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Research Article

Correlation Between Histopathological and Ultrasonographic Patterns in Thyroid Nodules at a Tertiary Hospital

Witrago Núñez LI[1]*, Zempoalteca Mendoza J[1], Hernández Lara González FE[2], Cholula Alarid R[3], Soancatl Rodríguez LG[3], Porras Aguilar E[3], Jiménez Céspedes S[4], Rosas Alfonso TA[5] and Martínez Tovilla Y[6]

[1]Attending Physician, Department of Pediatric Radiology, Hospital para el Niño Poblano, Puebla, México

[2]Attending Physician, Department of Pediatric Nephrology, Hospital para el Niño Poblano, Puebla, México

[3]Medical Social Service, Faculty of Medicine, Benemérita Universidad Autónoma de Puebla (BUAP), México

[4]Director of Hospital para el Niño Poblano, Puebla, México

[5]Deputy Director of Hospital para el Niño Poblano, Puebla, México

[6]Department of Pediatrics, Faculty of Medicine, Benemérita Universidad Autónoma de Puebla, (BUAP)/Mexican Burn Association, Chief of Education and Research, Hospital para el Niño Poblano, Puebla, México

***Corresponding Author:** Witrago Núñez LI, Attending Physician, Department of Pediatric Radiology, Hospital para el Niño Poblano, Puebla, México.

Received: May 15, 2024; **Published:** May 30, 2024

Abstract

Introduction: Primary Immune Deficiencies (PID) of rare, under-determined diseases particularly in sub-Saharan Africa. Our aim was to share the results of the follow-up of these patients.

Patients and Methods: We conducted a descriptive and analytical cross-sectional study at the Albert Royer National Children's Hospital in Dakar, in collaboration with other pediatric departments and the Immunology laboratory of the National Blood Transfusion Center. We included all patients received with suspected PID, from 2014 to 2021, after ruling out HIV infection. The diagnostic criteria were the recommendations of the Moroccan Society of Immunology. We did not include patients with incomplete data. A complete blood count was performed in all patients. Further explorations were carried out depending on the orientation. The data was analyzed with Excel 10.

Results: Out of 32 patients registered, 16 were included in a follow-up consultation (50%). The sex ratio was 0.6 and the mean age at diagnosis was 51.1 months. Inbreeding was observed in half of the patients (8/16). The warning signs were mainly infectious (11/16). The other symptoms were dermatological, such as eczema and warts (3/16), but also neurological, type ataxia (3/16). Anemia was observed in 12/16 children, lymphopenia in 4/16 children. Protein electrophoresis was performed in 10/16 children, immunoglobulin weight determination in 4/16 children and lymphocyte immunophenotyping in 10/16 patients. The main PIDs diagnosed were congenital neutropenia (3/16), severe combined immune deficiencies or SCID (3/16), telangiectasia ataxia (3/16), hypogammaglobulinemia (2/16), verruciform epidermodysplasia (2/16), Wiskott-Aldrich syndrome (1/16), chronic septic granulomatosis (1/16), Evans syndrome (1/16). The course was marked by relapses-remissions in 6/16 patients and discontinuation of follow-up in (5/16 patients). Bronchiectasis was observed in 2 patients, with secondary bacterial and fungal infections and digital hypocratism. 100% mortality was observed in carriers of SCID and Telangiectasia ataxia.

Conclusion: PIDs are suspected based on atypical clinical signs. Confirmation is difficult in low income countries. The development is marked by a risk of complications or death, hence the need to strengthen clinical-biological collaboration.

Keywords: *Primary Immune Deficiencies; Sub-Saharan Africa*

Introduction

The thyroid nodule is a focal lesion located within the thyroid gland whose characteristics and consistency differ from the rest of the glandular parenchyma [1]. In about 2% of pediatric patients, thyroid nodules can be found by palpation of the neck, most of them are usually benign and asymptomatic [2]. Thyroid nodules tend to be less frequent in pediatrics (0.05 - 5.1% prevalence), however, it has been shown that the percentage of malignancy is higher in children than in adults, with a percentage of 10 - 50% compared to adults with 5 - 10% malignancy [2].

The predisposing factors most related to the appearance of thyroid nodules and/or multinodular goiters are deficiency of iodine intake, mutations of the DICER 1 gene, among the congenital causes stand out the persistence of transient structures of the head and neck embryogeny such as brachial clefts, persistent thyroglossal duct, other causes of cervical masses are reactive adenopathies, vascular tumors (hemangiomas), laryngoceles, granules (mucoceles) teratomas or dermoid cysts [3].

Any pediatric patient with a history of head and neck irradiation or family history of thyroid cancer or associated pathological lymphadenopathies should be studied even if the lesion is smaller than 1 cm [3].

It is necessary to consider studying the nodules with ultrasound or fine needle aspiration puncture of all suspicious nodules, not only the largest, as this could lead us to under diagnose malignant nodules [4]. The most prevalent clinical presentation is the solitary nodule (33 - 77%) and the multinodular presentation (29 - 53%); in the case of thyroid nodules, the most common presentation is papillary carcinoma with a frequency of 90% [5].

The American Thyroid Association (ATA) and the American Association of Clinical Endocrinologists (AACE) published classification guidelines by ultrasound findings. ATA has 5 categories: high suspicion, intermediate suspicion, low suspicion, very low suspicion and malignancy. AACE proposes 3 categories, high risk, intermediate risk and low risk [6].

The American College of Radiology proposes the TI-RADS management to report the findings of the thyroid gland according to its appearance by ultrasound, it has 5 risk categories, each finding has a score and according to its sum gives us a risk level of TR1-TR5, each level has a management and follow-up recommendation [7].

Methods

This study was a qualitative, retrospective observational study conducted at the Hospital para El Niño Poblano (HNP), Puebla, México from December 2020 to December 2023. The study included pediatric patients aged 1 to 17 with thyroid nodules who met the inclusion criteria and underwent ultrasound and biopsy. The sample was non-probabilistic and convenience-based, focusing on patients with nodules classified as TI-RADS 4 or TI-RADS 5 and histopathological results. Variables analyzed included age, sex, histopathological report, histological type, nodule composition, echogenicity, shape, margin, echogenic foci, and vascularity. Data were extracted from electronic medical records, compiled into an Excel database, and analyzed using IBM SPSS Statistics version 25 with descriptive statistics (frequencies, percentages, central tendency, and dispersion measures) and Fisher's exact test.

Results

22 pediatric patients underwent percutaneous biopsy for thyroid nodules, with 5 excluded due to a lack of histopathological reports, resulting in a final sample of 17 patients. The patients ranged in age from 1 to 20 years, with a mean age of 11 years and a mode of 15 years. The standard deviation was 5.537, and the cohort included 9 females and 8 males (Table 1).

Description	Value
Total Patients Included	22
Patients Excluded (No histopathological report)	5
Final Sample Size	17
Mean Age (years)	11
Mode Age (years)	15
Standard Deviation of Age	5.537
Minimum Age (years)	1
Maximum Age (years)	20
Number of Female Patients	9
Number of Male Patients	8

Table 1: *Demographic characteristics.*

Ultrasound characteristics

The ultrasound characteristics of the thyroid nodules assessed in the study included a composition predominantly of solid nodules (12), with three being mixed and two cystic. The most frequent echogenicity observed was hyperechogenicity in seven patients, followed by isoechogenicity in six and hypoechogenicity in four. Regarding shape, 16 nodules were wider than they were tall, with only one presenting as taller than wide. Most nodules (15) exhibited defined margins, whereas one displayed lobulated margins, and another had an extra-thyroidal extension. Calcifications were detected in just one of the nodules, with the remaining 16 showing no calcifications. Vascularity, assessed post-color doppler, was noted in only one nodule, absent in the others. The ultrasound characteristics of the thyroid nodules assessed in the study included a composition predominantly of solid nodules (12), with three being mixed and two cystic. The most frequent echogenicity observed was hyperechogenicity in seven patients, followed by isoechogenicity in six and hypoechogenicity in four. Regarding shape, 16 nodules were wider than they were tall, with only one presenting as taller than wide. Most nodules (15) exhibited defined margins, whereas one displayed lobulated margins, and another had an extra-thyroidal extension. Calcifications were detected in just one of the nodules, with the remaining 16 showing no calcifications. Vascularity, assessed post-Color Doppler, was noted in only one nodule, absent in the others. The pathology results from the 17 biopsied nodules indicated a range of conditions: one case of thyroiditis, two inflammatory infiltrates, nine nodular hyperplasias, two papillary carcinomas, two multinodular goiters, and one follicular adenoma (Figure 1 and 2).

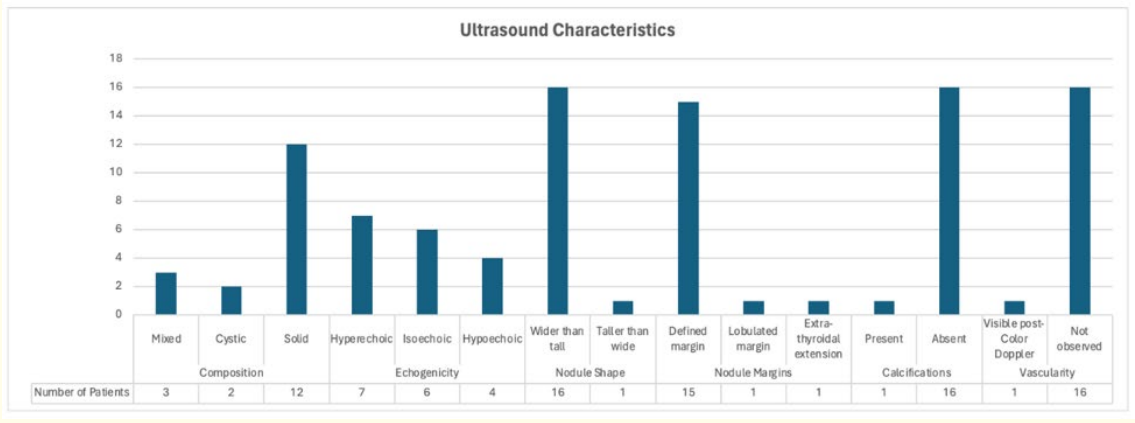

Figure 1: *Ultrasound characteristics.*

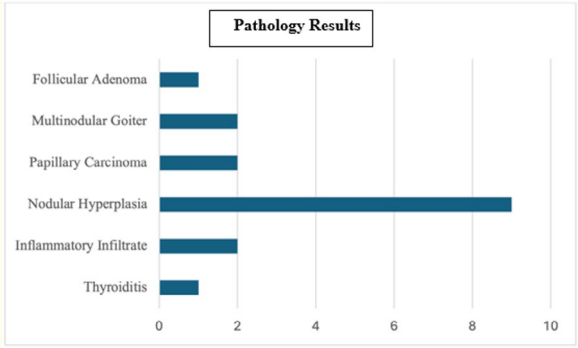

Figure 2: *Pathology results.*

Association of ultrasound findings associations with pathological results

The right thyroid lobe was predominantly affected, involved in 64.7% of cases, with nodular hyperplasia being the most common pathology at 41.2%, and including papillary carcinoma in 11.8% of cases, corresponding to two patients with malignant outcomes. Hyperechogenicity was the most variable and frequent echogenic characteristic, present in 41.2% of patients, mainly associated with nodular hyperplasia, followed by isoechogenic nodules at 23.5% and both hypoechoic and hyperechoic nodules associated with malignancy represented 5.9% each. Solid nodules constituted 70.6% of cases and were predominantly linked to nodular hyperplasia (35.3%) and exclusively to papillary carcinoma. Regarding nodule margins, 88.2% had defined margins with two malignancies identified; one had defined margins, and another featured extra-thyroidal extension, notable for its association with papillary carcinoma. Lobulated margins appeared in 5.9% of nodules but were related to nodular hyperplasia. Ultrasound features like orientation and calcifications showed no significant changes related to benign pathologies; however, a wider-than-tall orientation was observed in 94.1% of studies, contrasting with a taller-than-wide orientation exclusively found in papillary carcinoma cases, which also showed calcifications in the one nodule that had them. Vascularity was minimally indicative of malignancy, observed in only 5.9% of cases and associated with nodular hyperplasia (Table 2).

Association of pathology results								
		Follicular Adenoma	Multinodular Goiter	Papillary Carcinoma	Nodular Hyperplasia	Inflammatory Infiltrate	Thyroiditis	Total
THYROID LOBE	Right	1 (5.9%)	0 (0%)	2 (11.8%)	7 (41.2%)	0 (0%)	1 (5.9%)	11 (64.7%)
	Left	0 (0%)	2 (11.8%)	0 (0%)	2 (11.8%)	2 (11.8%)	0 (0%)	6 (35.3 %)
	Total	1 (5.9%)	2 (11.8%)	2 (11.8%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	17 (100%)
ECHOGENICITY	Hyperechoic	0 (0%)	1 (5.9%)	1 (5.9%)	4 (23.5%)	1 (5.9%)	0 (0%)	7 (41.2%)
	Hypoechoic	0 (0%)	0 (0%)	1 (5.9%)	1 (5.95%)	1 (5.9%)	1 (5.9%)	4 (23.5%)
	Isoechoic	1 (5.9%)	1 (5.9%)	0 (0%)	4 (23.5%)	0 (0%)	0 (0%)	6 (35.3%)
	Total	1 (5.9%)	2 (11.8%)	2 (11.8%)	9 (52.9%)	1 (5.9%)	1 (5.9%)	17 (100%)
COMPOSITION	Mixed	0 (0%)	0 (0%)	0 (0%)	2 (11.8%)	1 (5.9%)	0 (0%)	3 (17.6%)
	Quistic	0 (0%)	1 (5.9%)	0 (0%)	1 (5.95%)	0 (0%)	0 (0%)	2 (11.8%)
	Solid	1 (5.9%)	1 (5.9%)	2 (11.8%)	6 (35.3%)	1 (5.9%)	1 (5.9%)	12 (70.6%)
	Total	1 (5.9%)	2 (11.8%)	2 (11.8%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	17 (100%)
MARGINS	Defined	1 (5.9%)	2 (11.8%)	1 (5.9%)	8 (47.1%)	2 (11.8%)	1 (5.9%)	15 (88.2%)
	Extra-thyroidal	0 (0%)	0 (0%)	1 (5.9%)	0 (0%)	0 (0%)	0 (0%)	1 (5.9%)
	Lobulated	0 (0%)	0 (0%)	0 (0%)	1 (5.95%)	0 (0%)	0 (0%)	1 (5.9%)
	Total	1 (5.9%)	2 (11.8%)	2 (11.8%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	17 (100%)
ORIENTATION	Taller than wide	0 (0%)	0 (0%)	1 (5.9%)	0 (0%)	0 (0%)	0 (0%)	1 (5.9%)
	Wider than tall	1 (5.9%)	2 (11.8%)	1 (5.9%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	16 (94.1%)
	Total	1 (5.9%)	2 (11.8%)	2 (11.8%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	17 (100%)
CALCIFICATIONS	Absent	1 (5.9%)	2 (11.8%)	1 (5.9%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	16 (94.1%)
	Present	0 (0%)	0 (0%)	1 (5.9%)	0 (0%)	0 (0%)	0 (0%)	1 (5.9%)
	Total	1 (5.9%)	2 (11.8%)	2 (11.8%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	17 (100%)
VASCULARITY	Absent	1 (5.9%)	2 (11.8%)	2 (11.8%)	8 (47.1%)	2 (11.8%)	1 (5.9%)	16 (94.1%)
	Present	0 (0%)	0 (0%)	0 (0%)	1 (5.95%)	0 (0%)	0 (0%)	1 (5.9%)
	Total	1 (5.9%)	2 (11.8%)	2 (11.8%)	9 (52.9%)	2 (11.8%)	1 (5.9%)	17 (100%)

Table 2: *Association of pathology results.*

Discussion

This study included 22 patients who underwent percutaneous biopsy, of which 5 had to be excluded due to lacking histopathological reports. With ages ranging from 1 to 20 years, our sample size is small compared to other studies; Papendieck., *et al*. [8] included 106 cases under 19 years, while Broggi Ruiz., *et al*. [9] analyzed 66 cases under 17 years.

In our findings at HNP, a higher number of cases were observed in females, consistent with Papendieck., *et al*. [8] where 80.1% were females, and Broggi Ruiz., *et al*. [9] reported 78.8% cases in females, with mean ages of 13.6 and 10.94 years, respectively, like our study.

Broggi Ruiz., *et al*. [9] reported in their study that the main location of nodules was the right lobe in 43.9% cases, and Joseph-Luna., *et al*. [10] similarly reported the right lobe as the primary site in 49% cases, consistent with our findings.

Regarding the ultrasound characteristics of thyroid nodules, González-Flores., *et al*. [11] reported 83% cases with decreased echogenicity, 12% isoechoic, and only 5% hyperechoic, contrasting with our findings of a higher number of hyperechoic cases. Similarly, González-Flores., *et al*. [11] mentioned that 37 cases had solid composition, aligning with our study. Papendieck., *et al*. [8] found nodular hyperplasia as the main histological finding in 47 cases, coinciding with HNP's findings.

Papendieck., *et al*. [8] found that among ultrasound findings significantly associated with malignancy were solid nodules with poorly defined or irregular margins, intranodular microcalcifications, and pathological cervical lymph nodes, aligning with HNP's findings in solid composition, presence of microcalcifications, and extrathyroidal margins, though it should be emphasized that only two cases were reported with these characteristics.

The majority of our cases were benign, consistent with Broggi Ruiz., *et al*. [9] who reported 40 benign and 26 malignant cases, and Papendieck., *et al*. [8] reporting 83% benign cases with all malignancies being papillary carcinoma.

Conclusion

Ultrasound is a fundamental tool in the management of thyroid nodules in pediatric patients, as it allows for a detailed and precise evaluation of the thyroid gland and its potential abnormalities. Additionally, it is a safe, non-invasive, and cost-effective tool; however, the reliability of its results depends on the skill and experience of the operator.

Its ability to distinguish between benign and malignant lesions is still controversial, as despite providing information on the morphology and characteristics of the nodule, a definitive relationship between these findings and prognosis has not been established.

Nevertheless, this study serves as a precursor for the development of new protocols based on these results, aiming to establish criteria with a positive predictive value for malignancy, which should be confirmed with histopathological results.

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Volume 13 Issue 6 June 2024