EFFECT OF GONADOTROPHIN STIMULATION OF URINARY STEROID EXCRETION AFTER RELOCATION OF NORMAL AND CRYPTORCHID TESTES IN THE BOAR

R. M. LIPTRAP AND J. I. RAESIDE

*Department of Biomedical Sciences, University of Guelph,
Guelph, Ontario, Canada*

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It is well established that cryptorchidism is associated with degeneration of the seminiferous tubules, but there is less certain knowledge concerning the internal secretory capacity of the abdominal testis. Although unilaterally and bilaterally cryptorchid boars are able to excrete dehydroepiandrosterone (DHA) and oestrogens in amounts comparable to those of normal boars (Liptrap & Raeside, 1970), the abdominal testes of such animals show a limited response to gonadotrophin stimulation (Liptrap & Raeside, 1971). The purpose of the present study was to determine if the higher abdominal temperature was responsible, at least in part, for the limited response of the cryptorchid testis to stimulation by HCG, as reflected in the urinary excretion of DHA and oestrogens.

The breeding background of the cryptorchid Yorkshire pigs used in this study has been outlined by Fredeen & Newman (1968). Collection of urine for 48-hr periods, or for 24-hr periods when daily treatment with 2000 i.u. HCG (Pregnyl; Organon Inc., Montreal) was administered, was carried out as previously described (Liptrap & Raeside, 1971). The excretion values for DHA (3 β -hydroxyandrost-5-en-17-one), which is of testicular origin in the boar (Huis in't Veld, Louwerens & Reilingh, 1961), were determined as described by Raeside (1965). The results for total oestrogens in the urine samples were estimated with the procedure outlined by Raeside (1963). For convenience, all results are reported in mg/24 hr. Statistical comparisons with control levels for each boar were made using Student's *t* test (Snedecor, 1956).

In two normal boars, the cryptorchid condition was created surgically as outlined previously (Liptrap & Raeside, 1970). Relocation of the abdominal testes of cryptorchid boars was accomplished surgically under pentobarbital sodium (Diabutal; Diamond Laboratories, Downsview, Ont.) anaesthesia. The abdominal testes were brought out through incisions made in each flank. The peritoneum and muscle layers were closed routinely, except for a small opening through which the spermatic vessels passed. A pocket for the testis was created by subcutaneous blunt dissection so that when the skin incision was closed, the testis lay between the muscle layers and the skin.

A summary of the values for DHA and oestrogen excretion during HCG

stimulation before and after relocation of the testes is shown in Table 1. The values for a normal boar (3487) are also included at two ages which spanned the ages of the boars used in this study. A highly significant increase in urinary

TABLE 1

URINARY DHA AND OESTROGEN EXCRETION OF NORMAL AND CRYPTORCHID BOARS, FOLLOWING TREATMENT WITH HCG BEFORE AND AFTER RELOCATION OF THE TESTES

Boar no.	Cryptorchid condition	Age (months)	Treatment	DHA (mg/24 hr)	Oestrogen (mg/24 hr)	No. of samples†
3487	None	7	Pretreatment	8.84 ± 2.66	2.87 ± 1.19	5
			2000 i.u. HCG daily	51.78** ± 12.85	18.69** ± 4.71	5
			Post treatment	31.24** ± 15.01	22.52** ± 11.10	5
	None	29	Pretreatment	14.03 ± 0.49	3.94 ± 0.32	5
			2000 i.u. HCG daily	67.85** ± 15.14	16.96** ± 5.51	5
			Post treatment	12.92 ± 2.88	3.97 ± 0.87	5
	Surgically bilateral	10	Pretreatment	5.04 ± 0.76	0.85 ± 0.11	5
			2000 i.u. HCG daily	47.20** ± 13.47	18.15** ± 5.05	5
			Post treatment	53.74** ± 26.25	22.42** ± 12.70	5
		12	Testes placed in abdomen			
			Pretreatment	72.21 ± 5.13	8.24 ± 1.09	5
			2000 i.u. HCG daily	83.13 ± 12.41	16.04* ± 2.86	4
			Post treatment	76.37 ± 16.37	12.39 ± 2.01	4
3486	None	11	Pretreatment	8.34 ± 2.28	1.80 ± 0.68	5
			2000 i.u. HCG daily	26.83** ± 8.40	13.13** ± 8.15	4
			Post treatment	82.77** ± 29.89	37.84** ± 14.66	5
	Surgically bilateral	11	Testes placed in abdomen			
			Pretreatment	9.71 ± 0.96	2.22 ± 0.44	5
			2000 i.u. HCG daily	18.07* ± 2.64	2.30 ± 0.36	5
			Post treatment	9.18 ± 2.65	2.41 ± 0.91	5
		13	Pretreatment	9.71 ± 0.96	2.22 ± 0.44	5
			2000 i.u. HCG daily	18.07* ± 2.64	2.30 ± 0.36	5
			Post treatment	9.18 ± 2.65	2.41 ± 0.91	5
3390	Bilateral	20	Pretreatment	9.04 ± 1.40	3.25 ± 0.17	5
			2000 i.u. HCG daily	16.02* ± 2.37	6.75* ± 0.91	5
			Post treatment	17.21 ± 8.37	6.73 ± 3.16	5
	Testes out of abdomen	20	Testes placed in flank			
			Pretreatment	7.13 ± 1.15	2.89 ± 0.30	5
			2000 i.u. HCG daily	24.79** ± 6.23	8.16** ± 1.64	5
			Post treatment	13.42** ± 1.22	6.88** ± 0.42	5
		22	Pretreatment	7.13 ± 1.15	2.89 ± 0.30	5
			2000 i.u. HCG daily	24.79** ± 6.23	8.16** ± 1.64	5
			Post treatment	13.42** ± 1.22	6.88** ± 0.42	5
C-17	Bilateral	15	Pretreatment	17.94 ± 1.91	4.92 ± 0.56	5
			2000 i.u. HCG daily	32.66 ± 7.50	12.35* ± 3.31	5
			Post treatment	22.89 ± 4.16	10.38 ± 2.73	5
	Testes out of abdomen	15	Testes placed in flank			
			Pretreatment	16.13 ± 2.55	4.70 ± 0.95	5
			2000 i.u. HCG daily	29.90* ± 6.00	14.56** ± 1.38	5
			Post treatment	13.78 ± 3.93	3.49 ± 1.00	5
		16	Pretreatment	16.13 ± 2.55	4.70 ± 0.95	5
			2000 i.u. HCG daily	29.90* ± 6.00	14.56** ± 1.38	5
			Post treatment	13.78 ± 3.93	3.49 ± 1.00	5

Values for DHA and oestrogen expressed as means ± S.E.

* $P < 0.05$; ** $P < 0.01$.

† 48-hr samples, except during HCG treatment when 24-hr samples were collected.

DHA and oestrogen during and following HCG treatment occurred in two normal boars (3401, 3486). Following placement of the scrotal testes in the abdomen, no significant rise in steroid excretion occurred when HCG was administered, with

the exception of DHA excretion in one boar and oestrogen excretion in the other boar. In two bilaterally cryptorchid boars (3390, C-17), a limited increase in the urinary levels of DHA and oestrogen resulted from the administration of HCG. When the cryptorchid testes were placed outside of the abdominal cavity, however, a highly significant increase in urinary steroid levels was measured following the injection of HCG. For one boar, these high levels persisted during the post-treatment period.

The results suggest that normal and cryptorchid testes, when present in the abdominal cavity, have only a limited ability to respond to gonadotrophin stimulation by increasing steroid hormone production. Conversely, both normal and cryptorchid testes are able to respond to gonadotrophin stimulation by increased steroid production when they are in a position outside the abdomen. Hall (1965) has demonstrated with rabbit testis tissue that [^{14}C]-1-acetate incorporation into [^{14}C]testosterone *in vitro* is less at 40° C than at 38° C, suggesting that steroid biosynthesis is significantly lower at the abdominal temperature than at the scrotal temperature.

Although unilaterally and bilaterally cryptorchid boars are able to excrete levels of DHA and oestrogens which are comparable to those of normal boars (Liptrap & Raeside, 1970), stimulation of further endocrine activity with endogenous or exogenous gonadotrophin is quite limited. The present results indicate that the limitation in response to gonadotrophin in the naturally cryptorchid animal may be due, at least in part, to the higher abdominal temperature. Presumably environmental factors, such as the abdominal temperature, are more important than genetic factors associated with cryptorchidism, in the limited endocrine response of the testis to gonadotrophin stimulation.

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