Journal of Medical Ultrasound (2015) 23, 25—28

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.jmu-online.com

ORIGINAL ARTICLE

Incidental Thyroid Abnormalities on Carotid Color Doppler Ultrasound: Frequency and Clinical Significance

Masoud Pezeshki Rad [1], Seyed Rasoul Zakavi [2], Parvin Layegh [3], Alireza Khooei [4], Aria Bahadori [5*]

[1] *Vascular and Endovascular Research Center, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran,* [2] *Nuclear Medicine Research Center, Qaem Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran,* [3] *Endocrinology Research Center, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran,* [4] *Department of Pathology, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran, and* [5] *Department of Radiology, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran*

Received 23 July 2013; accepted 26 March 2014
Available online 4 July 2014

KEY WORDS
carotid artery,
duplex Doppler ultrasound,
fine-needle aspiration,
thyroid nodule

Background: Thyroid nodules are often incidentally detected during physical examination, Doppler ultrasound of carotid artery, and other imaging modalities and there are many controversies about the management of these incidentalomas. We focused on incidental thyroid lesions during carotid ultrasound and evaluated their importance and suspected malignant features.

Patients and methods: The thyroid gland was evaluated for any nodule(s) following carotid Doppler ultrasound in 290 patients. If there was an abnormal finding in the thyroid ultrasound, the patient was referred to an endocrinologist and after clinical and laboratory evaluation, fine-needle aspiration (FNA) biopsy was done if required.

Results: We found an abnormal thyroid in 63 (21.8%) patients and 57 (19.6%) of patients had incidental thyroid nodules; these were mainly in women and older patients. Based on size and ultrasound findings of the nodules, 28 (44.4% of abnormal thyroids) patients were referred for fine-needle aspiration biopsy and 15 patients agreed with this procedure. Aspiration cytology showed two nondiagnostic samples (13.3%), 10 benign lesions (66.6%), two follicular cell lesions (13.3%), and one (6.6%) Hürthle cell neoplasm lesion.

Conflicts of interest: The authors declare no conflicts of interest.

* Correspondence to: Dr. Aria Bahadori, Department of Radiology, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.
E-mail address: aria_bhd@yahoo.com (A. Bahadori).

http://dx.doi.org/10.1016/j.jmu.2014.04.005

Conclusion: Thyroid evaluation during carotid ultrasound has little benefits.

Introduction

The duplex ultrasound is a widely accepted method in evaluation of bilateral common carotid arteries and their internal and external branches. Grayscale ultrasound reveals atherosclerotic plaques and in conjunction with color and spectral Doppler ultrasound, the severity of stenosis can be determined [1,2].

The thyroid gland is located in close proximity to carotid vessels. Evaluation of the thyroid gland during carotid ultrasound is not a time consuming process and may have diagnostic benefits.

By contrast, thyroid malignancies do not usually have local symptoms and in most patients, thyroid nodules are discovered incidentally during physical examination and neck imaging for other purposes [3].

The reported prevalence of thyroid incidentalomas during Doppler ultrasound varies significantly in different studies and is affected by iodine supplementation, the patient's age and other less important factors [4,5]. The main goal of this study is to determine the prevalence of incidental thyroid lesions and their clinical significance during carotid ultrasound.

Patients and methods

This study was conducted under approval by the Institutional Review Board (with patient informed consent).

Study population

Possible associated thyroid disease and our project were explained to all patients who were referred for carotid ultrasound. After obtaining a written consent, all underwent thyroid ultrasound. Also, physical examination findings, signs and symptoms related to thyroid disease, and all demographic data were recorded. The patients were referred for carotid ultrasound because: (1) they were candidates for coronary artery bypass grafting; (2) they had a history of stroke or transient ischemic attack (TIA); or (3) they had vertigo (vertebral Doppler evaluation is almost always performed during the carotid Doppler process). Patients with known thyroid disease were excluded from the study.

Imaging and patient evaluation

Ultrasound examinations were performed with an available scanner (G40; Siemens, Erlangen, Germany), equipped with a linear transducer operating at 10 MHz. A board certified radiologist performed all carotid duplex examinations. Echogenicity of the thyroid, size and echogenicity of any focal abnormality (echogenicity of nodule relative to adjacent strap muscles), presence or absence of calcification, and border description of all lesions were recorded during ultrasound examinations.

In the presence of thyroid disorders, the patients were referred to an endocrinologist for further evaluation. The guidelines of the American Association of Clinical Endocrinologists were used for management of the patients [4]. Fine-needle aspiration (FNA) biopsies were performed with US guidance according to key recommendations of the guidelines.

The Bethesda system for reporting thyroid cytopathology was used for evaluation of cytological specimens [6].

Data and statistical analysis

Statistical analyses were performed by SPSS version 16 (SPSS Inc., Chicago, IL, USA). Univariate analysis was used for description of the findings and the Chi-square test and *t* test were used for comparison of the proportions and quantitative variables, respectively. Statistical significance was set at p value <0.05.

Results

General information

This study consisted of 290 patients undergoing carotid ultrasound over a 1 year period (September 2011 to September 2012). The mean (±standard deviation) age of the studied patients was 65 ± 11.8 (range: 30–91) years, including 167 (57.6%) males and 123 (42.4%) females.

Thyroid ultrasound results

Among 290 patients, 63 (21.8%) had thyroid abnormalities. Six patients (9.5%) had diffuse thyroid disease without distinct nodules and 57 patients (90.5%) had one or more thyroid nodule(s).

The mean (±SD) age of patients with thyroid abnormalities was statistically higher (67.8 ± 9.2 years) compared to patients with normal thyroid (64.3 ± 12.4 years, $p = 0.04$). The independent *t* test revealed that there was a statistically significant difference between the above group's age ($t = 2.056$, $p = 0.041$).

The female to male ratio was higher in patients with abnormal thyroid ultrasound (36/27) compared to patients with normal thyroid (87/140) ($p = 0.007$).

In patients with thyroid nodular disease, 34 (59.65%) had nodule(s) $\geq$ 10 mm. Analysis of echogenicity showed that 20 (31.7%) nodules were hypoechoic, 10 (15.9%) nodules were hyperechoic, and nine (14.3%) nodules were cystic (Table 1). The minimum size of detected thyroid nodules was 3 mm and the maximum size was

Table 1 Sonographic characteristics of most suspected nodules among abnormal nodular thyroids.

Variable (n = 57)	No. (%)
Cystic	9 (14.3)
Peripheral halo	5 (7.9)
Hyperecho	10 (15.9)
Heterogeneous	11 (17.5)
Isoecho	3 (4.8)
Hypoecho	20 (31.7)
Coarse calcification	4 (6.3)
Microcalcification	1 (1.6)

39 mm. The mean (±SD) diameter of nodules was 12.75 ± 7.68 mm.

None of the patients had blood thyroid stimulating hormone (TSH) level abnormalities.

Aspiration cytology results

We used a flowchart of the American Association of Clinical Endocrinologists for management of incidental thyroid abnormalities detected during carotid color Doppler [4]. FNA was suggested to all patients with a thyroid nodule >10 mm or any size with microcalcification. A total of 15 patients agreed to undergo FNA biopsy of the nodule.

In two cases, FNA biopsy samples were inadequate. Six patients had hyperplasia, two had thyroiditis (hyperplastic nodules with chronic thyroiditis), one had an adenomatous nodule, and one had a colloid nodule. Follicular lesions were reported in two patients and Hürthle cell neoplasm in one patient for FNA cytology (Table 2).

Three patients with thyroid nodules and suspicious cytology (2 follicular lesions and 1 Hürthle cell) were referred for surgery, but none of them underwent surgery due to age, dissatisfaction, and associated cardiovascular problems. The 6-month follow up of these three patients showed no change in nodule size. In our study, six patients had a diffuse heterogeneous thyroid gland without discrete nodules.

Discussion

Patients with TIA, a known stroke, some patients with vertigo, or candidates for coronary artery bypass graft usually undergo carotid (and vertebral) ultrasound. Occasionally, thyroid abnormalities are incidentally detected during ultrasound. The significance of these abnormalities is not known. Our study showed that 21.8% of patients had a thyroid abnormality and 19.6% had thyroid nodules.

Table 2 Cytopathologic results in patients who underwent fine-needle aspiration biopsy.

Variable (n = 15)	No. (%)
Inadequate	2 (13.3)
Hyperplasia	6 (40)
Thyroiditis	2 (13.3)
Adenomatous nodule	1 (6.7)
Colloid nodule	1 (6.7)
Follicular cell lesion	2 (13.3)
Hürthle cell neoplasm	1 (6.7)

The reported prevalence of incidental thyroid lesions during ultrasound for other reasons is highly variable and different from each other, depending on different demographics of the populations studied, differences in the underlying pathology, and the frequency of the transducer [7]. The prevalence of thyroid lesions that were incidentally detected during carotid ultrasound was 13.4% and 9.4% in studies by Carroll et al [8] and Steel et al [9], respectively. A higher prevalence of thyroid incidentalomas in our study may be related to iodine deficiency in the last decades in our country, when our patients were children. An iodine supplementation program was started in 1980 in Iran. It should be noted that several studies, including that by Knudsen et al [10], have emphasized that iodine status is a major environmental factor that determines goiter prevalence.

Due to the age of the patients in our study, the results of our study about prevalence, and ultrasonographic and cytological characteristics of thyroid incidentalomas cannot be generalized to the entire population.

In our study, we divided incidental thyroid abnormalities in to two groups: thyroid nodular incidentaloma and diffuse thyroid sonographic heterogeneities without discrete nodule(s).The society of radiologists in ultrasound consensus panel believe that FNA is likely unnecessary in diffusely enlarged glands with multiple nodules [11].

In our study, there was a significant relationship between age and nodular thyroid prevalence and as in all studies, the incidence of thyroid incidentaloma was higher in elderly patients.

Incidental thyroid nodules are more common in females than males. In our study, 57% of patients with thyroid abnormalities were female. In a study by Steel et al [9], 59% of patients were female and the mean age was 67.8 years.

The minimum size of detected thyroid nodules was 3 mm and the maximum was 39 mm, with a mean size 12.7 ± 7.7 mm. This was similar to the findings of the other study in the region, which found a mean size of 10.6 ± 7.9 mm [12]. In our study, 34 (54%) patients with thyroid abnormalities had thyroid nodule(s) > 10 mm in comparison to 27% in the study by Steel et al [9].

A total of 21 (33.4%) patients had nodule(s) with at least one suspicious grayscale ultrasonographic feature (solid hypoecho, microcalcification(s) in nodule, microlobulated or irregular border are suspicious according to previous studies) [13–16]. In a study by Taheri et al [12], 73.3% of thyroid nodules were hypoechoic. In that study, cystic and partially cystic thyroid nodules as well as the presence of microcalcifications were not mentioned and it is just divided into three groups. That may be the reason for the higher number of hypoechogenicity in this group. Also, in the study by Steel et al [9], nodules were only divided in two solid and cystic groups. It seems to be helpful to report detailed sonographic characteristics of incidental nodules, as these features have different powers to predict the risk of malignancy [5].

Nevertheless, suspicious nodules must be evaluated with FNAB [6]. In our study, 15 cases underwent FNA biopsy and

in two patients (13.33%), FNA biopsy samples were inadequate for cytology examination. Can and Peker [17] reported inadequate cytology in 27.2% of samples from FNA biopsy without US guidance, in comparison to 12.5% with US guidance. Also, Danese et al [18] reported inadequate samples in 8.5% of US guided FNA in comparison to 14.1% in FNA biopsy without US guidance.

In the study by Deandrea et al [19], 52% of histologically malignant nodules were found only with the aid of ultrasound-guided FNA biopsy.

FNA cytology results can be divided in to three groups in our study: two (13.3%) cases indeterminate, 10 (66.6%) benign, and three (20%) cases suspicious and need further evaluation (including follicular lesions and Hürthle cell neoplasm). In the study by Steel et al (9), 51.7% of specimens were benign, 20.7% were follicular, 17.2% were indeterminate, and 10.3% were malignant. In a study by Papini et al [13], from adequate FNA specimens, 76.3% lesions were benign, 18.1% suspicious, and 5.7% were malignant.

Previous studies, including some prospective studies, have suggested that the probability of malignancy in incidental thyroid nodules is low. Papini et al [13] revealed that the prevalence of cancer in nonpalpable thyroid nodules is 7.7%. Some of these detected cancers were occult thyroid carcinomas (microcarcinoma). These occult thyroid carcinomas may not need specific treatments. Many of them do not progress and some even regress without treatment [13,20].

In our experience, the cooperation of patients was poor, which was likely due to their higher age, associated cardiovascular diseases, and possibly more stress in the follow up of their new thyroid disease.

During this study, we aspirated only one suspicious nodule in each patient. Getting samples from all of the suspicious nodules leads to reduced false negative results [21].

In summary, although thyroid carcinoma is a relatively common disorder and hardly being found earlier, it leads to low morbidity and mortality. Patients who are referred for carotid ultrasound are relatively old, have major cardiovascular problems, low survival rates, and poor outcome. Therefore, their cooperation for thyroid incidentaloma follow up is poor. Due to additional cardiovascular problems, thyroid surgery may be a high risk in these patients. Further, most of the cases referred for surgery do not have a malignancy. The malignancy rate in patients that underwent surgery was 28.9% in the study by Papini et al [13].

We conclude that, in this preliminary study, thyroid evaluation during carotid ultrasound has little benefits.

Acknowledgments

This study was the postgraduate thesis of Aria Bahadori which was approved in the Faculty of Medicine in Mashhad University of Medical Sciences. The authors thank Mr Saeid Akhlaghi for analysis of the data.

This study was supported by the Faculty of Medicine and Deputy Research of Mashhad University of Medical Sciences.

References

[1] Gaitini D, Soudack M. Diagnosing carotid stenosis by Doppler sonography: state of the art. J Ultrasound Med 2005;24:1127—36.
[2] U-King-Im JM, Young V, Gillard JH. Carotid artery imaging in the diagnosis and management of patients at risk of stroke. Lancet Neurol 2009;8:569—80.
[3] Gough J, Scott-Coombes D, Fausto Palazzo F. Thyroid incidentaloma: an evidence-based assessment of management strategy. World J Surg 2008;32:1264—8.
[4] Gharib H, Papini E, Paschke R, et al. American Association of Clinical Endocrinologists, Associazione Medici Endocrinologi, and European Thyroid Association Medical Guidelines for Clinical Practice for the Diagnosis and Management of Thyroid Nodules. Endocr Pract 2010;16(Suppl 1):1—43.
[5] Gharib H, Papini E, Paschke R. Thyroid nodules: a review of current guidelines practices and prospects Eur J. Endocrinologist 2008;159:493—505.
[6] Cibas ES, Ali SZ. The Bethesda System for Reporting Thyroid Cytopathology. Am J Clin Pathol 2009;132:658—65.
[7] Turner HE, Moore NR, Byrne JV, et al. Pituitary, adrenal and thyroid incidentalomas. Endocr Relat Cancer 1998;5:131—50.
[8] Carroll BA. Asymptomatic thyroid nodules: incidental sonographic detection. AJR Am J Roentgenol 1982;138:499—501.
[9] Steel SR, Martin MJ, Mullenix PS, et al. The significance of incidental thyroid abnormalities identified during carotid duplex ultrasonography. Arch Surg 2005;140:981—5.
[10] Knudsen N, Laurberg P, Perrild H, et al. Risk factors for goiter and thyroid nodules. Thyroid 2002;12:879—88.
[11] Frates MC, Benson CB, Charboneau JW, et al. Management of thyroid nodules detected at US: society of radiologists in ultrasound consensus conference statement. Radiology 2005;237:794—800.
[12] Taheri MS, Hemadi H, Haghighatkhah HR, et al. Prevalence of incidental thyroid nodules diagnosed by ultrasound in an Iranian population. Iran J Radiol 2008;5:19—24.
[13] Papini E, Guglielmi R, Bianchini A, et al. Risk of malignancy in nonpalpable thyroid nodules: predictive value of ultrasound and color Doppler features. J Clin Endocrinol Metab 2002;87:1941—6.
[14] Frates MC, Benson CB, Doubilet PM, et al. Likelihood of thyroid cancer based on sonographic assessment of nodule size and composition. In: Paper presented at: 2004 Scientific Assembly and Annual Meeting Program of Radiological Society of North America; November 30, 2004. Chicago, USA.
[15] Peccin S, De Castro JAS, Furlanetto TW, et al. Ultrasonography: is it useful in the diagnosis of cancer in thyroid nodules? J Endocrinol Invest 2002;25:39—43.
[16] Chan BK, Desser TS, McDougall IR, et al. Common and uncommon sonographic features of papillary thyroid carcinoma. J Ultrasound Med 2003;22:1083—90.
[17] Can AS, Peker K. Comparison of palpation versus ultrasound guided fine needle aspiration biopsies in the evaluation of thyroid nodules. BMC Res Notes 2008;1:12.
[18] Danese D, Sciacchitano S, Farsetti A, et al. Diagnostic accuracy of conventional versus sonography — guided fine needle aspiration biopsy of thyroid nodules. Thyroid 1998;8:15—21.
[19] Deandrea M, Mormile A, Veglio M, et al. Fine needle aspiration biopsy of the thyroid comparison between thyroid palpation and ultrasonography. Endocr Pract 2002;8:282—6.
[20] Ross DS. Nonpalpable thyroid nodules-managing an epidemic. J Clin Endocrinol Metab 2002;87:1938—40.
[21] McGahan JP, Goldberg BB. Diagnostic ultrasound. 2nd ed. New York: Informa Healthcare; 2008. pp. 221—3.