

Association of Pre-operative Symptoms with X-ray Abnormalities in Thyroid Swellings

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Abstract

Introduction: Thyroid swelling is a common problem in clinical practice that poses challenges in detecting the type and size of the swelling. Despite the large number of patients the data available on such patients is relatively limited, especially regarding the appropriate pre-operative symptomatic and radiographic assessment.

Objectives: To assess, the association of pre-operative symptoms with X-ray abnormalities in thyroid swellings. (1) To study the variation in tracheal position with increase in size of the swelling, (2) to study the symptoms related to increase in the size of the thyroid.

Materials and Methods: This study was conducted in 30 patients with thyroid swellings >5 cm in ultrasonography, between 2011 and 2013. The parameters included were: Age, pathological data, radiography, thyroid function tests.

Results: In present study, most of the patients fall in the age group of 31-40 years and almost all patients are females, i.e., 26 out of 30 were females and only 4 were males. Of the 30 patients, 15 (50%) had colloid goiter, 8 (26.3%) had multinodular goiter, 4 (13.3%) had nodular goiter, 3 (10%) had papillary carcinoma. 5 patients had tracheal deviation whose severity was categorized as mild, moderate and severe with 2 were mild and severe each.

Conclusion: Thyroid swelling is more common in female population. As thyroid swelling increases, tracheal deviation also increases and the severity of tracheal indentation also increase.

Key words: Colloid goiter, Multinodular goiter, Nodular goiter, X-ray

INTRODUCTION

Goiter is enlargement of thyroid gland. It is the most common presentation of thyroid diseases. The word goiter is derived from “guttur,” the Latin term for throat.¹ Thyroid swelling is a common problem in clinical practice that poses challenges in detecting the type and size of the swelling. Compressive symptoms are common among patients with thyroid disease and represent an indication for thyroidectomy.² Compressive symptoms range from mild, presenting with neck pressure or globus sensation, to

severe, characterized by significant dysphagia or dyspnea. In rare cases, tracheal or esophageal compression leads to acute airway distress that requires emergent treatment with intubation or tracheostomy.³ Although diffuse thyroid enlargement is associated with tracheoesophageal compression, compressive symptoms are also commonly observed in patients with only mild to moderate thyroid enlargement. In addition to direct compression from an enlarged thyroid gland, dysphagia and shortness of breath may be a manifestation of thyrotoxicosis, Hashimoto thyroiditis, De Quervain thyroiditis, and other inflammatory diseases of the thyroid. Previous studies suggest that inflammation of the thyroid gland may be etiology of compressive symptoms, but this association has not been fully elucidated.¹ Despite the large number of goiter patients and the potential for surgical complications, data available on such patients is relatively limited, especially regarding the appropriate pre-operative symptomatic and radiographic assessment.⁴

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X-rays

X-rays with photon energies above 5-10 keV (below 0.2-0.1 nm wavelength) are called hard X-rays, while those with lower energy are called soft X-rays.⁵ Hard X-rays can traverse relatively thick objects without being much absorbed or scattered. For this reason X-rays are widely used to image the inside of visually opaque objects.

Due to their penetrating ability hard X-rays are widely used to image the inside of objects, e.g., in medical radiography and airport security. X-rays are emitted by electrons; they can be generated by an X-ray tube, a vacuum tube that uses a high voltage to accelerate the electrons released by a hot cathode to a high velocity. The high velocity electrons collide with a metal target, the anode, creating the X-rays. In medical X-ray tubes the target is usually tungsten or a more crack-resistant alloy of rhenium (5%) and tungsten (95%), but sometimes molybdenum for more specialized applications, such as when softer X-rays are needed as in mammography. In crystallography, a copper target is most common, with cobalt often being used when fluorescence from iron content in the sample might otherwise present a problem.

MATERIALS AND METHODS

Between October 2011 and March 2013, 30 patients of thyroid swellings were taken in present study. Patient's details, pathological data (fine needle aspiration cytology and histopathological examination), radiography (ultrasonography [USG] neck and digital X-ray neck both anteroposterior and lateral views) and serum T3, T4 and thyroid stimulating hormone were recorded from these patients. Size more than 5 cm of the thyroid gland in USG was included in the study. In X-ray neck an arbitrary midline drawn from mentum to suprasternal notch taken and the deviation of trachea from the midline was measured and noted. Compression of the trachea and calcification in the region of thyroid gland were also noted. Patient underwent thyroidectomy and the histopathology was noted in these patients. Size more than 5 cm and physiological goiter were excluded from the study. Patient's details included name, age, sex, history of swelling in the neck, pain in the swelling, difficulty in swallowing and difficulty in breathing (DIB) were noted (Figures 1-9).

Patients presented with huge swellings and compressive symptoms were compared with deviation of the trachea and indentation of trachea in X-ray.

Sample size: 30 patients with thyroid swelling.

Inclusion Criteria

- Age >15 years
- Both males and females



Figure 1: Clinical picture of thyroid swelling (Case 1)



Figure 2: Clinical picture of thyroid swelling (Case 2)



Figure 3: Clinical picture of thyroid swelling (Case 3)

- USG size >5 cm
- All thyroid swellings posted for surgery including malignancy.

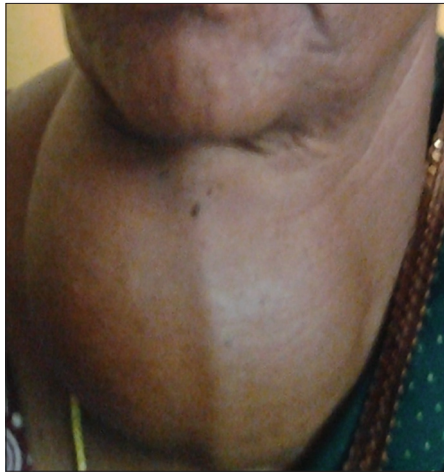


Figure 4: Clinical picture of thyroid swelling (Case 4)

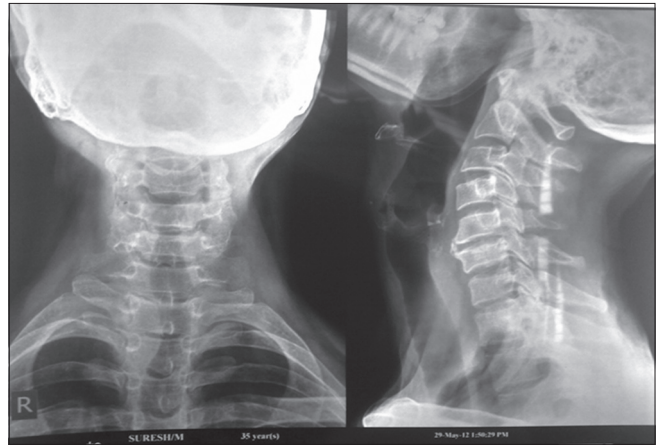


Figure 7: X-ray neck anteroposterior and lateral view (Case 3)

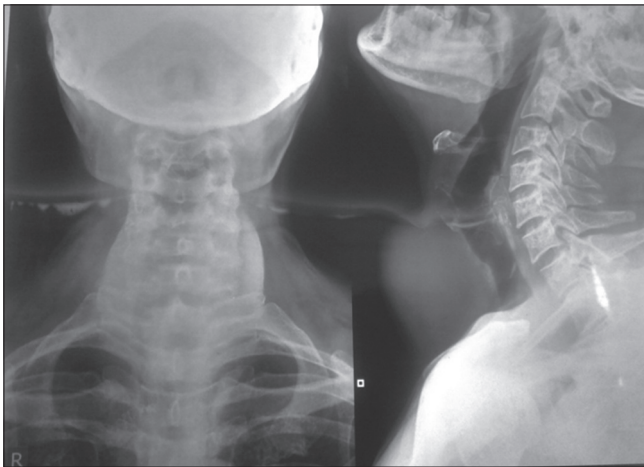


Figure 5: X-ray neck anteroposterior and lateral view (Case 1)

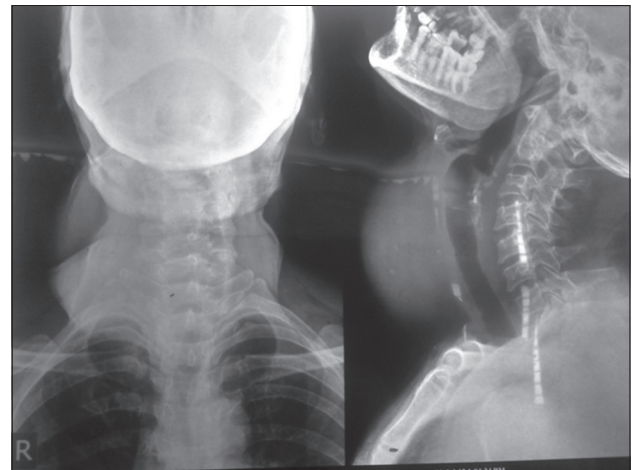


Figure 8: X-ray neck anteroposterior and lateral view (Case 4)

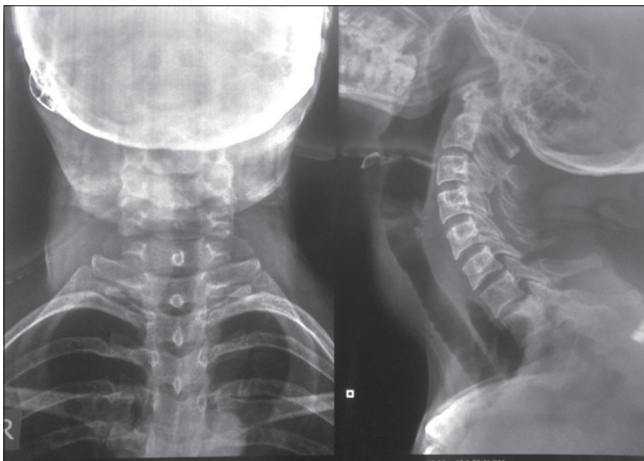


Figure 6: X-ray neck anteroposterior and lateral view (Case 2)

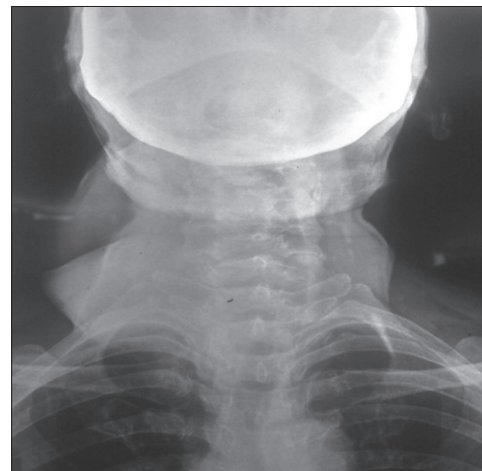


Figure 9: X-ray neck with arbitrary line

Exclusion Criteria

- Age <15 years
- Physiological goiter
- USG size <5 cm
- Patients with thyroid swelling who are unfit for surgery.

Statistical Methods Applied Are

1. Descriptive
2. Frequency
3. Chi-square test
4. Crosstabs (contingency table analysis).

Descriptive

The descriptive procedure displays univariate summary statistics for several variables in a single table and calculates standardized values (z scores). Variables can be ordered by the size of their means (in ascending or descending order), alphabetically, or by the order in which you select the variables (the default).

Frequencies

The frequencies procedure provides statistics and graphical displays that are useful for describing many types of variables. For a first look at our data, the frequencies procedure is a good place to start.

Chi-square Test

The Chi-square test procedure tabulates a variable into categories and computes a Chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values.

Crosstabs (Contingency Table Analysis)

The crosstabs procedure forms two-way and multi-way tables and provides a variety of tests and measures of association for two-way tables. The structure of the table and whether categories are ordered determine what test or measure to use. All the statistical calculations were done through SPSS for windows (version 16.0).

OBSERVATIONS AND RESULTS

The present study is hospital based prospective study between October 2011 and March 2013. We considered 30 patients in the present study, whose ultrasound size is ≥5 cm. Most of the patients presented with swelling in front of the neck rather than other symptoms.

In present study, most of the patients fall in the age group of 31-40 years and least in <20 years (Table 1).

In present study almost all patients are females, i.e., 26 out of 30 were females and only 4 were males (Table 2).

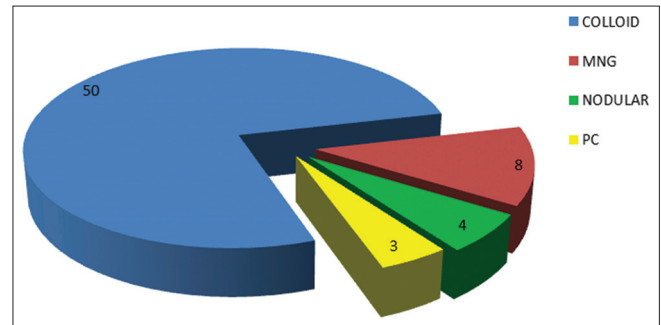
Table 3 shows statistical test applied to check statistically significance between them.

Table 4 and Graph 1 denote distribution of diagnosis of colloid goiter, multinodular goiter (MNG), nodular goiter and papillary carcinoma (PC). The most common type of goiter is colloid goiter and least is PC in present study.

In present study, all patients presented with swelling in front of neck. None presented with difficulty in swallowing (Graph 2).

Most of the patients, i.e., 19 out of 30 in present study has thyroid size (USG size) between 5 and 6 cm. Only 1 lies between 8 and 9 cm (Graph 3).

Table 5 denotes distribution of diagnosis in relation to age among all the types of goiter and PC. In the present study,



Graph 1: Diagnosis distributions

Table 1: Age distribution (n=30)

Age	Frequency	Percentage
<20	2	6.7
21-30	5	16.7
31-40	8	26.6
41-50	6	20.0
51-60	6	20.0
61-70	3	10.0

Table 2: Sex determinations

Sex	Frequency	Percentage
Female	26	86.7
Male	4	13.3

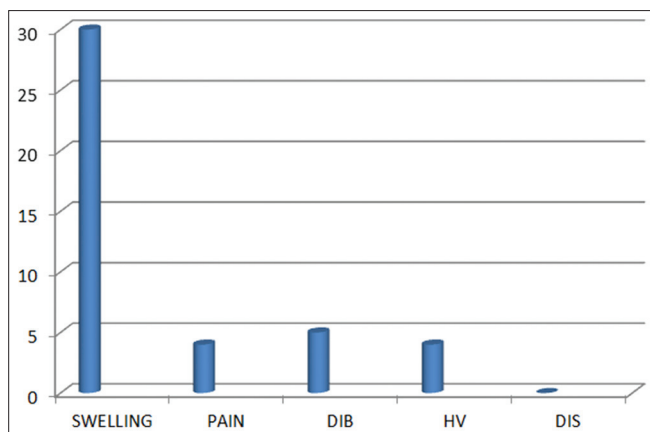
Table 3: Test statistics of age and sex

Test statistics	Age	Sex
Chi-square	4.800	16.133
df	5	1
Asymptotic significance	0.441	0.000 (statistically significant)

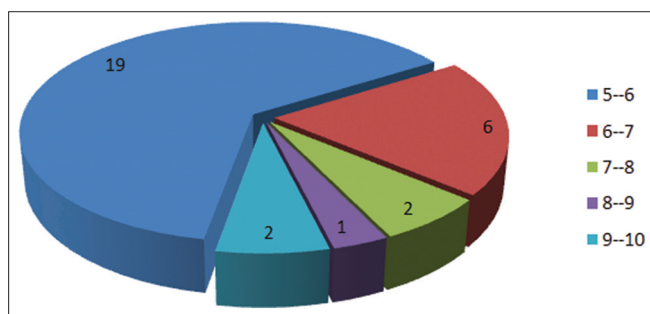
Table 4: Diagnosis distributions

Diagnosis	Frequency	Percentage
Colloid goiter	15	50
MNG	8	26.7
Nodular goiter	4	13.3
PC	3	10

MNG: Multinodular goiter, PC: Papillary carcinoma



Graph 2: Symptoms distribution



Graph 3: Distributions according to ultrasonography size

most common thyroid swelling is colloid and it is presented among the patients who lie between 41 and 50 years.

Among 19 patients whose size lies between 5 and 6 cm, 5 of them fall in the age group of 31-40 years (Table 6).

Table 7 denotes distribution of diagnosis in relation to sex. 13 among 26 females and 2 among 4 males presented as colloid goiter. Other 2 males presented as PC.

Table 8 denotes relations of USG size and DIB 2 each among 5 patients, who presented with DIB, have their thyroid size between 7-8 cm and 9-10 cm.

Table 9 shows relations of USG size and pain. 2 among 4, who presented with pain, have their size between 9 and 10 cm.

Table 10 shows relation of USG size and hoarseness of voice. 2 among 4 patients, who presented with hoarseness of voice, have their thyroid size between 9 and 10 cm.

Table 11 shows correlation of USG size and TD. Size of the thyroid and tracheal deviation in X-ray has linear correlation.

Table 12 shows distribution of tracheal indentation (TI) according to size. As size of thyroid increases, TI also increases.

Table 5: Distribution of diagnosis in relation to age

Age	Diagnosis				Total
	Colloid	MNG	Nodular	PC	
<20					
Frequency	2	0	0	0	2
Percentage	100.0	0.0	0.0	0.0	100.0
21-30					
Frequency	2	2	1	0	5
Percentage	40.0	40.0	20.0	0.0	100.0
31-40					
Frequency	4	1	1	2	8
Percentage	50.0	12.5	12.5	25.0	100.0
41-50					
Frequency	5	1	0	0	6
Percentage	83.3	16.7	0.0	0.0	100.0
51-60					
Frequency	2	3	1	0	6
Percentage	33.3	50.0	16.7	0.0	100.0
61-70					
Frequency	0	1	1	1	3
Percentage	0.0	33.3	33.3	33.3	100.0
Total					
Frequency	15	8	4	3	30
Percentage	50.0	26.7	13.3	10.0	100.0

MNG: Multinodular goiter, PC: Papillary carcinoma

Table 6: Distribution according to USG size and age

Age	USG size					Total
	5-6	6-7	7-8	8-9	9-10	
<20						
Frequency	2	0	0	0	0	2
Percentage	100.0	0	0	0	0	100.0
21-30						
Frequency	4	1	0	0	0	5
Percentage	80.0	20.0	0	0	0	100.0
31-40						
Frequency	5	2	0	1	0	8
Percentage	62.5	25.0	0	12.5	0	100.0
41-50						
Frequency	4	0	0	0	2	6
Percentage	66.7	0	0	0	33.3	100.0
51-60						
Frequency	2	3	1	0	0	6
Percentage	33.3	50.0	16.7	0.0	0.0	100.0
61-70						
Frequency	2	0	1	0	0	3
Percentage	66.7	0	33.3	0	0	100.0
Total						
Frequency	19	6	2	1	2	30
Percentage	63.3	20.0	6.7	3.3	6.7	100.0

USG: Ultrasonography

DISCUSSION

Goiter is an enlargement of thyroid gland. It may be euthyroid, hypothyroid or hyperthyroid. It's a process of progressive enlargement. This progression causes compressive symptoms such as DIB, pain, hoarseness of voice, difficulty in swallowing. Compressive symptoms are common in thyroid disease.

Table 7: Distribution of diagnosis in relation to sex

Sex	Diagnosis				Total
	Colloid	MNG	Nodular	PC	
Male					
Frequency	2	0	0	2	4
Percentage	50.0	0	0	50.0	100.0
Female					
Frequency	13	8	4	1	26
Percentage	50.0	30.8	15.4	3.8	100.0
Total					
Frequency	15	8	4	3	30
Percentage	50.0	26.7	13.3	10.0	100.0

MNG: Multinodular goiter, PC: Papillary carcinoma

Table 8: Relations of USG size and DIB

DIB	USG					Total
	5-6	6-7	7-8	8-9	9-10	
No						
Frequency	19	6	0	0	0	25
Percentage	76.0	24.0	0	0	0	100.0
Yes						
Frequency	0	0	2	1	2	5
Percentage	0	0	40.0	20.0	40.0	100.0
Total						
Frequency	19	6	2	1	2	30
Percentage	63.3	20.0	6.7	3.3	6.7	100.0

USG: Ultrasonography, DIB: Difficulty in breathing

Table 9: Relations of USG size and pain

Pain	USG					Total
	5-6	6-7	7-8	8-9	9-10	
No						
Frequency	19	5	1	1	0	26
Percentage	73.1	19.2	3.8	3.8	0	100.0
Yes						
Frequency	0	1	1	0	2	4
Percentage	0	25.0	25.0	0	50.0	100.0
Total						
Frequency	19	6	2	1	2	30
Percentage	63.3	20.0	6.7	3.3	6.7	100.0

USG: Ultrasonography

Goiter is the most prevalent endocrine condition in the world affecting over 500 million with prevalence rates reaching up to 30%.^{6,7} Local symptoms in patients with euthyroid goiter undergoing surgery have been reported to vary between 13% and 50%.^{8,9}

The neck and throat symptoms in patients with goiter have been invariably attributed to the glandular hypertrophy of the thyroid and its mass effect on the laryngotracheal framework.¹⁰

Compression and invasion of the laryngotracheal complex may also result in airway symptoms with narrowing of the lumen and or impaired mobility of the vocal fold with or without recurrent laryngeal nerve neuropathy.⁷

Table 10: Relation of USG size and hoarseness of voice

Hoarseness of voice	USG size					Total
	5-6	6-7	7-8	8-9	9-10	
No						
Frequency	18	6	2	0	0	26
Percentage	69.2	23.1	7.7	0	0	100.0
Yes						
Frequency	1	0	0	1	2	4
Percentage	25.0	0	0	25.0	50.0	100.0
Total						
Frequency	19	6	2	1	2	30
Percentage	63.3	20.0	6.7	3.3	6.7	100.0

USG: Ultrasonography

Table 11: Correlation of USG size and TD

Correlations	USG	TD
USG		
Pearson correlation	1	0.952 (**)
Significance (two-tailed)	0.000	
<i>n</i>	30	30
TD		
Pearson correlation	0.952 (**)	1
Significance (two-tailed)	0.000	
<i>n</i>	30	30

**High correlation at 0.01 (two-tailed). USG: Ultrasonography, TD: Tracheal deviation

Table 12: Distribution of TI according to size

TI	USG					Total
	5-6	6-7	7-8	8-9	9-10	
No						
Frequency	19	6	0	0	0	25
Percentage	76.0	24.0	0	0	0	100.0
Yes						
Frequency	0	0	2	1	2	5
Percentage	0	0	40.0	20.0	40.0	100.0
Total						
Frequency	19	6	2	1	2	30
Percentage	63.3	20.0	6.7	3.3	6.7	100.0

USG: Ultrasonography, TI: Tracheal indentation

In a series of over 3,000 thyroidectomies, Lacoste *et al.* found that 11% of patients complained of compressive symptoms.¹¹

MNG, one of the more common indications for thyroidectomy, is associated with compressive symptoms. In a 7 years series, 33% of patients diagnosed with benign goiter had compressive symptomatology.¹²

A separate study focusing on marked thyroid gland enlargement reported an incidence of compressive symptoms around 86%.¹³

Present study included 30 patients, who presented with swelling in front of the neck. Among them 8 patients were under the age group of 31-40 years, 6 patients each

were in the age group of 41-50 years and 51-60 years and 2 patients were <20 years.¹⁴ Among 30 patients 26 were females, i.e., 86.7% of the study were females.

Table 13 shows the comparison done between present study and other two studies which shows percentage of females.

All patients presented with swelling in front of neck. 5 out of 30 presented with DIB. It accounts for 16.7%. 4 out of 30 presented with pain, i.e., 13.3% and 4 presented with hoarseness of voice, i.e., 13.3%.

Shin *et al.*¹² showed in his work that 85% presented with swelling in front of the neck and 49.7% presented with DIB and 3.5% with hoarseness of voice.

15 patients were diagnosed to have colloid goiter, i.e., 50% had colloid goiter. Eight were diagnosed to have MNG, i.e., 26.7%. 4 out of 30 were diagnosed to have nodular goiter, i.e., 13.3% and 3 had PC, i.e., 10%. 19 patients among 30 had their thyroid size between 5 and 6 cm in ultrasound. It accounts for 63.3%. Six had between 6 and 7 cm, i.e., 20%. Two between 7 and 8 cm and 2 between 9 and 10 cm. Among 8 patients in the age group of 31-40 years, 6 were females, i.e. 20% of females was in the age group of 31-40 years. Five means 16.6% of females in the age group of 41-50 years. Most common presentation in present study was colloid goiter, i.e among 15 colloid goiter patients 5 (33.3%) were in the age group of 41-50 years and 13 were females and 2 were males. Among 3 patients with PC, 2 were males and all the 8 patients with MNG were females.

Two patients with the thyroid size on ultrasound between 9 and 10 cm presented with DIB, pain and hoarseness of voice each. Two patients with size between 7 and 8 cm presented with DIB and pain. One patient with size between 5 and 6 cm presented with hoarseness of voice was diagnosed as PC.

There was a linear correlation between size of the thyroid on ultrasound and tracheal deviation on X-ray. Five patients had tracheal deviation whose severity was categorized as mild moderate and severe with two were mild and severe each.

Fiorentino *et al.* examined this very overlap of symptoms by conducting a study on 25 goiter patients who complained

of local neck symptoms (throat discomfort, dysphagia, hoarseness).¹⁴

Gittoes *et al.*¹⁵ have shown that upper airway obstruction occurs in about one-third of patients with goiter seen in general medical endocrinology clinics, emphasizing the importance of optimal airway evaluation in goiter patients.

Shin *et al.* in their retrospective study on pre-operative evaluation of surgery on goiter done on 200 patients. Common presenting symptoms in their series included shortness of breath (approximately 50%) and dysphagia (approximately 50%), emphasizing the effect of cervical and substernal goiter on the adjacent cervical viscera. Multivariate analysis showed that the presence of shortness of breath was related to goiter size. Furthermore, the presence of shortness of breath was significantly related to the imaging finding of tracheal compression. Thus, clearly there is a relationship between shortness of breath, goiter size, and tracheal compression. Because of this relationship between shortness of breath and the objective computed tomography (CT) scan radiographic finding of tracheal compression, tracheal compression appears to be an important radiographic finding. Therefore, the pre-operative radiographic finding of tracheal compression is an appropriate surgical indication.¹⁶

Mellisant CF *et al.* showed in their prospective study 28 female patients with a goitre and without pulmonary disorders. Lung function measurements consisted of maximum expiratory and inspiratory flow-volume curves and of airway resistance. CT-scans and X-rays were performed during apnea at functional residual capacity. Almost all lung function tests were significantly correlated with each other. CT-scans and X-ray was significantly correlated to each other only the correlation between the tracheal narrowing measured with CT-scan and X-ray was significant.¹⁷

The obstruction due to enlarged thyroid can be dangerous because of narrowing of the trachea and the development of tracheitis with edema and tracheomalacia, leading to severe narrowing of the airway with serious obstruction resulting in a respiratory emergency.¹⁸

The main indications for surgery in thyroid disease include fear of malignancy, tracheoesophageal compression, and cosmetic reasons.¹⁹ Multiple studies have demonstrated improvement or resolution of compressive symptoms after thyroid surgery. Carolin *et al.* showed in their study a large series of patients with compressive symptoms secondary to thyroid disease. In the study, 85% of patients with pre-operative compressive symptoms had resolution of compressive symptoms after thyroidectomy.²⁰

Table 13: Comparison with other studies

Sex	Present study	Shin <i>et al.</i> ¹²	Gittoes <i>et al.</i> ¹⁵
Females (%)	26 (86.7)	130 (65)	134 (87.5)

Present study may have limitations as we have taken arbitrary line for the measurement of tracheal deviation.

CONCLUSION

The present study helps to arrive at several conclusions which are as follows:

- Thyroid swelling is more common in female population
- Colloid goiter is the most common presentation irrespective of age and sex
- If male patients present with thyroid swelling, malignancy has to be ruled out
- Male patients are at high risk for PC
- As thyroid swelling increases, tracheal deviation also increases
- As thyroid swelling increases, the severity of TI also increase
- As thyroid swelling increases, symptoms also increase
- Helps in pre and post-operative evaluation.

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