BIOCHEMISTRY OF SEMEN

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Semen is composed of spermatozoa and seminal plasma. Each of the 2 components can influence the chemical composition of the other and they should therefore in many instances be looked upon as a functional unit although they derive from different organs. The biochemical composition of the seminal plasma is extremely complex and differs remarkably in many respects from that of blood plasma and other body fluids. It has been extensively studied by biochemists, but most clinicians and reproductive biologists have not been particularly interested in the possible significance of changes in the biochemistry of the seminal plasma as causes of male infertility. One reason for this could be reports that pregnancies have been achieved in some species after insemination with epididymal spermatozoa. It is, however, important to realize that there are significant differences in the reproductive pattern between various species and the role of seminal plasma could therefore be different. These differences could perhaps explain some of the very significant diversities in chemical composition of the seminal plasma from our more common domestic and laboratory species. One should also recall that fertility could only be demonstrated if the epididymal spermatozoa had undergone special incubation and/or washing procedures which could have induced changes in the spermatozoa normally occurring in the seminal plasma.

Biochemical analysis of seminal plasma Biochemical analysis of seminal plasma can give information on

1. the secretory function or capacity of the accessory genital glands.

2. the ejaculatory process.

3. the integrity of the sperm membranes.

4. the secretion of endogenous and exogenous compounds into the seminal plasma and also the route of secretion.

5. the effects of specific factors in the seminal plasma on functional properties of the spermatozoa.

Secretory function of the accessory genital glands

Among compounds known to be suitable for the evaluation of the prostate are acid phosphatase, citric acid, inositol, zinc, and magnesium. Many other factors are also secreted mainly by the prostate, e.g. albumin, free fatty acids, cholesterol, alkaline phosphatase, lysozyme, a-amylase, and several other enzymes, but their usefulness as markers has been insufficiently examined. Examples of compounds secreted by the seminal vesicles are fructose, prostaglandins, amylo- 1,6,-glucosidase, and several basic proteins. Fructose in seminal plasma has frequently been used as an indicator of the testosterone activity in experimental animals, but there is no correlation between the fructose concentra- tion in the human seminal plasma and the androgen level in the blood.

The ejaculatory Focess The normal ejaculation is the result of strong contractions in the reproductive tract. It probably starts with contractions in the testis, epididymis and vas deferens. The first portion of fluid entering the urethra comes from the prostate. Frequently the fluids from the epididymis and ampullae - with the bulk of spermatozoa - come at the same time or shortly after. The last portion of the ejaculate comes from the seminal vesicles.

Since in the healthy man the composition of the seminal plasma is remarkably constant and independent of the time of abstinence (Eliasson 1965) one can conclude that the relative contributions from prostate and seminal vesicles are also constant. The ejaculation process must therefore be extremely well controlled. The physiological significance may be related to the fact that if spermatozoa come into contact with the fluid from the seminal vesicles before they have been in contact with the prostatic fluid their motility, viability, chromatin decondensation ability, etc., will be seriously affected. The situation can actually lead to sterility and is therefore an illustration to the claim that the seminal plasma is not only a transport medium for the spermatozoa. Biochemical analysis of split-ejaculates can be of great help in the diagnosis of such dysfunctions.

Integrity of sperm membranes

Spermatozoa contain a number of specific compounds. The release of such compounds into the seminal plasma (e. g. hyaluronidase, acrosin, LDH-X, cyto-chrome C and some isoenzymes of ASAT (GOT) and malic dehydrogenase) could serve as indicators of the integrity of the sperm membranes.

Secretion of compounds into seminal plasma

To be able to evaluate the origin of a specific factor in the seminal plasma one should not rely on analysis of organ extracts but use the split ejaculate technique.

Effects of seminal plasma components on spermatozoa

The interaction between seminal plasma and spermatozoa is frequently overlooked. For experimental work on spermatozoa it is important to know that washed spermatozoa have a strong tendency to adhere to glass which can induce significant experimental errors. The composition of the washing medium is important since some compounds, e.g. albumirl, amino acids, and EDTA can induce significant changes in the chemical composition of the spermatozoa and most likely also alter the structural properties of the membranes.

Biochemical analysis of spermatozoa

Spermatozoa are an exceptional cell population since they can be isolated in an intact form and without prior destruction of tissue. They are therefore suitable for a number of basic research problems related to cell physiology and biochemistry. In this review the discussion will limit to aspects related to human reproduction and more specifically to so called male fertility. The sperm head has two main component of interest for our studies, the nucleus with its condensed chromatin material and the acrosome with enzymes necessary for the penetration of the head into the egg. The DNA content in the head is, so far we can understand, constant throughout the maturation process which follows after the meiosis. However, the affinity or uptake of different stains by the spermatids and spermatozoa decreases as the maturation proceeds both within the testis and during the transit through epididymis.

Conclusion

Properly performed biochemical analyses of seminal plasma and spermatozoa will in the future be of great importance for the clinicians in diagnosis and therapy of

many andrological dysfunctions and for the reproductive biologists in their studies of the complicated mechanism involved in the production and delivery of fertile spermatozoa. The seminal plasma is a complex fluid originating from several glands (some of them functionally multiglandular), and there are obvious interactions between components in the seminal plasma and spermatozoa. As a general rule one should regard methods suitable for analysis of blood plasma unsuitable for seminal plasma until the opposite has been proven.