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## Factors Associated With Intraoperative Conversion to Total Thyroidectomy in Benign Goiters

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**Background:** Decision to undertake total thyroidectomy when gross inspection of the gland raises suspicion of widespread degenerative changes is often intraoperative. Knowing the factors associated with intraoperative conversion to total thyroidectomy may assist preoperative counselling. This study describes the probability of conversion to total thyroidectomy and factors associated with conversion among patients hitherto planned for partial thyroidectomy.

**Methods:** We reviewed 191 records and extracted data on patient demographics, the pre-operative radiograph findings, the weight of excised gland and the operation performed. Descriptive and inferential statistics were performed. Receiver operator curve was used to assess for cut-off point. P-value was set at 0.05.

**Results:** A total of 191 records was reviewed consisting of 181 females (94.8% 95% CI 90.6-97.5) and 10 males (5.2%, 95%CI 2.5-9.4). Only nodular goiters required conversion to total thyroidectomy. The overall probability of total thyroidectomy was 11%(95% CI 7.0-16.3). The probability of total thyroidectomy in female was 10.5%(95% CI 6.4-16.9) while in male was 20%(95% CI 2.5-55.6). The probability of total thyroidectomy in a female with nodular goiter was 8.1%(95% CI 4.8-13.5), compared to 28.6%(95% CI 3.7-71) in males. The risk of total thyroidectomy was associated with the weight of the excised gland.

**Conclusion:** Only nodular goiters required intraoperative conversion to total thyroidectomy and the probability of conversion was higher in males.

**Keywords:** thyroidectomy, probability, nodular goiter, gland weight

## 1.0 INTRODUCTION

Goiter is one of the most common indications for elective surgical intervention in adults globally. Moreover, it is the most common indication for thyroid gland surgery. Offering total thyroidectomy (TT) or bilateral subtotal thyroidectomy (BST) for benign goiter is controversial due to concerns about complications. Proponents of TT argue that primary TT offers an immediate permanent cure [1] and can be undertaken with relatively low risks of complication [2] because of minimal fibrosis. Whereas reoperation for recurrence bears a high risk of recurrent laryngeal nerve (RLN) injury and hypoparathyroidism [3, 4]. Proponents of bilateral subtotal thyroidectomy (BST) cite a high risk of similar complications and additionally, they cite the need for life long thyroid hormone supplementation when total thyroidectomy is performed for benign goiter [3, 5, 6]. The optimal surgical procedure for goiter is often an intraoperative decision in centers where total thyroidectomy is not the routine. The decision to undertake TT arises when malignancy is suspected [7] after gross inspection of the gland or when gross inspection reveals degeneration of the whole gland. Nonetheless, it is imperative that the patient understands the specific challenges of the procedure during the preoperative counseling [8] so that they may be ready to accept the common complications whether transient or permanent.

Unfortunately, several unpredictable factors may hamper concrete preoperative decision to select TT or BST preoperatively. This leads to a blanket or generic counseling or consent for the possibility of intraoperative conversion, and generic or blanket counseling may leave room for discord and legal issues. Several aspects of the uncertainties experienced in thyroidectomy are actively studied. Some specific areas include deciding the extent of diagnostic thyroidectomy in indeterminate thyroid nodule [9] or in benign goiters [3, 10], predicting the risk of difficult intubation [11] and predicting the probability of challenging thyroidectomy or its complications [12, 13]. In this report, we described the probability of conversion to total thyroidectomy and the factors associated with intraoperative conversion among patients hitherto planned for subtotal thyroidectomy or partial thyroidectomy. Information on the factors associated with intraoperative conversion to total thyroidectomy and the probability of the conversion may help to shape preoperative counseling especially now that emphasis is placed on autonomy and appropriate informed consent while at the same time balancing to avoid overtreatment or under treatment.

## 2.0 METHODOLOGY

This was a retrospective review of the medical records of patients who had thyroidectomy for benign goiter at the University of Ilorin Teaching Hospital, Ilorin, Nigeria. The hospital ethical clearance was obtained for this research. In the period under review, the practice in the center was to prepare for subtotal thyroidectomy in the primary presentation of benign goiter and total thyroidectomy in malignant or recurrent goiter. Nonetheless, generic or blanket counseling to cover for the possibility of intraoperative conversion to total thyroidectomy after gross inspection of the gland was offered.

We reviewed the records available for the patients who had thyroidectomy between January 2015 and December 2018. We excluded records of patients who had a preoperative diagnosis of malignant or recurrent goiter from the analysis. Information extracted included patients' demographics, the preoperative diagnosis, the neck radiograph results and the operation performed. We did not extract information on the postoperative follow-up. Specific information sought included age, sex, patient weight, the preoperative radiograph findings, the weight of excised gland and the operation performed. For analysis, we placed the records in age groups; <40, 41-60, >60 and, we grouped the weight of excised gland as <100g, 101 to 200g, above 200g. We standardized the weight of excised gland by calculating the gland weight per Kg body weight (gld/kg BW) because the expected normal weight of the thyroid gland varies depending on the individual's weight [14].

Data were analysed using SPSS version 20 and EasyR statistical software. Measures of central tendency/dispersion were presented using means and standard deviation. Descriptive statistics were presented in graphs and tables. Inferential statistics were by confidence limits and chi-square testing. Receiver operator curve was used to assess for cut-off point. P-value was set at 0.05.

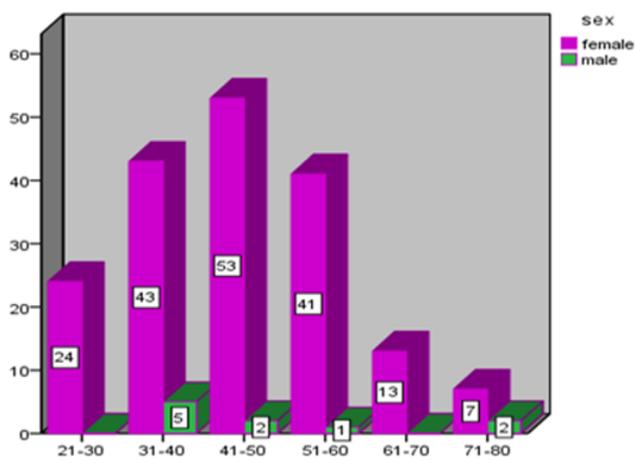
## 3.0 RESULTS

A total of 191 records was reviewed. Females were 181, (94.8% 95% CI 90.6-97.5), 10 males (5.2%, 95%CI 2.5-9.4). Female to male ratio was 18.1: 1. The overall mean age was 46.7±12.6, range 21-80, Interquartile Range (IQR) 36-53years. The mean age for females was 45.6 ±12.5 and for males was 47.0 ±15.2 (age distribution is shown figure1). The mean patient weight was 68.5 ±14.2 (figure1). The preoperative diagnosis was nodular goiter in 167 (87.4% 95%CI 81.9-91.8). The operation performed was bilateral subtotal thyroidectomy in 145 (76% 95% CI 69.2- 81.8) (table1). The risk for total thyroidectomy was 11% (95% CI 7.0-16.3), and the risk for at least complete lobectomy on one side was 16.7% (95%CI 11.8-22.8) (table2)

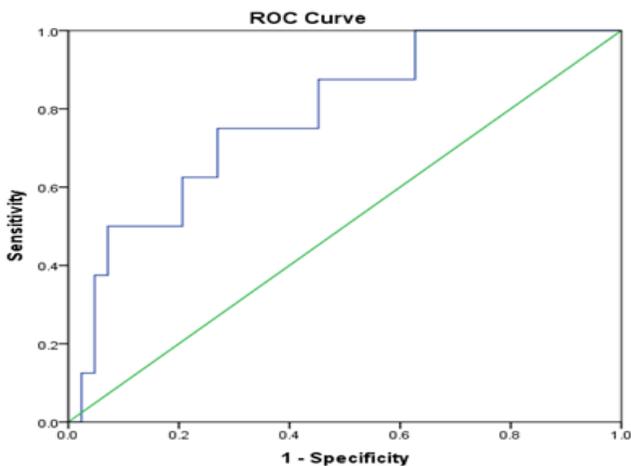
**Table1:** Distribution of preoperative diagnosis and final operation

	Preoperative diagnosis	Preoperative proposed thyroidectomy	Intraoperative Operative decision				
			Total thyroidectomy	Bilateral Subtotal	Near total	LplusI	HD
<b>Female</b>	Simple diffuse	Subtotal	0	6	0	0	0
	Toxic diffuse	Subtotal	0	6	0	2	0
	Simple nodular	Subtotal	10	116	9	3	3
	Toxic nodular	Subtotal	3	13	2	0	0
	Thyroid cyst	Lobectomy	0	0	1	0	0
	Malignant	Total	3	0	0	0	0
	Recurrent	Total	3	0	0	0	0
<b>Male</b>	Simple nodular	Subtotal	0	2	0	0	1
	Toxic nodular	Subtotal	2	1	0	0	1
	Thyroid cyst	Lobectomy	0	1	0	0	1
	Malignant	Total	1	0	0	0	0

LplusI-lobectomy plus Isthmusectomy, HD- Hartley Dunhill



**Figure 1:** Age distribution



**Figure 2:** Receiver Operating Characteristic(ROC) Curve for size of goiter associated with total thyroidectomy.

**Table2:** Probability (risks) of total thyroidectomy according to sex and type of goiter.

Age group in years	<40	41-60	>60	p-value
Total No. with goiter	63	83	19	0.173
No. with TT	4	14	3	
Weight of excised gland (gm)	<100	101-200	>201	p-value
Total No. of patients	87	33	19	
No. with TT	3	4	5	0.014
	Mini- mum value	Maxi- mum value	Mean ±SD	
Patient weight in kilogram	45	120	68.5 ±14.2	
Weight of excised gland in gram	10	1320	132 ±165	
Weight of excised gland/kg BWT	0.01	25	2.0±2.8	

Chi-square test of independence for TT rate between records of patients who weighed  $\leq 70$  and those who weighed  $>70$  was not statistically significant ( $p= 0.68$ ). In the records with a nodular goiter, the risk of total thyroidectomy was associated with the weight of the excised gland (table 3). There was no association between the features of airway pressure effect on plain neck radiograph and risk of TT (table4). The receiver operating Characteristic (ROC) curve for the weight of excised gland /kg body weight showed area under the curve 0.78 ( $p$ -value 0.008, 95% CI 0.63 -0.93) in figure2.

Minimum of 2.4gm/kg body weight was the cutoff at which there was a maximum balance of sensitivity and specificity for risk of total thyroidectomy (figure2).

**Table 3:** Association between age, gland weight and probability(risk) of total thyroidectomy and statistics of gland weight.

Risks	Percentage (95% CI)
Overall probability of total thyroidectomy	11( 7.0-16.3)
Overall Probability of at least one-sided complete lobectomy	16.7 (11.8-22.8)
Probability of total thyroidectomy in female	10.5(6.4-16.9)
Probability of total thyroidectomy in male	20(2.5-55.6)
Probability of at least one-sided complete lobectomy in female	15.0(10.1-21)
Probability of at least one-sided complete lobectomy in male	50(18.7-81.3)
Probability of total thyroidectomy in nodular goiter	10.0(5.6-15.8)
Probability of total thyroidectomy in female nodular goiter	8.1(4.8-13.5)
Probability of total thyroidectomy in male nodular goiter	28.6 (3.7-71)

**Table4:** Neck radiologic features and probability(risk) of total thyroidectomy

Radiologic features	Overall risk of TT	Risk of TT in nodular	P-value
Retrosternal extension	4.3%	11.4%	0.46
Tracheal compression	50%	1.2%	0.25
Tracheal Deviation	16.7%	49%	0.32
Tracheal Narrowing	10.3%	16.2%	0.52

**4.0 DISCUSSION**

In this review of 191 records of patients who had thyroidectomy, we found that one out of every ten patients required total thyroidectomy. Nodular goiters

were the only types of benign goiters that required intraoperative conversion to total thyroidectomy; the probability of intraoperative conversion in males was twice that of females. Moreover, 50% of the males required at least one complete lobectomy. The female records were close to twenty times as many as the male records in this review. Goiters are generally more common in females than in males, and the preponderance of female records reported here was similar to the earlier report in Ilorin[11, 15]. The peak age in the fifth decade was also similar to the previous report in Ilorin[15]. The probability of intraoperative decision of total thyroidectomy was higher in the male records compared to the females’.

Usually, the preoperative counseling and consenting for thyroidectomy is predicated upon the result of preoperative clinical, laboratory and imaging evaluation. However, the final operative decision often occurs intraoperatively. The surgeon may convert to TT if gross inspection of the gland reveals widespread cystic degeneration or suspicion of malignancy. In our review, nodular types of benign goiters were the ones that required conversion to total thyroidectomy. The weight of the excised gland was significantly associated with the probability of total thyroidectomy in this study. The age, patient weight and the local effect of the gland on the trachea were not significantly associated with intraoperative conversion to TT. The ROC showed that the weight of the excised tissue per kg body weight was a fair predictor of the probability of converting to total thyroidectomy. The larger the quantity of gland removed, the more likely TT. This information may be useful clinically by using a preoperative ultrasound scan to determine the glandular architecture as was done for a different reason by Olatunji et al [16] and to estimate the extent of glandular pathology.

In this study, the cut-off for predicting the probability of total thyroidectomy was 2.4g pathologic thyroid tissue per kilogram body weight. Our literature search did not reveal any study centered on the need for intraoperative conversion to TT for benign reasons as we have done here. We only found studies attempting to predict intraoperative conversion to TT after frozen section to exclude malignancy[7, 17]. In a study by Kennedy et al [18], a frozen section in a situation of indeterminate nodules led to conversion to TT in 9% of clinical diagnosis of benign thyroid nodules, 16% of clinical diagnosis of follicular neoplasm and 69% of clinical diagnosis of malignant nodule [18].The probability of at least one complete lobectomy was very high in the male records. Although, the risk of the surgical procedures requiring one complete lobectomy is not quite similar to

that of total thyroidectomy, yet each side where the lobe is completely excised bears its own risk of ipsilateral recurrent laryngeal nerve injury and inadvertent excision or devascularization of the ipsilateral parathyroid gland.

No previous study was found on the relationship between pathologic thyroid gland size and the risk of total thyroidectomy. However, in a recent study by Alsaqer et al among Saudis [14], the authors derived a linear equation for the estimated volume of the gland in relation to the weight of participants. In this study, the estimated cut-off of gland excision at which the risk of total thyroidectomy was highest was 2.4gm/kg.

Our study is limited because it is a retrospective review and we could not obtain the preoperative size of gland and ultrasound records. Subsequent studies should be prospective to remove our limitations and should consider preoperative imaging investigations to assess the gland volume and extent of gland pathology to estimate the volume of gland likely to be excised.

In conclusion, nodular goiters were the types of benign goiters that required intraoperative conversion to total thyroidectomy. The probability of conversion was higher in males and in glands where larger volumes were excised.

### Conflict of interest

The authors declare that there is no conflict of interest

### Authors' Contributions

**SO,OA,GR** conceived and designed the study, **SO,OA,BB,OH** collected data; **SO,OA,GR,BB** performed analysis and contributed to data analysis tool. All authors contributed to writing and revision of the manuscript.

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