

Thyroid Hormone Regulation

Topics that will be covered:

- Thyroid Hormone Regulation
- How the thyroid gland release T3 and T4
- How T3 and T4 are regulated

Thyroid Hormone Regulation

Starting with Thyroid Hormone Synthesis. The Hypothalamus secretes Thyrotropin-Releasing Hormone (TRH) leading to stimulation of Anterior Pituitary Glands to release Thyroid-Stimulating Hormone (TSH). TSH attach to TSH receptors on the thyroid gland leading stimulation of thyroid hormone release: Thyroglobulin (TG), T3 and T4. The Thyroid Gland secretes T3 10% and T4 90% of its secretion and tiny amount of TG.

What is the activate hormone?

It is T3. It does the functions of the thyroid gland.

Increased thyroid hormones mainly T3 have a Negative Feedback on the Anterior Pituitary TSH leadings to Decrease the TSH.

Thyroid Hormones T3 10% and T4 90% are found in one of two forms: **Free** or **Bound**. Free hormones represent 1% while Bound hormones represent 99% or more accurately 99.4%. Which means that the free hormones are around 0.6. The Bound hormones are bound to Thyroxine-Binding Globulin (TBG)

Total T3: it means both Free T3 and Bound T3

Total T4: it means both Free T4 and Bound T4.

So, Total T4 is 90% of all the thyroid hormones. Out of this 90%, 1% is free and 99% is bound. Same apply to T3, Total T3 is 10% of all the thyroid hormones. Out of this 10%, 1% is free and 99% is bound.

The Free Form of the Thyroid Hormones is the Biologically Active Form.

So, Free T3 is the active hormone.

T4 is converted to T3. T3 is the hormones that has the negative feedback on the pituitary. T3 is hormone with the thyroid gland function.

TBG: it is a **protein that bind T3 and T4**. It is synthesized in the liver.

- In Hepatic Patients: TBG Decreased leading to Increased FreeT3 and Free T4
- In Pregnancy: Estrogen Increased leading to decrease in the breakdown of the TBG leading to Increased TBG and that leads to Decreased FreeT3 and Free T4.

FreeT3 is the active form. T4 can be converted to T3.

T4 through Deiodinase is converted to T3 (or rT3). Deiodinase is considered mono Deiodinase as it removes one iodine from the T4.

Deiodinase has Three Types:

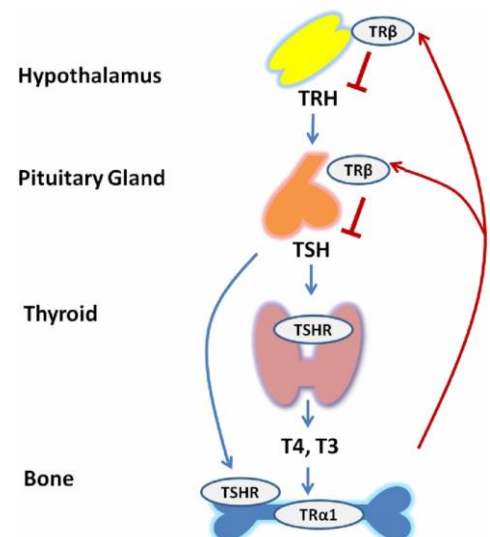
- Type 1: Liver
- Type 2: Peripheral Tissues (like Heart, Muscles and Bones)
- Type 3: CNS, Fetus

Deiodinase enzyme converts T4 to T3 (active form)

Deiodinase remove one Iodine from the T4.

- If it removed an Iodine from the side of the T4 then it forms T3. I
- If it removed an Iodine from the middle (central) iodine there it forms Reverse T3 (rT3) (an inactive foment of T3).

Normally, only 1% of converted T3 are rT3.)



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Important Notes:

Thyroid Hormone Regulation

- oHypothalamus → TRH → Stimulation of Anterior Pituitary Glands → release TSH → TSH receptors on the thyroid gland → Stimulation of thyroid hormone → TG (Thyroglobulin)
- oT3 → 10%
- oT4 → 90%

Active Form: Free T3

- oTotal T3: it means both Free T3 and Bound T3
- oTotal T4: it means both Free T4 and Bound T4.
- oTotal T4 is 90% of all the thyroid hormones. Out of this 90%, 1% is free and 99% is bound.
- oTotal T3 is 10% of all the thyroid hormones. Out of this 10%, 1% is free and 99% is bound

TBG

- oIn Hepatic Patients: Decreased TBG → Increased FreeT3 and Free T4
- oIn Pregnancy: Estrogen Increased → Increased TBG → Decreased FreeT3 and Free T4.

Conversion of T4 to T3

- oT4 → Deiodinase → T3 (or rT3)
- oDeiodinase has Three Types:
- oType 1: Liver
- oType 2: Peripheral Tissues (like Heart, Muscles and Bones)
- oType 3: CNS, Fetus

