

Beta-Estradiol, Hemorheology and Women Health

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Abstract

The best way to protect women's health is still a challenge. Although beta-estradiol protects women from thromboembolism and cardiovascular disease, the introduction of exogenous hormones causes the opposite effect. This article discusses how impaired hemorheology may be the cause of the paradoxical effects of hormones on women's health and why future treatments also should improve hemorheological parameters.

Estradiol and Hemorheology

During menopause, women are protected against thromboembolism and cardiovascular diseases by estrogen levels, being that the most prevalent the beta-estradiol [1]. Lack of beta-estradiol after menopause or introduction of hormone of contraceptive pills or hormone replacement therapy cancels this protection, raising the risk of thromboembolic events and cardiovascular diseases [2,3]. At first, we believed that the increased incidence of thromboembolic events and cardiovascular disease was due to the fact that the type of estrogen used in contraceptive pills and hormone replacement therapy (HRT) was not the natural estrogen beta-estradiol but the ethinyl estradiol, contained in most of these medicines. Since that thromboembolism and cardiovascular diseases are linked to impaired hemorheology, we hypothesized that the responsible was ethinyl estradiol. In order to test this hypothesis, we have added to men's blood different concentrations of beta-estradiol or ethinyl estradiol and we performed tests for aggregation and deformability of red blood cells (RBC). Our surprise was both beta-estradiol and ethinyl estradiol acted in a similar way, increasing RBC deformability only in determined concentration. Therefore, the reason of the impaired hemorheology is not due the hormone is natural or synthetic but because of blood's concentration [4].

Hemorheology, Microcirculation and Health

Hemorheology is a science of the deformation and flow of blood [5]. Hemorheology is related to the behavior of RBC, and dependent on the shear rate. Deformability and aggregation of RBC interfere with viscoelasticity of blood [6]. RBC deformability is impaired in diseases such as diabetes and circulatory disorders. In low shear rates, RBC tend to aggregate in shapes resembling a stack of coins and are dependent on the medium (as plasma proteins, as fibrinogen) and the cellular properties. The inflammatory response is the major cause of RBC aggregation. RBC aggregation is present in various diseases, such as chronic inflammatory conditions, malignant diseases and circulatory disorders. Higher RBC aggregation is related to poor prognostic in ischemic disease. The impaired blood flow is related to the severity of circulatory problems, and hemorheological problems interfere in both blood flow and tissue perfusion. Aging related impairment of hemorheological parameters are linked to the aging disease progression [7]. The role of RBC in blood flow and viscosity is higher when blood vessels diameters decrease [8]. Therefore, RBC aggregation and RBC deformability are critical to blood flow in the microcirculation. Type 2 diabetes (T2D) is a major factor of health concern and a good example of how hemorheology and microcirculation affects women's health. T2D is linked to various common diseases such as cardiovascular diseases and cancer among them [9]. After menopause, there is an increased risk of T2D and prediabetes, although it is not established if this increased risk is due to hormonal deficiency or to aging, although T2D risk appears to be increased after oophorectomy and premature menopause.

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The use of HRT appears to decrease the risk of T2D [10]. There is an increased erythrocyte aggregation and impairment of heart rate variability in older women with type 2 diabetes compared with same age nondiabetic women, suggesting that the impairment in the microcirculation may lead to cardiovascular problems. The same population submitted to exercise training reduced the aggregation of the red blood cells, without changing the glycemic control [11]. Compared with controls, patients with T2D have reduced blood flow both peripheral and cerebral while there are an increase of the whole blood viscosity and fibrinogen. In patients with T2D and cerebrovascular disease, there is an increased whole blood viscosity over a wide range of shear rates [12]. The erythrocyte deformability also is reduced in T2D patients compared with healthy controls and are even worse in T2D patients with complications as nephropathy or retinopathy [13].

Conclusion

The decline of women health is often accompanied by impairment of hemorheology and microcirculation. Therefore, any treatment for improve health also should improve hemorheology and microcirculation. Based on our experiment, there is an ideal concentration of estradiol for increase the health status and protect women against diseases such as thromboembolism and cardiovascular diseases [4]. Probably the use of hormonal treatment can be harmful or beneficial dependent on blood concentration of estradiol. In order to improve women health, we should provide a treatment which decrease T2D risk and provide the best concentration of blood estradiol. Probably changing lifestyle (diet and exercise) along with ensuring a correct concentration of estradiol and promoting an improvement of the hemorheological parameters are the best way to enhance health and decrease risk of diseases. In conclusion, the decline in women's health is related to decreased or excess beta-estradiol and worsening of hemorheology. The best treatment to improve women's health also should improve hemorheology.

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