Hydroxyethylstarch compared with modified gelatin as volume preload before spinal anaesthesia for Caesarean section

M. P. VERCAUTEREN, V. HOFFMANN, H. C. COPPEJANS, A. L. VAN STEENBERGE AND H. A. ADRIAENSEN

Summary
We studied 90 patients undergoing elective Caesarean section under spinal anaesthesia who received lactated Ringer’s solution 1000 ml with up to 1000 ml of modified gelatin, lactated Ringer’s solution 1000 ml with up to 1000 ml of 6% hydroxyethylstarch or only up to 1000 ml of 6% hydroxyethylstarch. Lumbar puncture was performed as soon as 500 ml of the colloid were infused. The incidence of hypotension, number of patients requiring a vasopressor and doses of ephedrine required to restore arterial pressure were significantly lower in favour of those receiving the crystalloid–hydroxyethylstarch combination. In both groups receiving the 2000 ml preload, packed cell volume (PCV) values decreased by more than 20%, which may be of concern in patients already presenting with mild anaemia. In patients who received the colloid without the crystalloid, PCV values decreased by 14% but the risk of severe hypotension was comparable with the crystalloid–gelatin combination. (Br. J. Anaesth. 1996; 76: 731–733)

Key words

The risks and benefits of hydration before spinal anaesthesia in obstetrics are subject to much debate. After spinal anaesthesia, even up to 2000 ml of crystalloids may reduce but not eliminate hypotension. During extradural anaesthesia it has been demonstrated that greater volumes of crystalloids (20 ml kg⁻¹) even increase the risk of hypotension compared with lower volumes [1]. This raises doubts, mainly about the usefulness of crystalloid preloading and hydration before (semi-)urgent Caesarean section. However, with colloids, less volumes are required, oncotic pressure may be maintained, but too little attention has been paid to the different properties of the available colloids. The purpose of this study was to compare gelatin with hydroxyethylstarch.

Methods and results
After obtaining approval from the Hospital Ethics Committee and informed consent, we studied 90 term patients presenting for elective Caesarean section, allocated randomly to one of three groups. Sixty patients received lactated Ringer’s solution 1000 ml starting in the obstetric ward after which on arrival in the operating theatre they received an additional 16-gauge i.v. cannula for infusion of either modified gelatin (Geloplasma, Merieux, France) or hydroxyethylstarch (HAES-steril 6%, Fresenius, Germany). Another 30 parturients received hydroxyethylstarch 500 ml in the obstetric ward and another 500 ml of the same substance in the operating theatre. Exclusion criteria included patients with pre-eclampsia, hypertension, diabetes, multiple gestation, polyhydramnios, systolic arterial pressure < 100 mm Hg and packed cell volume (PCV) values less than 30% before commencing the anaesthetic technique. Anaesthesia was started during infusion of the second 500-ml volume and comprised a combined spinal–extradural technique using a 26-gauge pencil-point spinal needle (Unisys-corp, Japan). Spinal block was performed with plain bupivacaine 6.6 mg and sufentanil 3.3 μg (i.e. a mixture of 0.5% bupivacaine 2 ml and 1 ml of sufentanil 5 μg ml⁻¹, of which 2 ml were injected) after which an extradural catheter (Perifix Braun, Germany) was inserted for supplementary anaesthesia and relief of postoperative pain. Subsequently, patients were turned to a 15° left lateral tilt. Arterial pressure and heart rate were monitored automatically (Datex AS/3, Helsinki, Finland) every 2.5 min. Ephedrine (5-mg increments) was given when systolic arterial pressure (SAP) decreased to less than 100 mm Hg or to more than 25% (compared with baseline values or at two consecutive measurements), heart rate increase of decreased by 25% (from baseline or at two consecutive measurements) but also in the event of nausea/vomiting or any sense of fainting or non-well-being, even without evidence of haemodynamic instability.

The amount of colloid administered at the moment of spinal injection was recorded. After infusion of 1000 ml of the colloid, a venous blood sample was obtained to measure PCV for comparison with the preoperative value. Measurements and therapy were performed by an anaesthetist unaware of the design of the study.
Data are expressed as mean (SEM). Statistical analysis was performed with the two-tailed Student’s t test for parametric and the Fisher’s exact test for non-parametric data (Macintosh IIsi, StatView II). P < 0.05 was considered significant.

There were no differences between the groups in age mean 29.4 (range 25–44), 30.1 (23–42) and 29.2 (20–44) yr, weight (81 (SD 14), 75 (16) and 78 (17) kg) or duration of pregnancy (38.0 (1.5), 38.2 (0.5) and 37.8 (2.6) week). All procedures were uneventful and the mean upper sensory level, determined with an ether swab, reached T2–3 in all groups (table 1). Extravascular supplementation was not necessary before delivery in any patient. Severe hypotension (< 90 mm Hg) was noted in one of 10 patients in the lactated Ringer’s–HES group compared with at least one of three patients in the lactated Ringer’s–gelatin and HES groups (P < 0.05). Ephedrine was required less frequently P < 0.05 in the lactated Ringer’s–HES group (11 patients vs 22 patients and 20 patients in the lactated Ringer’s–gelatin and HES groups, respectively). As a consequence, the mean dose requirement of ephedrine was also lower in the former group. The mean lowest recorded systolic arterial pressure was higher in lactated Ringer’s–HES treated patients but this was significant only compared with the group receiving HES alone (P < 0.05) in which hypotension occurred more abruptly.

PCV values in the groups receiving 2000 ml of preload revealed a decrease of 20.3 % and 21.9 %, respectively, whereas with 6 % HES alone it was 14.2 % (P < 0.001 compared with the lactated Ringer’s–HES group). In none of the parturients was there evidence of respiratory or cardiac problems suggesting fluid overload.

All neonates had Apgar scores greater than 8 at 1 and 5 min and weighed more than 2800 g (mean weight 3170 (range 2820–3360) g, 3180 (2850–3340) g and 3210 (2800–3410) g).

Comment

This study demonstrated that volume preloading is worthwhile if the correct regimen is selected. Our finding that approximately 10 ml kg⁻¹ of a colloid or 1000 ml of lactated Ringer’s solution with modified gelatin was inadequate to increase the incidence of hypotension may cast doubt on the benefit of hydration compared with no volume treatment. As demonstrated recently, the use of 1000 ml of crystalloids alone did not appear to be better than preloading with only 200 ml [2]. The incidence of hypotension (< 90 mm Hg in one of three patients) was comparable with our results in the groups receiving gelatin with crystalloids or HES alone, although in the study of Jackson, Reid and Thorburn, extremely high doses (up to 50 mg) of ephedrine were required. In the present study in which therapy was started earlier, ephedrine requirements were significantly lower.

In addition to the lack of apparent haemodynamic benefit, volume preloading may have several other disadvantages. The risk of pulmonary oedema, as a result of accumulation of extravascular lung water, may be reduced by the use of colloids as these maintain the oncotic pressure of plasma. Efforts to increase placental blood flow may be counteracted partly by haemodilution. Marked decreases in PCV values decrease the oxygen-carrying capacity of maternal blood. If additional hypotension still occurs despite high preloading volumes, as with the crystalloid–gelatin combination, fetal oxygenation may be seriously compromised.

However, compared with crystalloids, the properties of the available colloids may differ considerably. Hydroxyethylstarch may offer several advantages such as venous thrombosis prophylaxis and an allergic potential which is seven times lower (1/2100) than that of the gelatins [3]. Even in concentrations of 10 % it seems to be safe for the neonate as placental transfer in a sheep preparation has been found to be almost negligible [4]. The 6 % concentration may be preferable in obstetric practice as, compared with the 10 % concentration, its volume retaining effect in excess of 100 % lasts only 30 min which is ideal to cover the interval between administration and delivery. Although hydroxyethylstarch costs twice as much as gelatin, it is six times less expensive than human plasma proteins.

Although we were able to maintain the most optimal haemodynamic stability with the crystalloid–HES combination, our findings were not different from the results of Jackson, Reid and Thorburn [2]. We confirmed that high volumes, even containing gelatins, may not prevent cardiovascular instability, but we suggest that more attention should be paid to the choice of the regimen, colloid, or both. Recently, another study confirmed the superiority of a crystalloid–HES combination.

Table 1 Preloading, anaesthetic and hypotensive data (mean (SEM) or number). *P < 0.05, **P < 0.01, ***P < 0.001 compared with the lactated Ringer’s (LR)–HES 6 % group

<table>
<thead>
<tr>
<th></th>
<th>LR-gelatin (n = 30)</th>
<th>LR-HES 6% (n = 30)</th>
<th>HES 6 % (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colloid preload (ml)</td>
<td>913.3 (72.2)</td>
<td>756.7 (45.6)</td>
<td>853.1 (33.1)</td>
</tr>
<tr>
<td>Height of block</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(dermatomes &gt; T7)</td>
<td>4.7 (0.4)</td>
<td>4.8 (0.4)</td>
<td>4.3 (0.5)</td>
</tr>
<tr>
<td>Lowest SAP (mm Hg)</td>
<td>100.5 (3.7)</td>
<td>108.2 (2.7)</td>
<td>94.1 (3.7)*</td>
</tr>
<tr>
<td>SAP &lt; 100 mm Hg (n)</td>
<td>18*</td>
<td></td>
<td>16*</td>
</tr>
<tr>
<td>SAP &lt; 90 mm Hg (n)</td>
<td>10*</td>
<td>3</td>
<td>12*</td>
</tr>
<tr>
<td>Ephedrine dose (mg)</td>
<td>7.6 (1.5)**</td>
<td>2.5 (0.8)</td>
<td>6.2 (1.5)*</td>
</tr>
<tr>
<td>Preoperative PCV (%)</td>
<td>35.2 (0.8)</td>
<td>35.5 (0.85)</td>
<td>34.9 (0.6)</td>
</tr>
<tr>
<td>PCV after colloid 1.0 litre</td>
<td>28.1 (0.6)</td>
<td>27.9 (0.75)</td>
<td>30.07 (0.6)*</td>
</tr>
<tr>
<td>Decrease in PCV (%)</td>
<td>20.3 (1.2)</td>
<td>21.9 (1.1)</td>
<td>14.2 (1.0)*****</td>
</tr>
</tbody>
</table>
compared with crystalloids alone [5]. After intrathecal injection of 0.75 % hyperbaric bupivacaine 12 mg, the incidence of hypotension was 45 % in those receiving the combination of 500 ml 6 % HES and lactated Ringer’s solution 1000 ml which was significantly lower than the 85 % incidence in the group receiving 2000 ml of crystalloid alone.

We agree with the advice of Rocke and Rout [6] that hydration should not be abandoned routinely without additional studies. We would be interested to know the haemodynamic safety of the high preload used in the present study and the effect of colloids alone combined with the preventive use of vasopressor increments.

References


