HEART

Editorial

Management of polycythaemia in adults with cyanotic congenital heart disease

Adults with polycythaemia secondary to cyanotic congenital heart disease may be at greater risk from injudicious venesection than from their polycythaemia.[1] Despite an established literature on the subject, patients are frequently put at risk from acute volume depletion and chronic iron deficiency. This article aims to clarify some of the issues surrounding venesection and to set out guidelines for when and how to venesect these patients.

The polycythaemia of chronic hypoxaemia may be more precisely termed erythrocytosis as, in contrast to polycythaemia rubra vera,[2] it is the red blood cell mass alone that is increased. This secondary polycythaemia, or erythrocytosis, is a physiological response to tissue hypoxia. Hypoxia increases erythropoetin, which in turn stimulates the bone marrow to produce increased numbers of circulating red cells, enhancing oxygen carrying capacity as well as producing an increase in the erythrocyte mass, haematocrit, and whole blood viscosity. The improved tissue oxygenation that results from this adaptation may be sufficient to reach a new equilibrium at a higher haematocrit.[3] However, adaptive failure can occur if the increased whole blood viscosity impairs oxygen delivery and negates the beneficial effects of erythrocytosis.[1 4]

Polycythaemic cyanotic patients experience symptoms caused by the detrimental effects of hyperviscosity on tissue oxygen delivery rather than by a high haematocrit itself (table 1).[5]

A number of widely held misconceptions result in inappropriate venesection. First, that it is performed to prevent the risk of stroke, therefore secondly, that it should be done routinely to keep the haematocrit < 65% regardless of symptoms, and thirdly that volume replacement is not required.

The idea that hyperviscosity is a risk factor for cerebral arterial thrombosis in adults with cyanotic heart disease has arisen from studies in other patient groups. This, along with the observation that symptoms of reduced cerebral blood flow secondary to hyperviscosity are transiently relieved by venesection, has led to the widespread belief that haematocrit levels in patients with cyanotic heart disease should not be allowed to rise "too high".

The risk of vascular occlusion in patients with primary polycythaemia rubra vera relates both to degree of erythrocytosis and to thrombocytosis, and treatment guidelines in this disease recommend venesection to maintain a haematocrit ⩽ 45.[2 6] Haematologists all too often automatically extend these guidelines to include cyanotic patients with secondary erythrocytosis. In fact, there is no evidence that venesection alone (without myelosuppressive treatment) reduces the risk of thrombosis in polycythaemia rubra vera; on the contrary, patients who undergo frequent venesection have a higher incidence of vascular occlusion.[2] It is clear, therefore, that findings in this elderly (mean age ~ 65 years[6]) patient group with malignant myeloproliferation should not be extrapolated to adults with cyanotic heart disease, not only because they are younger and have a reactive erythrocytosis, but also because there is no increase in other myeloid lines, indeed, many cyanotic patients are thrombocytopenic.[7]

Cyanotic infants have long been known to be at risk from cerebral infarction, and Taussig recognised the additional dangers of dehydration in these patients.[8] However, the risk of cerebral infarction in cyanotic children younger than four years relates to iron deficiency and a relative anaemia, rather than to polycythaemia.[9 10] Furthermore, cerebral infarction in these patients follows venous thrombosis rather than arterial occlusion.[10] There were only nine cyanotic patients older than four years who had a cerebrovascular accident in Phornphutkul *et al*'s retrospective study from 1950 to 1970; however, in this small group there was an association between raised haematocrit (mean 63) and stroke.[10] In contrast, during a 35 year follow up of 188 patients with Eisenmenger's syndrome, the 7.9% incidence of stroke by age 31 years was not related to haematocrit (Daliento and Somerville, personal communication, 1998). In addition, regardless of haematocrit, Perloff *et al* were unable to demonstrate a risk of stroke in a study of 112 adults (mean age 36 years) with cyanotic heart disease followed for 748 patient years.[5] There is thus no evidence to support routine venesection to prevent stroke in adults with cyanotic heart disease.

If repeated venesections are performed to treat a high haematocrit rather than the patient's symptoms, iron deficiency results. The microcytic iron deficient erythrocytes not only have a reduced oxygen carrying capacity but are also more rigid and less deformable than iron replete biconcave red blood cells, causing an increase in viscosity and negating any beneficial effect of lowering the haematocrit.[11 12] Another potentially detrimental effect of iron deficiency is that it moves an often already

Table 1 Symptoms of hyperviscosity in polycythaemic cyanotic patients

Headache
Faintness and dizziness
Blurred vision, amaurosis fugax
Fatigue
Myalgia, muscle weakness
Paraesthesiae
Depressed mentation, sense of distance
Chest and abdominal pain

Table 2 Recommendations for venesection in adults with cyanotic congenital heart disease

Symptom	*Action*
No symptoms of hyperviscosity	Venesection not indicated
Symptoms of hyperviscosity	
Haematocrit > 65, no dehydration	Isovolumic venesection (400–500 ml)
Haematocrit 60–65, iron replete	Isovolumic venesection (400–500 ml)
Haematocrit < 65, iron deficient	Low dose iron treatment; closely monitoring haematocrit

right-shifted oxyhaemoglobin dissociation curve further to the right,[13] reducing oxygen affinity in the lungs. Furthermore, if standard doses of iron supplements are given in an attempt to treat the iron deficiency, uncontrolled erythropoeisis occurs and the haematocrit rises rapidly, resulting in a cycle of excessive venesection and iron deficiency, with the patient remaining symptomatic from both haematocrit induced and iron deficiency induced hyperviscosity.[3] If ferrous sulphate 200 mg once daily (65 mg elemental iron) is given and the blood count monitored closely, with withdrawal of iron treatment as soon as the haematocrit begins to rise (often within a week), large swings in haematocrit, excess venesection, and further iron deficiency should be avoided.[11]

When venesection is performed without volume replacement, the acute fall in systemic blood flow, oxygen delivery, and cerebral perfusion can result in cardiovascular collapse.[14] Isovolumic venesection is therefore recommended, with the simultaneous infusion of an equal volume of 0.9% saline or colloid.[1 11 15]

It should be possible to avoid iatrogenic complications if basic guidelines for venesection are followed (table 2). Some patients are stable without symptoms of hyperviscosity at a haematocrit of > 70; venesection is not indicated for these patients.[11] Venesection should be carried out only for symptoms of hyperviscosity when the haematocrit is > 65 and the patient is not dehydrated. When the haematocrit is < 65, iron deficiency induced hyperviscosity should be sought as venesection will aggravate rather than relieve symptoms. Any dehydration should be corrected before assessing the need for venesection.

In summary, the objects of venesection in adults with cyanotic congenital heart disease should be to relieve the symptoms of hyperviscosity when the haematocrit is > 65, and to minimise the degree of iron deficiency. If these guidelines are more widely appreciated, then overzealous venesection will be avoided, and a significant cause of morbidity among these patients reduced.

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