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journal homepage: <http://www.ijporlonline.com/>Pediatric thyroid nodules: A single center experience^{☆, ☆ ☆}Jason Trahan^a, Abhita Reddy^a, Ellen Chang^a, Ricardo Gomez^a, Pinki Prasad^a, Anita Jeyakumar^{b, *}^a Louisiana State University-Health Science Center, 533 Bolivar Street Suite 566, New Orleans, LA 70112, United States^b Division of Otolaryngology, Virginia Tech-Carilion School of Medicine, 1 Riverside Circle, Roanoke, VA 24016, United States

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ABSTRACT

Objectives: 1. Analyze our center's experience with thyroid nodules. 2. Evaluate the efficacy of fine needle biopsy. 3. Compare our experience with the 2015 ATA guidelines.**Methods:** IRB approved retrospective chart review from July 1993–July 2014 at a tertiary pediatric institution. Patients under age 21 with documented thyroid nodules who underwent fine needle aspiration, and/or thyroidectomy were included.**Results:** 126 patients were identified. 84.1% (n = 106) were female. Age range was 12 months–20 years. The average age was 13.3 ± 4.1 years. The nodules ranged from 0.5 cm to 6 cm 53.9% (n = 68) had a fine needle biopsy done. 42.6% (n = 29) fine needle biopsies were benign, 26.5% (n = 18) were non-diagnostic, 13.2% (n = 9) were classified as “atypia”, 0.09% (n = 6) were consistent with thyroiditis, and 0.09% (n = 6) were suspicious for papillary carcinoma.

78.6% (n = 99) underwent surgery. 7 patients with “benign” needle biopsies underwent surgery: all had follicular adenoma. 7 patients with “atypia” needle biopsies underwent surgery: one patient had papillary thyroid cancer. 8 patients with non-diagnostic needle biopsies underwent surgery: one patient had papillary thyroid cancer. All the patients with needle biopsy suspicious for papillary carcinoma had papillary carcinoma on final pathology.

99 patients underwent surgery: 14.1% (n = 14) had papillary carcinoma and 2% (n = 2) had medullary carcinoma.

Conclusion: Our review of pediatric thyroid nodules at our institution supports data previously reported. 84% of identified patients were female, supporting previous data that nodules are more prevalent in the female population. Of the 126 patients identified, 12.7% had thyroid carcinoma, supporting the 7–25% range described in previous literature. Our institution showed a high positive predictive value of FNA for papillary thyroid carcinoma.

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1. Introduction

Thyroid carcinoma is a rare occurrence in the pediatric population [1], thus its reported incidence and prevalence has been inconsistent. It is the most common endocrine cancer in children

and constitutes 0.5–3% of all pediatric cancers [2]. The prevalence of palpable thyroid nodules in the pediatric population has been documented to be between 0.5 and 1.8% [2], however in post-mortem studies, incidental thyroid nodules in the same population has been shown to be approaching 13% [2]. Recent reports suggest an increased incidence of thyroid nodules and thyroid cancer over the last several decades [3,4]. Similar to adults, the majority of pediatric thyroid nodules are benign [1,5]. However, there has been a reported 3–5X increased risk of malignancy in pediatric thyroid nodules [5]. Pediatric thyroid malignancy has also been shown to have an increased risk of regional metastasis, making diagnosis and treatment increasingly important [6,7].

* Work was done at Louisiana State University-Health Science Center and Children's Hospital New Orleans.

** Some data was presented at the Annual Academy Meeting, September 2015.

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2. Objectives

Our goal was to analyze our centers experience in the diagnosis and management of pediatric thyroid nodules. We evaluated the efficacy of fine needle aspiration (FNA) relative to patient demographic information and final pathology. We also analyzed our current diagnostic strategy relative to the recently released pediatric thyroid cancer and nodule guidelines from the American Thyroid Association (ATA) [5].

3. Method

IRB approved retrospective chart review from July 1993 to July 2014, using the diagnosis code 241.9 from the International Classification of Diseases, Ninth Revision, Clinical Modification: ICD-9-CM 2015. Patients who underwent FNA, thyroidectomy, or both were included. The FNA was done under ultrasound guidance by the pathologist. Sedation was used if the patient was unable to tolerate the FNA with topical anesthesia. Patients over the age of 21 were excluded from the review (our institution sees patients up till age 22). Data collected included: age, gender, size of nodule (if documented), pathology on FNA, final pathology (after thyroidectomy), pre and post-operative TSH and free T4, and history of prior radiation exposure. Correlations were evaluated between the measures collected.

4. Results

A total of 125 patients were identified. The demographic information is summarized in Table 1. 84.8% (n = 106) were female. The age range of the patients was 12 months–20 years. The average age was 13.3 ± 4.1 years. The follow up range was 6 months–10 years; however, majority of the pre-Katrina patients were lost to follow up.

Presenting symptoms could be found for only the most recent 24 patients who underwent thyroidectomy. Twelve were referred for a palpable thyroid mass/nodule, 1 of these patients had papillary thyroid carcinoma on final pathology, and the rest were benign. Nine were referred for thyromegaly: 1 of these patients had papillary thyroid carcinoma; 1 patient was referred with a palpable neck mass, this patient had papillary thyroid carcinoma with nodal metastasis; 1 patient had thyroidectomy for Grave's disease and had benign pathology and one patient with history of Hashimoto's thyroiditis had a thyroidectomy with papillary thyroid carcinoma on final pathology. Presenting data is summarized in Table 2.

The nodules ranged in size from 0.5 cm to 6 cm 50.4% (n = 63) had an FNA performed. The FNA data is summarized in Table 3. 38.1% (n = 24) of fine needle biopsies were benign, 30.2% (n = 19) were non-diagnostic, 14.3% (n = 9) were classified as "atypia", 7.9% (n = 5) were classified as follicular lesions, and 9.5% (n = 6) were positive for thyroid carcinoma on FNA.

Table 1
Demographic information.

Total number of patients included	125
Female: Male ratio	5.5:1
Fine needle aspiration	66
Thyroidectomy	98
Hemithyroidectomy	53
Total thyroidectomy (initial)	32
Completion	4
Unknown (incomplete records)	13
Papillary thyroid carcinoma	14
Medullary thyroid carcinoma	2

Table 2
Presenting symptoms (24 most recent surgical patients).

Symptom	Benign pathology	Papillary thyroid carcinoma?
Thyroid mass/ Nodule	11/12	1/12
Neck mass	0/1	1/1
Thyromegally	8/9	1/9
Grave's disease	1/1	0/1
History of Hashimoto's	0/1	1/1

The 6 earliest patients in our study with thyroid carcinoma had no pre-operative imaging or FNA, and it appears that the decision for surgery was based solely on having a palpable nodule. Of the 24 with "benign" FNA, 15 went on to have surgery; none of these patients had thyroid carcinoma. 9 patients with non-diagnostic FNA went on to have surgery, 1 patient had papillary thyroid carcinoma. Of the 9 patients with "atypia" on FNA 8 had surgery, 1 patient had papillary thyroid cancer. All 5 patients with FNA showing a follicular lesion had thyroidectomies, none of these patients had thyroid carcinoma on final pathology. All 6 of the patients with FNA consistent with thyroid carcinoma had thyroidectomies, and all 6 had papillary thyroid carcinoma on final pathology. A "benign" FNA was 100% sensitive; a positive diagnosis of papillary carcinoma was 100% sensitive; however, if the FNA was reported as atypia or "non-diagnostic", our study showed an 11.1% malignancy rate.

78.4% (n = 98) patients included in this review underwent a hemithyroidectomy or total thyroidectomy. In the group of patients that had surgery, 54% (n = 53) initially had a hemithyroidectomy. 31 had a right-sided hemithyroidectomy and 22 had a left-sided. 4 right-side lobes and none of the left lobes were positive for thyroid carcinoma on final pathology. These 4 patients all went on to receive a completion thyroidectomy. 32.6% (n = 32) had an initial total thyroidectomy, 8 of these were positive for thyroid carcinoma on final pathology. In 13.3% (n = 13) of the surgical patients it was unclear, due to incomplete or lost records, whether the patient had a hemi or total thyroidectomy.

Within the 98 patients that underwent surgery, 14.3% (n = 14) had papillary carcinoma and 2% (n = 2) had medullary thyroid carcinoma. Our study found 12.8% (n = 16) of our patients to have thyroid cancer. 75% (n = 12) of patients diagnosed with thyroid malignancy were female.

5. Discussion

Pediatric thyroid nodules and thyroid carcinoma are rare entities in the pediatric population. However, recent reports suggest an increasing incidence over the last several years [3,4]. The recent ATA guidelines indicate that among 15–19 year olds, thyroid cancer is the 8th most frequently diagnosed cancer and the second most common cancer among girls [5]. Adolescents have a 10× greater incidence than younger children in the incidence of thyroid carcinoma, and there is a noted female to male preponderance (5:1) during adolescence that does not exist in younger children [5]. Documentation in both adults and children supports that females are at higher risk for developing thyroid nodules [8–10]. Our data was consistent with current reports: in our pediatric population, 84.8% of all patients identified were female and 75% of those with thyroid malignancy were female.

In our review, we identified 125 patients who underwent FNA, thyroidectomy, or both for palpable or incidentally found nodules. Our study found 16 (12.8%) of our patients to have thyroid cancer. 14 of the 16 were papillary and the remaining 2 were medullary

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