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Thyrotropin-Releasing Hormone (TRH) Effects on Bovine Plasma Thyroxine[1] (37925)

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Numerous investigators have accumulated evidence that thyrotropin-releasing hormone (TRH) stimulates secretion of thyrotropin (TSH) *in vivo* and *in vitro* (1–3). Convey *et al.* (4) observed a linear and marked elevation in serum thyroxine in bovine between 1 and 5 hr post treatment. Since other investigators (5) have observed rapid elevation (5–10 min) of TSH with TRH infusion and electrical stimulation, our objective was to determine possible immediate changes in bovine plasma thyroxine occurring within 1 hr of TRH infusion. This study contributes to an overall long range objective to determine if thermoneutral hormonal levels may be sustained under environmental heat or tropical conditions by releasing factors (6).

Materials and Methods. Three mature nonlactating Guernsey cows weighing an average of 238 kg were acclimated to a constant temperature of 18°, 50% room humidity for 7 days in the Missouri Climatic Laboratory, and prepared with a jugular catheter 24 hr prior to experimentation. A single dose of 100 μg TRH[3] (synthetic) was infused via jugular catheter, flushed with saline, and blood samples were collected at 0, 0.25, 0.5, 1, 2, 4, and 6 hr postinfusion. Each cow was tested four times, allowing at least 1 day between runs. Two sham and two TRH infusions were performed on each animal with the exception of Cow 1, which received an additional TRH treatment and was sampled at 0, 5, 10, 20, 25, 30, 35, 40, 50, 60, and 70 min. Animals were maintained in individual environmental chambers, and samples were collected remotely to avoid disturbance or excitation. Thyroxine was determined by the competitive protein binding assay (7) with values corrected for recovery and expressed as ng/ml.

Results. The biphasic results of TRH infusion on bovine plasma thyroxine are shown in Table I. All animals exhibited a dramatic increase at 30 min postinfusion (43.3 ± .6 vs 89.5 ± 6.9) followed by a decline to nearly normal (46.2 ± 1.1 vs 51.2 ± 3.8) levels at 2 hr. Sham values show no significant changes. After the initial peak of thyroxine and subsequent decline, values showed a gradual increase with 6 hr values being elevated by 40.8% (Fig. 1). Figure 2 shows the TRH response within the first hour of infusion. At 10 min no response was observed. At 20 min thyroxine was elevated to 72 ng/ml as compared to 45 ng/ml for post infusion values, peaking at 30 min (87 ng/ml, 90% elevation) and declining to 55 ng/ml at 50–70 min. At 50 min postinfusion plasma thyroxine values were elevated by 22% compared to base values.

Discussion. Clearly demonstrated is a biphasic response of plasma thyroxine in bovine with a dramatic peak within 30 min, a sharp decline in the next hour, followed

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TABLE I. Mean Effect of TRH (100 μg) on Bovine Plasma Thyroxine (ng/ml).

Time (hr)	Sham	Treatment	% Change
Base	40.3 ± 2.1[a,b]	41.0 ± 1.6[a,b]	1.7
0.25	43.6 ± 1.0	44.6 ± 3.2	2.2
0.50	43.3 ± 0.6	89.5 ± 6.9	106.6
1.00	44.0 ± 0.5	59.2 ± 4.4	34.5
2.00	46.2 ± 1.1	51.2 ± 3.8	10.8
4.00	45.8 ± 0.8	61.6 ± 3.2	34.5
6.00	45.8 ± 1.0	64.5 ± 4.7	40.8

[a] $N = 6$.
[b] Standard error.

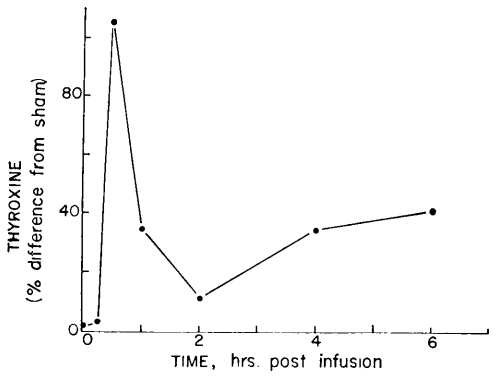

FIG. 1. Bovine plasma thyroxine time response to TRH infusion (% difference from sham).

by a gradual elevation up to at least 6 hr. Presumably the administered TRH initiated release of TSH for stimulation of the release of thyroxine. Martin and Reichlin (5) reported elevation of plasma TSH in rats within 5 min, while larger doses of TRH produced responses that were still rising at 15 min postadministration. This elevation was blocked by prior administration of thyroxine. Another possibility is that synthetic TRH infused via jugular vein is acting directly on the thyroid gland. Normally TRH is confined to the portal vessels and pituitary; but with peripheral injection, abnormally high concentrations of TRH would be exposed to most body organs including the thyroid. Kajihara *et al.* (8) reported that a single injection of TSH in guinea pigs caused an apparent increase on intracellular colloid droplet formation in the thyroid as early as 10 min. With 10 μg of TRH injection the colloid droplet formation was also observed as early as 10 min and was indistinguishable from that found

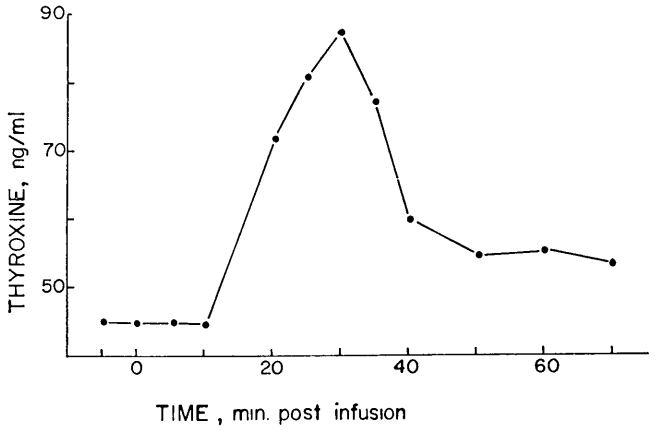

FIG. 2. Time response of TRH infusion (100 μg) on plasma thyroxine (ng/ml) concentrations (Cow 1).

after TSH injection. The first peak of thyroxine can possibly be explained by either the direct action of TRH or TSH on the thyroid gland. The second gradual elevation can be explained by TSH effects, possibly with its action on the thyroid gland somewhat inhibited due to the initial elevation of thyroxine.

Summary. The jugular infusion of synthetic TRH (100 μg) initiated a biphasic response of thyroxine in bovine. The first peak was observed within 30 min followed by a decline at 2 hr. The values then showed a gradual elevation up to 6 hr at the conclusion of the experiment. These data indicate that in bovine the biphasic response of TRH may be due to either the direct action of TRH or TSH in the first phase with the second phase due presumably to TSH.

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