

ORIGINAL RESEARCH

Surgical treatment of thyroid nodules in paediatric patients: Pre-operative imaging, surgical management and post-operative care

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ABSTRACT

Background: Thyroid surgery is crucial for treating children with benign thyroid disorders, and imaging of thyroid nodules is a crucial component of the diagnostic process. **Objective:** Analysis of the clinical traits, surgical management, postoperative complications, and prognosis associated with thyroid surgery in children and adolescents is the goal. **Methods:** Retrospective clinical data analysis was done on children and teenagers who underwent thyroid surgery for benign thyroid illness or thyroid malignancy. Each tumor's pre-operative diagnostic characteristics were noted to distinguish benign from malignant tumors. We next discussed several surgical procedures for treating various thyroid problems as well as post-operative complications. **Results:** Information from 52 kids was assessed. Pre-operative imaging identified malignant (n=9), suspicious for malignancy (n=4), borderline (n=3), probably benign (n=6) and benign (n=15) cases. There was no statistical difference in the mean age between the benign and malignant groups and gender difference. 15 individuals had fine needle aspiration (FNA) as the sole diagnostic procedure without any later surgical intervention. Surgical procedure such as thyroid lobectomy, thyroidectomy, paratracheal neck dissection, neck dissection and partial pleurectomy was conducted in rest 37 patients. Unilateral vocal cord paralysis was observed in 1 patient after surgery. Other post-operative complications observed were localized wound infections and temporary hypoparathyroidism. **Conclusion:** This study showed that thyroid surgery and pre-operative imaging are safe and effective procedures that should only be performed by qualified radiologists and skilled surgeons. The preoperative evaluation and treatment of postoperative results and complications both depend heavily on paediatrician.

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INTRODUCTION

The frequency of solid thyroid nodules in children is believed to be between 1% and 1.7%, with the incidence of these nodules tending to rise as children become older [1]. The management of thyroid nodules poses a frequent difficulty for paediatricians. Thyroid abnormalities, such as nodules or cystic lesions, are observed in a significant proportion of children (ranging from 20% to 57%) who have neck ultrasounds for various reasons [2]. The prevalence of malignancy in a single thyroid nodule in children is

estimated to range from 19% to 26.4%, which is notably greater compared to the 5% incidence observed in adults [3]. Hence, it is important for healthcare practitioners in the field of paediatrics to possess a comprehensive understanding of the assessment and evaluation of thyroid nodules in children.

The differential diagnosis for thyroid nodules encompass a range of conditions, including structural, developmental, and non-neoplastic lesions, as well as benign and malignant neoplasms. It is of significance

to note that a considerable number of non-neoplastic thyroid nodules in children have a temporary nature, often leading to a reduction in size over a period of time [4]. It is crucial to acknowledge that nodules located in the upper poles of the thyroid gland are often not detectable by touch, even when they are of considerable size [5]. Incidentally detected non-palpable nodules identified through imaging techniques exhibit a relatively low malignancy rate of 4% [6]. The 2015 guidelines established by the American Thyroid Association (ATA) do not provide any specific recommendation regarding the utilisation of ultrasound as a screening tool. Prior to the recent publication of paediatric recommendations [7], the approach to managing thyroid carcinoma in children mostly relied on extrapolating from adult guidelines by ATA.

Nevertheless, it is important to note that the clinical manifestation and behaviour of tumours might vary considerably in paediatric patients. These differences may include bigger tumour size, early infiltration of the tumour capsule, and more widespread lymph node involvement [8]. The utilization of fine-needle aspiration biopsy (FNAB) continues to be the primary approach in the diagnostic evaluation of thyroid nodules, and it has been extensively established as the most effective technique for distinguishing between benign and malignant thyroid nodules. Furthermore, thyroid scintigraphy offers valuable functional imaging data that plays a crucial role in the diagnostic evaluation of thyroid nodules and in the subsequent monitoring of malignancies. Ultrasound sonography, computed tomography (CT), and magnetic resonance imaging (MRI) play a crucial role in the preoperative assessment of thyroid goitres and thyroid cancer. The management of thyroid nodules and cancer is centred on the implementation of suitable surgical procedures, the mitigation of potential problems, and the application of adjuvant medication in certain situations [9].

The purpose of this study is to provide a description of the patient features of paediatric thyroid nodules and well-differentiated thyroid cancer as observed in our institution. Additionally, we aim to provide our experience in the diagnosis and therapy of all kind of thyroid tumors in the paediatric population.

MATERIALS AND METHODS

Patient selection

We performed retrospective evaluation of patients who underwent thyroid fine needle aspiration (FNA) or thyroid surgery. The age range of the patients included in the study was from birth to 18 years. A cohort of 52 individuals diagnosed with thyroid nodules received medical care at Pediatric department. The research omitted one patient with medullary thyroid cancer, as well as three individuals who were excluded due to either receiving prior treatment elsewhere or transferring their care to another institution after the initial biopsy.

Pre-operative imaging techniques

Prior to undergoing surgery, all patients had imaging procedures, including ultrasound sonography (US) examinations of the thyroid and neck, as per the recommendation outlined in the ATA guideline [7]. In addition, seven patients had MRI to assess regional lymph nodes subsequent to the first US. However, none of the MRIs yielded supplementary findings or led to modifications in surgical recommendations. Four patients who had substantial neck disease were also subjected to chest Computed Tomography (CT) scans without the use of contrast agents in order to assess the presence of lung metastases, all of which yielded negative results. The ultrasound examination revealed the presence of lymph nodes with suspicious features, including enlarged size, rounded morphology, absence of central hilum, cystic appearance, presence of peripheral vascularity on Doppler imaging, and micro-calcifications [10].

Clinical staging

Each thyroid nodule was prospectively classified into 1 of 5 diagnostic categories by real-time US: "malignant," "suspicious for malignancy," "borderline," "probably benign," and "benign" [11]. Number of patients in each clinical stage is presented in Table 1. We evaluated the diagnostic accuracy of thyroid US and the cut-off US criteria by comparing the ultrasound sonography diagnoses of thyroid nodules with cytopathologic results.

Clinical staging	n (%)	Imaging features of tumor
Malignant	9 (17.3)	Lack of a cystic lesion or the halo sign, an uneven form, hypoechogenicity, heterogeneity, an undefined border, the presence of calcification, and invasion of nearby organs are all characteristics of this lesion.
Suspicious for malignancy	4 (7.7)	Microcalcifications, a taller-than-wide form, rim calcifications with a tiny extrusive soft tissue component, and irregular edges (infiltrative, microlobulated) are all signs of extrathyroidal expansion.
Borderline	3 (5.7)	Solid nodules that are isoechoic or hyperechoic, partly cystic with eccentric solid parts, devoid of microcalcification, with irregular margins or extrathyroidal expansion, or with a form that is taller than broad
Probably benign	6 (11.5)	Without any of the sonographic characteristics mentioned in low, middle, or high suspicion patterns, spongiform or partly cystic nodules

Benign	15 (28.4)	Cystic lesions, devoid of any solid components
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Surgical intervention

The surgical procedure was carried out by highly skilled head and neck surgeons who possess expertise in thyroid surgery for adult patients, as well as extensive understanding in pediatric otorhinolaryngology. The monitoring of the recurrent laryngeal nerves was conducted as a standard practice both before and after the surgical procedures in all individuals. The pediatric endocrinologists from the Department of Pediatrics conducted thyroid ultrasound and ultrasound-guided fine-needle aspiration (FNA) on a thyroid nodule. The demographic and preoperative data encompassed several variables, namely the annual patient count, age distribution, average age, specific surgical procedures performed and any associated problems. In this study, we conducted a retrospective analysis to examine the various surgical procedures performed for thyroid problems in pediatric patients. Our objective was to assess if thyroid surgery in children yields comparable outcomes and morbidity rates to those observed in adults, as described in current literature. The data presented in this study are provided as medians accompanied by ranges.

RESULTS

The mean age at presentation was 13.1 years in all patients who underwent thyroid surgery, with a range of 5 to 18. There was no statistical difference in the mean age between the benign and malignant groups (14.3 and 11.8 years respectively) (Table 1). When gender differences were analyzed, there was no predominance as total male patients were 24 versus 28 patients.

Out of the total sample size of 52 pediatric patients, 15 individuals had fine needle aspiration (FNA) as the sole diagnostic procedure without any later surgical intervention, while the other 37 patients underwent

thyroid surgery. Among the surgical group, 21 cases were identified as benign, while 16 cases were confirmed to be malignant. Table 2 displays the characteristics of the patients and the sizes of their tumors. Out of the total of 15 patients who had fine-needle aspiration (FNA) alone, five samples were originally deemed non-diagnostic. It is worth noting that all of these procedures were conducted with the assistance of ultrasound (US) guidance. Among these cases, two patients underwent additional fine-needle aspiration (FNA) procedures, which revealed benign cytology. Additionally, two patients presented with cystic nodules that disappeared following aspiration. Lastly, one patient was lost to follow-up after the initial FNA. The cytological analysis of the other ten samples indicated benign findings according to the Bethesda classification. These findings included six cases of benign nodules, two cases of colloid nodules, and two cases of lymphocytic thyroiditis. Thirty-seven patients who had undergone post FNI tumor removal surgery were included in the study, with tumors classified as either benign or malignant (Table 3). Within the benign cohort, a total of 10 individuals received thyroid lobectomy, while 5 patients got complete thyroidectomy. These procedures were performed to address the presence of large multinodular goiters accompanied by symptoms of compression. In addition to the removal of the benign tumor, three cases of paratracheal neck dissection, two cases of selective neck dissection, and one case of sternotomy and partial pleurectomy were performed. Among the cohort of patients diagnosed with malignancy, a total of 7 individuals had lobectomy, while 4 individuals first underwent complete thyroidectomy, followed by paratracheal neck dissection in 2 cases, selective neck dissection in 2 cases, and Sternotomy and partial pleurectomy in 1 case.

Table 2: Baseline patient demographics and tumor characteristics

Characteristic	FNA-only	Benign	Malignant
Number of Patients	15	21	16
Age at diagnosis (years)			
Mean (SD) [range]	13.2 (2.6) [6–18]	14.3 (2.8) [5–17]	11.8 (2.9) [7–18]
Gender			
Male	5	12	7
Female	10	9	9
Tumor size, cm			
< 2	9	13	6
2–4	4	6	7
> 4	2	2	3
US characteristics			
Cystic components	5 (33.3 %)	8 (38.1 %)	1 (6.3 %)

Table 3: Surgical procedures conducted in paediatric patients

Surgical procedure	Number of patients	
	Benign (n=21)	Malignant (n=16)
Lobectomy	10	7
Total thyroidectomy	5	4
Paratracheal neck dissection	3	2
Selective neck dissection	2	2
Sternotomy and partial pleurectomy	1	1

Postoperative complications

These complications can encompass a wide range of medical issues that arise in relation to surgical complications, a total of 37 patients who had thyroidectomy were observed, among whom two cases exhibited unilateral vocal cord paralysis. The occurrence of substantial extra-capsular dissemination with direct tumor involvement (T4) of the recurrent laryngeal nerve was expected during the surgical procedure. The patient in question experienced persistent hypoparathyroidism due to significant central neck involvement, making them the sole individual in the research cohort to encounter this particular problem.

A limited number of postoperative problems were seen, primarily consisting of localized wound infections that were successfully treated with the administration of antibiotic treatment. Among the cohort of 11 patients, constituting 22% of the total sample, it was observed that temporary hypoparathyroidism exhibited improvement subsequent to calcium therapy. Conversely, in the case of 2 patients, constituting 4% of the sample, hypoparathyroidism persisted as a permanent condition. Postoperative radioactive iodine ablation was administered to all individuals diagnosed with thyroid cancer. The patient had recurrent lymph node metastases and lung metastasis after to the first cervical therapy.

All patients received TSH suppression treatment with the goal of achieving a TSH level below 0.1mIU/L. The patients were monitored by the utilization of blood thyroglobulin (Tg), neck ultrasonography (US), and whole-body scanning (WBS). The patient was deemed to be disease-free during the follow-up period if the basal thyroglobulin (Tg) level was below the detectable limit of 0.2 ng/mL, and the stimulated Tg level was below 1 ng/mL (achieved by either T4 withdrawal or Thyrogen administration). Additionally, both the ultrasound (US) and whole-body scan yielded negative results.

DISCUSSION

Paediatric thyroid illness is uncommon and shows variations in pathogenesis, clinical presentation, and long-term consequences [12]. Thyroid cancer is the eighth most common cancer diagnosed in adolescents between the ages of 15 and 19 and the second most common cancer among girls. Papillary thyroid cancer, which accounts for >90% of juvenile cases, is the most prevalent malignancy in kids. Thiamazole

antithyroid medication therapy is the first line of treatment for Grave's disease in children. Due to reports of propylthiouracil-induced vasculitis and fast progressing PTU liver failure with a poor likelihood of reversibility, PTU should not be administered to pediatric patients [13]. Radioactive iodine therapy is a safe and effective treatment, but it has a significant risk of developing thyroid cancer, hypothyroidism, or gonadal damage as a result of radiation exposure. As a result, its usage as first therapy is declining [14]. Paediatric patients with a big goiter aggravating thyroid cancer prefers to achieve remission sooner rather than later or if they are unable to take antithyroid medications, surgical therapy for Graves' disease is advised. Unfortunately, children often experience more difficulties after surgery, greater recurrence rates, and need lifetime thyroid hormone replacement [15].

The primary therapy for thyroid cancer in children and adolescents, thyroid surgery is crucial for the management of benign thyroid illnesses in these age groups. Locoregional lymph node metastases are the typical initial presentation of well-differentiated thyroid carcinoma, however this does not impact the patients' prognosis. The majority of patients (62.7%) in the surgical group underwent FNA on the main thyroid nodule before surgery. We are beginning to implement the 2015 pediatric recommendations' suggestion to get cytological confirmation of metastatic disease to lymph nodes in the lateral neck prior to surgery now that Tg test from FNA washout is now available at our facility [7]. FNA was made available before all thyroid operations and to all patients with thyroid nodules where it was appropriate. We initially used imaging tools to determine the type of thyroid tumor. When compared to published statistics, our institution's rate of malignancy appears to be rather high in the benign and undetermined categories [16]. The Bethesda staging system's published data is based on adult populations with a 5–15% malignancy risk, however in our cohort, more than 50% of surgically excised nodules were benign. We continue to maintain that FNA should always be done before surgery, as suggested in the just-released pediatric guidelines [7]. 17 kids had lobectomies, while 9 kids with thyroid tumors had complete thyroidectomies. For individuals with stage N1 lymph node involvement, our method advised lymph node dissection. Because adolescents and adults have a greater incidence of lymph node metastases, prophylactic dissection on N0 patients

may be advised. According to Mao et al., papillary thyroid carcinoma in children has a good prognosis since cervical lymph node metastases is not a standalone factor and can result in postoperative problems during neck dissection. We concur with this conclusion.

The number of complications in our study was comparable to those reported in previous publications [17-19] and included temporary hypoparathyroidism in 19.0% of patients, permanent hypoparathyroidism in 3.4% of patients, one permanent unilateral recurrent nerve palsy, and one unilateral excision of accessory nerve. Radioiodine treatment was used as postoperative care for all of our cancer patients. Only one patient developed lung metastases and recurrent lymph nodes. There were no signs of recurrent illness or disease progression from the baseline at the time of diagnosis throughout follow-up for any additional individuals.

Additionally, we discovered that the prognosis was good for kids and teenagers who first presented with a sizable tumor with cervical lymph node metastases. All thyroid cancer patients received standard replacement treatment, postoperative radioactive iodine therapy, and ongoing follow-up. Total and partial thyroidectomy was shown to be an effective and safe operation for treating thyroid illness in children and adults. Postoperative complications from surgery for benign disease and thyroid cancer also had a similar result profile as those described by different authors. Finally, based on our findings, thyroid tumor care in children may be successfully completed with pre-operative imaging methods, a surgeon with extensive expertise in adult thyroid surgery, and competency in paediatric pharmacotherapy.

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