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Expert Opinion

Does iron chelation by eumelanin contribute to the ethnic link with maternal mortality?

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Introduction

Significant disparities in maternal mortality between white and black mothers have been noted for over 80 years and remain an extremely serious problem. Black women are still four times more likely than white women to die in pregnancy or childbirth in the UK [1].

The lack of progress in resolving this issue is surprising. Whilst socio-economic conditions and related factors are thought to be responsible for some of the health disparities between ethnic groups there remains the possibility that other contingencies may contribute to the link with skin colour.

In this communication we suggest a mechanism which may be a contributary cause of the adverse obstetric and perinatal outcome. Since there is correlation between maternal deaths and epidermal pigmentation this may indicate that the skin pigment melanin is in some way directly implicated.

Epidermal melanin

Melanins are polymeric pigments derived from the oxidation of tyrosine. In humans, the synthesis of melanins takes place in specialised pigment-generating cells (melanocytes) where it is deposited in pigment granules (melanosomes) and transferred to surrounding cells. In the case of skin pigmentation, melanin granules are continuously synthesised by epidermal melanocytes and transferred to the adjacent epidermal cells. The degree of skin pigmentation is determined by several genetic factors, including the rate of melanin synthesis, and the size and number of melanin granules transferred to epidermal cells [2].

Metal chelation

A notable property of melanin is its powerful metal-chelating characteristic [3–4] with a marked affinity for iron [5]. As the epidermal cell population is constantly turning over, being lost by surface desquamation [6], there is continuous replacement of epidermal pigment. Thus, the turnover of epidermal melanin provides an excretory pathway for iron and may constitute a contributary factor in circumstances leading to anaemia. These include dietary deficiency of iron, impaired absorption, chronic blood loss and several other potential factors [7].

Melanin-bound iron excretion and iron homeostasis

An investigation of iron metabolism in mice has demonstrated that *trans*-epidermal iron elimination accounts for 20–25 % of the daily iron loss in the absence of epidermal pigmentation and this is amplified by increased epidermal turnover [8]. Human data published by Green et al. [9] show significant daily excretion of iron from epidermal turnover and the total iron loss is related to the degree of pigmentation, being 0.95 mg/day in white subjects compared with 2.42 mg/day for Bantu. These data are based on steady-state conditions so it is not clear whether the increased transdermal iron loss is compensated for by increased uptake, but it is considered unlikely in the presence of dietary deficiency.

There is little evidence that relates directly to the effects of iron deficiency on sickle cell anaemia or other haemoglobinopathies, but the evidence of Hershko et al. [10] shows a reduced frequency of iron-deficiency anaemia (IDA) associated with sickle cell trait.

Iron-deficiency anaemia and risk of adverse perinatal maternal outcome

A prominent influence adversely affecting maternal health is the incidence of anaemia in pregnancy [11] and it has been demonstrated that there is a clear association between iron-deficiency anaemia in

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pregnancy and the risk of atonic postpartum haemorrhage [12–13]. Thus, any mechanism increasing the likelihood of IDA may be considered a risk factor leading to adverse clinical outcome.

Hypothesis

We suggest that dark-skinned (Type IV-VI) women, exhibit significantly increased iron loss via melanin complexation and trans-epidermal excretion compared to those with lighter skin, and this mechanism may comprise a significant contribution to increased vulnerability to iron-deficiency anaemia and lead to some of the observed disparities in maternal mortality.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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