THE INFLUENCE OF DROPERIDOL ON BLOOD VISCOSITY IN MAN

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SUMMARY
A decrease in blood viscosity and haematocrit values was found after the intravenous administration in man of droperidol. This change seems to be related to the sedative and sympatholytic effects of this agent.

An increase in blood viscosity and haematocrit, and a decrease in plasma volume, have been shown to follow stimulation of the sympathetic nervous system, as associated with, for example, severe exercise, emotional excitement or the administration of some sympathomimetic amines (Kaltreider and Meneely, 1940; Kaltreider, Meneely and Allen, 1942; Cohn, 1966). It is to be expected that a depression of sympathetic nervous activity will produce opposite effects. Guanethidine and phenoxybenzamine, which have an adrenergic blocking action, have in fact been reported as producing an increase in plasma volume (Weil and Chissey, 1968).

No studies have been published as yet on the effect of this latter group of agents on blood viscosity and haematocrit. Droperidol, a neuroleptic drug, is known to reduce sympathetic activity by means of sedation and a specific adrenergic blocking effect (Foldes et al., 1966; Yelnosky, Katz and Dietrich, 1963; Deligne, 1968).

The purpose of this study was to determine whether the injection of droperidol in man influences blood viscosity and haematocrit values.

METHODS
Forty healthy unpremedicated patients, awaiting minor surgery (twenty males and twenty females) ranging in age from 18 to 68 years were investigated. The first sample of blood was taken immediately after arrival in the anaesthetic room.

Thirty of the patients (twenty males and ten females) then received, through the same needle, an intravenous injection of droperidol 1 mg/8 kg. The remaining ten patients, who served as the controls, did not receive any medication. One hour later a second sample of blood was taken in all forty patients. At each stage 8 ml of blood was drawn from the brachial vein, without tourniquet, into a plastic tube containing 25 units of dried heparin. These samples were then examined for blood viscosity, haematocrit, and for albumin and globulin concentrations in the plasma.

Blood viscosity measurements were repeated three times, for each sample, at 37°C in a synchroelectric cone-plate viscometer (Brookfield, L.V.T.) at the following shear rates: 230, 115, 46, 23 and 11.5 inverse seconds (Wells, Denton and Merrill, 1961). Haematocrit was determined in duplicate in a Clay-Adams micro-haematocrit centrifuge at 12,000 g for 3 minutes (Dacie and Lewis, 1968). Plasma proteins were measured in twenty-eight patients by the standard biuret method.

Pulse, indirect blood pressure and degree of sedation or sleep were noted during the studies.

RESULTS
A decrease in the viscosity of blood at all shear rates was observed in twenty-five of the thirty patients who received droperidol. In the remaining five, there was either no change or very slight increase in blood viscosity values (fig. 1). Table I summarizes the effect of droperidol on the viscosity of blood which was calculated in centipoises from the shear stress/shear rate ratio. The average reduction in blood viscosity at different shear rates with droperidol was 6.7 per cent (range 5.6 -7.9 per cent). As assessed by Student's t-test, these are statistically significant changes (P<0.05


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Changes in blood viscosity in forty unpremedicated patients after 1 hour. Droperidol 1 mg/8 kg given to thirty patients. Ten patients not given droperidol.

- 1 hour after droperidol. ○ Controls after 1 hour. (DHBP = dehydrobenzperidol = droperidol.)

**TABLE I**

*Mean changes in haematocrit and blood viscosity before and 1 hour after injection of droperidol 1 mg/8 kg. Data from thirty unpremedicated patients awaiting minor surgery. All changes were significant (P<0.05).*

<table>
<thead>
<tr>
<th>Hematocrit (%)</th>
<th>Blood viscosity (centipoise)</th>
<th>Shear rates (sec⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beforedroperidol</td>
<td>44.98</td>
<td>23.00</td>
</tr>
<tr>
<td>SD</td>
<td>3.70</td>
<td>0.50</td>
</tr>
<tr>
<td>1 hr after droperidol</td>
<td>42.98</td>
<td>4.34</td>
</tr>
<tr>
<td>SD</td>
<td>4.0</td>
<td>0.44</td>
</tr>
<tr>
<td>Change %</td>
<td>-4.2</td>
<td>-6.3</td>
</tr>
</tbody>
</table>

**TABLE II**

*Mean changes in haematocrit and blood viscosity on arrival in the anaesthetic room and 1 hour later. Data from ten unpremedicated patients awaiting minor surgery. Droperidol not injected. None of the changes was statistically significant.*

<table>
<thead>
<tr>
<th>Hematocrit (%)</th>
<th>Blood viscosity (centipoise)</th>
<th>Shear rates (sec⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>42.98</td>
<td>23.00</td>
</tr>
<tr>
<td>SD</td>
<td>3.4</td>
<td>0.47</td>
</tr>
<tr>
<td>After 1 hr</td>
<td>42.80</td>
<td>4.34</td>
</tr>
<tr>
<td>SD</td>
<td>4.1</td>
<td>0.57</td>
</tr>
<tr>
<td>Change %</td>
<td>-0.5</td>
<td>+1.3</td>
</tr>
</tbody>
</table>
for each comparison). In the ten control cases blood viscosity at the different shear rates (table II) increased insignificantly by an average of 2.7 per cent (range 0.6–5.9 per cent).

Haematocrit values in the droperidol-treated group were reduced in twenty-seven cases, and showed no changes in the remaining three (fig. 2).

DISCUSSION

In this study, decreases in blood viscosity and haematocrit values have been noted after the administration of droperidol. This agent reduces sympathetic activity both by its central depressant effect which causes marked sedation and by its blocking of the alpha receptors (Foldes et al., 1966; Yelnosky, Katz and Dietrich, 1963; Deligne, 1968). As a result, a dilation of blood vessels, including the arterioles and venules, occurs. Under these conditions of reduced vascular resistance flow rates, and therefore also shear rates, should increase. It is well known that blood viscosity values are lowest at high shear rates, when red cell aggregations tend to be dispersed (Wells, 1964; Aronson et al., 1968). Since the reduction in blood viscosity caused by vasodilation and increased blood flow cannot be measured in vitro, the observed reduction in blood viscosity must be due to some additional factor such as haemodilution. Weil and Chissey (1968) found that patients who received daily doses of guanethidine or phenoxybenzamine (adrenergic blocking agents) over a three-week period showed an increase in plasma volume after the first week of medication. Other investigators (Kaltreider, Mencey and Allen, 1942; Cohn, 1966) showed that the administration of sympathomimetic amines caused a decrease in plasma volume and an increase in the haematocrit. They explained these effects on the basis of changes in hydrostatic and capillary filtration pressures. During anaesthesia with cyclopropane, a sympathomimetic agent, an increase in blood viscosity has been claimed by Albert, Jain and Shadid (1964).

When hydrostatic pressure decreases after the use of agents that reduce sympathetic tone, such as droperidol, the intravascular osmotic pressure, though unchanged, becomes relatively higher. This may encourage fluid retention and dilution hypervolemia because of a redistribution of fluid between the intravascular and extravascular compartments. It seems reasonable to suggest, therefore, that an increase in plasma volume may be another factor contributing to the reduction in
blood viscosity and haematocrit, which in this study occurred without associated blood loss, haemolysis or alteration in plasma protein values.

Unpremedicated patients under the stress of impending surgery showed no significant change in blood viscosity. On the other hand, blood viscosity was lowered to a statistically significant degree in patients who were resting in a quiet, relaxed atmosphere and who served as controls for a series of electrical sleep therapy studies (Magora, Hershko and Aronson, 1970). This seems to indicate that sedation decreases blood viscosity and might alone be responsible for the results obtained with droperidol. Nevertheless, the specific pharmacological effect of droperidol on the blood vessels cannot be ruled out as a contributing factor in the reduction of blood viscosity.

This study was performed in the surgical and anaesthesia research laboratories of the Hebrew University-Hadassah Medical School, Jerusalem.

REFERENCES


