normal serum. Moreover, the negative correlation between the \( \alpha_1 \)-antitrypsin concentration and amyloid-A-degrading activity during changes in disease activity suggests that the \( \alpha_1 \)-antitrypsin concentration regulates the degrading activity. The differences in amyloid-A-degrading activity between patients with rheumatoid arthritis complicated by amyloidosis and those with rheumatoid arthritis alone cannot, however, be explained solely on the basis of the concentration of immunoreactive \( \alpha_1 \)-antitrypsin.

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References


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Effect of venesection on calf blood flow in polycythaemia

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Abstract

Calf blood flow at rest and during postocclusive reactive hyperaemia was measured using an electrocardiogram-triggered plethysmograph in 14 patients with polycythaemia (nine with primary disease and five with polycythaemia secondary to cyanotic heart disease) before and after a course of venesection. The mean packed cell volume was reduced from 0.57 to 0.47, and whole-blood viscosity fell by 50% at low shear rates. Venesection did not affect rest flow, but peak flow was increased by 18%. The increase in peak flow failed to compensate for the reduced haemoglobin content of the blood, calculated haemoglobin delivery being reduced by 23% at rest and 10% during reactive hyperaemia.

These results indicate that while venesection improves blood viscosity, this does not necessarily lead to improved delivery of oxygen to the tissues.

Introduction

Polycythaemia, whether primary or secondary, is associated with both a rise in whole-blood viscosity and an increase in thrombotic events.1-3 Cerebral blood flow is reduced in patients with a raised packed cell volume and may return to normal after venesection.4-6 Peripheral blood flow may be reduced in polycythaemia7, and this has been presumed to be directly related to hyperviscosity.8 9 Severe intermittent claudication is associated with increased whole-blood viscosity,5 and venesection may improve calf blood flow and haemoglobin delivery.10-12 Reduction of packed cell volume and hence viscosity by infusion of low-molecular-weight dextran also increased peripheral blood flow temporarily in patients with claudication.12-14

In this study we examined the influence of venesection on calf blood flow in patients with primary and secondary polycythaemia using a sensitive plethysmograph.
Methods

We studied 14 patients (two women). Nine had primary polycythemia and five polycythemia secondary to cyanotic heart disease. The mean age was 47 years (range 23–65 years), and the packed cell volume ranged from 0.49 to 0.71 (mean 0.57).

Whole-blood viscosity was measured at 37°C in blood anticoagulated with EDTA (4 mol/l) using a Contraves low shear viscometer (Contraves Ltd, Ruislip) and a Deer rheometer (Rheometer Marketing, Leeds) across a range of shear rates from 0.1 to 220/s. Resting calf blood flow was recorded in both legs in a room at constant temperature (24 ± 0.5°C) with a semi-continuous, electrocardiogram-triggered, strain-gauge plethysmograph (Periflow, Janssen), which automatically computed blood flow for sequential periods of five heart beats.

Peak flow was measured after four minutes of arterial occlusion at 200 mm Hg, the first estimate being made within three heart beats of release of the occlusion. The blood count was recorded with a Coulter S Plus counter, and all the baseline measurements were repeated after 48 hours. The packed cell volume was reduced to less than 0.44 (less than 0.50 in cyanotic patients) by removing 250-500 ml of venous blood at 10- to 14-day intervals. The blood count and measurements of viscosity and blood flow were repeated on two further occasions not less than two weeks after the last venesection.

The results obtained before and after venesection were analysed for statistical significance using Wilcoxon’s rank sum test for paired data.

Results

The figure shows the results. After venesection the packed cell volume was reduced from 0.57 ± SD 0.07 to 0.47 ± 0.07. Whole-blood viscosity fell from 219 ± 50 to 110 ± 51 mPa.s (p < 0.01) at 0.1/s and from 7.82 ± 2.52 to 4.71 ± 1.08 mPa.s (p < 0.01) at a shear stress of 936 mPa (9.36 dyn/cm²) in the Deer rheometer.

Resting blood flow was not significantly increased, but peak flow during reactive hyperaemia rose by 18%, from 23.7 ± 5.3 to 27.9 ± 7.1 ml/100 ml/min (p < 0.01). Haemoglobin delivery (calculated as haemoglobin concentration × blood flow) was reduced by 23%, (p < 0.01) at rest and by 10% (p < 0.01) during peak flow. In two patients with severe cyanotic heart disease anginal chest pain and calf claudication occurred after the reduction in packed cell volume.

Discussion

These results show that reducing the packed cell volume and hence viscosity does not necessarily result in increased delivery of haemoglobin to the calf. This conflicts with previous work,19 which showed improved delivery of haemoglobin and calf blood flow after venesection in patients with intermittent claudication, although an earlier study by the same group had failed to show benefit.14 Other workers have shown an increase in cardiac output after venesection in patients with polycythemia but no change in tissue oxygen delivery.15

The role of whole-blood viscosity in determining peripheral blood flow is controversial. Several groups have shown that in-vivo changes in viscosity do not influence blood flow14 15 and that reduction of the oxygen content of blood at a fixed viscosity results in increased cardiac output.16 Patients with polycythemia may compensate for increased whole-blood viscosity by a reduction in systemic and pulmonary resistance.17 18 The current results support recent work in rabbits showing that isovolumic haemodilution increases peripheral blood flow secondary to an increase in systemic vascular conductance related to the fall in the carriage of oxygen rather than to reduced viscosity. Our study provides no evidence that increased delivery of haemoglobin to the tissues follows haemodilution, but we appreciate that plethysmography measures total arterial inflow and provides no information about tissue nutrition at the capillary level.

There is evidence that reduction of blood viscosity may improve cerebral circulation, but it is well recognised that the control mechanisms of the cerebral and peripheral circulations differ. Our objective measurements of peripheral blood flow after reduction of viscosity by venesection showed that this may be detrimental to muscle haemoglobin supply, and this was supported by the clinical occurrence of ischaemic symptoms.

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References


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