BIOPHYSICS AND BIOCHEMISTRY

α-Fetoprotein in Human Fetal Vitreous Body

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α-Fetoprotein was detected in human fetal vitreous body and its concentrations on gestation weeks 16-24 were measured. The concentration of α-fetoprotein was maximum during week 17 of pregnancy (17.4 mg/ml), but then decreased and reached 1.42 mg/ml by week 24.

Key Words: α-*fetoprotein; vitreous body; human fetuses*

α-Fetoprotein (AFP) is a glycoprotein present in vertebrate serum during the embryo and fetal development. This protein is also a tumor marker found in cancer patients [1,8]. Serum levels of AFP are measured in pregnant women for the diagnosis of some developmental disorders in the fetus [10]. For example, high level of AFP in maternal blood indicates defects in neural tube development (open neural tube) in the fetus, while low level is characteristic of Down's syndrome [9].

During the early stages of embryonic development, AFP is produced mainly by yolk sac visceral endoderm cells, while during the fetal period it is synthesized by liver cells, released into circulation, and transported to target cells [4,7].

AFP exhibits high affinity to polyunsaturated fatty acids (PUFA). These acids are not synthesized in human fetuses during the prenatal development, and one of the main functions of AFP during embryonic and fetal periods is PUFA transport from maternal blood through the placenta to fetal organs and tissues [3,5]. The capacity of AFP to bind estrogens suggests that it protects the developing fetus from maternal estrogens [1].

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The presence of AFP in CNS was documented for the cerebrospinal fluid; specific AFP receptors were found on the neurons of some vertebrates throughout embryo development. AFP was detected by immunoperoxidase staining in neurons of various compartments of the developing brain in mouse, rat, and chicken embryos. This protein was also detected in the retinal internal nuclear layer of a 9-week *Papio hamadryas* fetus [11,12]. Addition of AFP to culture medium during culturing of chicken embryonic retinal neurons resulted in its uptake by differentiating neurons and ganglionic cells [6]. These observations indicated that intracellular presence of AFP was a result of its uptake by neurons, but not of its intracellular synthesis [11]. These data attest to an important role of this protein in the development of CNS and developing retinal neurons.

Vitreous body is an internal eye medium playing an important role in the morphogenesis of eye structures and differentiation of retinal cells. During the early period of prenatal development, the vitreous body is characterized by the presence of hyaloid blood vessels, which can deliver AFP.

We tested human fetal vitreous body for AFP.

MATERIALS AND METHODS

Biological material (from aborted fetuses of gestation weeks 16-20) and autopsy material (dead fetuses after

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preterm delivery) was obtained from licensed hospitals of the Ministry of Health, working within the framework of legislation of the Russian Federation on Public Health Protection in accordance with approved list of medical indications. Fetal age corresponded to the period determined by the obstetrician.

Enucleated eyes were cleansed from adjacent tissues and washed in several portions of saline (0.9% NaCl). The cornea was then cut out along the limbus under an MBS-9 magnifying glass and the vitreous body was removed together with the lens, after which the lens was accurately removed and the vitreous body was cleansed from fragments of the retina. Specimens of the vitreous body were then centrifuged (12,500 rpm, Eppendorf centrifuge 5417R, 4°C, 30 min), the supernatants were collected and used for measurements of AFP concentrations. The measurements were carried out on an AdviaCentaur CP closed chemiluminescent analyzer (Siemens) using antiAFP.

RESULTS

The measurements showed the presence AFP in human fetal vitreous body at different stages of prenatal development from week 16 until week 24 (Table 1). The highest concentration of AFP was recorded during week 17 (more than 2-fold surpassed the corresponding parameter during week 16). After week 17, AFP concentration gradually decreased. It is noteworthy that AFP concentration during weeks 20-21 was significantly lower than during weeks 21-22 and 22. After week 22, the concentration of AFP decreased again.

The presence of AFP in the CNS and in the inner neuroblast layer of the retina in vertebrates is assumed to be due to its involvement in differentiation of neurons [11]. The presence of AFP in human fetal vitreous body adjacent to the entire retinal inner surface can be also explained by differentiation of the retinal neurons. As a messenger protein, AFP can deliver the substances essential for neuron growth and differentiation, *e.g.* PUFA [3,5].

A possible source of AFP in human fetal vitreous body is the blood circulating in the hyaloid vessels, located in the vitreous body of the developing eye. Fluctuations in AFP concentrations during development (Table 1) can be explained by individual features of the fetuses and depend on fetal age and status. However, AFP concentrations in the vitreous body generally decrease with age, which is in line with a known trend to a decrease in concentration of this protein in systemic circulation of the fetus [1].

The data available by the present time indicate that AFP and polypeptide growth factors, such as epidermal growth factor and transforming growth factor-beta (TGF-β), have some common characteristics. It was shown that AFP modulates their activities, and this effect can be realized via modulation of various stages of signal transmission cascade by binding of the growth factor to membrane receptors [1].

TABLE 1. Concentration of AFP in Human Fetal Vitreous Body during Early Period of Development

Fetal age, weeks	AFP concentration, mg/ml
16	7.95
17	17.39
20-21	2.18
21-22	6.23
22	6.13
22-23	4.32
24	1.42

We previously showed immunochemical location of TGF-β_2 protein in human fetal retina [2]. The presence of AFP in the vitreous body at similar stages of human fetus development can indicate interactions of these molecules during the development of the retina.

Hence, AFP can be an important indicator of the developing eye status in health and disease. Further studies of the role of AFP in the development of ocular tissues should be carried out.

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