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Effect of Bilateral Cryptorchidism on the Biochemical Composition of Testis and Sex Accessory Organs in Albino Rats

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Bilateral cryptorchidism was induced surgically in adult Wister strain albino rats and the biochemical composition of testis and sex accessory organs have been analysed. TSI of testis, ventral prostate and seminal vesicles were markedly decreased along with tissue dry matter. While the testis had elevated lipolysis with sparing of carbohydrates, the epididymis had suppressed lipolysis with increased carbohydrate utilization on cryptorchidism. Phospholipid content of the tissues was depleted considerably, while the cholesterol was generally accumulated. The cryptorchid testis recorded hypoalbuminic and hypoglobulinemic condition. The importance of these changes on the physiological activities of these tissues was discussed.

Key Words: Bilateral cryptorchidism, Testis, Sex accessory organs, Hypoalbuminia, Hypoglobulinemia, Phospholipids, Cholesterol

Introduction

Cryptorchidism is a fairly frequent syndrome which has been studied from different points of view (Javier Zamudio 1971). These studies have been focussed either on the sperm quality or on the testicular physiological activities like oxygen consumption and endocrinological changes during cryptorchidism (Hall 1970, Massie et al. 1969). There have been conflicting and contradictory statements on the nature of changes in the biochemical constituents of testis during cryptorchidism (Fleeger et al. 1968, Johnson 1970). Though considerable work has been carried out on testis in cryptorchidism very scanty information is available on sex accessory organs. However, no conclusive evidence and uniform concepts have been postulated concerning the biochemistry of testis during cryptorchidism (Javier Zamudio 1971). Hence the present study has been undertaken in order to understand the possible effect of cryptorchidism on the biochemical constituents of testis and sex accessory organs.

Materials and Methods

Adult male Wister strain albino rats weighing 150±5 g and 100 days age were selected for the study. The first batch of 6 rats were anaesthetized with anaesthetic ether, perineal area shaved, swabded with 95% ethanol; 1 cm long bilateral incisions were made at the level of the inguinal canals and testes were carefully translocated into abdominal cavity with blunt forecaps. Care was taken to avoid damage to the testicular artery. Both the inguinal canals have been sutured with silk thread to prevent the descent of the testes from abdominal cavity (Ewing & Schambacher 1970). The second batch of 6 rats were sham operated and maintained at laboratory conditions (26 ± 2°C and 12 hr of light and 12 hr of darkness), fed on standard rat diet (Hindustan Lever Ltd., Bombay) and water was supplied *ad libitum* for a period of 30 days. The animals were sacrificed by cervical dislocation and the testes, and accessory sex organs like epididymis, ventral prostate, and seminal vesicles were isolated carefully, weighed, chilled rapidly in ice box and utilized for biochemical analyses. The tissue somatic indices, dry matter, and water content of the tissues were estimated gravimetrically. Tissue protein fraction (Cohn et al. 1940), total proteins (Lowry et al. 1951), total carbohydrates (Carroll et al. 1956), total lipids (Folch et al. 1957), cholesterol, tryglycerides and free fatty acids (Natelson 1971), phospholipids (Bieri & Prival 1965), glycerol (Burton 1957), and lipase activity (Huggins & Lapides 1955) were estimated in testes, sex accessory organs and serum.

Results and Discussion

The data are presented in tables 1–3. Cryptorchidism has been reported to impair androgenesis (Dekrester et al. 1979), with vacuolization of Leydig cells (Vanstraaten et al. 1978) and deranged spermatogenesis (Kerr Jeffrey et al. 1979). The observed depletion in the tissue somatic indices of the reproductive tissues (table 1) indicate the possible tissue atrophy, probably because of impaired androgenesis under cryptorchidism, since the functioning of these tissues were androgen dependent (Albert 1961, Baija & Mathur 1981, Mann 1964, Segal & Nelson 1959, Umapathy et al. 1980). But epididymis has remarkably maintained the normal level of tissue somatic index, which suggests the prevalence of alternative mechanism for the maintenance of epididymal integrity. Since epididymis operates androgenesis (Hamilton et al. 1970), its structure seems to have been maintained inspite of impaired testicular androgenesis. The depleted testicular dry matter suggests induced tissue degradations. Increased dry matter of prostate and seminal vesicles was suggestive of their impaired functioning leading to accumulation of organic compounds. In view of considerable depletion of total protein content, induction of atrophic activities in all these tissues can be expected. However, total carbohydrate content was elevated in the testes and seminal vesicles. In view of impaired spermatogenesis in cryptochid testis (Kerr Jeffrey et al. 1979) carbohydrate utilization might have been decreased leading to their accumulation in the tissue (Massie et al. 1969). The elevated carbohydrate content in seminal vesicle was also suggestive of its decreased utility. Since seminal vesicles secrete fructose and citric acid under normal conditions through the utilization of carbohydrates (Mann 1964, Samuels et al. 1962), accumulation of carbohydrates in

Table 1 *TSI, dry matter, water content, total proteins, total carbohydrates and total lipids in testis, epididymis, ventral prostate, and seminal vesicles of control and experimental animals. Values are mean of 6 observations. Mean ± S.D.; + and — indicate per cent increase and decrease over control. 'P' indicates the level of significance and 'NS' non-significance*

S. No.	Component	Testis		Epididymis		Prostate		Seminal vesicle	
		Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental
1.	TSI	1.159 ±0.045	0.97 ±0.043	1.091 ±0.027	1.031 ±0.06	0.597 ±0.014	0.504 ±0.029	0.398 ±0.024	0.347 ±0.025
		—16.31 $P<0.001$		—5.5 NS		—15.58 $P<0.001$		—12.81 $P<0.01$	
2.	Water content (mg./g. wet wt.)	785.16 ±12.5	801.2 ±14.62	767.2 ±11.9	753.67 ±31.07	746.3 ±29.8	707.9 ±27.1	737.5 ±22.3	695.1 ±25.1
		+2.03 NS		—1.79 NS		—5.15 NS		—0.057 NS	
3.	Dry matter (mg/g. wet wt.)	214.74 ±26.46	198.8 ±13.66	232.8 ±8.1	246.33 ±20.32	253.7 ±27.26	292.1 ±18.23	262.5 ±11.04	304.9 ±20.07
		—7.42 NS		+5.81 NS		+15.14 $P<0.01$		+16.15 $P<0.01$	
4.	Total proteins (mg/g. wet wt.)	148.8 ±6.2	126.59 ±13.78	159.57 ±4.7	128.71 ±21.86	169.66 ±15.09	91.46 ±21.57	186.15 ±11.60	115.8 ±7.8
		—14.9 $P<0.01$		—19.34 $P<0.01$		—46.09 $P<0.001$		—37.78 $P<0.001$	
5.	Total carbohydrates (mg/g. wet wt.)	2.194 ±0.56	4.577 ±0.349	3.76 ±0.42	2.136 ±0.17	1.713 ±0.119	2.036 ±0.137	1.134 ±0.098	1.453 +0.019
		+108.61 $P<0.001$		—43.19 $P<0.001$		+18.86 $P<0.01$		+28.13 $P<0.01$	
6.	Total lipids (mg/g. wet wt.)	69.9 ±3.21	51.7 ±1.9	80.56 ±2.15	99.62 ±6.78	83.5 ±5.5	90.9 ±7.0	89.1 ±9.2	81.24 ±8.92
		—26.04 $P<0.001$		+22.4 $P<0.001$		+8.86 NS		—8.82 NS	

Table 2 *The levels of phospholipids, lipase activity, cholesterol, triglycerides, glycerol and free fatty acids in testis, epididymis, ventral prostate, and seminal vesicles of control and experimental animals. Values are mean of 6 observations; Mean ± S.D.; + and — indicate per cent increase and decrease over control. 'P' indicates the level of significance and 'NS' non-significance*

S. No.	Component	Testis		Epididymis		Prostate		Seminal vesicle	
		Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental
1.	Phospholipids (mg/g. wet wt.)	37.89 ±2.14	11.94 ±2.7	30.82 ±3.12	24.39 ±2.3	18.86 ±1.64	14.66 ±0.83	25.07 ±1.16	32.62 ±4.45
			—66.49 $P<0.001$		—20.86 $P<0.01$		—22.27 $P<0.001$		+30.12 $P<0.001$
2.	Lipase (μ mol of PNPA cleaved/mg protein/hr.)	0.447 ±0.059	0.936 ±0.244	0.964 ±0.206	0.464 ±0.042	0.642 ±0.05	0.632 ±0.02	0.654 ±0.052	0.750 ±0.03
			+109.4 $P<0.001$		—51.87 $P<0.001$		—1.56 NS		+14.68 $P<0.01$
3.	Cholesterol (mg/g. (wet wt.)	3.602 ±0.476	5.074 ±0.62	2.151 ±0.106	2.199 ±2.09	2.852 ±0.265	3.637 ±0.477	2.958 ±0.691	5.947 ±1.54
			+40.87 $P<0.001$		+2.23 NS		+27.52 $P<0.001$		+101.04 $P<0.001$
4.	Triglycerides (mg/g. wet wt.)	20.28 ±1.36	25.42 ±1.92	21.683 ±2.036	34.8 ±7.74	25.49 ±1.92	25.46 ±1.92	32.62 ±4.45	28.37 ±2.3
			+25.35 $P<0.001$		+60.49 $P<0.001$		—1.18 NS		—13.03 $P<0.05$
5.	Glycerol (mg/g. wet wt.)	1.842 ±0.16	2.078 ±0.079	0.641 ±0.05	2.206 ±0.25	5.947 ±1.54	4.33 ±0.46	0.964 ±0.206	1.842 ±0.16
			+12.81 $P<0.01$		+244.15 $P<0.001$		—27.19 $P<0.001$		—91.08 $P<0.001$
6.	Free fatty acids (mg/g. wet wt.)	28.93 ±3.69	32.39 ±3.47	25.07 ±1.16	42.69 ±2.82	34.8 ±7.74	35.68 ±8.89	25.49 ±1.92	48.10 ±8.62
			+11.96 NS		+70.28 $P<0.001$		+2.53 NS		+88.7 $P<0.001$

the tissue was indicative of decreased functional status of the tissue under cryptorchidism. In view of decreased total lipid content of testicular tissue under cryptorchidism, a shift in the pattern of utilization of substrates from carbohydrate to lipids can be expected under cryptorchid conditions. Since lipid content of experimental epididymis was elevated with a depletion of total carbohydrate content, utilization of carbohydrates in preference to lipids can be envisaged in the epididymis under cryptorchidism. Thus the existing evidences indicate that a testis with utilization of lipids and accumulation of carbohydrates and an epididymis with utilization of carbohydrates and sparing of lipids seem to be functionally deranged. Depleted phospholipid content of the tissues under cryptorchidism (table 2) suggests breakdown of structure and impaired synthetic activities in them, since phospholipids have been associated with structure and synthetic activities of the tissue (Tata 1967). The triglyceride content of epididymis was elevated, which can be due to decreased lipase activity. But in testis there was elevation in triglyceride content inspite of activated lipase, suggesting the possible conversion of phospholipids into glycerides. The glycerol and free fatty acid contents of the tissues were elevated, which can be

Table 3 *The levels of soluble proteins, structural proteins, α, β-globulins, γ-globulins and albumins (mg/g. wet wt.) in testis of control and cryptorchid rats**

S. No.	Component	Testis		
		Control		Experimental
1.	Soluble proteins	58.53 ±3.84	−19.34 $P<0.001$	47.21 ±2.41
2.	Structural proteins	87.86 ±9.79	−35.82 $P<0.001$	56.38 ±5.46
3.	α, β-globulins	12.93 ±1.39	−77.16 $P<0.001$	2.953 ±0.692
4.	γ-globulins	28.96 ±3.69	−35.5 $P<0.001$	18.68 ±1.34
5.	Albumins	8.432 ±0.507	−66.18 $P<0.001$	2.852 ±0.265
6.	A/G Ratio	0.201	−34.83	0.132

**Note :* Values are mean of 6 observations, mean ± S.D.; + and − indicate per cent increase and decrease respectively. 'P' denotes level of significance

explained on the basis of increased lipolytic activities. The cholesterol content showed accumulation in all the tissues except in epididymis. Since cholesterol mobilizes towards androgenesis in testes (Hafiez et al. 1972, Hall 1970), its accumulation was indicative of impaired testicular androgenesis. But in epididymis there was non-significant change in cholesterol content which can be explained on the basis of operation of androgenesis in the tissue. In view of elevated cholesterol content in prostate and seminal vesicles, its non-utilization towards the formation of seminal plasma can be expected (Eliasson 1966).

The cryptorchid testis seems to have been subjected to proteolysis in view of high depletions in soluble and structural protein fractions (table 3). Since α, β, and γ- globulin fractions were depleted, decreased lipoprotein, mucoprotein, and glycoprotein fractions can be expected in cryptorchid testis. Since sialic acid, one of the important glyco and muco protein fraction of the testis was depleted in non-functioning testis (Dixit et al. 1980), such a possibility of depletion of these protein fractions in cryptorchid testes can be visualised. In view of depleted albumin content, impaired spermatogenesis can be expected, since albumins were essential for spermatogenic activities (Danielli 1950). Hence under cryptorchidism, testis was subjected to hypoalbuminic, and hypoglobulinemic conditions. In view of lower A/G ratio, higher extent of depletion of albumins can be expected in a cryptorchid testis.

Hence the existing evidences suggest that a testis with induced lipolysis, inhibited carbohydrate utilization, hypoalbuminic, and hypoglobulinemic conditions seems to become non-functional. Similarly a non-functional epididymis exhibits inhibited lipolysis and activated carbohydrate utilization. Further confirmatory studies in this direction are in progress.

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