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# Introductory Chapter: Introduction to Thyroid Disorders

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Additional information is available at the end of the chapter

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## 1. Physiological considerations

Thyroid disorders are most common endocrine problem next to diabetes mellitus. Thyroid disorders affect women more compared to men. Thyroid glands secrete, store, and release triiodothyronine (T3) and thyroxine (T4). The hormone T4 gets converted into T3 at tissue level and produces its effect. Iodine is necessary for production of thyroid hormone. Iodine in food is trapped by thyroid gland and is utilized in hormone production. Pituitary and hypothalamus control thyroid gland hormone secretion. TRH from hypothalamus modulates through pituitary to produce TSH, which in turn controls thyroid hormone production. If T4 and T3 are low, TSH level increases to stimulate thyroid gland to secrete more hormone. T3 and T4 hormones have profound effect on the body. Almost all the tissues are stimulated, and body metabolism is increased. T3 and T4 affect cardiovascular system, GI tract, brain, metabolism, weight, bone, etc. With increased T4 and T3, there is tachycardia, diarrhea, hyperglycemia, lowering of cholesterol, increased growth rate in infant, normal brain development, and sexual function. Undiagnosed hypothyroidism in infants not only affects physical and bony growth but also damages brain growth. If untreated, it leads to permanent damage.

Thyroid functions are affected by congenital absence of thyroid glands, autoimmune thyroid disease, surgical removal, infiltrative diseases, and after radiation to neck. Drugs like amiodarone, lithium, interferon alpha, and interleukin 2 prevent thyroid glands from making hormone and causing hypothyroidism.

Pituitary damage by tumor radiation or surgery can affect thyroid glands and cause secondary hypothyroidism.

For brain maturation and brain function, thyroid hormone is necessary. Thyroid diseases like hypothyroid can cause lethargy, hyporeflexia, depression, memory impairment, weight gain, dry

skin, and constipation along with dyslipidemia. Hyperthyroidism produces weight loss, tremors, irritability, and hyperreflexia. Glucose intolerance can also be caused by hyperthyroidism.

Thyroid hormone acts through T3 with nuclear receptors and regulation of gene expression. Hormone deficiency can cause retarded brain maturation and neurological impairment. Thyroid hormone deficiency is caused by congenital and maternal hypothyroidism. Hypothyroidism causes lethargy, hyporeflexia, poor motor coordination, and memory impairment. Hypothyroidism is also associated to bipolar affective disorders, depression, or loss of cognitive functions, especially in the elderly. Thyroid hormone deficiency, even of short duration, may lead to irreversible brain damage.

There is suggestion that reduction in circulating thyroid hormone concentrations is one of the factors mediating impaired neurological development in intrauterine growth retardation and premature babies. More research is required to resolve these questions and ultimately shows if thyroid hormone or iodide supplementation in hypothyroid mothers in the antenatal period and in premature neonates can reduce the prevalence of neurodevelopmental delay.

## **2. Hyperthyroidism**

Hyperthyroidism, which is usually due to autoimmune thyroiditis, clinically presents with tachycardia, increased systolic BP, weight loss in spite of increased appetite, and tremors in both hands. The cardiovascular system reveals fast pulse and sometimes irregular pulse known as auricular fibrillation. Auscultation of chest reveals systolic murmur. Neurological examination reveals brisk knee jerk, and patients show anxiety. There is history of diarrhea. In thyrotoxicosis, bone resorption leads to hypercalcemia. There is decreased PTH, decreased urinary, and fecal calcium excretion. There is hyperphosphatemia. Bone mineral density is decreased due to osteoporosis. Forearms are more affected.

## **3. Hypothyroidism**

In hypothyroidism, patient has a puffy and pallor look. Skin is dry, BP may be increased, and tongue is bigger and voice is hoarse and has constipation due to poor bowel movements. In hypothyroidism, PTH and vitamin D are increased due to low urinary calcium excretion. Decreased bone resorption and formation occurs. Serum osteocalcin and alkaline phosphatase are decreased. Bone turnover is also decreased.

## **4. Effect of thyroid disorders on bone**

Skeletal growth is influenced by thyroid hormone and growth hormone. In thyroid deficiency, there is decreased skeletal growth due to decreased growth hormone and insulin growth factor. Osteoblastic activity is decreased. In childhood thyrotoxicosis, there is advanced bone age due to premature fusion of epiphysis.

## 5. Thyroid carcinoma

Thyroid carcinoma like anaplastic, follicular, and adeno may eventually cause hypothyroidism. Diabetes mellitus is associated more with hypothyroidism. In Grave's disease, eyes are involved which is termed as thyroid ophthalmopathy.

Thyroid diseases affect both mother and child before and after delivery. Untreated thyroid dysfunctions can affect neurointellectual development of fetus.

## 6. Thyroid disorders in pregnancy

During pregnancy, human chorionic gonadotrophin is produced from placenta. This is structurally similar to TSH. Hence, this stimulates thyroid gland, leading to increase in T4 and T3 and decrease in TSH. Thyroid binding globulin is increased due to estrogen and in turn binds T4 and increases T4 level and increases T4 to T3 conversion. There is increased iodine consumption and increased renal iodine clearance. There is increase of iodine transfer to fetus.

## 7. Thyroid function test in pregnancy

1. Increased TBG, T4, and iodine clearance, decreased thyrotropin, and increased placental type 3 deiodinase leading to decreased thyroxin level
2. TSH level varies with trimester
  - 2.5  $\mu\text{g}$  in the first trimester
  - Less than 3  $\mu\text{g}$  in the second trimester
  - Less than 5  $\mu\text{g}$  in the third trimester
  - T4 = 1.5 times higher

## 8. Factors influencing thyroid functions in pregnancy

1. Increase in human chorionic gonadotrophin in the first trimester stimulates TSHR. This leads to transient gestational hyperthyroidism or hyperemesis gravidarum. Antithyroid drugs are not needed in this situation.
2. Increase in estrogen leads to increased TBGT level.
3. Altered immune reaction leads to autoimmune phenomenon.
4. Increased thyroid hormone metabolism occurs in placenta.

5. Increased urinary excretion of iodine in pregnancy impairs thyroid hormone production. This in turn leads to goiter, maternal, and fetal hypothyroidism. Maternal hypothyroidism is seen in 2–3%. Thyroid hormone requirement increases by 25–50  $\mu\text{g}/\text{day}$ .

The current open access book on thyroid disorders covers many interesting topics. On the whole, various titles are interesting and provide additional information. I am sure this online book on thyroid disorders will be read by readers with great enthusiasm.

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