Controversial Effect of Vitamin E Supplementation in Subjects with Down Syndrome

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Introduction

Down syndrome (DS) is caused by a total or partial trisomy of chromosome 21 in humans.

The overexpression of the enzyme Superoxide dismutase (SOD) located in chromosome 21 leads to an elevated oxidative stress which contributes to the pathology of DS (see Figure 1).

Using antioxidants to reduce oxidative stress levels is a promising approach for slowing or preventing DS associated features and maybe improving cognitive function.

Vitamin E is a lipid-soluble antioxidant that protects from lipid peroxidation and DNA damage. The intake of vitamin E might be useful in preventing cognitive deterioration in DS.

Results of Vitamin E Supplementation Studies

In vitro studies: Vitamin E is neuroprotective, increases neuronal survival and protects from chromosomal damage.
Animal studies: Vitamin E delays cognitive decline in aged mice and improves cognitive deficits in newborn mice.
Clinical trials: Vitamin E attenuates the systemic oxidative stress.

Vitamin E: Isomers and toxicity

Vitamin E consists of four tocopherol isomers (α, β, γ, δ) and four tocotrienol isomers (α, β, γ, δ). They are closely related chemically (see Figure 2) but they differ in their biological effectiveness.

- Radical-scavenging activity: α-tocopherol > other tocopherols > tocotrienols >> chemically synthesized α-tocopherol

• Mixtures of different forms of vitamin E have a broader range of free-radical-scavenging abilities.

• High doses of Vitamin E can have toxic effects, including apoptotic activity (tocotrienols more than tocopherols), adverse effects on offspring (high maternal α-tocopherol) and hemorrhagic toxicity.

Discussion

Despite the mostly promising results of in vitro and animal studies, interventional studies of vitamin E supplementation in DS human subjects have not been conclusive.

Possible explanation for the lack of effect

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<td>Not enough vitamin E crosses the blood-brain barrier</td>
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Table 1 Problems and solutions of clinical research done on the subject of vitamin E supplementation in DS. *Vitamin C seems to improve other compounds to cross the blood-brain barrier.

Conclusions

- There is no consistent proof that vitamin E improves the outcome in DS.
- Antioxidant intervention should start soon after birth, before the chronic oxidative damage is already installed.
- Well-designed research needs to be done to select the right isomer and dose of vitamin E.
- Theoretically, the best treatment choice would be the natural α-tocopherol combined with either other isomers or vitamin C.
- There are potential adverse effects from high doses and prolonged supplementation. The safety of vitamin E should be evaluated.
- Until we have clear evidence of the benefits of vitamin E supplementation, parents should be discouraged of giving it to their children with DS.

References