691 diagnostic confidence/lesion. That for the neck ultrasound scanning was 0 to 0.961 diagnostic confidence/lesion. That for the neck computed tomography scanning was 0 to 0.944 diagnostic confidence/lesion and for the neck ultrasound scanning plus the neck computed tomography scanning, the working area was 0 to 0.981 diagnostic confidence/lesion. Above 0.691, 0.961, and 0.944 diagnostic confidence/lesion, the physical examination of the head and neck, the neck ultrasound scanning, and the neck computed tomography scanning had the risk of overdiagnosis. However, the neck ultrasound scanning plus the neck computed tomography scanning had the least risk of overdiagnosis (above 0.981 diagnostic confidence/lesion). The details of beneficial score analyses are reported in Figure 4 and Table 5.

4. Discussion

Sensitivity and accuracy of neck computed tomography to detect cervical lymph node metastasis were superior than those of neck ultrasound. In contrast, all the diagnostic parameters of the neck

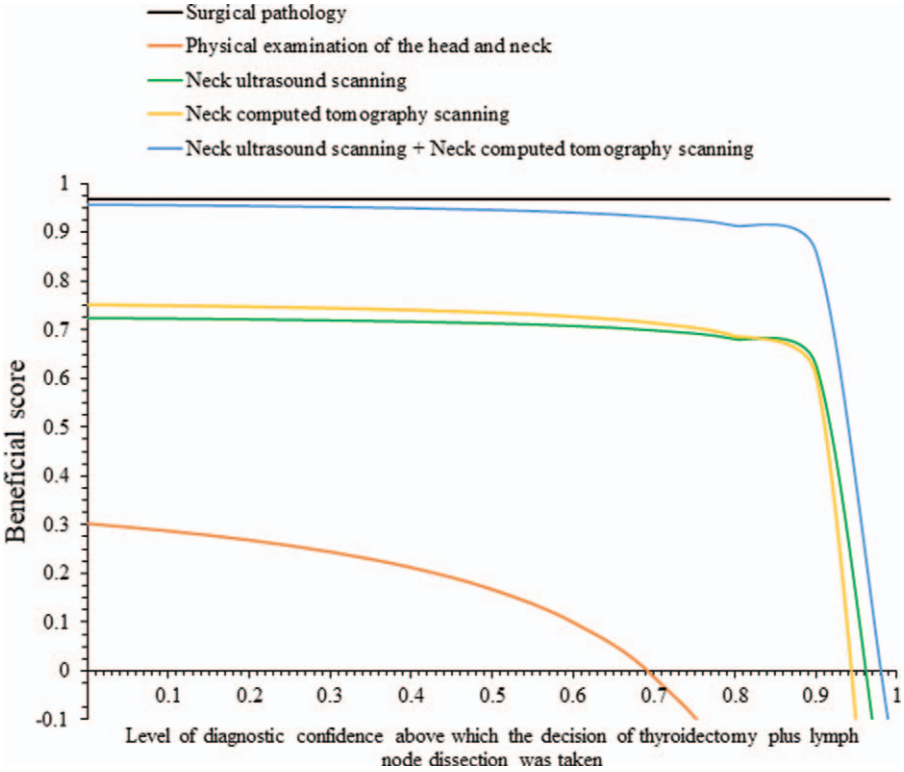

Figure 4. Beneficial score analysis for index test for decision-making of thyroidectomy plus lymph node dissection.

Table 5

Beneficial score analysis for index tests.

Level of diagnostic confidence above which the decision of thyroidectomy plus lymph node dissection was taken	A beneficial score of index tests				
	Surgical pathology	Physical examination of the head and neck	Neck ultrasound scanning	Neck computed tomography scanning	Neck ultrasound scanning + neck computed tomography scanning
0	0.9675676	0.302703	0.724324	0.751351	0.956757
0.1	0.9675676	0.287688	0.723123	0.74955	0.955556
0.2	0.9675676	0.268919	0.721622	0.747297	0.954054
0.3	0.9675676	0.244788	0.719691	0.744402	0.952124
0.4	0.9675676	0.212613	0.717117	0.740541	0.94955
0.5	0.9675676	0.167568	0.713514	0.735135	0.945946
0.6	0.9675676	0.1	0.708108	0.727027	0.940541
0.7	0.9675676	−0.01261	0.699099	0.713514	0.931532
0.8	0.9675676	−0.23784	0.681081	0.686486	0.913514
0.9	0.9675676	−0.91351	0.627027	0.605405	0.859459
0.99	0.9675676	−13.0757	−0.34595	−0.85405	−0.11351

ultrasound scanning plus the neck computed tomography scanning was far superior to neck ultrasound alone. The results of the diagnostic performance of the current study are consistent with those of prospective studies[11,20] and meta-analyses.[3,14] Computed tomography is less operator-dependent,[14] the retropharyngeal, retrosternal, and mediastinal areas of lymph nodes are possible to evaluate with computed tomography,[11] and it provides the view of the skull to the mediastinum.[14] Neck ultrasonography provides information for sensitive focal lesions and it is difficult to evaluate the entire neck by ultrasound.[14] At the same time, neck computed tomography provides information for a high-resolution image of the lesion concerning the surrounding cervical viscera.[14] Unavailability of the entire neck for diagnosis is resulted in a higher rate of detection of false-negative cervical lymph node metastasis by neck ultrasound scanning. Quality of ultrasound images were poor because of an 8–10 MHz transducer used. Modern sonography of the head and neck uses between 12–16 MHz transducer. This (8–10 MHz transducer) was a factor in reducing ultrasound sensitivity. Neck computed tomography to detect cervical lymph node metastasis has the supporting role in the planning of thyroidectomy plus lymph node dissection but the major trade-off is radiation dose and the use of iodinated contrast for which might delay the iodine ablation treatment(s).

The current study was used it for neck computed tomography. Iohexol is iodine-based contrast material and it was strictly restricted before thyroidectomy plus lymph node dissection.[14] Body iodine is cleared within 1 to 2 months. Also, it is not a potential biomarker of thyroid ablation.[14,21] The benefit of improved neck imaging usually outweighs any potential risk associated with a 1 to 2 months delay in radioactive iodine imaging or treatment(s).[14,21]

In the index test, 200 (80%) patients out of 250 patients were reported cervical lymph node metastasis in the neck ultrasound and/or neck computed tomography scans. However, 81 (44%) patients out of 250 patients were reported cervical lymph nodes metastasis in the physical examination of the head and neck. The result of the prevalence of cervical lymph node metastasis of the current study is consistent with those of prospective[11] and retrospective[13] studies. The prevalence of cervical lymph node metastasis among patients with papillary thyroid cancer is 30% to 80%.[13] The physical examination of the head and neck provided little information for decision-making of thyroidectomy plus lymph node dissection.

Neck ultrasound and neck computed tomography both reported false positive and false negative values. Neck ultrasound and neck computed tomography both had poor sensitivity and specificity in the central neck compartments.[11] Also, ultrasound is operator-dependent and nodes smaller than 1 cm and near to the mandible are mostly missed by ultrasound.[20] Not all metastatic nodes from papillary carcinoma are "markedly hypoechoic". In fact, some metastatic papillary Ca nodes are often hyperechoic compared to adjacent muscle. Radiologists with great expertise in thyroid imaging can rule out negative predictive values of imaging modalities.

The general concept of this research is very interesting and can be useful for clinical practice. However, there are certain points where the study has a limitation, for example, the retrospective study and lack of dynamic study. In the other limitations of the study, the experience of radiologists have an impact on the detection rate of cervical lymph nodes metastasis of patients with papillary thyroid cancer[10] but the study did not take into account the experience of the radiologists for analysis. The study did not bifurcate the results into central compartments and lateral compartments. However, imaging modalities have different diagnostic parameters for different compartments of cervical lymph nodes.[11,12] The inter-and intra-observer reliability was not evaluated in the study. Long-term outcomes were available since the study was a retrospective study. However, the study included the patients with complete data including neck computed tomography scan, ultrasound scan, and pathological diagnosis, which is necessary to calculate the accuracy. In contrast, this criterion has ruled out those patients not examined by neck computed tomography scan or ultrasound thus missing the cervical lymph nodes dissection (n = 50). These patients are essentially important when the study is trying to differentiate the indolent nodules from the aggressive ones. Severe bias will be brought in the evaluation of the diagnostic tests and the accuracy is elevated unintentionally. Comparison of these points with the surgical or long-term outcome would be significant. The study has extremely high (24%) positive family history compared to other series.

5. Conclusions

The current study has meticulously correlated ultrasound and computed tomography findings in cases of papillary thyroid cancer against surgical pathology in this evidence-level 3 diagnostic study at thorn bury level 3, diagnostic impact. The optimal investigations for thyroid cancer are a topical subject and this study offers new knowledge. The physical examination of the head and neck provided little information for decision-making of thyroidectomy plus lymph node dissection. Only sensitivity and accuracy of neck computed tomography are superior to neck ultrasound. However, the diagnostic performance of neck ultrasound scanning plus the neck computed tomography scanning is superior to neck ultrasound alone to detect cervical lymph nodes metastasis of patients with papillary thyroid cancer. The neck computed tomography scanning can be used as a complementary method in addition to neck ultrasound to detect cervical lymph nodes metastasis of patients with papillary thyroid cancer. However, the risk of exposure to ionizing radiation, the rescheduling patients for neck computed tomography, and possibly delay iodine ablation treatment for at least 1 to 2 months must be considered. The findings of this study are particularly novel or add significant new information in the field of papillary thyroid cancer.

Acknowledgments

The authors are thankful for the radiological and non-radiological staff of the Haian People's Hospital of Jiangsu Province, Haian, Jiangsu, China.

Author contributions

Conceptualization: Liang Chen.
Formal analysis: Guiling Lu.
Methodology: Guiling Lu.
Project administration: Guiling Lu, Liang Chen.
Resources: Liang Chen.
Validation: Liang Chen.
Visualization: Liang Chen.
Writing – original draft: Guiling Lu.
Writing – review & editing: Guiling Lu.

References

[1] Zheng R, Zeng H, Zhang S, Chen W. Estimates of cancer incidence and mortality in China, 2013. Chin J Cancer 2017;36:1–6.
[2] Zhao L, Pang P, Zang L, et al. Features and trends of thyroid cancer in patients with thyroidectomies in Beijing, China between 1994 and 2015: a retrospective study. BMJ Open 2019;9:1–9.
[3] Xing Z, Qiu Y, Yang Q, et al. Thyroid cancer neck lymph nodes metastasis: meta-analysis of US and CT diagnosis. Eur J Radiol 2020;129:1–35.
[4] Kitahara CM, Sosa JA. The changing incidence of thyroid cancer. Nat Rev Endocrinol 2016;12:646–53.
[5] Robenshtok E, Fish S, Bach A, Domínguez JM, Shaha A, Tuttle RM. Suspicious cervical lymph nodes detected after thyroidectomy for papillary thyroid cancer usually remain stable over years in properly selected patients. J Clin Endocrinol Metab 2012;97:2706–13.
[6] Bates MF, Lamas MR, Randle RW, et al. Back so soon? Is early recurrence of papillary thyroid cancer really just persistent disease? Surgery 2018;163:118–23.
[7] 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.
[8] Wu JH, Zeng W, Wu RG, Wang M, Ye F, Fu MY. Comparison of ultrasonography and CT for determining the preoperative benign or malignant nature of thyroid nodules: diagnostic performance according to calcification. Technol Cancer Res Treat 2020;19:1–6.
[9] Brauckhoff K, Biermann M. Multimodal imaging of thyroid cancer. Curr Opin Endocrinol Diabetes Obes 2020;27:335–44.
[10] Moon HJ, Kim EK, Yoon JH, Kwak JY. Differences in the diagnostic performances of staging US for thyroid malignancy according to experience. Ultrasound Med Biol 2012;38:568–73.
[11] Lesnik D, Cunnane ME, Zurakowski D, et al. Papillary thyroid carcinoma nodal surgery directed by a preoperative radiographic map utilizing CT scan and ultrasound in all primary and reoperative patients. Head Neck 2014;36:191–202.
[12] 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.
[13] Liu X, Ouyang D, Li H, et al. Papillary thyroid cancer: dual-energy spectral CT quantitative parameters for preoperative diagnosis of metastasis to the cervical lymph nodes. Radiology 2015;275:167–76.
[14] Suh CH, Baek JH, Choi YJ, Lee JH. Performance of CT in the preoperative diagnosis of cervical lymph node metastasis in patients with papillary thyroid cancer: a systematic review and meta-analysis. Am J Neuroradiol 2017;38:154–61.
[15] Cho SJ, Suh CH, Baek JH, Chung SR, Choi YJ, Lee JH. Diagnostic performance of CT in detection of metastatic cervical lymph nodes in patients with thyroid cancer: a systematic review and meta-analysis. Eur Radiol 2019;29:4635–47.
[16] Borhani S and Hedayati M. A review of diagnostic approaches to medullary thyroid carcinoma. 2017. DOI: 10.1101/116905.[Preprint Server].
[17] Carty SE, Cooper DS, Doherty GM, et al. American Thyroid Association Surgery Working Group; American Association of Endocrine Surgeons; American Academy of Otolaryngology-Head and Neck Surgery; American Head and Neck SocietyConsensus statement on the terminology and classification of central neck dissection for thyroid cancer. Thyroid 2009;19:1153–8.
[18] Zhou Y, Han Z, Dou F, Yan T. Pre-colectomy location and TNM staging of colon cancer by the computed tomography colonography: a diagnostic performance study. World J Surg Oncol 2021;19:1–13.
[19] Wang M, Sun P, Zhao X, Sun Y. Ultrasound parameters of thyroid nodules and the risk of malignancy: a retrospective analysis. Cancer Control 2020;27:1–8.
[20] Anand N, Chaudhary N, Mittal MK, Prasad R. Comparison of the efficacy of clinical examination, ultrasound neck and computed tomography in detection and staging of cervical lymph node metastasis in head and neck cancers. Indian J Otolaryngol Head Neck Surg 2007;59:19–23.
[21] Mishra A, Pradhan PK, Gambhir S, Sabaretnam M, Gupta A, Babu S. Preoperative contrast-enhanced computerized tomography should not delay radioiodine ablation in differentiated thyroid carcinoma patients. J Surg Res 2015;193:731–7.