Sex Steroid Hormones Affect Carnitine Concentrations of Blood and Organs in Rats

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Abstract

326 male and 325 female rats were randomly assigned to one or a combination of the following treatments:

- Carnitine supplementation (CARN) – 2g carnitine per liter drinking water, begun 60 ± 3 days before sacrifice
- Estradiol (ESTRA) – daily injections approximating natural female production begun 61 ± 1 days before sacrifice
- Testosterone (TEST) – daily injections approximating natural male production begun 62 ± 1 days before sacrifice
- Hypophysectomy (HYPOX) – pituitary surgically removed 41 ± 13 days before sacrifice
- Castration (CAST) – testes (male) or ovaries (female) removed 63 ± 4 days before sacrifice
- No treatment (control)

Plasma, liver, heart, muscle, and epididymis samples were obtained, processed and frozen. Carnitine concentrations were determined using a radioenzymatic assay1. Z-tiles were calculated with the control groups as the reference populations.

Materials & Methods

Introduction

- Men and women exhibit different incidences of clinical abnormalities:
  - Men are more prone to visceral fat accumulation and cardiovascular disease
  - Women’s incidences of visceral fat accumulation and cardiovascular disease increase after menopause
  - There are also differences in substrate utilization during endurance exercise between the sexes:
    - Men have higher carbohydrate oxidation rates
    - Women have higher lipid oxidation rates
  - Sex steroid hormones have effects on metabolism:
    - Testosterone stimulates lipolysis in adipose tissue
    - Estradiol can directly inhibit complexes I and V of the mitochondrial electron transport chain
  - Carnitine:
    - is an amino acid derivative which shuttles long-chain fatty acids into the mitochondria for β-oxidation
    - can serve as an indicator of metabolic state and mitochondrial acyl-CoA content
    - was examined in this project in blood and organs of rats undergoing various hormonal treatments

Results

* Indicates significant difference from control group

Conclusions

- Carnitine supplementation consistently increased carnitine in plasma and all organs except liver
- Testosterone increased carnitine in plasma and organs except liver where it had little effect
- Speculation: some decreases seen in male muscle may be due to aromatization of testosterone to estradiol
- Estradiol decreased carnitine in plasma and organs except liver where it increased carnitine
- Pituitary function elevated carnitine in almost all compartments
- testosterone present in larger amounts than estradiol is necessary for epididymal carnitine to be on the same order of magnitude as control rats

References


Legend

- HYPOX
- CAST
- ESTRA
- TEST
- HYPOX/ESTRA
- CAST/ESTRA
- HYPOX/TEST
- HYPOX/CAS
- HYPOX/CAST/TEST

Materials & Methods

- Males
- Females
- Abnormalities:
  - Men are more prone to visceral fat accumulation and cardiovascular disease
  - Women’s incidences of visceral fat accumulation and cardiovascular disease increase after menopause
  - There are also differences in substrate utilization during endurance exercise between the sexes:
    - Men have higher carbohydrate oxidation rates
    - Women have higher lipid oxidation rates
  - Sex steroid hormones have effects on metabolism:
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  - Carnitine:
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