LAS HORMONAS TIROIDEAS

OBJETIVOS

- **Parte 1**: Conocer cómo se regulan las hormonas tiroideas en nuestro organismo.
- **Parte 2**: Conocer qué efectos tiene y aprender a aplicar protocolos específicos.

MUSCLESPAIN DIET&TRAINING SYSTEMS

EQUIPO MUSCLESPAIN	¿QUÉ EFECTOS TIENEN?

FUNCIONES
↑ la producción de las polimerasas de ARN, estimulando la síntesis proteica
↑ el consumo de oxígeno , producción de calor en la mitocondria y la captación de glucosa
↑ producción de insulina y la funcionalidad de esta
↑ cantidad de receptores beta adrenérgicos
Efectos ionotrópicos y cronotrópicos sobre el corazón
Es vital para la síntesis de neurotransmisores como la serotonina y regula nuestro reloj biológico
↑ la degradación del colesterol y la cantidad de receptores de LDL

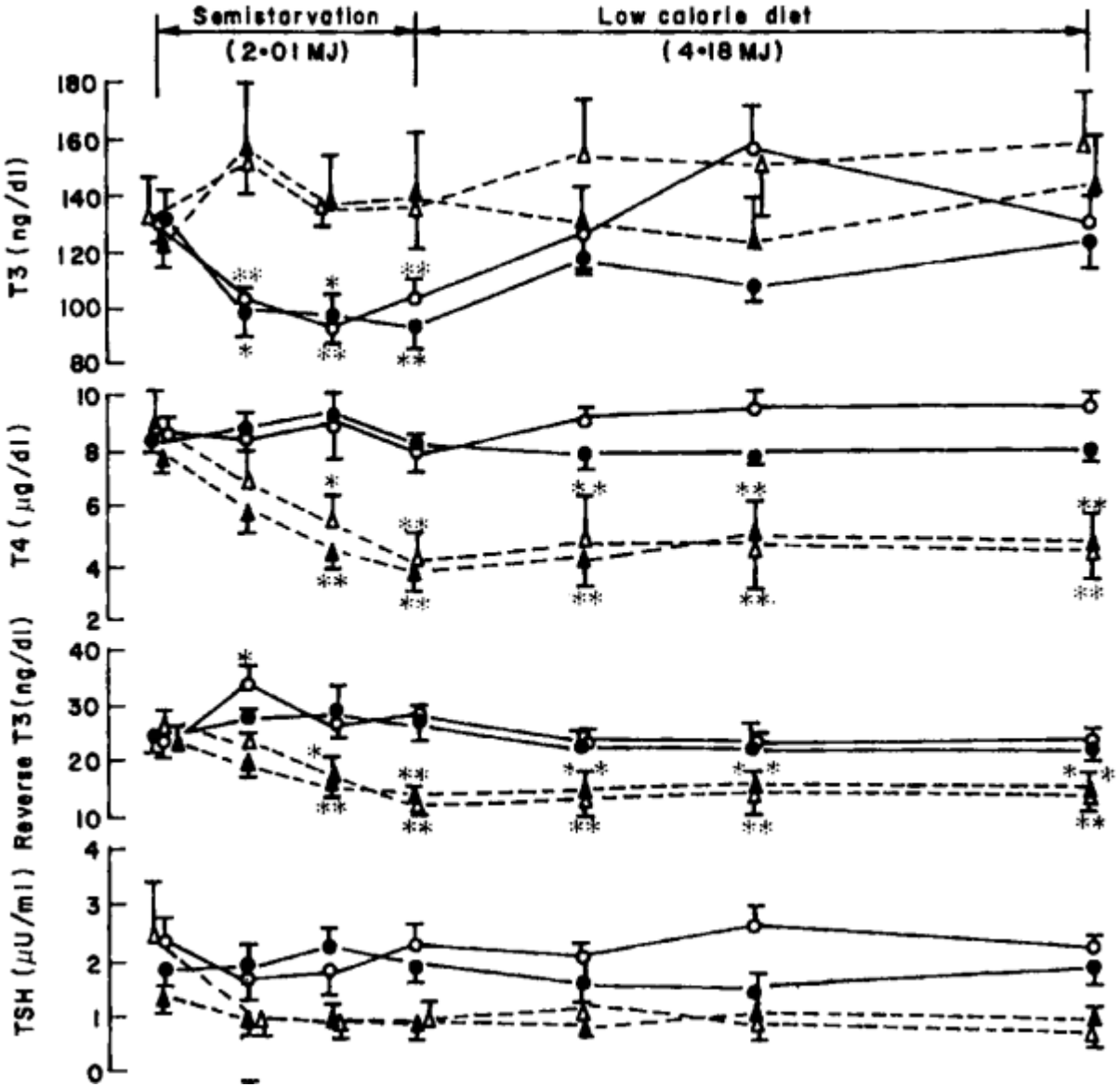
Effect of 'physiological' doses of triiodothyronine replacement on the hormonal and metabolic adaptation to short-term semistarvation and to low-calorie diet in obese patients

Table 1. General data (m ± SEM) of the patients (divided into four groups) who participated in the study

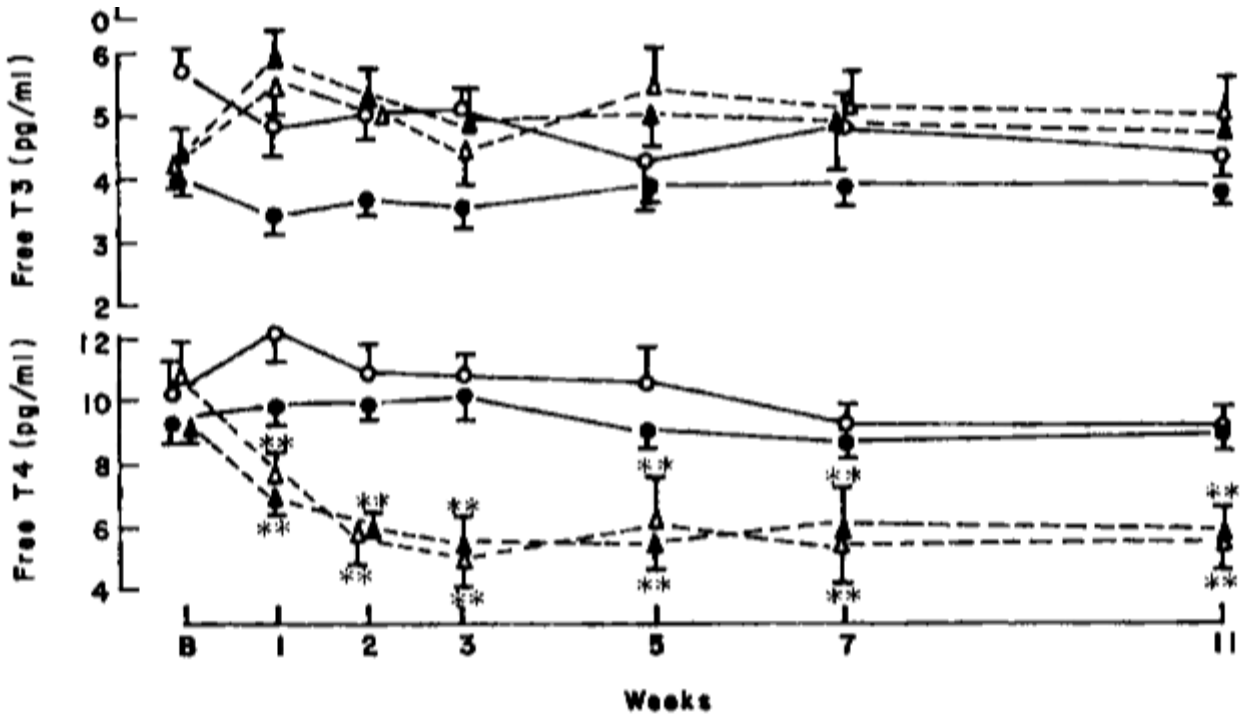
Groups	No. of subjects	Age (years)	Sex	Height (cm)	Body weight (kg)	BMI	Dietary treatment during the semi-starvation (2·01 MJ) period (0–3 wks)†	Pharmacological treatment
I	7	38·0 ± 4·4	6 F; 1 M	165·7 ± 2·5	119·3 ± 4·1	39·7 ± 2·2	P66g; L1·38g; CHO51g	Placebo
II	7	34·0 ± 3·0	5 F; 2 M	162·0 ± 3·7	107·2 ± 5·3	40·9 ± 1·4	P33g; L0·69g; CHO84g	Placebo
III	7	35·4 ± 1·8	4 F; 3 M	166·3 ± 3·4	112·3 ± 9·6	40·0 ± 2·1	P66g; L1·38g; CHO51g	T3 40 μg/d
IV	7	39·6 ± 4·7	4 F; 3 M	160·4 ± 4·5	103·9 ± 6·3	40·5 ± 1·9	P33g; L0·69g; CHO84g	T3 40 μg/d

* BMI (Body Mass Index): body weight (kg) divided by height^2 (m).
† P, proteins; L, lipids; CHO, carbohydrates.

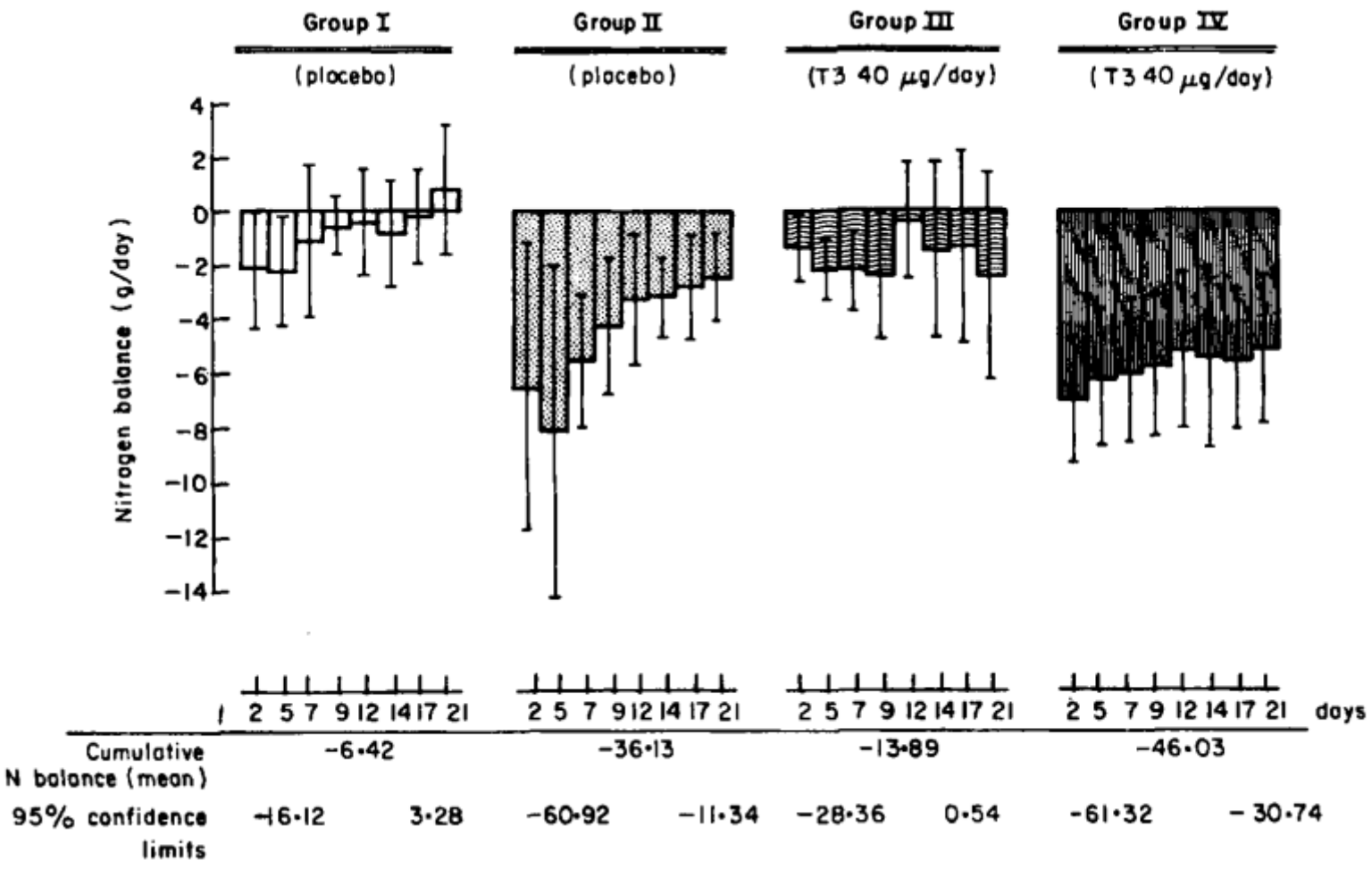
EFECTOS EN PERSONAS EUTIROIDEAS



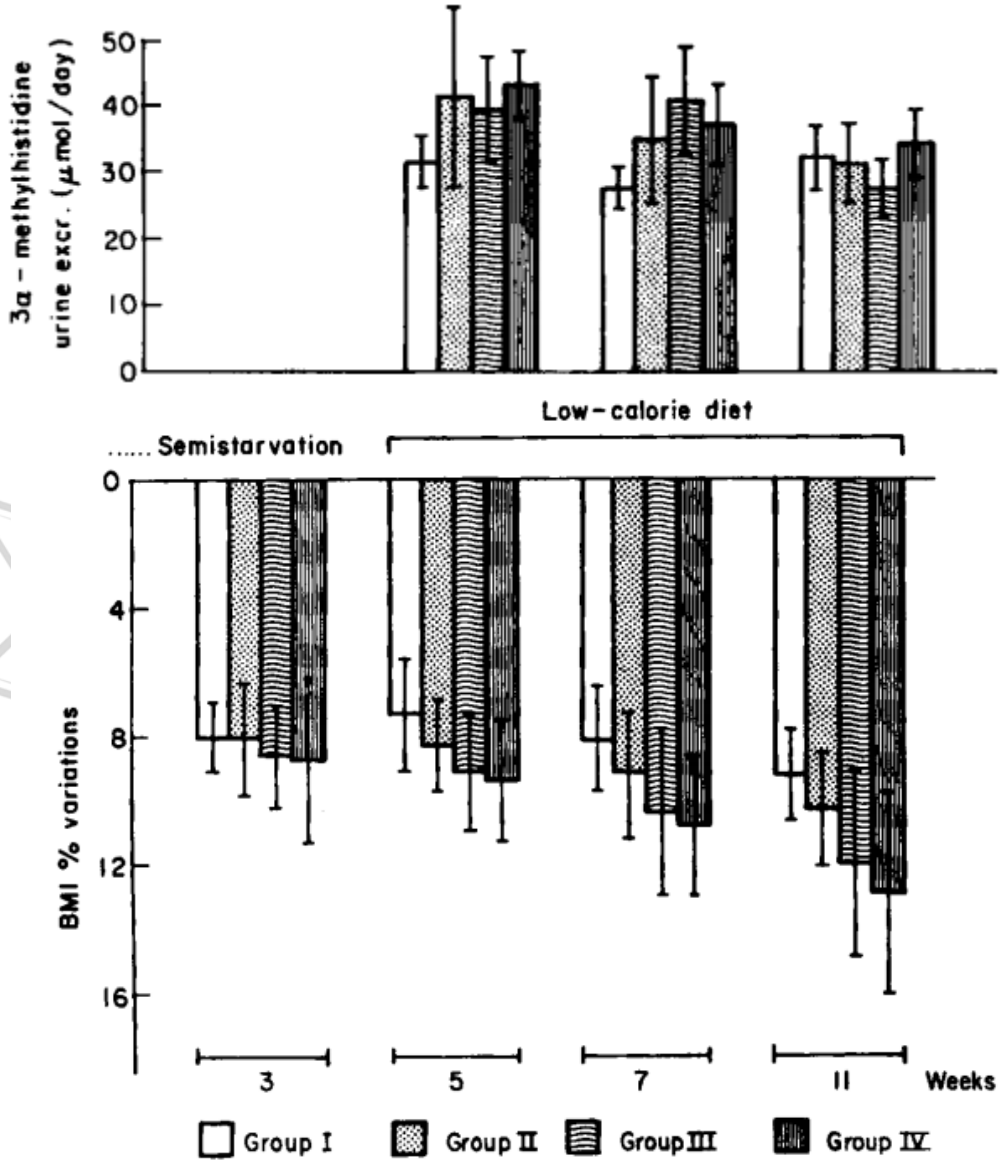
EFECTOS EN PERSONAS EUTIROIDEAS



EFECTOS EN PERSONAS EUTIROIDEAS



EFECTOS EN PERSONAS EUTIROIDEAS



Recuerda que los grupos 1 y 3 ingirieron más proteína

Treatment of obesity with triiodothyronine and a very-low-calorie liquid formula diet.

Moore R, Grant AM, Howard AN, Mills IH

Summary In a double-blind trial physiological doses (60 μg/day) of triiodothyronine (T_3) were compared with placebo in a group of obese patients on a 320 kcal/day (1·34MJ) liquid formula diet. T_3-treated patients had a significantly greater weight-loss by the 12th week. Analysis of serum levels of T_3 and thyroxine (T_4) showed that those patients in the placebo group whose weight-loss tended to level off at a plateau towards the end of the trial also had the lowest T_3 levels and resting metabolic rate (RMR) at that time. Patients in the T_3 group had a steady rise in serum T_3 levels during the 12 wk period. Those with the highest final T_3 levels had the greatest tendency for their weight-loss to level out and, paradoxically, had the least suppression of serum T_4 levels and lowest RMR. Some obese patients who do not readily lose weight on conventional low-calorie diets may have an impaired metabolic clearance rate of T_3 and a degree of T_3 resistance.

Treatment of obesity with triiodothyronine and a very-low-calorie liquid formula diet.

Moore R, Grant AM, Howard AN, Mills IH

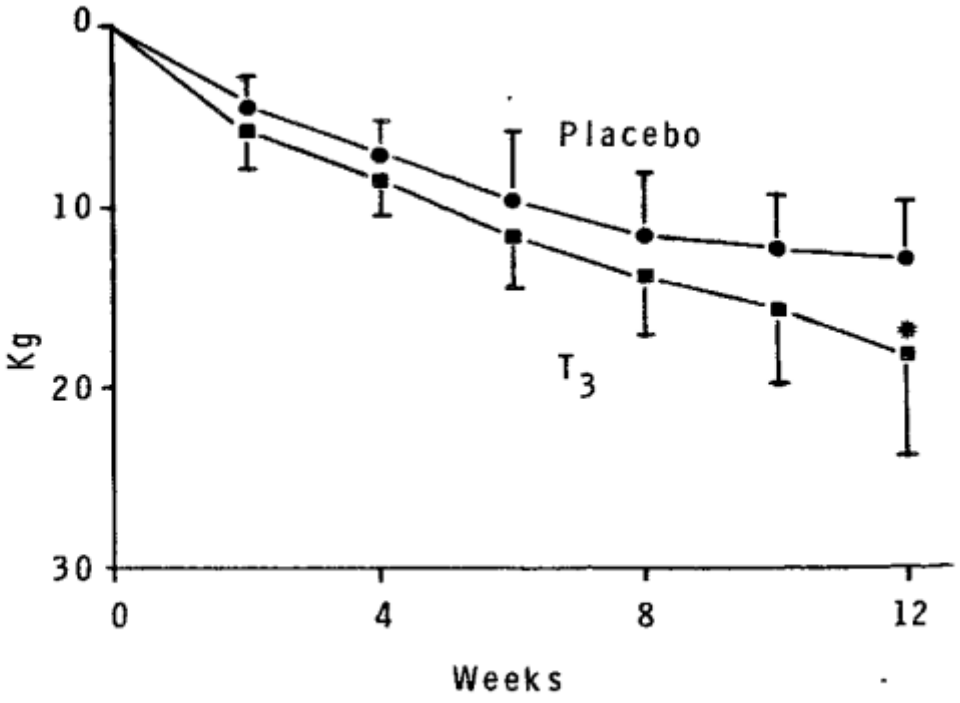


Fig. 1—Cumulative mean weight-loss in each group.

Treatment of obesity with triiodothyronine and a very-low-calorie liquid formula diet.

Moore R, Grant AM, Howard AN, Mills IH

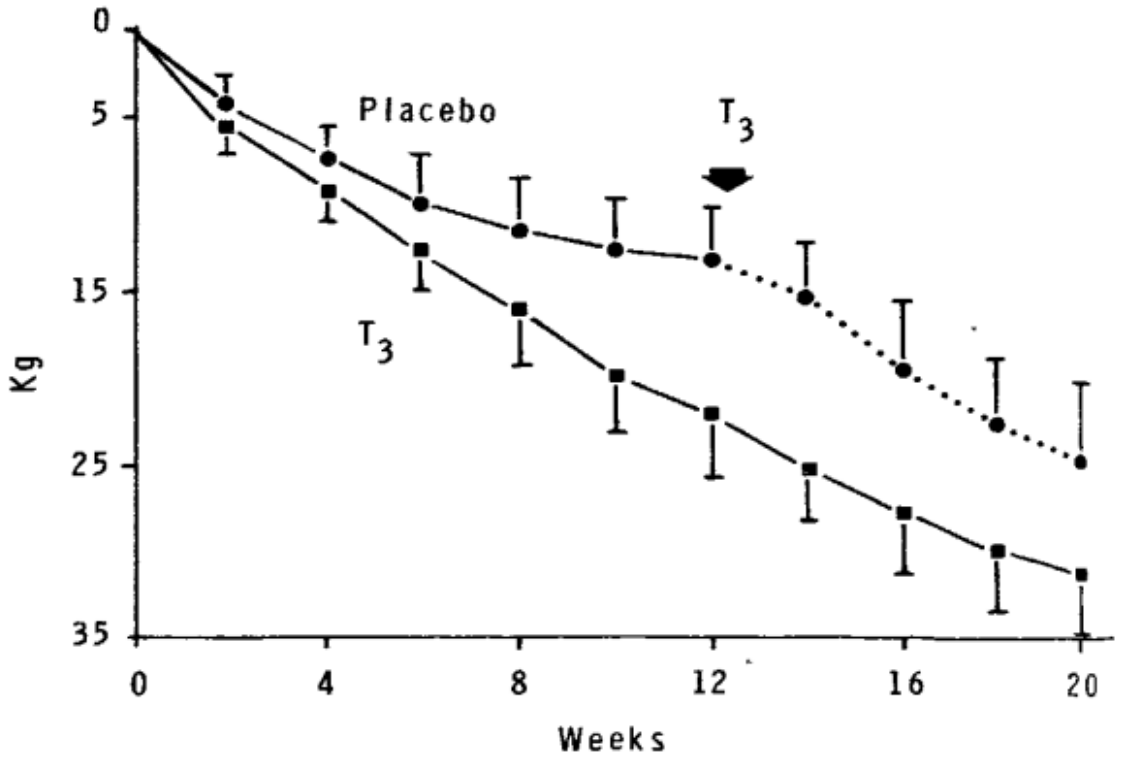


Fig. 2—Cumulative weight-loss in patients who continued with the diet beyond 12 wk.

A CONTROLLED STUDY OF THYROID ANALOGS IN THE THERAPY OF OBESITY

By Grant Gwinup, M.D.

A los pacientes se les dijeron que cada vez que se estancara el peso, subieran semanalmente o 25mcg de T3 o 100mcg de T4 hasta que se restaurara la pérdida de peso o los efectos secundarios no fueran tolerables.

La dosis medias al final del estudio fueron:

- **T3**: 275mcg diarios (150-500mcg)
- **T4**: 1400mcg diarios (800-2400mcg)

A CONTROLLED STUDY OF THYROID ANALOGS IN THE THERAPY OF OBESITY

By Grant Gwinup, M.D.

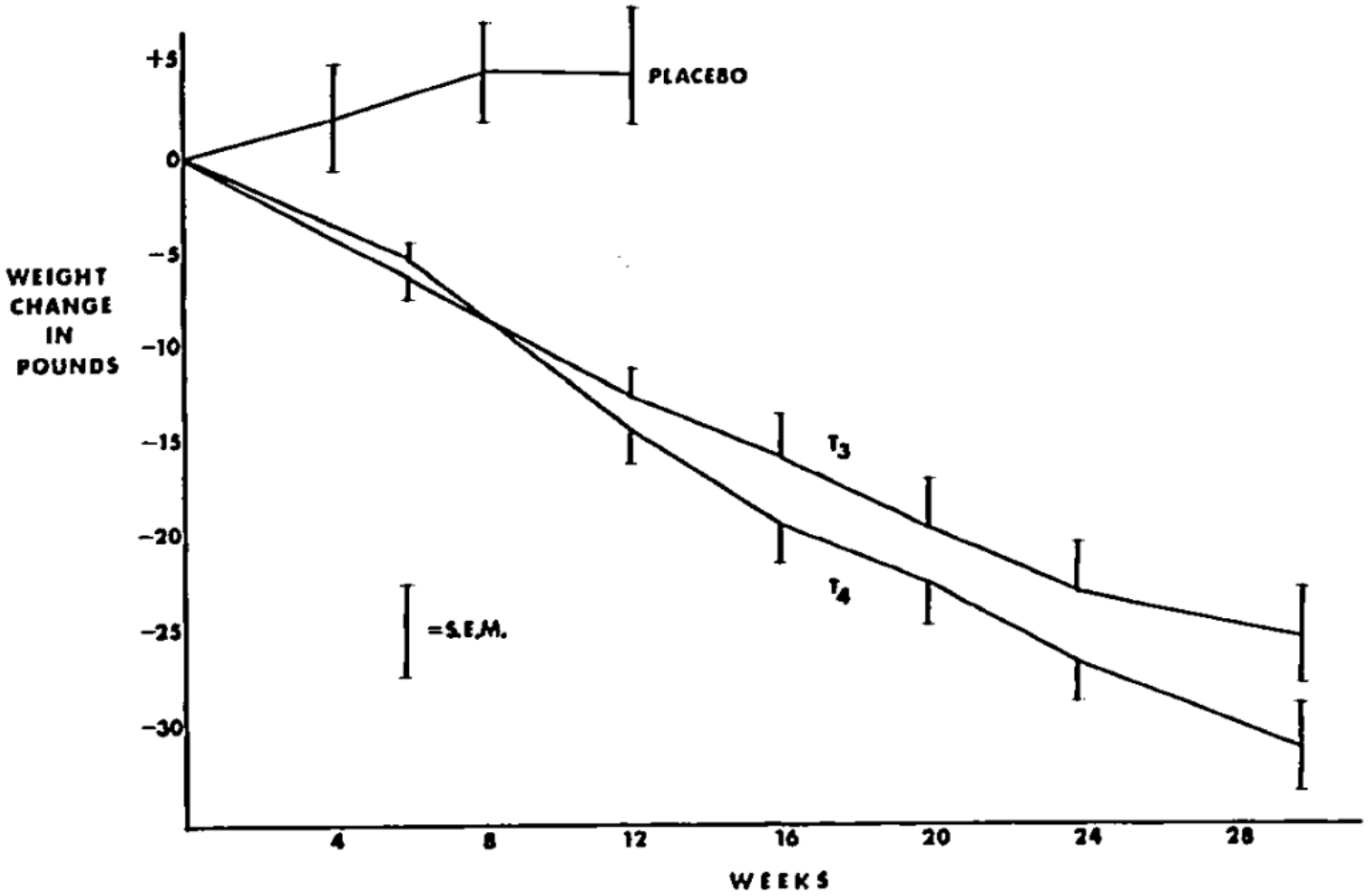
Group	*Weeks in Therapy*	*Mean Weight Change*	*Mean Change Diastolic Pressure*	*Mean Change Systolic Pressure*	*Mean Change Pulse*	*Mean Change Cholesterol*
T_3	30 (6)	—25	—13	+9	+18	—80
T_4	30 (7)	—30	—24	+6	+25	—63
Placebo	13 (4)	+5	+0.5	—1	—6	—2

DIET&TRAINING SYSTEMS

EFECTOS EN PERSONAS EUTIROIDEAS

A CONTROLLED STUDY OF THYROID ANALOGS IN THE THERAPY OF OBESITY

By Grant Gwinup, M.D.



Quantitative and Qualitative Effects of L-Triiodothyronine in Massive Obesity

By DOROTHY R. HOLLINGSWORTH, THOMAS T. AMATRUDA, JR. AND ROBERT SCHEIG

Seventeen massively obese patients were treated with either L-triiodothyronine (75 μg. three times a day) plus an 800-calorie diet or by diet plus placebo in a randomized double blind protocol. Weight loss data in hospitalized patients at eight weeks revealed a significantly greater mean weight loss of 29.1 pounds in the L-triiodothyronine group as compared with 17.2 pounds in the controls ($p < .025$). At 12 weeks there was no longer a significant difference in hospitalized patients with a mean weight loss of 37.0 pounds in the L-triiodothyronine group compared with 23.3 pounds in the controls ($p < 0.15$). Weight loss was unfavorably altered by hospital discharge and at 24 weeks the average weight loss of 48.1 pounds in the L-triiodothyronine group versus 29.4 pounds in the controls was not statistically significant. Subjective side effects were negligible, but one patient on L-triiodothyronine developed atrial fibrillation and was removed from the study. Gas chromatographic analysis of fat biopsies from the left buttock and dorsal cervical hump revealed a lower concentration of 16:1 and higher concentration of 16:0 and 18:0 fatty acids in the latter. Neither form of treatment altered this pattern significantly. Hyperuricemia in both groups returned to normal but the decline in serum urate was more striking in the patients treated with L-triiodothyronine. Treatment of obesity with L-triiodothyronine significantly accelerates weight loss in hospitalized patients for eight weeks but is recommended only in healthy, well motivated, massively obese (over 100 pounds above ideal weight) subjects who are agreeable to prolonged hospitalization, concomitant diet therapy, and long-term follow-up. (Metabolism 19: No. 11, November, 934-945, 1970)

EFECTOS EN PERSONAS EUTIROIDEAS

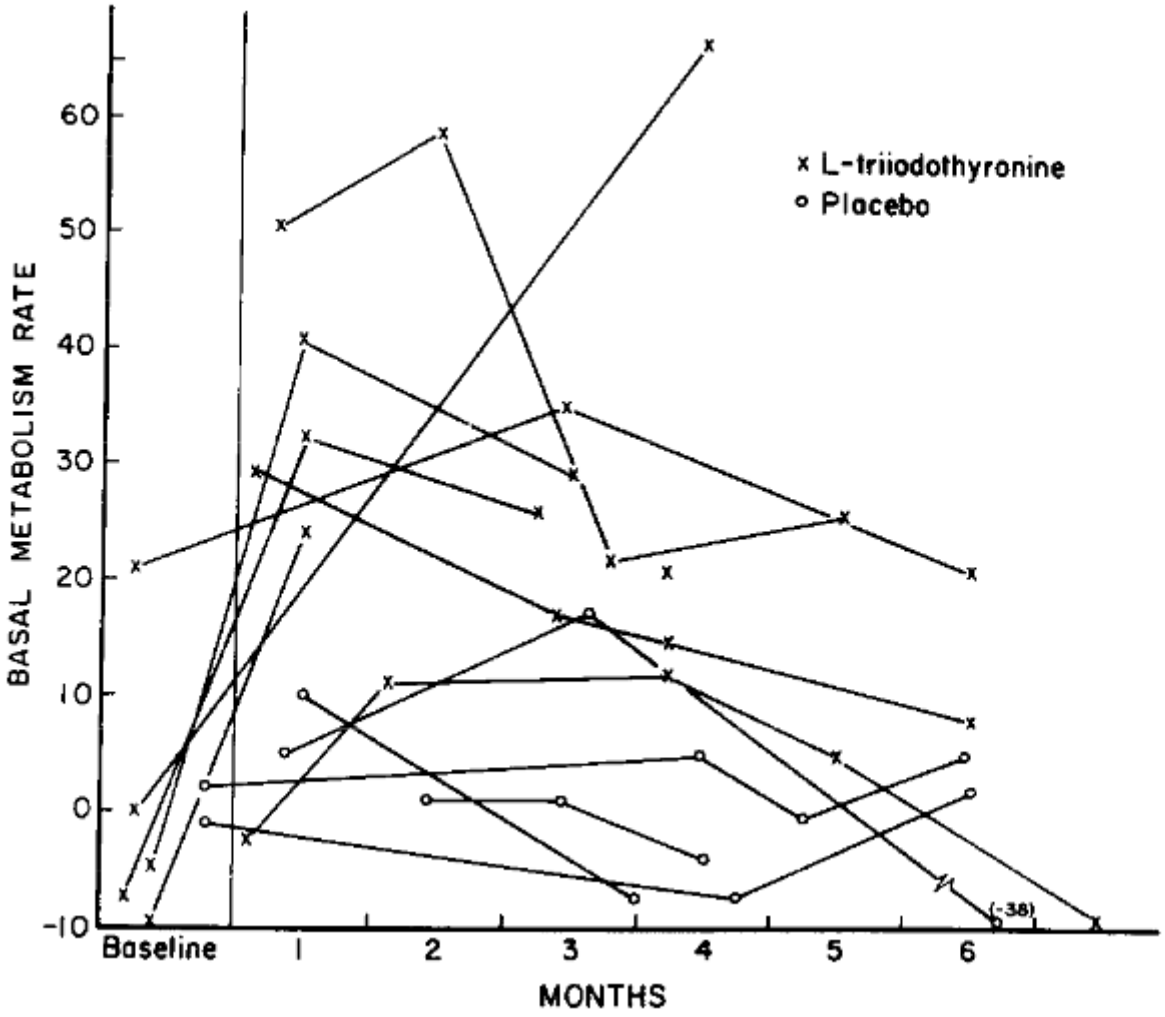


Table 5.—Symptoms and Physical Findings in Massively Obese Patients Before and During Therapy (800-calorie Diet Plus L-Triiodothyronine: 75 μg. Three Times Daily)

Patient		Symptoms						Physical Findings				
		Weakness	Anxiety	Palpitations	Insomnia	Appetite	Stools	Pulse	B.P.	Sweating	Tremor	Reflexes
J.McN.	1*	1 +	0	0	0	3 +	1/d	88	138/98	0	0	1 +
	2 †	1 +	1 +	1 ‡	0	2 +	1/d	68–96	112/70	0	1 +	3 +
G.S.	1	0	0	0	0	0	1/d	88	140/88	3 +	0	2 +
	2	0	0	0	0	0	0–1/d	120	160/80	0	0	2 +
R.C.	1	0	0	0	0	0	2/d	104	140/100	0	0	2 +
	2	0	0	0	1 +	0	2/d	96–120	110/70	2 +	1 +	3 +
S.E.	1	0	0	0	4 +	0	1/d	104	140/86	0	0	2 +
	2	1 +	2 +	0	4 +	0	1/d	120	150/70	0	1 +	2 +
S.C.	1	0	0	0	0	0	1/d	76	140/84	0	0	2 +
	2	0	2 +	1 +	0	0	1/d	88	110/70	2 +	1 +	4 +
J.P.	1	0	0	0	0	0	1/d	72	140/96	0	0	0
	2	0	0	0	1 +	0	1/d	84–100	120/80	0	2 +	3 +
C.Ge.	1	0	0	0	0	0	1/d	76	150/98	0	0	2 +
	2	1 +	1 +	0	0	2 +	2–3/d	108	130/60	0	2 +	3 +
D.H.	1	0	2 +	0	0	0	1/d	104	140/90	0	0	2 +
	2	0	2 +	1 +	0	2 +	2/d	112	140/90	2 +	2 +	3 +
A.C.	1	0	0	0	4 +	0	1/d	88	150/100	4 +	0	2 +
	2	0	0	0	1 +	0	0–1/d	100	120/76	0	1 +	4 +

* Before therapy.

† During 24-week study.

Table 7.—Weight Loss of Hospitalized Patients on 800-calorie Diet or Diet Plus 225 μg. L-Triiodothyronine per Day

	Weight Loss in Pounds at 8 Weeks*	Weight Loss in Pounds at 12 Weeks*
800-Calorie Diet Plus L-Triiodothyronine	(9 Patients) 29.1 † ± 2.3	(7 Patients) 37.0 ‡ ± 5.3
800-Calorie Diet Plus Placebo	(5 Patients) 17.2 ± 3.7	(5 Patients) 23.3 ± 5.8

* Mean ± SE.

† $p = < .025$ and > 0.01 versus Placebo Group.

‡ $p = < 0.15$ and > 0.10 versus Placebo Group.

Effect of Short-Term Thyroxine Administration on Energy Metabolism and Mitochondrial Efficiency in Humans

Darcy L. Johannsen[1], Jose E. Galgani[1,2], Neil M. Johannsen[1], Zhengyu Zhang[1], Jeffrey D. Covington[1], Eric Ravussin[1]*

Abstract

The physiologic effects of triiodothyronine (T3) on metabolic rate are well-documented; however, the effects of thyroxine (T4) are less clear despite its wide-spread use to treat thyroid-related disorders and other non-thyroidal conditions. Here, we investigated the effects of acute (3-day) T4 supplementation on energy expenditure at rest and during incremental exercise. Furthermore, we used a combination of *in situ* and *in vitro* approaches to measure skeletal muscle metabolism before and after T4 treatment. Ten healthy, euthyroid males were given 200 μg T4 (levothyroxine) per day for 3 days. Energy expenditure was measured at rest and during exercise by indirect calorimetry, and skeletal muscle mitochondrial function was assessed by *in situ* ATP flux (^{31}P MRS) and *in vitro* respiratory control ratio (RCR, state 3/state 4 rate of oxygen uptake using a Clark-type electrode) before and after acute T4 treatment. Thyroxine had a subtle effect on resting metabolic rate, increasing it by 4% ($p = 0.059$) without a change in resting ATP demand (i.e., ATP flux) of the *vastus lateralis*. Exercise efficiency did not change with T4 treatment. The maximal capacity to produce ATP (state 3 respiration) and the coupled state of the mitochondria (RCR) were reduced by approximately 30% with T4 ($p = 0.057$ and $p = 0.04$, respectively). Together, the results suggest that T4, although less metabolically active than T3, reduces skeletal muscle efficiency and modestly increases resting metabolism even after short-term supplementation. Our findings may be clinically relevant given the expanding application of T4 to treat non-thyroidal conditions such as obesity and weight loss.

Effect of Short-Term Thyroxine Administration on Energy Metabolism and Mitochondrial Efficiency in Humans

Darcy L. Johannsen[1], Jose E. Galgani[1,2], Neil M. Johannsen[1], Zhengyu Zhang[1], Jeffrey D. Covington[1], Eric Ravussin[1]*

Table 1. Thyroid profile before (Day 1) and after (Day 4) 3 days of T4 supplementation (mean ± SD).

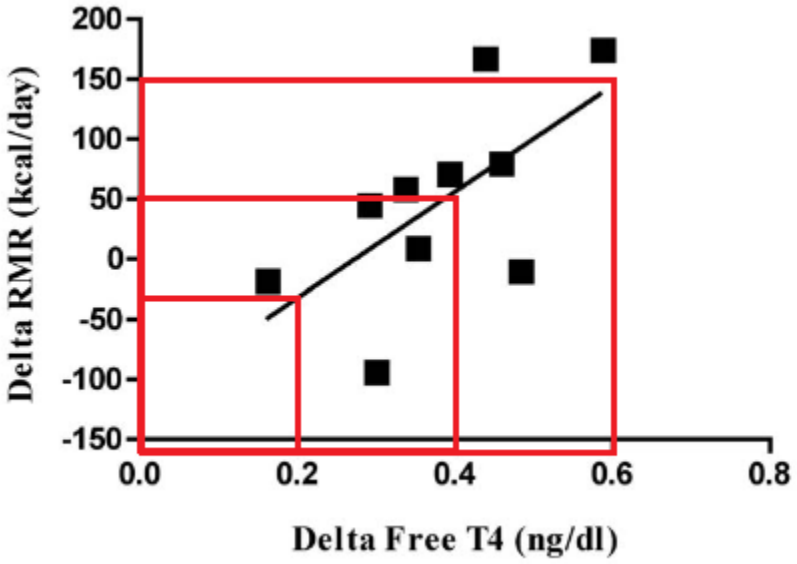
	Day 1	Day 4	*P* value
T3 (ng/dl)	111±15	109±12	0.68
TSH (μU/ml)	1.82+0.95	0.87+0.35	**0.005**
T4 (μg/dl)	7.1±1.0	10.0±0.7	**0.003**
Free T4 (ng/dl)	1.18±0.13	1.56±0.13	**<0.001**
Thyroid binding capacity (μg/dl)	17.0±3.8	17.2±3.7	0.57

Table 2. Metabolic rate (RMR), respiratory quotient (RQ) and vital signs during rest before (Day 1) and after (Day 4) 3 days of T4 treatment (mean ± SD).

	Day 1	Day 4	*P* value
Body Weight (kg)	75.0±4.7	75.0±4.8	1.00
RMR (kcal/d)	1612±142	1672±129†	**0.059**
Resting RQ	0.83+0.03	0.85+0.03	**0.02**
Heart Rate (bpm)	57±9	59±8	0.38
Blood Pressure (mm Hg)			
Systolic	122±9	121±6	0.91
Diastolic	83±6	83±6	0.84

Effect of Short-Term Thyroxine Administration on Energy Metabolism and Mitochondrial Efficiency in Humans

Darcy L. Johannsen[1], Jose E. Galgani[1,2], Neil M. Johannsen[1], Zhengyu Zhang[1], Jeffrey D. Covington[1], Eric Ravussin[1]*



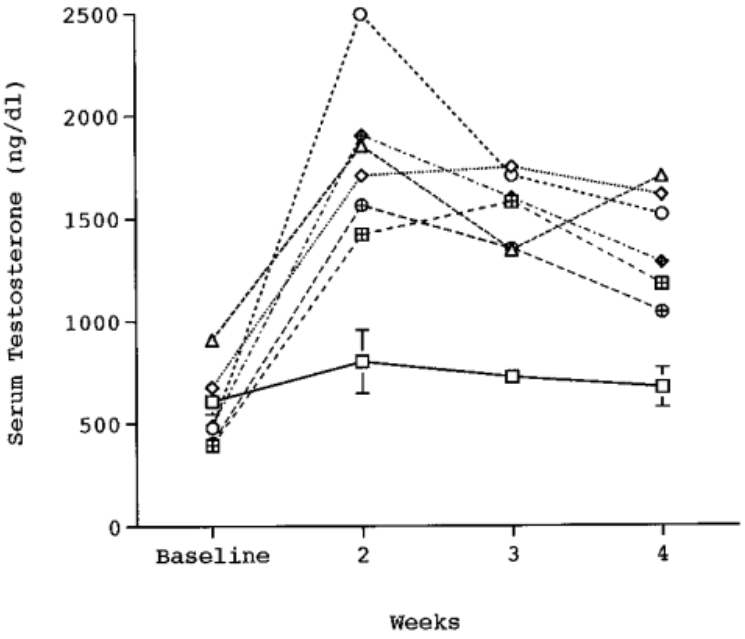
Testosterone Administration Preserves Protein Balance But Not Muscle Strength during 28 Days of Bed Rest 1

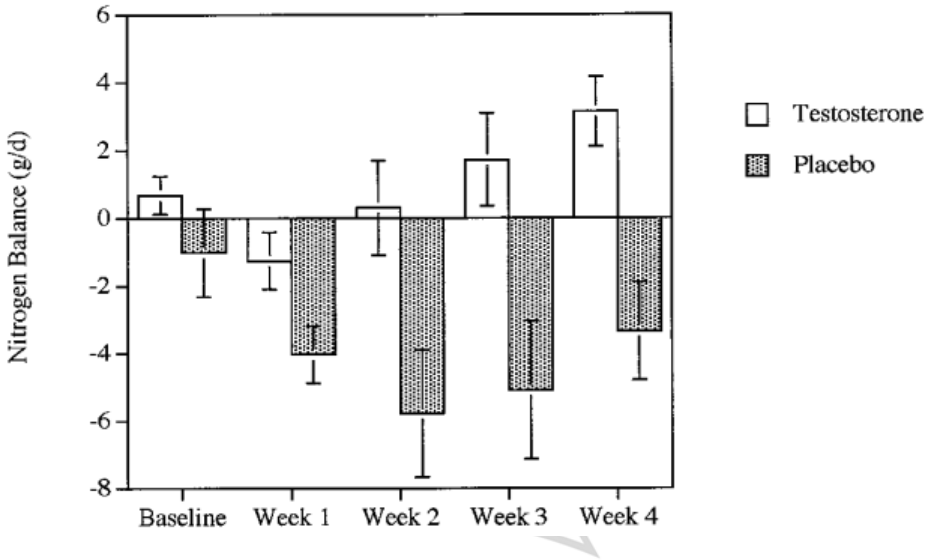
ABSTRACT

Decrements in muscle strength as a result of prolonged bed rest are well defined, but little is known about potential countermeasures for preventing loss of strength under this condition. The purpose of this study was to determine whether testosterone administration would preserve protein balance and muscle strength during prolonged bed rest. Ten healthy men (age, 36 ± 2 yr; height, 177.2 ± 3.4 cm; weight, 80.5 ± 3.9 kg; mean ± SE) were admitted to our in-patient metabolic unit. After a 1-week ambulatory run-in period, each subject was confined to bed for 28 days at 6° head-down tilt while receiving a daily oral dose of T_3 (50 μg/day). During the bed rest/T_3 period, six of the men were randomized to receive testosterone enanthate by im injection (T; 200 mg/week) while four received placebo in a double blind fashion. Nitrogen balance was determined throughout, and whole body [^{13}C]leucine kinetics were assessed at baseline and on day 26 of bed rest. Before bed rest and on the third day of reambulation, the muscle strength of the knee extensors and flexors and shoulder extensors and flexors was determined at 60°/s on a Cybex isokinetic dynamometer. Despite improved [^{13}C]leucine kinetics and maintenance of nitrogen balance and lean body mass in T-treated subjects, little preservation of muscle strength, particularly in the knee extensors, was noted. Muscle strength [reported as the best work repetition in foot-pounds (FtLb)] for right knee extensors declined (P = 0.011) similarly in both groups; from 165 ± 15 to 126 ± 18 FtLb in T-treated men and from 179 ± 22 to 149 ± 13 FtLb in placebo-treated men. Overall, there was less of a decline in extension and flexion strength of the shoulder compared to the knee, with no benefit from T. These results suggest that in the absence of daily ambulatory activity, T administration will not increase or, in the case of this bed rest model, preserve muscle strength. (*J Clin Endocrinol Metab* **84:** 207–212, 1999)

DIET&TRAINING

Testosterone Administration Preserves Protein Balance But Not Muscle Strength during 28 Days of Bed Rest 1





REVERTIR CATABOLISMO

En un entorno poco propicio como una inmovilización en cama, una carga androgénica de ~144 semanales fue capaz de atenuar parte de las adaptaciones negativas a nivel del metabolismo proteico inducido por el uso de 50mcg diarios de T3.

Estableciendo un factor de seguridad de 1,5 para individuos de bajo-medio nivel en dieta hipocalórica, se debería emplear, al menos, una carga androgénica de 216 a la semana por cada 50mcg de T3 o 200mcg de T4.

O lo que es lo mismo:

- 4,32 por cada 1mcg de T3
- 1,08 por cada 1mcg de T4

Si queremos obtener un incremento significativo en nuestra TMB, debemos emplear, al menos:

- 250mcg diarios de T4
- 62,5mcg diarios de T3

Si lo que deseamos es simplemente emplearlo a modo de evitar una cierta adaptación a nivel de la TMB, limítate a emplear T4 a una dosis diaria de entre 12,5 a 50mcg diarios, regulando según los niveles de TSH y T4L en analítica.

PUNTOS CLAVE

- Tanto el uso de T3 como de T4 son efectivas para la pérdida e grasa, sin embargo, las dosis a emplear para conseguir un efecto significativo con mucho mayores a lo que la gente piensa.
- No es necesario emplear grandes cantidades de AAS para atenuar el catabolismo proteico inducido por el uso de estas hormonas.
- Su perfil de tolerabilidad es muy elevado a nivel de efectos secundarios graves.