SEMINAL FLUID ACID PHOSPHATASE IN STERILITY

BY

G. E. DELORY, M.Sc., Ph.D.

Biochemist, Royal Infirmary, Preston, Lancs

The discovery of large amounts of "acid" phosphatase in the seminal fluid and the prostate gland has proved of great value in the diagnosis and treatment of prostatic cancer. Nevertheless the fascinating question of the function of this enzyme still awaits an answer. The most obvious starting hypothesis is that the enzyme is concerned with spermatozoal motility, and it may be noted in this connexion that acid phosphatase is not present in the prostate before puberty, although it appears precociously in the rhesus monkey after injection of testosterone propionate (Gutman, Sproul, and Gutman, 1936).

It seemed worth while to estimate the acid phosphatase content of the semen of patients attending hospital for advice because of the sterility of their marriages, and to correlate the findings with observations of pH, volume, abundance, motility, and morphology of spermatozoa. If the enzyme played a fundamental part in maintaining optimal conditions for fertility, then we would expect to find a correlation between the enzyme content and the physical observations. At the same time a low enzyme content might have been demonstrated in samples of seminal fluid from patients who showed no other abnormality to account for their sterility.

Examination of the Seminal Fluid

The patients were requested to deliver the samples to the department as soon as possible after the emission. In the majority of cases the ejaculate was received into a condom and transferred immediately to a dry phial. Through the kind co-operation of Dr. G. B. Manning and Dr. C. V. Harrison samples were received from the Royal Infirmary, Bolton, and the Pathological Department of Liverpool University, respectively. In these instances the determinations of constituents other than acid phosphatase were carried out in the laboratories of the senders. Preliminary experiments showed that there was no serious diminution in enzyme content when the sample was analysed up to 48 hours after collection. No preservative was needed.

Each sample of seminal fluid was suitably diluted (usually 1 in 4,000) and the acid phosphatase content estimated as previously described (Watkinson, Delory, King, and Haddow, 1944). The other properties—pH, abundance, morphology, and motility of spermatozoa—were studied in the usual manner (Lane-Roberts, Sharman, Walker, and Wiesner, 1939). The findings are given in the accompanying table. The correlation coefficients between the acid phosphatase content and the motility and between the enzyme content and the abundance of spermatozoa were 0.046 and 0.047, respectively, showing complete absence of correlation.

Discussion

From the table of results it will be seen that, although the lowest acid phosphatase figure recorded (244 units per ml.) is from a sample showing no motility, the highest figure (7,000 units per ml.) is also found in the presence of reduced motility. While the former figure is low, it still represents a considerable amount of enzyme, and it is difficult to believe that this would be insufficient to allow carbohydrate metabolism to proceed at the rate required to maintain an optimum degree of spermatozoal motility, if this indeed is the function of that enzyme.

Gutman and Gutman (1941) estimated the acid phosphatase content of samples from 24 sterile males. The semen contained only 33 units of acid phosphatase in one case, but all the others gave results within normal limits. They do not, however, report the results of any other examinations on the samples. There is no correlation in the present determinations between the acid phosphatase content of the seminal fluid and either the motility or the abundance of spermatozoa. This does not support the hypothesis advanced by Gutman and Gutman (1941) that the enzyme is responsible for spermatozoal motility. Mann

The Seminal Fluid of Patients Attending Hospital for Sterility

No.	Vol. (ml.)	Spermatozoa (Millions/ml.)	Motility (%)	Abnormal Forms (%)	pH	Acid Phosphatase (Units/ml.)
1	6.5	77	Nil	—	8.0	244
2	1.5	96	60	20	8.0	1,400
3	3.5	64	60	20	8.0	1,560
4	5.5	Nil	—	—	8.0	1,020
5	5.0	90	—	—	8.0	630
6	2.5	90	80	—	8.5	2,680
7	2.1	Nil	—	—	7.8	2,560
8	3.5	90	—	—	7.6	1,230
9	3.0	90	96	—	7.9	1,120
10	1.0	20	90	—	—	2,560
11	3.8	164	—	—	8.4	560
12	3.5	200	Nil	30	7.8	2,500
13	2.8	12	74	60	7.8	1,500
14	1.8	12	85	—	7.8	550
15	4.0	80	1	30	7.8	1,600
16	5.9	130	90	—	—	1,200
17	6.0	15	Nil	90	—	1,200
18	8.0	4	85	85	8.0	840
19	6.0	61	86	—	8.0	960
20	3.6	100	90	36	7.8	1,300
21	5.8	15	15	50	7.6	1,600
22	4.5	40	38	25	7.8	2,700
23	5.5	166	10	10	7.8	390
24	3.6	Nil	—	—	7.5	720
25	4.0	263	60	46	7.8	2,600
26	2.2	63	Nil	30	—	860
27	3.1	260	80	20	—	1,200
28	4.6	15	Nil	76	7.8	3,600
29	11.9	114	10	—	—	2,800
30	3.0	10	Nil	—	—	700
31	3.5	20	50	48	7.8	7,000
32	3.0	48	Nil	50	7.8	818
33	4.0	260	95	—	8.0	1,500
34	5.0	25	Nil	50	8.4	2,300
35	2.7	140	90	—	8.0	1,800
36	1.6	45	Nil	45	8.2	1,200

(1946) studied the reducing sugar of seminal fluid and found it to be *d*-fructose; he suggested that its main function was to supply the spermatozoa with readily glycolysable material.

Working with prostatic secretion obtained by digital massage, Lundquist (1946) obtained evidence leading to the conclusion that the function of acid phosphatase was the splitting of phosphorylcholine into choline and inorganic phosphate. On the other hand, Lardy and Philips (1941) have shown that when seminal fluid is stored there is an increase in the ester phosphorus at the expense of lipid phosphorus, and suggested that the fatty acid produced is then oxidized to provide energy for spermatozoal motility. In view of this work, samples of seminal fluid were tested for lecithinase by the method of King and Dolan (1933), but the presence of such an enzyme could not be demonstrated.

Since the metabolism of human spermatozoa is almost entirely glycolytic (MacLeod, 1939) it seems probable that acid phosphatase is not concerned with spermatozoal motility and that its function is still unknown.

Summary

Samples of seminal fluid from 36 men attending hospital for investigation of sterility have been examined for acid phosphatase content, pH, morphology, motility, and abundance of spermatozoa.

No correlation exists between the enzyme concentration and either the number of spermatozoa present or their motility.

There is no evidence that the acid phosphatase is constantly low in male sterility.

Lecithinase was not detected in the seminal fluid.

It is probable that acid phosphatase is not responsible for the maintenance of spermatozoal motility.

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REFERENCES

- Gutman, A. B., and Gutman, E. B. (1941). *Endocrinology*, **28**, 115.
 Gutman, E. B., Sproul, E. E., and Gutman, A. B. (1936). *Amer. J. Cancer*, **28**, 485.
 King, E. J., and Dolan, M. E. (1933). *Biochem. J.*, **27**, 403.
 Lane-Roberts, C., Sharman, A. A., Walker, K., and Wiesner, B. P. (1939). *Sterility and Impaired Fertility*, p. 374, Hamish Hamilton, London.
 Lardy, H. A., and Philips, P. H. (1941). *Amer. J. Physiol.*, **133**, 602.
 Lundquist, F. (1946). *Nature*, **158**, 710.
 MacLeod, J. (1939). *Proc. Soc. exp. Biol.*, N.Y., **42**, 153.
 Mann, T. (1946). *Biochem. J.*, **40**, 481.
 Watkinson, J. M., Delory, G. E., King, E. J., and Haddow, A. (1944). *British Medical Journal*, **2**, 492.

Medical Memoranda

A Case of Sulphaguanidine Anuria

During the last few years sulphaguanidine has been extensively used to combat bacillary dysentery. The toxic effects of this drug have been very slight compared with the other members of the sulphonamide group, though huge doses are sometimes administered. In view of the rarity of sulphaguanidine anuria the following case is presented.

CASE REPORT

On Jan. 10, 1946, an R.A.F. corporal aged 32 was admitted to a British military hospital. For five days he had had abdominal pain and severe diarrhoea, his stools containing blood and mucus. He was put on sulphaguanidine, 6 g. immediately and 4 g. four-hourly. Before starting treatment, however, two stools were sent to the clinical laboratory (these proved to be negative for pathogenic organisms). He vomited three times on Jan. 13, and again early next morning. On the 14th he confessed that he had not passed urine for 24 hours and that he had not taken the prescribed amount of fluid.

On examination he was slightly anaemic and the bladder seemed empty. He was catheterized, 9 oz. (255 ml.) of blood-stained urine being withdrawn. The clinical laboratory reported heavy crystalluria in this specimen. His red blood cell count was 4,000,000 per c.mm., haemoglobin 77% (Sahli), and blood urea 210 mg. per 100 ml. Cystoscopy was performed. The catheter was passed up the left ureter to the limit, and 20 ml. of 2% sodium bicarbonate solution was injected into the pelvis of the kidney. On withdrawal of the catheter good effluxes of blood-stained urine were seen. The catheter would not go beyond 2 cm. up the right ureter, and 40 ml. of the bicarbonate solution was injected, but on withdrawal there was no efflux into the bladder. The post-operative treatment consisted of fluids by mouth, 20 ml. of 40% sucrose intravenously, sodium citrate, and an intravenous drip of normal saline.

On Jan. 15 he had occasional bouts of vomiting. The drip was changed to glucose. At 5.30 p.m. 4 oz. (114 ml.) of very heavily blood-stained urine was withdrawn from the bladder. The intravenous drip had been continued all day, the solution having been changed to 3.5% sodium sulphate. Next day his condition was unchanged, and cystoscopy was again carried out. Peristalsis was seen down both ureters, but there was no efflux from either orifice. The catheter in the left ureter was blocked at 5 cm. from the orifice, but on withdrawal an ordinary efflux was seen. Catheterization of the right ureter was unsuccessful. A second attempt to catheterize the left ureter was successful and the catheter was left *in situ*.

On Jan. 17 his general condition was satisfactory, and heavily blood-stained urine was recovered from the indwelling catheter. The haemoglobin was 55% (Sahli). On the 18th he had an epistaxis and a slight haematemesis. While the catheter was left in position ureteric wash-outs with 5 ml. of 1% sodium bicarbonate solution were given, and up to 10 a.m. on the 18th 145 ml. had been injected up the catheter and a total of 260 ml. of blood-stained urine recovered. Between 10 a.m. and 8 p.m. on the 18th, the injection of fluid up the in-dwelling catheter was discontinued, and during this time 105 ml. of blood-stained urine flowed down. At 11 p.m. an

ordinary rubber catheter was passed into the bladder and 24 oz. (680 ml.) of blood-stained urine was withdrawn. There was no change in his condition on Jan 19. Next day the left ureteric catheter was withdrawn, but the bladder catheter was left *in situ*. Drainage was now satisfactory and the clinical condition slowly improved. The urinary output became normal, and iron was given to combat the anaemia. On Feb. 5 the erythrocyte count was 3,030,000, haemoglobin 65% (Sahli). The patient's appetite was good, and he was very contented. On Feb. 20 the blood urea was 30 mg. per 100 ml., the red cells numbered 3,730,000, and the haemoglobin was 82% (Sahli).

COMMENT

Cystoscopy followed by ureteral catheterization is a life-saving measure in these cases. It is suggested that the ureteral catheters be left *in situ* and that the kidneys be washed out with 1-2% solution of sodium bicarbonate, the amount of fluid injected and the amount of urine subsequently collected being charted so that the return of kidney function may be assessed. Sodium sulphate, 3.5% solution, or glucose-saline should be given continuously by the intravenous route.

I wish to thank Lieut.-Cols. W. D. Hughes, R.A.M.C., and J. Mackay-Dick, R.A.M.C., for their kind advice, and especially Major B. Brookes, R.A.M.C., who carried out the surgical treatment. I should also like to thank Col. R. H. C. Pryn for permission to publish this report.

PAUL B. WOOLLEY, M.B., Ch.B.,
Capt., R.A.M.C.

Empyema of the Gall-bladder in a Child

The following case seems worthy of record in view of its rarity. The success of treatment without drainage was an interesting feature.

CASE HISTORY

A Chinese boy aged 6 was admitted to hospital on Sept. 16, 1946. There was a history of fever and chilliness for ten days, and of pain in the right hypochondrium and epigastrium for four days. The mother stated that he had been healthy and had never suffered from any abdominal complaint suggestive of typhoid fever, dysentery, or appendicitis. About ten days before admission there was a gradual onset of malaise and feverishness, followed six days later by pain in the right hypochondrium and epigastrium, and the mother discovered a mass below the right ribs. The bowels had been acting normally, and there had been no nausea or vomiting.

His temperature on admission was 102.8° F. (39.3° C.), pulse 140, and respirations 24. There was slight jaundice of the conjunctivae. On inspection the abdomen, which was slightly distended, clearly showed a round tumour below the ribs on the right side. This moved on respiration and was tender. Examination of the blood showed a leucocytosis of 25,000 per c.mm., and a van den Bergh reaction was direct negative, indirect positive. *Ascaris* eggs were present in the stools. He was given penicillin, 10,000 units three-hourly for three days, without any effect on his temperature, which continued to swing to 104° F. (40° C.). This treatment was followed by sulphadiazine, 0.5 g. four-hourly for five days, also without effect.

Operation.—On Sept. 24, under open ether and local anaesthesia, the abdomen was opened through a right subcostal incision. The gall-bladder was found distended, thickened, and roughened, but there were no adhesions of omentum or bowel. No stone or worm could be palpated in the cystic or common bile-ducts. The liver was enlarged, but no abscesses were found. The gall-bladder was stitched to the parietal peritoneum by a purse-string suture, and opened: 15-20 ml. of thick greenish pus was evacuated, and the interior explored by a finger. The gall-bladder was closed and 80,000 units of penicillin in 10 ml. of distilled water was injected into it. The wound was closed in layers. Examination of the pus showed a pure staphylococcal infection. The day after operation there were signs of consolidation of the lungs; penicillin, 15,000 units three-hourly, was given for three days, after which the patient made an uninterrupted recovery.

COMMENT

Infection of the gall-bladder was probably via the blood stream, but the presence of *Ascaris* eggs in the stools raises the possibility of a worm having temporarily blocked the cystic duct. However, a case I recently operated on, in which obstruction of the common bile-duct by an *Ascaris* caused severe colic and obstructive jaundice, contrasts with the predominance of fever in the above case.

S. C. CHEN, M.B., Ch.B.,
Moukden Hospital, China.