EFFECT OF FREQUENT EJACULATIONS ON THE COMPOSITION OF HUMAN SEMINAL PLASMA

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Summary. In order to study the control and secretory capacity of the prostate gland and seminal vesicles, semen samples were collected at regular intervals. Despite a marked reduction in volume of samples collected at 24 hr intervals or shorter, the concentration of fructose (from seminal vesicles), transaminase, acid phosphatase, cholesterol (from prostate gland) and neuraminic acid (from both systems) was almost unchanged. This indicates that during emission of semen not only the composition of fluid from each system but also the relative amounts from each of them is kept constant.

INTRODUCTION

Several studies have been carried out on the effect of repeated ejaculations on the volume of seminal fluid and its content of spermatozoa in man and animals (Freund, 1963). The effect of frequent ejaculations on the biochemical composition of the semen has to some extent been evaluated in some mammals but apparently not in man. Mann (1948) found slight changes in the concentration of fructose and lactic acid in bull semen when eight ejaculates were collected within 60 min. In successively collected ejaculates from a bull there was also an increase in pH, indicating an increase in the relative contribution of the bulbo-urethral glands to the semen (for ref. see Kirton, Hafs & Hunter, 1964).

The present study is part of an investigation to examine the control and secretory activity of some of the accessory genital organs in man. Increased knowledge of basic processes in this field is of great importance for a better understanding of the physiology of these glands as well as the patho-physiology of certain diseases such as prostatitis.

MATERIALS AND METHODS

Semen samples were obtained at 24 hr intervals from eleven healthy men between 25 and 35 years of age, either by masturbation or by coitus condomatus. The seminal fluid was transferred to plastic bottles and placed in a refrigerator (+4 to +6° C) within 20 min. The bottles were then transferred to a freezer (−20° C) within 12 hr and stored until analysed. The analyses usually were
performed within 2 weeks. Control experiments revealed that the assays were not influenced by the condom, the plastic bottles or by the storage used. Before the analyses the semen was thawed at room temperature and centrifuged to remove the spermatozoa.

*Determination of fructose.* 0·1 ml seminal plasma was mixed with 0·3 ml CdSO₄ reagent (3·4667 g CdSO₄+16·93 ml n-H₂SO₄+distilled water to 100 ml), 1·0 ml distilled water and 0·1 ml 1·1 n-NaOH. After thorough mixing the test tube was left standing for 15 min and then centrifuged. The clear supernatant was used for the determination according to Karvonen & Malm (1955).

*Determination of cholesterol.* This was performed according to the method of Boetzelaer & Zondag (1960).

*Determination of n-acetyl neuraminic acid.* The thiobarbituric acid method by Warren (1959) was used with the change that to 0·2 ml seminal fluid, diluted 1 : 5 with distilled water, was added 1·6 ml distilled water and 0·2 ml n-H₂SO₄. The colour was read at 551 mµ. Standards containing 0·05 and 0·1 mµoles crystalline n-acetyl neuraminic acid were always included.

*Determination of acid phosphatase.* Lundquist's (1949) modification of Gutman & Gutman's method (1940) was used. The colour was read at 600 mµ. 1 unit is the activity that releases 1 mg phenol/hr at 37°C.

*Determination of glutaminic oxalic acid transaminase (GOT).* This was performed according to Reitman & Frankel's method (1957) using the got-reagent (Sigma Chemical Co.). The colour was read at 505 mµ against water. Seminal plasma contains oxalic acid, pyruvic acid and possibly also other compounds that give coloured hydrozone with the reagent. Therefore the extinction after 60 min of incubation was corrected by subtracting the extinction obtained in control samples (no incubation). All measurements were carried out in a Beckman DB spectrophotometer.

**Table 1**

<table>
<thead>
<tr>
<th>Subject</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>2·2</td>
<td>4·3</td>
<td>7·2</td>
<td>2·7</td>
<td>5·3</td>
<td>5·2</td>
<td>4·3</td>
<td>3·4</td>
<td>8·3</td>
<td>5·1</td>
<td></td>
</tr>
<tr>
<td>Fructose (mg/100 ml)</td>
<td>75</td>
<td>405</td>
<td>165</td>
<td>203</td>
<td>240</td>
<td>270</td>
<td>375</td>
<td>150</td>
<td>210</td>
<td>158</td>
<td></td>
</tr>
<tr>
<td>Cholesterol (mg/100 ml)</td>
<td>69</td>
<td>33</td>
<td>33</td>
<td>30</td>
<td>42</td>
<td>36</td>
<td>—</td>
<td>38</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuraminic acid (µmoles/100 ml)</td>
<td>485</td>
<td>395</td>
<td>325</td>
<td>415</td>
<td>380</td>
<td>280</td>
<td>335</td>
<td>225</td>
<td>295</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Acid phosphatase (units/ml)</td>
<td>6000</td>
<td>3040</td>
<td>4560</td>
<td>2640</td>
<td>3360</td>
<td>3600</td>
<td>3520</td>
<td>1440</td>
<td>5120</td>
<td>2480</td>
<td></td>
</tr>
<tr>
<td>Transaminase (GOT) (units/ml)</td>
<td>525</td>
<td>510</td>
<td>340</td>
<td>390</td>
<td>220</td>
<td>155</td>
<td>325</td>
<td>480</td>
<td>495</td>
<td>570</td>
<td></td>
</tr>
</tbody>
</table>

**RESULTS**

Table 1 shows the absolute value for the quantity of each substance in the first sample from each individual. Despite wide variations in absolute values between the subjects there was a striking similarity in the pattern during the experiments.
Composition of human seminal plasma

Table 2 shows the mean changes in weight of the ejaculates and in the quantities of the various compounds investigated in successive ejaculates produced at 24 hr intervals. In each case values are expressed as percentages of those present in the first ejaculate of the series. Part of the data is also shown in Text-fig. 1. The very close relationship between weight and total content of the various compounds means that the relative concentration of each compound is kept constant. The good agreement between the first and second control samples indicates that 3 days are sufficient for complete replenishment of the secretion of the accessory glands.

Table 2
MEAN CHANGES IN WEIGHT AND IN TOTAL AMOUNT OF FRUCTOSE, ACID PHOSPHATASE, TRANSAMINASE, NEURAMINIC ACID AND CHOLESTEROL IN SUCCESSIVE SAMPLES OF HUMAN SEMINAL FLUID COLLECTED AT 24 HR INTERVALS EXPRESSED AS A PERCENTAGE OF THE FIRST SAMPLE (±S.E.)

<table>
<thead>
<tr>
<th>Test</th>
<th>Sample</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Weight</td>
<td>100</td>
<td>70.5±9</td>
<td>58.1±5.5</td>
<td>63.4±6.3</td>
<td>46.5±6.7</td>
</tr>
<tr>
<td>Fructose</td>
<td>100</td>
<td>71.0±10.0</td>
<td>57.8±10.0</td>
<td>67.4±10.0</td>
<td>99.8±4.5</td>
</tr>
<tr>
<td>Acid phosphatase</td>
<td>100</td>
<td>64.5±6.8</td>
<td>51.7±4.5</td>
<td>49.8±3.1</td>
<td>44.8±2.2</td>
</tr>
<tr>
<td>Transaminase (got)</td>
<td>100</td>
<td>68.6±3.3</td>
<td>51.8±3.8</td>
<td>63.4±9.0</td>
<td>49.3±8.1</td>
</tr>
<tr>
<td>Neuraminic acid</td>
<td>100</td>
<td>61.0±6.3</td>
<td>55.4±7.4</td>
<td>50.5±5.7</td>
<td>37.7±3.8</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>100</td>
<td>69.6±6.4</td>
<td>68.8±5.3</td>
<td>63.5±2.8</td>
<td>60.0±10.0</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>100</td>
<td>±6.0</td>
<td>99.8±4.5</td>
<td>113.1±7.6</td>
</tr>
</tbody>
</table>

Text-fig. 1. Mean changes in volume (O), acid phosphatase (●), transaminase (○○) (×) and cholesterol (□) in human semen samples collected at 24 hr intervals (n = 11).
For further information see Table 2.

One individual submitted a series of samples collected at 12 hr intervals, and another a series collected at 8 hr intervals. Text-figs. 2 and 3 show graphically the results obtained from these samples. For the sake of clarity curves are given.
only for changes in weight of the ejaculate and for those of substances where the slope of the curve deviated most from the curve for weight. Although the decrease in these cases is more pronounced than in samples obtained at 24 hr intervals, the same pattern is presented. It should be noted that the secretory activity of the individual who delivered samples at 12 hr intervals is much less than that of the subject delivering samples at 8 hr intervals. There was no second sample after 3 days in the series illustrated in Text-fig. 2, but from that subject other samples have been obtained, the values of which are in close agreement with that of the first control sample.

**DISCUSSION**

It is known that during ejaculation the three main glandular systems contributing to the ejaculate are discharged successively (Broesike, 1911; Gutman & Gutman, 1941; Hansen, 1946; Lundquist, 1949; Eliasson, 1959). The first
portion comes from the prostate gland and contains the main bulk of acid phosphatase, which is secreted solely from this organ. The second portion contains the secretion from the testis, the epididymis, the vas deferens and the ampulla and, therefore, contains the highest concentration of spermatozoa. The third portion consists mainly of the secretion from the seminal vesicles and contains the highest concentration of fructose, a substance specific for this organ. During ejaculation the secretions from these organs become more or less mixed. By using the split-ejaculate method it has been shown that in man oör and cholesterol originate from the prostate gland, while neuraminic acid is secreted in equal concentrations from the prostate gland and seminal vesicles (Eliasson, 1964, unpublished observation).

Since fructose originates from the seminal vesicles, acid phosphatase, transaminase and cholesterol from the prostate gland and neuraminic acid from both systems it is surprising that the relative concentration of each compound is constant despite a marked decrease in volume of the semen. This observation indicates that not only the composition of the fluid from each system but also the relative amounts from each of them is kept constant. The close control of the secretory activity of the main accessory genital glands in man is further evident in the two experiments with a shorter collection frequency. Even with a high degree of exhaustion of the secretory capacity of the organs the relative concentration of all compounds was kept constant (Text-figs. 2 and 3).

This secretory pattern in man is different from that found in bulls (for ref. see Kirton et al., 1964). In this species the relative concentration of fructose (from the vesicular glands) decreased while the pH increased in successive samples of semen, indicating an increase in the relative contribution of the bulbo-urethral glands in relation to that from the vesicular glands.

This series of observations indicates that in man the proportional contribution of the prostate and seminal vesicle to the ejaculate is constant for and characteristic of a given individual, and is unaffected by changes in the volume of the ejaculate or by frequency of emission. However, preliminary investigations (unpublished) on the concentration of prostaglandin present in successive semen samples show this was not constant. The factors governing changes in prostaglandin concentration are under investigation.

ACKNOWLEDGMENTS

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REFERENCES


