Endocrine disorders are increasing worldwide. Diseases of thyroid gland are amongst the most abundant endocrine disorder in the world second only to diabetes mellitus (Heuck et al., 2000). Epidemiology of subtypes of thyroid disorders have been reported from many parts of the world particularly Denmark (Carle et al., 2006), Australia (Leary et al., 2006), Turkey (Gozu et al., 2006), United Kingdom (Rashid and Rashid, 2007), Thailand (Sarinnapakorn et al., 2007), Italy (Papi et al., 2007), Netherland (Muller et al., 2008), India (Prakash et al., 2007; Shashi et al., 2009; Singh et al., 2010), Africa (Ogbera and Kuku, 2011), Nepal (Regmi et al., 2011), Spain (Egea et al., 2011), and U.S.A. (Bahn et al., 2012). It has been estimated that about 45 million people in India suffer from thyroid disease. Thyrotoxicosis is the widely prevalent disorder of the thyroid in north India (Kochupillai, 2000). The principal lesions of thyroid gland are goiter (diffuse or nodular), thyroiditis neoplasms and adenomas. Simple goiter is extremely common throughout the world and is thought to affect more than 200 million individuals. It is most prevalent in mountainous areas but also occurs in non-mountainous areas remote from sea (Tsegaye and Ergete, 2003).

Thyroid diseases are primarily conditions that affect the amount of thyroid hormones being produced. Excess production leads to hyperthyroidism while diminished production leads to hypothyroidism (Ridgeway, 1996). The clinical symptoms of hypothyroidism are weakness, weight gain, bradykinesia, periorbital puffiness, paresthesias, lethargy, cold intolerance, alopecia, skin pallor, muscle cramps, depression, memory loss and infertility (Guimaraes et al., 2009). Hypothyroidism is one of the pathological condition associated with lipid metabolism and finally dyslipidemia (Pucci et al., 2000). Thyroid hormone appears to play role in the regulation of hepatic lipase, which alter HDL cholesterol subtractions (Tan et al., 1998). Patients with hyperthyroidism experiences weight loss, fatigue, heat intolerance, increased bowel moments, exophthalmos, fast heart rate, insomnia, warm moist skin, palpitations, trembling in hands and staring gaze (Boelaert et al., 2010).
The impairment of sodium-potassium ATPase activity has been reported in the presence of thyroid dysfunction. The state of erythrocyte sodium-potassium ATPase activity can be used as an early marker for diagnosis of thyroid hypo (Nicolini et al., 2004) and hyperfunction (Prasad and Nayak, 2009). Creatine kinase is an important clinical marker for muscle damage. In recent years studies have been conducted to establish a relationship of creatine kinase levels in thyroid disease (Bayraktaroglu et al., 2009), but the exact etiology is not known.

The present investigation was carried out to study pattern of adenomatous and metabolic thyroid lesions and biochemical abnormalities in serum level of enzymes, lipids, glucose and ionogram in patients of thyroid dysfunction. An attempt has also been made to correlate the levels of these biochemical parameters with thyroid stimulating hormone, triiodothyronin and thyroxine in hypo and hyperthyroidism.

812 thyroid patients in the age group of 25 – 55 (mean age- 39.78 ± 11.54 years) and 200 age and sex matched euthyroid controls were randomly selected from different districts of Himachal Pradesh, India. A detailed history with emphasis on symptoms related to impaired thyroid function was recorded. Blood samples of thyroid patients and euthyroid controls were analysed for the estimation of thyroid function hormones (TSH, T3 and T4), activities of various enzymes such as sodium-potassium ATPase, hepetic lipase, creatine kinase, glucose-6 phosphate dehydrogenase and alpha amylase, lipids, glucose and ionogram viz., sodium, potassium, calcium and chloride and heamoglobin. The biochemical data was statistically analyzed by using chi square test, odd ratios with 95% CI and One way ANOVA with post hoc test,. Differences were considered statistically significant at $P<0.05$. The correlations between thyroid dysfunction and biochemical parameters were performed by Pearson’s bivariate correlation matrices.

**Clinical Symptoms**

- The clinical signs and symptoms of hypothyroidism were assessed by the method of Zulewski et al. (1997).

- Scoring of signs and symptoms for the diagnosis of hyperthyroidism was done by Wayen’s index (Crooks et al., 1959).
Most frequent symptoms among hypothyroid patients were weight gain (60.11%), bradykinesis (60.11%), weakness (59.11%), decreased appetite (57.37%), constipation (50.54%) and intolerance to cold. Univariate analysis showed that most of the clinical symptoms differ significantly (p<0.001) between overt hypothyroid and subclinical hypothyroid patients.

The hyperthyroid patients exhibited symptoms viz., weight loss (58.06%), Appetite increase (58.06%), fatigue (53.22%), insomnia (47.41%), tremors (46.12%), heat intolerance (45.16%), palpitations (43.54%), staring gaze (37.09%), exophthalmos (36.12%) and trembling hands (13.84%). Univariate analysis showed that these symptoms were more pronounced in overt cases than the subclinical patients (p<0.001).

**Demographic risk factors**

The various demographic factors such as socio-economic and nutritional status, body mass index, basal metabolic rate and blood pressure were assessed.

The chi-square analysis revealed that the low socio-economic class was most prone to thyroid disease. The results were statistically significant ($\chi^2 = 59.32$, P<0.001).

The prevalence of thyroid disease was significantly ($\chi^2 = 98.15$, P < 0.001) higher (48.52%) in patients with poor nutritional status, whereas fair and good nutritional status had lower incidence of thyroidism. Malnutrition enhances the thyroid dysfunction.

One way ANOVA with post hoc Tukey’s HSD multiple comparison analysis described a highly significant (P<0.0001) increase in body mass index in hypothyroid patients ($F = 2084.622$, $q = 3.70 – 9.61$, 95% CI = 3.32 – 9.95) whereas in hyperthyroid patients, the body mass index was declined ($F = 1545.860$, $q = -1.55$ to – 5.22, 95% CI = -1.50 to -5.44) indicating the underweight state of these patients.
The basal metabolic rate was significantly (P<0.0001) decreased in hypothyroids (F = 1487.366, q = -194.30 to -390.39, 95% CI = -212.23 to -374.30) whereas it was elevated in hyperthyroid patients (F = 1751.628, q = 198.75 – 409.78, 95% CI = 180.76 – 425.35) as determined by One way ANOVA with post hoc Tukey’s HSD multiple comparison test.

There was a significant (P<0.0001) elevation in both systolic (F = 86.211, q = 0.79 – 7.00, 95% CI = 3.32 – 9.95) and diastolic blood pressure (F = 749.892, q = 3.31 – 11.33, 95% CI = 3.32 – 9.95) in hypothyroid patients. In hyperthyroid patients only systolic blood pressure was elevated significantly (F = 749.040, q = 17.81 – 29.82, 95% CI = 3.32 – 9.95, P<0.0001).

Thyroid function tests

The serum samples of all the patients and controls were analyzed for TSH, T3 and T4 hormones. On the basis of thyroid function, the patients were subdivided into subclinical and overt cases.

Subjects with levels of TSH, T3 and T4 within normal reference range (TSH- 0.4 – 4.20 µIU/ml ; T3- 0.80 to 1.90 ng/ml ; T4- 4.8 to 12.0 µg/dl) were taken as euthyroid controls

The level of TSH was elevated significantly (P< 0.0001) in subclinical hypothyroid patients (q = 7.05, 95% CI = 6.21 – 7.79) and declined in subclinical hyperthyroid (q = -2.11, 95% CI = -2.37 to -1.85) patients compared to euthyroid controls.

In overt hypothyroid patients, TSH concentration was significantly (P<0.0001) elevated (q = 10.30, 95% CI = 9.55 – 11.05), while T3 and T4 levels were declined (T3, q = -1.26, 95% CI = -1.33 to -1.19; T4, q = -5.76, 95% CI = -6.00 to -5.52), while in overt hyperthyroid cases, there was a significant fall in TSH concentration (q = -2.12, 95% CI = -2.35 to -1.89) and rise in T3 and T4 levels (T3, q = 5.26, 95% CI = 5.08 – 5.44 ; T4, q = 8.88, 95% CI = 8.25 – 9.51) in comparison to euthyroid controls.
Biochemical Parameters

Enzymes

Sodium-potassium ATPase

- The activity of sodium-potassium ATPase was significantly (P<0.001) elevated in hypothyroids (t = 14.84, 95% CI = 17.36 – 13.39) and decreased in hyperthyroids (t= 23.74, 95% CI = -20.71 to -17.54) compared to euthyroid controls.

- Pearson’s bivariate correlation analysis revealed that in hypothyroid patients, the activity of sodium-potassium ATPase was significantly (P<0.05) increased with rise in TSH concentration (Y=151.48x + 1.3881, r = 0.51542), whereas in hyperthyroid patients, the enzyme activity was decreased (Y=84.972x + 54.888, r = 0.67231) due to low levels of TSH.

- In hypothyroid patients, there was a significant (p<0.01) inverse relationship between sodium – potassium ATPase activity and levels of T3 (Y = 177.85x – 53.15, r = -0.7832) and T4 (Y=192.14x – 8.332, r = -0.8299).

- The hyperthyroid patients revealed a significant (P<0.01) inverse relationship between sodium – potassium ATPase activity and T3 (Y= 128.30x – 5.288, r = -0.8535), however the correlation for T4 was non significant statistically.

Hepatic lipase

- The activity of hepatic lipase was significantly (P<0.001) decreased in hypothyroid patients (t = 15.63, 95% CI = -9.12 to – 7.08) and increased in hyperthyroid patients (t= 15.92, 95% CI= 9.26 – 13.76) compared to euthyroid controls.

- In hypothyroid patients, Pearson’s bivariate correlation analysis revealed a significant (P<0.05) inverse association of hepatic lipase activity with TSH (Y= 29.150x - 0.6627, r = - 0.5967) and a positive relationship with T3.
(Y = 18.244x + 15.439, r = 0.54517) and T4 (Y = 12.433x + 3.0296, r = 0.68971) concentrations.

- Hepatic lipase activity revealed a non significant relationship with thyroid hormones in hyperthyroid patients.

**Creatine Kinase**

- Creatine kinase activity in hypothyroid patients was significantly (t = 58.78, 95% CI = 48.71 – 50.34, P<0.001) increased compared to that of euthyroid group. Conversely, in hyperthyroid patients the activity of creatine kinase was significantly (t = 34.18, 95% CI = -28.81 to -26.57, P<0.001).

- Pearson’s bivariate correlation analysis revealed a positive relationship between creatine kinase activity and TSH levels in both hypothyroid (Y = 135.12x + 1.2428, r = 0.82054, P<0.01) and hyperthyroid cases (Y = 77.575x + 33.276, r = 0.54190, P<0.05).

- There was a significant (P<0.01) negative relationship between creatine kinase activity and thyroid hormones in both hypothyroid (T3, Y = 155.14x – 26.37, r = -0.6829 ; T4, Y = 163.27x – 4.532, r = -0.7565) and hyperthyroid patients (T3, Y = 104.23x – 3.492, r = -0.7996 ; T4, Y = 130.33 x – 2.739 r = -0.6329).

**Glucose 6 phosphate dehydrogenase**

- The activity of glucose 6 phosphate dehydrogenase (G-6PD) was significantly (P<0.001) decreased in hypothyroids (t = 12.81, 95% CI = -3.31 to -2.43), whereas in hyperthyroid group, the G-6PD activity was elevated (t = 17.49, 95% CI = 3.92 – 4.91) compared to euthyroid controls.

- The Pearson’s bivariate correlation analysis showed a significant (P<0.05) negative relationship between G-6PD activity and TSH concentration in both hypothyroids (Y = 7.8740x – 0.0896, r = -0.4425) and hyperthyroid patients (Y = 23.475x – 32.21, r = -0.6481).
The glucose-6 phosphate dehydrogenase activity exhibited significant (P<0.05) positive relationship with T3 (Y = 6.2626x + 2.8913, r = 0.56019) and T4 (Y = 5.6278x + 0.40478, r = 0.50585) in hypothyroid as well as in hyperthyroid group (T3, Y = 36.342x + 2.885, r = 0.6583; T4, Y = 31.50x + 2.7910, r = 0.69405).

**Alpha- Amylase**

The activity of alpha- amylase was significantly (P<0.001) decreased in hypothyroids (t = 32.32, 95% CI = -22.49 to -19.91) and increased in hyperthyroids (t= 19.45, 95% CI = 13.53 – 16.57) compared to euthyroid controls.

Pearson’s bivariate correlation analysis revealed a significant inverse correlation between serum alpha- amylase activity and TSH concentration in both hypothyroid (Y= 55.690x - 0.8143, r = - 0.6350, P<0.05) and hyperthyroid (Y= 149.25 x – 72.90, r = -0.8887, P< 0.01) patients.

Alpha- amylase activity exhibited a significant (P<0.05) positive relationship with T3 and T4 in both hypothyroids (T3, Y= 44.771x +14.877, r = 0.42714 ; T4, Y= 39.715x + 2.7089, r = 0.52569) and hyperthyroid patients (T3, Y= 157.35x + 2.945, r = 0.4702; T4, Y= 75.700x + 3.5470, r = 0.61057).

**Lipids**

Total cholesterol level was significantly (P< 0.0001) increased in both subclinical (F = 429.78, q = 40.96, 95% CI = 36.43 - 45.49) and overt hypothyroid patients (F = 429.78, q = 51.24, 95% CI = 47.17 - 55.31) compared to euthyroid controls as demonstrated by One way ANOVA with post hoc Tucky’s HSD multiple comparison test, which indicate that increase in TSH secretion was accompanied by hypercholesterolemia.

Pearson’s bivariate correlation analysis revealed a significant positive relationship between total cholesterol and TSH (Y = 174.43x + 2.3853, r = 0.79949, P <0.01) and negative correlation with T3 (Y = 231.11x – 90.52, r = -0.7840, P <0.01) and T4 (Y = 261.08x – 16.12, r = -0.9316, P<0.001) in overt hypothyroid patients.
In overt hyperthyroid patients, a significant \((P < 0.0001)\) decrease in total cholesterol level \((F = 58.53, q = -16.15, 95\% \text{ CI } = -19.93 \text{ to } -12.37)\) as compared to euthyroid controls, whereas in subclinical hyperthyroid patients the decline in total cholesterol level was statistically non-significant as demonstrated by One way ANOVA with post hoc Tucky’s HSD multiple comparison test. Correlation matrices revealed significant \((P<0.05)\) positive relationship between total cholesterol and TSH \((Y = 137.55 x + 49.333, r = 0.68404)\). A non-significant relationship was found between total cholesterol and thyroid hormones. There was a decline in the total cholesterol concentration with decrease in TSH levels in hyperthyroidism.

High density lipoproteins (HDL) level was significantly \((P<0.001)\) declined in both overt hypothyroid \((F =552.86, q = -21.51, 95\% \text{ CI } = -23.24 \text{ to } -19.78)\) and hyperthyroid patients \((F = 170.877, q = -17.11, 95\% \text{ CI } = -19.22 \text{ to } -15.00)\), as determined by One way ANOVA with post hoc Tucky HSD multiple comparison test. Pearson’s correlation analysis indicated a significant \((P<0.05)\) negative relationship between HDL and TSH \((Y = 52.325x – 1.133, r = -0.5814)\) in subclinical hypothyroids. HDL revealed a negative relationship with TSH \((Y = 49.821x – 0.6516, r = -0.4123, P<0.05)\) and a positive correlation with T3 \((Y = 36.135x + 32.133, r = 0.71105, P<0.01)\) and T4 \((Y = 30.571x – 3.9414, r = 0.58952, P<0.05)\) in overt hypothyroid group. HDL revealed a significant \((P<0.05)\) negative correlation with T3 \((Y= 64.542x – 2.767, r = -0.4426)\) and T4 levels \((Y= 86.534x – 2.318, r = -0.4061)\) in cases of overt hyperthyroidism.

Low density lipoproteins (LDL) concentration was significantly \((P<0.0001)\) elevated in subclinical \((F = 534.97, q = 52.25, 95\% \text{ CI }= 47.36 – 57.14)\) as well as overt hypothyroid patients \((F = 534.97, q = 60.33, 95\% \text{ CI }= 55.94 – 64.72)\) as determined by One way ANOVA with post hoc Tucky’s HSD multiple comparison test. There was significant \((P<0.05)\) positive relationship of LDL with TSH \((Y= 108.60x + 2.6692, r = 0.54571)\) and inverse relationship with T3 \((Y= 158.77x – 97.17, r = -0.6947)\) and T4 \((Y= 178.98x - 13.13, r = -0.6344)\).

There was a significant \((P<0.001)\) decline in the LDL concentration in both subclinical \((F = 85.566, q = -14.50, 95\% \text{ CI } = -18.90 \text{ to } -10.10)\) and overt
hyperthyroid patients (F = 85.566, q = -21.81, 95% CI = -25.62 to – 18.00, P<0.0001 in comparison to euthyroid controls as demonstrated by One way ANOVA with post hoc Tucky’s HSD multiple comparison test. Correlation matrices revealed a positive association of LDL levels with TSH (Y = 70.218x + 46.330, r = 0.68401, P<0.05) and a significant (P<0.01) negative relationship with T3 (Y = 107.40x – 4.504, r = -0.7378, P<0.01) and T4 (Y = 153.66x – 4.372, r = -0.7843).

Very low density lipoproteins (VLDL) were significantly elevated in both subclinical (F = 103.107, q = 6.45, 95% CI = 5.59 – 7.31, P< 0.05) and overt hypothyroid patients (F = 103.107, q = 12.77, 95% CI = 12.00 – 13.54, P< 0.01) compared to euthyroid controls as demonstrated by one way ANOVA with post hoc Tucky’s HSD multiple comparison test. Pearson’s bivariate correlation analysis revealed that VLDL levels had a significant positive relationship with TSH (Y = 28.756x + 0.40885, r = 0.71260, P<0.01) and negative relationship with T3 (Y = 36.161x – 13.24, r = -0.8112, P<0.01) and T4 (Y = 40.565x - 2.377, r = -0.9843, P<0.001) in overt hypothyroid patients.

There was significant (P<0.05) decrease in VLDL level in overt hyperthyroid patients (F = 24.222, q = -4.28, 95% CI = -5.04 to -3.52) compared to euthyroid controls as demonstrated by one way ANOVA with post hoc Tucky’s HSD multiple comparison test. In subclinical group the VLDL were within normal reference range (19 – 25 mg/dl). VLDL levels exhibited significant (P<0.05) positive correlation with TSH (Y = 17.794x + 8.1651, r = 0.57896) and a negative relationship with T3 (Y = 24.226x – 0.7756, r = -0.6102) and T4 (Y = 31.614x – 0.7198, r = -0.6202).

Serum triglycerides levels were significantly (P<0.0001) elevated in both subclinical (F = 839.09, q = 49.15, 95% CI = 45.07 – 53.23) and overt hypothyroid patients compared to euthyroid controls (F = 839.09, q = 65.04, 95% CI = 61.37 – 68.71) as demonstrated by one way ANOVA with post hoc Tucky’s HSD multiple comparison test. Pearson’s bivariate correlation analysis revealed a significant (P<0.05) positive relationship between triglycerides level and TSH in subclinical (Y = 131.22x + 2.4087, r = 0.61749) and overt hypothyroid (Y = 147.96x + 1.7119, r = 0.59976) cases. In these patients, a rise in TSH causes hypertriglyceridemia. A highly significant (P<0.01)
negative relationship of serum triglycerides level with T3 (Y= 180.40x – 63.87, r = -0.7825) and T4 (Y= 196.05x - 9.471, r = -0.7853) exhibited by overt hypothyroid group.

- In hyperthyroid patients, a significant decline in triglycerides level was observed in overt cases (F = 17.74, q = –11.49, 95% CI = -16.01 to –6.97, P< 0.0001) compared to euthyroid controls as demonstrated by one way ANOVA with post hoc Tukey’s HSD multiple comparison test. Correlation matric revealed significant (P<0.05 ) positive relationship of triglycerides with TSH (Y= 86.266x + 44.153, r = 0.54458) and a negative relationship with T3 (Y= 119.65x – 3.986, r = -0.5454) and T4 (Y= 157.71x – 3.704, r = -0.5551)

Glucose

- Glucose level was elevated significantly (P<0.0001) in both overt hypothyroid (F= 325.212, q = 31.27 – 41.85, 95% CI = 27.06 – 45.63) and hyperthyroid patients (F = 424.199, q = 22.49 – 41.38, 95% CI = 18.79 – 44.58) compared to euthyroid controls as determined by One way ANOVA with post hoc Tukey’s HSD multiple comparison test. In subclinical cases, the rise in glucose levels was statistically non significant.
- Glucose showed a significant positive correlation with TSH (Y= 108.03x + 3.0562, r = 0.68043, P<0.05), and inverse relationship with T3 (Y= 162.86x – 95.95, r = -0.7471, P<0.01) and T4 concentrations (Y= 197.32x – 18.13, r = -0.9542, P<0.001) in overt hypothyroid group. Hyperthyroid patients exhibited a significant (P<0.01) inverse relationship of glucose with TSH (Y= 166.82x – 134.1, r = -0.7654) and a positive correlation with T3 (Y= 76.072x + 10.602, r = 0.77612) and T4 (Y= 20.65 x + 9.5777, r = 0.77.76).

Ionogram

- The serum sodium ions were elevated significantly (P< 0.001) in subclinical (F = 979.728, q = 14.89, 95% CI = 12.97 – 16.81) as well as in overt (q = 33.90, 95% CI = 32.17 – 35.63) hypothyroid cases compared to euthyroid controls as
demonstrated by one way ANOVA with post hoc Tucky’s HSD multiple comparison test. There was significant (P <0.01) positive correlation between sodium ions and T3 (Y = 169.89x + 60.266, r = 0.81245) and T4 (Y = 158.40x + 7.7685, r = 0.70788, P<0.001) in overt hypothyroids as demonstrated by Pearson’s bivariate correlation analysis. The relationship between sodium ions and TSH was statistically non significant.

- The serum sodium ions level decreased significantly (P<0.001) in overt hyperthyroid patients (F = 103.107, q = -10.06, 95% CI = -11.66 to -8.46) compared to euthyroid controls determined by one way ANOVA with post hoc Tucky’s HSD multiple comparison test. In subclinical cases, decrease in sodium levels was statistically non significant. Correlation matrices revealed significant (P<0.01) inverse relationship between sodium ions and TSH (Y = 136.24 x – 38.81, r = -0.8334).

- The potassium ions concentration was significantly (P<0.001) declined in overt hypothyroid patients (F = 111.280, q = -0.89, 95% CI = -1.02 to -0.76) compared to euthyroid controls as demonstrated by One way ANOVA with post hoc Tucky’s HSD multiple comparison test. In subclinical patients the potassium ions were within normal reference range (3.2- 5.5 mMol/L). Correlation matrices showed a significant (P<0.01) negative association of serum potassium levels with TSH (Y= 7.5893x - 1341, r = -0.7121) and a positive relationship with T3 (Y= 5.1010x + 4.6929, r = 0.87153, P<0.01) and T4 (Y= 3.9612x + 0.69231, r = 0.86904).

- Potassium ions were elevated significantly (P< 0.001) in overt hyperthyroid patients (F= 506.741, q = 0.39 – 2.08, 95% CI = 0.22 – 2.24) compared to euthyroid controls as demonstrated by One way ANOVA with post hoc Tucky’s HSD multiple comparison test. Potassium ions exhibited a significant negative relationship with TSH (Y= 4.2619x – 5.778, r = -0.8433, P<0.01) and a positive relationship with T3 (Y= 0.3265x + 0.49700, r = 0.47830, P<0.05) and T4 (Y= 5.536x + 0.48845, r = 0.51516, P<0.05).

- The serum calcium levels was rise significantly (F = 803.275, q = 2.65, 95% CI = 2.46 – 2.81, P < 0.0001) in overt hypothyroid patients compared to euthyroid controls.
as determined by one way ANOVA with post hoc Tucky’s HSD multiple comparison test. Pearson’s bivariate correlation analysis revealed that VLDL levels had a significant positive relationship with TSH (Y= 5.3072x + 0.12519, r = 0.70534, P<0.01) and negative relationship with both T3 (Y= 7.6961x – 4.766, r = -0.9391, P<0.001) and T4 (Y= 8.7727x – 0.6742, r = -0.8979, P<0.01).

In overt hyperthyroid patients, the calcium ions were significantly (F = 281.575, q = -1.62, 95% CI = -1.78 to – 1.46, P<0.001) lower than the corresponding value for the euthyroid controls as depicted by one way ANOVA with post hoc Tucky’s HSD multiple comparison test. Pearson’s bivariate correlation analysis showed a significant (P<0.05) positive correlation between calcium ions and TSH (Y= 9.2303x + 0.766, r = 0.7662).

The serum concentration of chloride ions was significantly (P<0.0001) elevated in overt hypothyroid patients (F = 111.280, q = 9.12, 95% CI = 7.67 – 10.57) compared to euthyroid controls as determined by One way ANOVA with post hoc Tucky’s HSD multiple comparison test. In subclinical hypothyroid patients the chloride ions were within the reference range (96-105 mEq/L). Pearson’s correlation analysis showed a significant (P<0.05) positive relationship between chloride ions and TSH (Y= 121.35x + 1.238, r = 0.6758) and an inverse relationship of LDL with T3 (Y= 101.38x – 25.757, r = -0.49171) and T4 (Y= 94.641x – 3.9734, r = -0.51272).

There was a significant (P< 0.0001) decrease in chloride levels in overt hyperthyroid cases (F = 124.223, q = –10.84, 95% CI = -12.41 to -9.27) compared to euthyroid controls was demonstrated by one way ANOVA with Tucky’s HSD multiple comparison test. Correlation matrices revealed a significant (P<0.05) positive relationship between chloride ions and TSH (Y= 83.138x + 21.28, r = 0.5437) and an inverse relationship of chloride ion with T3 (Y= 67.796x – 1.8089, r = -0.51270) and T4 (Y= 51.252x – 1.6396, r = -0.50930).

Pathological anomalies

One hundred fifty six patients in the age group of 25-55 (mean age- 41.08 ± 10 65 years) with thyroid swellings were studied for pathological abnormalities during the
study period. The major presenting symptom in all the patients was diffuse or nodular
swelling of the thyroid. Patients gave a history of swelling being present for more
than one year in seventy two case (46.15%), between three month to one year in sixty
six cases (42.31%) and less than three months in eighteen cases (11.54%).

➢ The goiter size of these patients was graded according to criteria recommended by the
joint WHO/UNICEF/ICCIDD (1994). 77.56% (121) patients have Grade 1 type of
goiter while 22.44 % (35) patients have Grade 2 type of goiter.

➢ Thyroid function tests revealed fifty percent patients were hypothyroid, thirty three
hyperthyroid (21.55%) and forty five have unaltered hormonal profile (28.85%).

➢ The most frequently encountered thyroid lesion was thyroiditis in eighty nine cases
(57.05%), followed by carcinomas (22.44%). Goitre was found in twenty two cases,
while adenoma was observed only in ten patients.

Hashimoto’s thyroiditis

➢ The smears of sixty nine diagnostic cases of Hashimoto’s thyroiditis revealed
presence of numerous lymphoid cells at different stages of maturation, including
mature and immature lymphoid cells and few plasma cells. There were small groups
of hyperplastic follicular cells in acinar or ball like clusters with vesicular nuclei and
scant cytoplasm. Sheets of Hürthle cells with abundant granular and eosinophilic
cytoplasm and marked nuclear pleomorphism were present. Hemosiderin- laden
macrophages and multinucleated giant cells were prominent.

Subacute thyroiditis

➢ Twenty patients were diagnosed to have sub-acute thyroiditis. In sub-acute thyroiditis
the cell population contained nacroic follicular cells, neutrophils, fibroblasts,
lymphocytes, macrophages and multinucleated giant cells. Aggregates of
paravacuolar granules with degenerative and proliferative changes of the follicular
cells infiltered by lymphocytes were visible. Multinucleated giant cells with more
than 50 nuclei were present. The nuclei of these cells varied in their shape and size.
Papillary thyroid carcinoma

- The morphological subdivision of thirty-five carcinoma cases showed 50.56% of papillary, 26.97% of follicular, and 22.47% of medullary carcinoma.

- The papillary carcinoma was characterized by presence of papillary clusters of follicular cells. Long and slender papillae having a thin fibrovascular cores, surrounded by monolayer of tumor cells were visible. The large tumour cells were cuboidal to columnar in shape, have basophilic cytoplasm, and pale nuclei with irregular nuclear outline. A monolayer sheet of pleomorphic hypertrophied and atrophied tumour cells were observed in a tall cell variant of papillary carcinoma. Psammoma bodies, the small concentric calcified spherules, located within the papillary formation of follicles, were prominent.

Follicular thyroid carcinoma

- The pathological changes in follicular carcinoma include hypercellularity and presence of highly crowded and overlapped malignant follicular cells. The nodules composed of atrophied thyroid follicles were prominent. The edges of follicles were irregular and infiltrate into the fibrous capsule. Fibrous tissues exhibited highly degenerative structure, vacuolated, and small sized follicles. Vascular and capsular invasions were visible.

Medullary thyroid carcinoma

- In medullary carcinoma, cells were present in fragments and in isolated dispersed pattern. Microfollicular pattern was seen in focal areas. The lumina of the follicles contained small deposits of amyloid or were empty. A mixed cell population with small round cells, plasacytoid cells, and large cells was present. The plasacytoid cells have dense cytoplasm with eccentrically placed oval nuclei having coarse granular chromatin and small nucleoli. Mild pleomorphism with binucleated and multinucleated tumor cells was seen in these cells.
Colloid goitre

- The colloid goitre revealed presence of abundant, thick colloid material with cracking and bubble pattern. Sheets of benign follicular cells in honeycomb pattern were seen. The degenerative, vacuolated, small sized follicles surrounded by benign follicular cells with scanty cytoplasm were present. The scalpping of colloid material observed in some follicles.

Multinodular goitre

- The multinodular goitre showed presence of variable sized atrophied and hyperatrophied thyroid follicles with hemorrhagic background. There was excessive cellularity of parenchyma and increase in number of follicular cells. Areas of hyperplasia with considerable variation in follicular size were prominent. Scalpping of colloid material occurred in the periphery of the follicles. Interfollicular disintegration was observed. Fibrosis capsules with degenerative changes were present. Fibrous tissues formed trabacular patterns.

Adenoma

- Follicular adenoma exhibited abundant hyperplastic follicular cells arranged in clusters, acini, and small or large monolayered sheets with hemorrhagic background with little colloid. The macrofollicles composed of variable shaped small sized atypical follicular cells were present. The microfollicles contained osteoclast like giant, round follicular cells having pleomorphic nuclei. Various sized hyperatrophied and atrophied compressed follicles were visible. Highly degenerative follicles with extensive fibrous tissue formation were observed. In some cases, foamy cells were seen.

- The evaluation of clinic-pathological features of different syndromes of thyroid revealed that patients with thyroid carcinoma and sub-acute thyroiditis were...
associated with hyperfunctional thyroid activity. There was a significant association between hypothyroidism and goiter, adenomas and chronic Hashimoto’s thyroiditis.

- This study showed female preponderance of the thyroid disease over males.

- Our results showed that thyroid dysfunction can lead to dyslipidemia, hyperglycemia, electrolyte imbalance and alterations in activities of sodium-potassium ATPase, hepatic lipase, creatine kinase, glucose-6 phosphate dehydrogenase and alpha – amylase. Future studies analyzing the pathogenic mechanism of oxidative stress and inflammatory markers in hypo and hyperthyroidism would further validate the present findings.