

ROLE OF PRE-OPERATIVE INVESTIGATIONS IN PREVENTING THE POST-OPERATIVE COMPLICATIONS OF THYROID SURGERY

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ABSTRACT: Thyroid surgeries are performed worldwide for various indications. In the past complications of thyroid surgeries were reported more than 24%. With an increase in accuracy in Cytological reporting, non-invasive radiological investigations to know the extent of the tumor and infiltration of malignant tumors, the complications are reduced to less than 4%. AIM: To evaluate the predictability of pre-operative investigations in preventing the post-operative complications of thyroid surgery.

MATERIALS AND METHODS: A prospective study conducted on 86 patients by investigating before thyroid surgeries with FNAC, ultrasonography, CT scan, X-ray Neck lateral view, MRI, 2D ECHO of Cardia, isotope scanning, video laryngoscopy and thyroid function tests. Demographic characteristics of the patients and indications for thyroid surgeries were used to predict the post-operative complications. Post-operative investigations included serum calcium levels, Thyroid function tests and serum Electrolyte levels to diagnose the complications.

RESULTS: sensitivity of FNAC was 93.33%, ultra sound Neck was 92.83%, serum calcium was 89.16%, in thyroid function tests it was 77.66%. With X-Ray Neck the specificity was 57.66%, CT scan was 44.50%, MRI was 15%, and isotope study was 30.6%, Doppler study was 33.83% and 2DEcho was 27.83%. Pre-operative assessment was Airway obstruction 3.48%, hematoma formation 4.65%, RLN palsy 3.48%, Hypocalcaemia 33.72%, wound infection 4.65% were the complications encountered.

CONCLUSIONS: Thorough investigations prior to surgery of thyroid, proper selection of the surgical procedure, tumor location knowledge, understanding the pathophysiology of the thyroid disease and type of anesthesia gives confidence to the surgeon and avoids complications. The methods applied in the present study had a definitive role in preventing hypocalcaemia with an incidence of 33.72% and RLN palsy 3.48%. These were added upon by the experience of the operating surgeon.

KEYWORDS: Thyroid Gland, Thyroidectomy, Thyroid Function Tests, FNAC, Complications, Goiter, Tumor and Hypocalcaemia.

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INTRODUCTION: There is continuous advancement in the surgical techniques of Thyroid gland as well as pre-operative assessment criteria used in order to reduce the intra and post-operative complications. Thyroid surgery is safe now unlike in the past years when it was fraught with blood loss, endocrinal imbalance, and recurrent nerve paralysis and electrolyte deficiencies. The reports from USA state that there was 30% increase in the inpatient thyroid surgeries and 61% increase on outpatient thyroid surgeries between 1996 and 2006.¹ A similar trend is also expected in India in the near future. In spite of these developments the potential complications following Thyroidectomy are Recurrent Laryngeal nerve Injury and hypocalcaemia which may result in permanent voice changes and long term metabolic changes in the bones respectively.² Among the different factors playing their role in the complications of thyroid surgery a few are type of disease, type of operation, training and experience of the surgeon.^{3,4,5,6,7}

Chen A.Y et al concluded that for successful thyroid surgery requires careful preoperative investigations, type of anesthesia, choice of surgical procedure and post-operative care.⁸ Pre-anesthetic assessment for thyroid surgeries is very important especially in larger goiters. CT scan chest, or MRI chest are reliable to evaluate intubation problems and peri operative complications. Pre-operative pulmonary function testing, 2D ECHO of Cardia and tracheal compression assessment will help in prediction of mixed obstructive and restrictive disease of lungs, pericardial effusion and above 50% compressions of trachea respectively.⁹

Thyroid function test T3, T4 TSH levels in the patient prior to surgery helps the anesthetist to choose the intravenous inducing agents and anesthetic gases which makes the recovery smooth which is an ideal situation in all thyroid surgeries.¹⁰ Similarly prior endocrinal investigations prevent post-operative hypocalcaemia and thyroid storms during the immediate recovery stage.

All the pre-operative diagnostic procedures are conducted to diagnose the type of lesion, extent of the disease, involvement of surrounding vascular structures, operability and predict the complication in the post-operative period. Hence keeping this in view the present study is conducted to investigate the close association between the pre-operative planning and the post-operative complications in thyroid surgery patients.

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MATERIALS AND METHODS: The present study was conducted in MGM Hospital attached to Kakatiya Medical College, Warangal, between Jan 2011 and Dec 2014. 86 Patients attending the department of ENT with thyroid swellings were included in the study.

Inclusion Criteria:

1. Patients aged above 20 years and below 65 years.
2. Patients presenting with thyroid swellings and diagnosed as benign, malignant tumors, solitary or multiple nodules and colloid goiters.

Exclusion Criteria:

1. Patients undergoing re operations and enucleations.
2. Patients with anaplastic carcinoma.
3. Patients with untreated thyrotoxicosis.

All the surgeries were performed by the senior surgeon of same unit. The study was conducted to collect data from pre-operative diagnostic procedures from all the patients, type of anesthesia used and post-operative complications and their predisposing factors. They included demographic information, surgical indications and the type of surgery undertaken. The complications included Bleeding, hematoma, Airway obstruction, RLN palsy and Hypocalcaemia. Hypocalcaemia was graded depending upon serum calcium levels less than 7.6 mg/mL with or without symptoms. Severe Hypocalcaemia was treated immediately with calcium infusion, whereas mild Hypocalcaemia was treated with oral calcium.

Other complications like hoarseness of voice, tracheomalacia, seroma formation and wound infection. After thorough history taking, clinical examination and the investigations undertaken were Thyroid function tests, Blood counts, X-ray Neck lateral view and X-Ray chest PA and lateral views. FNAC was done in all the patients. CT scan Neck and Chest, Ultrasonography of Neck, MRI scan isotope scanning were done in patients with large goiters, retrosternal extension, Multinodular Goiters and Malignant thyroid diseases presenting with hard nodules.

Patients with thyroid swellings with doubtful carotid involvement were subjected to Doppler studies of the carotids. Patients with high Thyroid hormone levels were subjected to 2DEcho, pulmonary function tests and renal and hepatic function tests. Frozen section studies were performed wherever necessary to change the course of surgical decision. The indications for thyroid surgery were, Hyperthyroidism, Solitary nodules, Multinodular goiters, malignant tumors, Colloid goiters and aesthetic appearance.

The surgical types included were unilateral thyroidectomy, Bilateral Total Thyroidectomy, Unilateral and contra lateral sub- total thyroidectomy, Bilateral Sub- total thyroidectomy. Unilateral or bilateral neck node dissection included in malignant tumors. All the patients were operated under General anesthesia. Standard statistical methods were applied in analyzing the data using mean, standard deviation (SD), chi-square test, t-test were applied. A p value less than 0.05 was taken as having statistical significance.

OBSERVATIONS AND RESULTS: 86 patients included in the present study from the department of ENT of a tertiary referral

Hospital (MGM Hospital) at Warangal attached to Kakatiya Medical College. These patients presented with thyroid swelling and were diagnosed with different diseases of the thyroid on investigations. The mean age for the entire study group was 43.64 and 59 (68.60%) of the patients were aged below 50 years. The females to male ratio was 3.83:1 (Females were 69 and the males were 18). The T- value was 1.82044 and the P-value was 0.036. The mean age for females was 42.33 with standard deviation 12.83 and for males it was 49.05 with Standard deviation 14.35 (Table 1).

Among the different diseases encountered in the present study the commonest lesion was Large colloid goiters 29/86 (33.72%), Unilateral solitary nodule of thyroid (19.76%), Multinodular goiter with thyrotoxicosis 14 (16.27%), Papillary carcinoma of the thyroid (12.79%), follicular carcinoma of thyroid 6 (6.975) and Hashimotos disease in 7 (8.13%) of the patients. The incidence of malignant growths was 17/86 (19.76%), among them female patients were 12/86 (13.95%) and males were 5/86(5.81%) with a female preponderance of 2.4:1. (Table2).

Pre-operative investigations undertaken in the diagnosis and preparation of the patient for the surgery were analyzed and found that the sensitivity of FNAC was 93.33%, ultra sound Neck was 92.83%, serum calcium was 89.16%, thyroid function tests were 77.66%. The other investigations were performed depending upon the necessity of the disease and patients built and risk factors like heart disease, obesity and endocrinal status and found to specific with X-Ray Neck 57.66%, CT scan in 44.50%, MRI in 15%, and isotope study in 30.6%, Doppler study in 33.83% and 2DEcho in 27.83% (Table 3). All the patients were diagnosed based on the FNAC reports alone; biopsy was not done in any of the patients.

An analysis of symptoms of presentation of patients in the present study showed that the swelling was taken as an indication of surgery in 66.27%, dysphagia in 41.86%, suspected malignancy in 20.93%, proven malignancy in 19.76%, Hyperthyroidism in 18.60%, Aesthetic cause in 16.27% and airway obstruction in 9.30% of the patients (Table 4).

Among the procedures undertaken Unilateral Total thyroidectomy (Hemi-thyroidectomy) was done in 30 (27.90%) of the patients followed by Bilateral Total Thyroidectomy in 17 (19.11%), Bilateral Sub- total Thyroidectomy in 14 (13.95%) of the patients. Unilateral Hemi and contralateral sub-total thyroidectomy was done in 14 (13.95%) and Unilateral or Bilateral Neck node dissection was done in 11 (10.46%) of the patients (Table5).

The incidence of complications showed that Airway obstruction was observed in 3 (3.48%), Tracheomalacia in 1 (1.16%), unilateral RLN palsy in 3 (3.48%), Hematoma in 4 (4.65%) and seroma in 1 (1.16%) of patients. Recurrence after surgery for malignant growths was observed in 3 (3.48%) and Wound infection in 4 (4.65%) of the patients (Table 6). Hypocalcaemia was observed in 29/86 (33.72%) of the total patients and 12.79% occurring following surgery for large colloid goiters (Table 6). There was no incidence of bilateral RLN pals in this study. There were no deaths in the present study. Multiple complications were observed in only 2 patients (2.32%).

DISCUSSION: In this study an attempt was made to correlate investigations with the operative findings and their role in

avoiding or predicting complications. The incidence of RLN palsy was found to be 3.48% which falls within the incidence reported in various reports of literature. First thyroid surgery was performed by Theodor Kocher in 1889 a Swiss surgeon.¹¹ The complications remain the same even though the adjuvant methods of identifying the RLN, advanced anesthetic equipment are used in the modern times.

The complications are intra operative bleeding, RLN palsy (hoarseness of voice), Hematoma formation, Airway obstruction, Hypocalcaemia and wound infection.^{2,12} Avoiding complications requires improvement in thyroid surgeries which can be achieved only by using advanced methods of identifying the tumor location in relation to RLN with the help of CT scan, MRI and Ultrasound neck.

Similarly identifying vitamin D deficiency and initiating calcium oral therapy prior to surgery prevents the complication of Hypocalcaemia. Improvement in surgical training to identify parathyroid glands sparing the periglandular adipose tissue to preserve their vascularity would also prevent the chances of Hypocalcaemia.⁸

Patients undergoing surgery with large tumors and goiters are subjected to wider dissection and tissue manipulation and are associated with wide range of complications.³ The present study showed the incidence of descending order for Hypocalcaemia incidence as Bilateral Total Thyroidectomy>Unilateral Total Thyroidectomy (Hemithyroidectomy) > Bilateral sub- total

Thyroidectomy>Unilateral Thyroidectomy and Bilateral Neck node dissection.

The incidence of RLN injury was significant higher in cases underwent BTT than other procedures; the risk was also increased significantly for neck node dissection, regardless of surgical type 9. Patients presenting with large swellings of thyroid especially those with retrosternal extension are subjected to wide range of investigations including, CT scan chest, and MRI scan of Neck and chest, FNAC and ultrasound examination with a possible risk during surgery.¹⁰

Similarly patients presenting with hard nodules in the thyroid gland, suspected carotid compression and bruit heard on auscultation of the thyroid gland are subjected to X-ray neck lateral view, CT scan with contrast or MRI to diagnose tracheal compression and high vascularity of the tumor.^{11,12} These would help in accurate diagnosis as well as total excision of the tumor.^{13,14} Most of the surgeries of thyroid were not associated with Hypocalcaemia during the post-operative period in the present study similar to the age group factor, type of Histopathology of the tumor (Table6).

Duclos A et al from their multicentre study opined that the post-operative complications depend upon mostly on the surgeon's choice of type of surgery and the indications of surgery of thyroid cannot be used as a predictor of complications provided other human factors are excluded.¹⁵ Old patients have low incidence of Hypocalcaemia than younger patients 1%; Increase in age of 1 year decreases the incidence.¹⁵ In Geriatric age patients due to looser connective tissue, it is easy to dissect parathyroid gland from the neighboring thyroid tissue, whereas injury to Berry's ligament, tubercle of Zuckerkandl, tracheo-esophageal groove, inferior and superior thyroid poles and RLN are more prone to damage.¹⁶

Injury to RLN can be reduced by careful dissection, minimizing stretch and minimal usage of cautery in the vicinity of the nerve or using a nerve monitor.^{17,18} Patients with larger tumors or goiters tend to visit larger Hospitals or tertiary hospitals where surgeon's who are exposed to such clinical experience are available and more detailed exposure and demonstration of RLN for teaching purpose is regularly attempted.⁸

In such experienced hands the incidence of post-operative complications is low But it is difficult to judge the skill of a surgeon based on the institution characteristics alone.¹⁸ In the present study incidence of Hypocalcaemia was 33.72%. It is commonly seen in patients with extensive resection of the thyroid tumors or goiters, recurrent goiters, female patients, Grave's disease. It occurs 1 to 6% of patients in experienced surgeons otherwise its incidence is 13% (Text Book of Stell and Maran).

A transient or permanent hypo-Parathyroidism occurs after accidental devascularization of the parathyroid glands during the ligation of the thyroid gland vessels or less commonly by the removal of the parathyroid glands 10. In nodular goiters few indications for surgery are bilateral compression of trachea with dyspnea in supine position, hyperthyroidism, rapid growth with malignant change and aesthetic appearance.

The complications include recurrence rate 10 to 50%, RLN palsy 0-14% and hypocalcaemia 1.2-10.6%.¹⁹ Pre-operative investigations in such patients must include preparation of red blood suspension (440,1200 ml), 2D Echo of Cardia, renal function tests, pulmonary function tests and administration of Carbimazole, iodine and propranolol to maintain the heart rate less than 90 /minute and BMR at < 20.30%.¹⁹

General anesthesia and cervical plexus block can be used for thyroidectomy in multinodular goiters.¹⁹ In patients with pre-operative high levels of TSH, anti-thyroid antibodies and thyroiditis predicts postoperative need for Hormonal Replacement Therapy (HRT) and necessary counseling should be done before surgery.²⁰ The importance of pre-operative thyroid investigations is to achieve normal thyroid hormonal levels prior to surgery.

Pre-operative use of Carbimazole makes the gland more vascular and higher bleeding occurs during surgical procedures. Similarly reduced WBC count following use of Carbimazole makes the patient susceptible to infections in the post-operative period. Nowadays beta blockers are used to supplement Carbimazole to achieve cardiac stability.²¹

If the hormonal levels are not brought to normal levels there is every possibility of overdose of anesthetics and potential to develop atrial fibrillation, high blood pressures and thyroid storm.²² Similarly in hypothyroid states individuals take long time to recover from anesthesia following thyroid surgeries.²³

Pre operatively thyroxin should be administered in a titrated manner to avoid higher levels before surgery as it may result in ischemia and infarction of Cardia due to increased demand by this tissue.²⁴ As an anesthetist point of view hypothyroidism may result in Cardiac suppression, hypoglycemia, impaired hepatic function, depressed ventilator drive and decreased plasma and blood volume.²² Patients

undergoing thyroid surgeries with profound Myxedema may land in Myxedema coma characterized by severe lethargy, hypothermia, Bradycardia and hypoxemia due to hypoventilation. It should be treated urgently with intravenous T3 and T4 keeping in view the possibility of the patients developing Congestive Cardiac Failure and Myocardial ischemia.²⁵

Pre-operative preparation of the patient rapidly for surgery should include beta blockers, steroids, anti-thyroid drugs and iodine. Beta blockers should be used judiciously to avoid precipitation of CCF or bronchospasm in patients with COPD.²¹ Premedication is to be avoided in these patients and use of H2 receptor blockers like Ranitidine with Metaclopramide or oral sodium citrate solution is safe.²⁶

Using cervical plexus block and cervical epidural anesthesia as adjuvant is associated with potential risk of Cardio respiratory arrest and inadequate anesthesia and early wearing out of analgesia and hence in the present times endotracheal intubation followed by general anesthesia is ideal.^{27,28}

Premedication with glycopyrrolate, 100% oxygenation prior to intubation and shorter opioids like fentanyl would help in drying up the secretions, testing the adequacy of anti-thyroid drugs, ample intubation time and adequate analgesia respectively.^{29,30,31} Total Intravenous Anesthesia (TIVA) with Propofol is excellent due to its rapid onset, rapid recovery, antiemetic property and synergistic action with fentanyl.^{32,33}

CONCLUSIONS: The purpose of pre-operative preparation of the patient for thyroid surgery includes investigations to confirm the diseases of thyroid and prepare the surgeon to predict and be cautious regarding post-operative complications. Both the surgeon and the patient should be prepared well to correct the multiple complications with proper maneuvers. They are anatomic variations of RLN and parathyroid glands for the surgeon and Hypocalcaemia and thyroid storm for the patient. Older age is one factor which helps the surgeon in dissecting Parathyroid's because of the loose anatomic attachment.

Hypocalcaemia was observed in 29/86 (33.72%) of the total patients and 12.79% occurring following surgery for large colloid goiters of parathyroid gland. Implementing the preoperative imaging is helpful to identify the parathyroid glands and prevent postoperative Hypocalcaemia in younger patients. Therefore, complete preoperative evaluation and mental readiness may have a positive effect on prevention of postoperative complications.

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Age Group years	M	F
20-29	02	12
30-39	02	17
40-49	03	16
50-59	05	10
60-65	06	10

Table 1: Showing the sex incidence in different age groups (n=86)

Type of thyroid disease	Total	Male	%	Female	%	F:M ratio
Follicular carcinoma of thyroid	06	02	02.32	04	04.65	2:1
Papillary carcinoma of thyroid	11	03	03.48	08	08.30	2.66:1
Large Colloid goiter	29	08	08.30	21	24.41	2.62:1
Unilateral Solitary nodule of thyroid	17	02	02.32	15	17.44	7.5:1
Multinodular goiter with thyrotoxicosis	14	03	03.48	11	12.79	3.66:1
Hashimotos Disease	07	01	01.16	06	06.97	6:1

Table 2: Showing distribution diseases of the thyroid in male and female patients (n=86)

Type of thyroid disease	Papillary carcinoma of thyroid-11	Follicular carcinoma of thyroid-06	Large Colloid goiter-29	Unilateral Solitary nodule of thyroid-17	Multinodular goiter with thyrotoxicosis-14	Hashimotos Disease-07	Mean sensitivity
Investigations							
Thyroid function tests	07- 63.63%	06-100%	21-72.41%	10-58.82%	14-100%	05-71.42%	77.66
FNAC	10-90.90%	06-100%	26-89.65%	17-100%	13-92.85%	06-85.71%	93.33
X-Ray Neck	04-36.36%	05-83.33%	23-79.31%	07-41.17%	09-64.28%	03-42.85%	57.66
CT scan	03-27.27%	03-50%	15-51.72%	04-23.52%	12-85.71%	02-28.57%	44.50
MRI	01-9.09%	02-33.33%	8-27.58%	01-5.88%	02-14.28%	00	15
Isotope study	08-72.72%	01-16.16%	1-3.44%	06-35.29%	08-57.14%	00	30.6
Serum Calcium	100%	06-100%	28-96.55%	15-88.23%	11-78.57%	05-71.42%	89.16
Ultrasound Neck	11-100%	06-100%	27-93.10%	17-100%	09-64.28%	07-100%	92.83
Doppler study	06-54.54%	03-50%	09-31.03%	5-29.41%	03-21.42%	01-14.28%	33.83
2D Echo	02-18.18%	03-50%	11-37.93%	3-17.64%	04-28.57%	01-14.28%	27.83
Table 3: Showing percentage of positive values of investigations in thyroid diseases (n=86)							

Symptoms	Total-86	Percentage
Swelling in the Neck	57	66.27%
Hyperthyroidism	16	18.60%
Dysphagia	36	41.86%
Aesthetics	14	16.27%
Airway obstructions	08	9.30%
Malignancy	17	19.76%
Suspected malignancy	18	20.93%
Table 4: Showing the Symptomatic indications for thyroid surgery (n=86)		

Type of surgery	M	%	F	%
Bilateral Total Thyroidectomy	04	4.65	13	19.11
Unilateral Total Thyroidectomy (Hemi-thyroidectomy)	06	6.97	24	27.90
Unilateral hemi & contralateral sub- total Thyroidectomy	04	4.65	10	13.95
Bilateral Sub- total Thyroidectomy	02	2.32	12	13.95
Unilateral Thyroidectomy and Bilateral Neck node dissection	02	2.32	09	10.46
Table 5: Showing types of surgery in males and Females (n=86)				

Type of Thyroid disease	Papillary carcinoma of thyroid-11	Follicular carcinoma of thyroid-06	Large Colloid goiter-29	Unilateral Solitary nodule of thyroid-17	Multinodular goiter with thyrotoxicosis-14	Hashimotos Disease-07
Complications						
Hematoma	00	00	02.6.89%	00	01-07.14%	01-01.28%
Bleeding	00	00	00	00	00	00
Airway Obstruction	01-09.09%	00	01-03.44%	00	01-07.14%	00
Tracheomalacia	01-09.09%		00	00	00	00
RLN palsy	01-09.09%	00	01-03.44%	00	01-07.14%	
Hypocalcaemia	07-08.13%	04-4.65%	11-12.79%	00	07-08.13%	00
Seroma	00	00	01-03.44%	00	00	00
Recurrence	02-18.18%	01-16.66%	00	00	00	00
Wound infection	00	01-1.16%	01-03.44	01-5.88%	00	01-14.28%
Table 6: Showing complications of thyroid surgeries (n=86)						