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Detection of Complications Resulting from Thyroid Surgery in Iraqi Children

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Abstract: Background: Thyroid surgery is rare in paediatrics, although its frequency has increased in recent years. Objective: The aim of this study is to analyse the clinical outcomes of these procedures in a paediatric surgical center. Patients and methods: We recruited 40 pediatric patients who underwent thyroid surgery, aged between 4 and 13 years, and collected clinical and surgical data in terms of preoperative histological examination, surgical outcomes, complications, and risk factors related to postoperative patients. Results: Our study enrolled illnesses of children who underwent to total thyroidectomy surgery were 30 cases which have Multinodular thyroid goiter was 22.5%, Graves' disease was 20%, while illnesses of children who underwent to lobectomy surgery was 7 cases, which include benign nodules was 7.5%, uninodullar thyroid goiter was 5%, and central neck dissection (CND) was 3 cases, surgery time, min was 94.42 ± 46.78, blood loss (mL) was 184.61 ± 116.72, blood transfusion included 5 cases, length of stay in hospital ≤ 2 days was 85% of patients, length of stay in hospital > 2 days was 15% of patients, Intensive care unit admission was 4 cases, the mortality rate was 2 cases, postoperative complications was 10 cases. Our findings shown the quality of life, which identify into physical function, was 93.10 ± 2.56, social and emotional aspects were 87.38 ± 4.80, psychology function was 82.63 ± 5.89, and daily activity aspect was 84.44 ± 6.91. Conclusion: Our current study reported that total thyroidectomy is the preferred, most effective, and safest method of treatment for children, which has contributed to improved quality of life, fewer complications, shorter operative time, and reduced adverse long-term outcomes.

Keywords: Thyroid surgery; Children; Post–operative complications; Quality of life; Histological examination.

INTRODUCTION

The thyroid gland is an endocrine organ whose main function is to perform the synthesis of thyroid hormones that control the metabolism of the human body. For this, the thyroid requires iodine, which can only be obtained from food sources [Utria, A. F. *et al*., 2020]. The thyroid gland is located in the lower and anterior part of the neck in front of the cervical trachea, just below the cartilages that make up the larynx: the thyroid and the cricoid [Alkhars, A. *et al*., 2019; Wémeau, J.-L. *et al*., 2011]. The gland is characterized by having an isthmus, the right lobe, and the left lobe, these are not symmetrical to each other [Wémeau, J.L. *et al*., 2011]. Closely associated with the thyroid gland, on the back are located small oval glands called parathyroid glands responsible for regulating the metabolism of calcium and phosphorus in the body through the parathyroid hormone (PTH) [Niedziela, M. *et al*., 2006 – Ritter, A. *et al*., 2020]. The internal composition of the thyroid gland is very peculiar and varies depending on its functional state [Brauckhoff, M. *et al*., 2002]. The functional units of the thyroid are the thyroid follicles, spherical structures formed by a single layer of cubic epithelial cells surrounded by a basement membrane [Legré, M. *et al*., 2020]. Epithelial cells are specialized in synthesizing and secreting the thyroid hormones that contain iodine: Thyroxine (T4) and triiodothyronine (T3) [Francis, G. L. *et al*., 2015]. These hormones are responsible for regulating the rate of basal metabolism and significantly influence the growth and maturation, especially of nervous tissue. The follicles are also filled with a glycoprotein complex called thyroglobulin (thyroid colloid), in which the hormones are stored before their secretion [Schneider, R. *et al*., 2018 – Breuer, C. *et al*., 2013]. When the thyroid gland is not able to produce enough thyroid hormone, the so-called hypothyroidism originates. On the contrary, when an excess occurs, hyperthyroidism originates. [Puri, P. *et al*., 2019]

The second type of secretory cells present in the thyroid appears in the form of isolated cells disseminated between the follicular cells inside the basement membrane of the follicles. These cells are called parafollicular cells or C cells and are responsible for producing a hormone, calcitonin, which regulates blood calcium concentrations, along with PTH [Tuli, G. *et al*., 2021; Wood, J. H. *et al*., 2011]. Each cell causes a different type of cancer, and depending on which cell the cancer is caused in, it will have a different severity and treatment. [Tuggle, C. T. *et al*., 2008 – Baumgarten, H. D. *et al*., 2019]

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Given the proximity of the thyroid gland to the larynx and the vocal cords and the possible association with the speech therapy disorders that thyroidectomized patients may suffer, it is of interest for this work to make a brief reminder of the anatomy and function of these structures [Yu, Y. R. *et al*., 2017; De Jong, M. *et al*., 2020]. The larynx is made up of cartilaginous pieces that articulate with each other. The main cartilages of the larynx are the thyroid, cricoids, arytenoids, and epiglottis [Scholz, S. *et al*., 2011]. The thyroid cartilage makes up most of the anterior and lateral walls of the larynx and partially envelops the other cartilage [White, W. M. *et al*., 2009]. The larynx has a sphincter function that regulates the passage of air during breathing. Internally, the larynx presents a duct lined with mucosa in which we can find the vocal cords [Cheng, J. *et al*., 2013]. The vocal cords are folds of epithelium that line the larynx [Akkari, M. *et al*., 2014]. Inside each fold, we find a ligament, the vocal ligament, and a small muscle, the vocal muscle [Yang, S. *et al*., 2017]. Before phonation, the vocal folds have to be in contact, keeping the glottal cleft closed so that it gets in the way of the exhaled air [Elfenbein, D. M. *et al*., 2016]. As the air is expelled, there is a progressive increase in subglottic or infraglottic pressure. When this pressure is higher than the closing pressure of the vocal folds, they are forced to separate, and the air comes out forcefully, producing a sudden decrease in the pressure in the glottal cleft. Several nerves participate in laryngeal innervation, highlighting the vagus nerve that provides the two laryngeal nerves, the upper one of a sensitive nature for the cricothyroid muscle and the lower or recurrent nerve for the rest of the intrinsic laryngeal muscles. [Meyer, T. *et al*., 2006]

PATIENTS AND METHODS

We collected all data of 40 patients from different hospitals in Iraq: a cross-sectional of study acquired over 24 months pertaining to pediatric patients suffering from thyroid surgery.

Data were gathered on children under the age of 13 who underwent thyroid surgery from our hospital based on the indications offered by pediatric Endocrinologists. Patients were included if they were under the age of 13 and had either a benign or malignant thyroid illness that required surgery. Also, patients with past parathyroid illness or calcium homeostasis abnormalities were excluded to minimize future selection confounding variables.

The surgical procedures used included total thyroidectomy (TT), thyroid lobectomy (LT), and complete thyroidectomy with dissection in the central cervical region if adenopathies were found intraoperatively.

Postoperative complications and risk factors for transitory hypoparathyroidism were examined. The European Society of Endocrinology Clinical Guideline defines transitory hypoparathyroidism as a condition with biochemical hypocalcemia (ionized Ca 2 + <1.16 mmol/l) as well as incorrect PTH levels for at least four weeks.

Vitamin D, as well as calcium, were used to treat hypocalcemia which occurred after surgery. Remission of transitory hypoparathyroidism was defined as the stabilization of ionized Ca2+ for at least two consecutive readings without integrative treatment.

All patients have been followed up for at least three months, with five post-operative controls involving laboratory testing and clinical screening. Ionized calcium as well as PTH levels were measured concurrently. Calcium and levels of PTH were evaluated systematically on the day prior to the operation (to rule out a preexisting calcium homeostasis condition), the day after an operation, upon discharge, one month later, and three months following. Before hospital discharge, all patients were examined by an adult endocrinologist, followed by a pediatric endocrinologist seven days later. Patients who need supportive care had endocrinological testing for a month after discharge to determine whether or not their serum calcium levels had reverted to normal. Statistical analyses were carried out by SPSS version 22.0; for dichotomous variables, Fisher's test was used. The significance level for the P value was selected at 0.05.

RESULTS

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Table 1: Demographic and preoperative of children data

Characteristics	Number of patients, [40]	Percentage [%]
Age		
4 – 7	9	22.5%
8 – 10	14	35%
11 – 12	17	42.5%
Sex		
Male	14	35%
Female	26	65%
BMI, Kg/m2		
Underwent	7	17.5%
Normal weight	11	27.5%
Overweight	9	22.5%
Obesity	13	32.5%
Family history		
Yes	12	30%
No	28	70%
Prior surgeries		
Yes	8	20%
No	32	80%
Comorbidities		
Yes	16	40%
No	24	60%
Hypertension	5	12.5%
Diabetes	3	7.5%
HIV	3	7.5%
Obesity	2	5%
Kidney diseases	1	2.5%
Asthma	2	5%
Illnesses		
Total thyroidectomy	**30**	**75%**
MEN2A Medullary Thyroid Carcinoma	4	10%
Graves' disease	8	20%
Multinodular thyroid goiter	9	22.5%
Papillary thyroid cancer (PTC)	4	10%
Follicular thyroid cancer (FTC)	5	12.5%
Lobectomy	**7**	**17.5%**
Benign nodules	3	7.5%
Uninodullar thyroid goiter	2	5%
Papillary thyroid cancer (PTC)	1	2.5%
Completion thyroidectomy	1	2.5%
Central neck dissection (CND)	**3**	**7.5%**
Symptoms		
Difficulty swallowing	9	22.5%
Hoarseness or voice changes	8	20%
Goiter	4	10%
Difficulty breathing	3	7.5%
Pain or discomfort in the neck	5	12.5%
Fatigue	4	10%
Weight changes	2	5%
Changes in mood or behavior	4	10%
Swelling in the neck area	1	2.5%
Parents' variables		

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Smoking status		
Yes	10	25%
No	30	75%
Marital status		
Married	34	85%
Divorced	6	15%
Employment status		
Employed	32	80%
Un - employed	8	20%
Economic status, $		
< 800	8	20%
800 – 1000	26	65%
> 1000	6	15%

Table 2: Preoperative diagnostics data

Variables	**Number of patients, [40]**	**Percentage [%]**
Histological		
Fine needle aspiration (FNA)	6	15%
TIR 1	7	17.5%
TIR 2	10	25%
TIR 3A	13	32.5%
TIR 3B	9	22.5%
TIR 4	5	12.5%
TIR 5	5	12.5%
Graves's disease	24	60%
MEN 2A syndrome	16	40%
Imaging		
Ultrasound	40	100%
CT scan	30	75%
MRI	6	15%
Tumor side		
Unilateral	28	70%
Left	17	60.71%
Right	11	39.29%
Bilateral	*12*	*30%*
Tumor focality		
Unifocal	18	45.0%
Multifocal	22	55.0%
Tumor size		
> 1.5 cm	34	85.0%
< 1.5 cm	6	15.0%
Parathyroid glands		
Four are left in place	20	50.0%
Two are left in place	12	30.0%
One left in place	8	20.0%

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Table 3: Intraoperative outcomes

Parameters	Number of patients, [40]	Percentage [%]
Surgery time, min	94.42 ± 46.78	
Blood loss (mL), Mean±SD	184.61 ± 116.72	
Blood transfusion, n (%)	5	12.5%
Length of stay in hospital, days		
≤ 2	34	85%
> 2	6	15%
Intensive care unit admission		
Yes	4	10%
No	36	90%
Mortality rate		
Death	2	5%
Alive	38	95%

Table 4: Postoperative complications

Parameters	Number of patients, [40]	Percentage [%]
Bleeding or hematoma	1	2.5%
Recurrent laryngeal nerve injury	1	2.5%
Multinodular thyroid goiter	3	7.5%
Graves' disease	1	2.5%
Papillary thyroid carcinoma	1	2.5%
Cowden Syndrome	1	2.5%
Papillary thyroid carcinoma	2	5%
Total	***10***	***25%***

Table 5: Determine the quality of life for children after thyroid surgery

Items	QoL scores
Physical function	93.10 ± 2.56
Social and emotional aspects	87.38 ± 4.80
Psychology function	82.63 ± 5.89
Daily activity	84.44 ± 6.91

Table 6: Determine risk factors affected on pediatric postoperative thyroid surgery

Risk factors	OR	CI 95%
Female gender	2.88	0.35 – 4.56
Multinodular thyroid goiter	2.94	0.22 – 6.71
Thyroid disease	1.08	0.55 – 4.82
Type of surgery	1.11	0.08 – 8.75
Papillary thyroid carcinoma	2.81	1.73 – 5.20
Benign or malignant lesion	3.42	2.71 – 5.91

DISCUSSION

Our study was enrolled clinical and demographic, which show children with ages (11 – 12) years) were the greatest rate, which include 17 cases. Patients with ages (8 – 10) years included 14 cases; patients with (4 – 7) years included 9 cases; males was 35%, and Female was 65%. BMI classification was distributed into underweight with 7 cases, normal weight with 11 cases, overweight with 9 cases, and obesity with 13 cases. The most common comorbidities prevalent were hypertension got 5 cases, diabetes got 3 cases, and HIV got 3 cases; illnesses of children who underwent to total thyroidectomy surgery were 30 cases, which have Multinodular thyroid goiter was 22.5%, Graves' disease was 20%, while illnesses of children who underwent to lobectomy surgery was 7 cases, which include benign nodules was 7.5%, uninodullar thyroid goiter was 5%, and central neck dissection (CND) was 3 cases, greatest symptoms prevalence within children patients were difficulty swallowing was 9 cases, hoarseness or voice changes was 8 cases, and pain or discomfort in the neck was 5 cases.

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According to preoperative diagnostics data, histological findings were TIR 2 included 10 cases, TIR 3A included 13 cases, TIR 3B was 9 cases, TIR 1 was 7 cases, and Fine needle aspiration (FNA) was 6 cases, imaging techniques used in diagnoses were ultrasound had 40 cases, CT scan had 30 cases, and MRI was 6 cases, tumor side was shown that unilateral 28 cases, where left side was 17 cases, the right side was 11 cases, and bilateral was 12 cases, tumor focality found unifocal with 18 cases, and multifocal had 22 cases, tumor size identified into > 1.5 cm included 34 cases, and < 1.5 cm included 6 cases, parathyroid glands classified into 4 left in place got 20 cases, two left in place got 12 cases, and one left in place got 8 cases.

In addition, our findings were registered intraoperative data, which identify into surgery time, min was 94.42 ± 46.78, blood loss (mL) was 184.61 ± 116.72, blood transfusion included 5 cases, length of stay in hospital ≤ 2 days was 85% of patients, length of stay in hospital > 2 days was 15% of patients, Intensive care unit admission was 4 cases, the mortality rate was 2 cases, post-operative complications were 10 cases. Our findings shown the quality of life, which identify into physical function, was 93.10 ± 2.56, social and emotional aspects were 87.38 ± 4.80, psychology function was 82.63 ± 5.89, and daily activity aspect was 84.44 ± 6.91.

American study was shown that the surgical pathology of the thyroid gland has been increasing its incidence in recent years, especially that of tumor origin. Currently, the incidence of thyroid nodules is estimated between 2 and 6 cases per 100,000 inhabitants, being more frequent in the female sex and in ages close to children. [Chan, W.-F. *et al*., 2006]

The publication of clinical guidelines of British study specific for pediatric age has modified the management in this age range. Thus, compared to the adult population, emphasis is placed on the higher proportion of malignancy in thyroid nodules (22-26% in children vs. 5-10% in adults) and a greater aggressiveness of the tumors, although with a better response to treatment and a higher survival rate. [Witte, J. *et al*., 1996]

A Germany study noticed that a common cause of thyroidectomy in pediatric age is the one performed for prophylactic purposes for the prevention of medullary thyroid carcinoma (MTC) in multiple endocrine neoplasia syndrome type 2 (MEN2). CMT accounts for 1-2% of all thyroid tumors, but it is the leading cause of death in this syndrome. [Segal, K. *et al*., 1998]

Some studies agreed that papillary carcinoma is the most common histological subtype, accounting for 80% of all cases. It is characterized by a slow growth frequently affecting a single lobe of the gland although it is common that it spreads to the lymph nodes of the neck. This is the carcinoma with the best prognosis, with a 99% survival rate. Follicular carcinoma shows more aggressive behavior, although part of the reason may be because it occurs at a later age and stages. It is characterized by not spreading to the lymph nodes, but it can spread to regions such as the lungs or bones. [Hallwirth, U. *et al*., 1999; Vaiman, M. *et al*., 2008]

Other studies had shown medullary carcinoma has a 5-year survival rate of around 80% and can occur sporadically (80% of cases) or hereditarily (the remaining 20%). Sporadic medullary carcinoma usually appears in aging adults and affects only one thyroid lobe. However, familial medullary carcinoma affects young adults and children and usually affects both thyroid lobes. [Scerrino, G. *et al*., 2001; Edafe, O. *et al*., 2014]

CONCLUSION

According to our outcomes, pediatric thyroid nodules have a poor prognosis and a greater risk of cancer. Pediatric thyroid cancer can be surgically resected with little problems, as well as excellent surgical and oncological results. In the vast majority of cases, total thyroidectomy is still the preferred technique and is more effective to treat children, which development of quality of life, lowers complications and surgery time less, and decrease of adverse outcomes in the long term.

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