Alpha-Fetoprotein Test

- Detects alpha-fetoprotein in the blood, used to monitor certain cancers like hepatomas.

Human α-fetoprotein (AFP) is a glycoprotein associated with tumors, originating from fetal mammalian sources, and plays a crucial role in both ontogenic and oncogenic development. This tumor biomarker is encoded by the AFP gene located on chromosome 4q25.[1] The fetal protein consists of a single polypeptide chain with a molecular weight of 70 kDa, incorporating 3% to 5% carbohydrate content.[2] This protein is characterized by a triplicate domain architecture, which is structured by intramolecular loops that are influenced by disulfide bonds. AFP is positioned within the α-1 anodic region in the electrophoretic profile, exhibiting a marginally slower migration rate in comparison to albumin.[3] AFP is synthesized primarily in the yolk sac, fetal liver, and gastrointestinal tract during gestation; however, it is also re-expressed in various adult neoplasms of mixed mesodermal or endodermal derivation.[4]

In clinical laboratory settings, AFP has been utilized as both a post-operative tumor biomarker and a gestational age-dependent indicator for fetal abnormalities, proving effective in screening for neural tube defects and aneuploidies.[5] Elevated maternal serum AFP levels are indicative of neural tube defects in the fetus, whereas lower levels are correlated with chromosomal abnormalities.[6] AFP derived from the yolk sac and liver exhibits distinct carbohydrate compositions. The half-life of AFP is approximately 4 to 5 days. Analogous to albumin, serum AFP has the capacity to bind and transport a myriad of ligands, including bilirubin, fatty acids, retinoids, steroids, heavy metals, dyes, flavonoids, phytoestrogens, dioxin, and various pharmaceuticals.[7,9]

AFP can be fractionated via affinity electrophoresis into three glycoforms—L1, L2, and L3—based on its interaction with the lectin lens culinaris agglutinin. The AFP-L3 glycoform demonstrates a strong binding affinity to lens culinaris agglutinin due to the presence of an additional α-1-6 fucose residue linked to the reducing terminus of N-acetylglucosamine, distinguishing it from the L1 isoform.[10] The L1 isoform is generally associated with non-hepatocellular carcinoma hepatic inflammation.8 Conversely, the L3 isoform is specific to malignant tumors, and its detection can help identify patients requiring heightened surveillance for the potential onset of hepatocellular carcinoma, particularly in high-risk groups such as those with chronic hepatitis B and C or liver cirrhosis.[11]

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