Erythrocyte tocopherol isomers
as an adjunct in the investigation of vitamin E deficiency
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Introduction

Biolab has established a method for the measurement of erythrocyte α- and γ-tocopherol using reverse-phase HPLC, as an adjunct to plasma measurement of vitamin E in diagnostically difficult situations [1]. The derived reference interval for erythrocyte α-tocopherol is 1.3-5.7 μmol/L and for plasma α-tocopherol 25 - 60 μmol/L. According to results for vitamin E-replete subjects, the mean ratio of erythrocyte to plasma α-tocopherol is 0.10 (range 0.03-0.19).

While development of neurological dysfunction due to vitamin E deficiency in adults usually requires ten to twenty years of fat malabsorption, symptoms can develop within eighteen months in children with vitamin E deficiency [2]. The syndrome of Ataxia with Vitamin E Deficiency (AVED) occurs as a result of genetic abnormalities in the alpha-tocopherol transfer protein; patients with this familial isolated vitamin E deficiency have markedly decreased plasma vitamin E levels and neurological symptoms characteristic of vitamin E deficiency. Neurological function has been shown to improve with appropriate vitamin E therapy and progressive neurological damage may be prevented in children by starting supplementation at an early age [3,4].

Indications

Serum α- and γ-tocopherol concentrations are commonly used as markers of vitamin E status, but in certain conditions may have a limited diagnostic value. For example, the serum level in patients suffering from ataxia with vitamin E deficiency (AVED syndrome) can fluctuate rapidly during supplementation, rather than achieving a steady state. The erythrocyte tocopherol content is less susceptible to fluctuations after supplementation and is therefore a possible marker of tissue vitamin E status.

The maintenance of serum concentrations of α-tocopherol normally depends on the action of α-tocopherol transfer protein, secreted by hepatocytes, to preferentially take up α-tocopherol from the portal blood, while other forms of vitamin E are more rapidly metabolized and excreted [4,5]. As a result, blood and cellular concentrations of other vitamin E isomers are lower than those of α-tocopherol and have been the subjects of less research [6,7].

The erythrocyte tocopherol content is thus a possible marker of tissue vitamin E status in subjects with gross lipid abnormalities and also in subjects suspected of having AVED syndrome, in which there is an abnormality of α-tocopherol transfer protein.

Synonyms

Erythrocyte tocopherol isomers, erythrocyte vitamin E status, red cell tocopherol isomers.

Patient preparation

The patient should refrain from taking nutritional supplements containing vitamin E the day before the collection of the blood sample.
Specimen requirements

The method is based on the combined measurement of red cell and serum vitamin E, so two blood samples are required - one lithium heparin whole blood tube (green top Venoject tube) plus one serum separator (gold top Venoject tube) – tubes available from Biolab on request. At least 3.0 mls of blood is required in each tube.

If posted, the unseparated whole sample at room temperature should reach Biolab within 24 hours of venipuncture.

Methodology

Tocopherol determinations are carried out by reverse phase high pressure liquid chromatography (HPLC) [8], quantitating both \( \alpha \)- and \( \gamma \)-tocopherol.

Interpretation of results

Erythrocyte tocopherol measurement has a role in the investigation of difficult cases of vitamin E deficiency. There is a good correlation between serum and erythrocyte \( \gamma \)-tocopherol, but not between serum and erythrocyte \( \alpha \)-tocopherol, which reflects the important role of \( \alpha \)-tocopherol transfer protein in the maintenance of body vitamin E status. There are no previous reports in the scientific literature of the erythrocyte /plasma \( \gamma \) -tocopherol ratio.

Chow [5] measured the distribution of tocopherols in serum and red blood cells, reporting a range for serum \( \alpha \)-tocopherol of 15.3-34.8 \( \mu \)mol/L and for erythrocyte \( \alpha \)-tocopherol of 2.1-4.2 \( \mu \)mol/L, with a mean erythrocyte /plasma ratio of 0.15. Mino et al [6] measured serum and red cell tocopherols in a Japanese population and recorded a serum \( \alpha \)-tocopherol range of 12.4-36.9 \( \mu \)mol/L, an erythrocyte range of 2.3-5.6 \( \mu \)mol/L, with a mean erythrocyte/plasma ratio of 0.18. The influence of supplementation dosages on serum and erythrocyte tocopherols was researched by Lehmann et al [7], who reported mean values for \( \alpha \)-tocopherol in serum of 23.9 \( \mu \)mol/L and in erythrocytes of 5.1 \( \mu \)mol/L, with a mean erythrocyte /plasma ratio of 0.21.

Our results on vitamin E-replete subjects suggest a reference interval for erythrocyte \( \alpha \)-tocopherol of 1.3-5.7 \( \mu \)mol/L, with a range for the erythrocyte /plasma \( \alpha \)-tocopherol ratio of 0.03-0.19 (mean value 0.10). Our results also suggest a reference interval for erythrocyte \( \gamma \)-tocopherol of 0.5 -2.4 \( \mu \)mol/L, with a range for the erythrocyte /plasma \( \gamma \)-tocopherol ratio of 0.11-0.67 (mean value 0.28).

References