Anaesthetic Induction for Caesarean Section with Etomidate Compared with Thiopentone

P. J. C. HOULTON, J. W. DOWNING, R. J. R. BULEY, J. G. BROCK-UTNE

SUMMARY

Anaesthesia for caesarean section demands a technique that provides perfect narcosis without neonatal depression. To date, no ideal induction agent has been found for obstetric anaesthesia, although thiopentone is still considered the safest. A new agent, etomidate (0.3 mg/kg) has been studied in a group of parturients who underwent elective caesarean section in the left lateral tilt position.

The results obtained are compared with those from a similar series, in which the management was identical, except that anaesthesia was induced with thiopentone 3.5 mg/kg. The infants in the present series were usually extremely lively after delivery, and generally sustained respiration in a shorter time than those after thiopentone. In addition, maternal-to-fetal base excess gradients were narrower with etomidate than with thiopentone. Thus etomidate may offer some advantage over thiopentone for anaesthetic induction at elective caesarean section, and appears worthy of further trial.


Anaesthesia for caesarean section demands a technique that guarantees narcosis for the mother without depression of the newborn. Numerous induction agents, including thiopentone, propanidid, alphaxalone (Alfathesin), methohexitone and ketamine, have been studied for obstetric anaesthesia, but none has proved ideal.

The search for a better intravenous induction agent, free of undesirable cardiac or respiratory side-effects, led to the synthesis of etomidate. The effects of this drug in man were recently described by Doenicke et al. Etomidate appears to have certain characteristics making its use in midwifery suitable. The drug is rapidly metabolized in the body, yet possesses an appropriate duration of action for initiation of hypnosis for caesarean section.

After induction of anaesthesia with etomidate, cardiorespiratory depression is minimal and no evidence of histamine release is detectable, as occurs with some other commonly used intravenous agents.

We have therefore investigated etomidate as an induction agent for obstetric anaesthesia and compared it with thiopentone, currently the induction agent of choice for caesarean section.

PATIENTS AND METHODS

Forty-eight healthy pregnant patients at term, scheduled for elective caesarean section, were studied, after their informed consent had been obtained. All patients conformed to the 'clinically acceptable ideal case' as described by Crawford, without evidence of hypertension, pre eclamptic toxemia, diabetes, rhesus antibody production or placental dysfunction. Gestational age was between 38 and 42 weeks. The fetus was a singleton with vertex presentation, and membranes were intact in each case.

All patients ingested mist. magnesium trisilicate BPC 15-30 ml pre-operatively. Atropine 0.6 mg, combined with metoclopramide 10 mg, was given intravenously 3-5 minutes before anaesthetic induction. A 'desensitizing' dose of alcuronium 2.5 mg was given intravenously.

The mothers were placed on the operating table in the left lateral tilt position, with the wedge under the right hip. After the patients had breathed pure oxygen for 5 minutes, anaesthesia was induced intravenously with etomidate 0.3 mg/kg mixed in the syringe with suxamethonium 1.75 mg/kg. The patient's trachea was rapidly intubated while an assistant applied pressure to the cricoid cartilage.

Anaesthesia was maintained with 50% nitrous oxide in oxygen, 0.6% enflurane, muscle relaxants (alcuronium 0.2 mg/kg) and controlled ventilation. Maternal arterial blood was sampled at delivery and umbilical arterial and venous blood samples were drawn immediately at birth from a section of the umbilical cord isolated between two haemostatic clamps. Blood samples were stored on ice and blood gases were analysed by an International Laboratories IL 413 blood gas analyser. The results were checked on a Radiometer BMS Mk II apparatus. Electrodes were calibrated with standard buffer solutions and certified gases, or the Radiometer gas-mixing device.

Base excess values were derived from the hydrogen ion concentration and carbon dioxide tension. Results were analysed statistically (Student's t test for unpaired data) with a Hewlett-Packard 9815A programmed desk calculator. Fetal base excess values were corrected for the degree of haemoglobin desaturation present in the umbilical cord blood samples. Induction-to-delivery (ID) and uterine incision-to-delivery (UD) intervals were recorded, and the time to sustained respiration by the newborn was measured with a stop-watch.

Babies were awarded a modified Apgar score (Apgar minus colour) 2 and 5 minutes after birth. Subsequent
care and management of the newborn were in accordance with previous protocols.

The patients were interviewed on the first postoperative day and questioned as to awareness during surgery, dreams, whether pleasant or unpleasant, and the occurrence of postoperative nausea and vomiting.

The results obtained from this study were compared with those in a group of 37 parturients who were managed identically, but in whom anaesthesia was induced with thiopentone 3.5 mg/kg. The groups were comparable with regard to body mass. In group I the mean mass was 70.8 kg, range 53.0 - 84.5 kg and 70.0 kg, range 50.0 - 88.5 kg in group II. The women in group I were, however, younger than their counterparts in group II. In group I the mean age was 23.7, range 17 - 36, and 26.8 in group II, range 20 - 35 (P<0.05).

The mean dosage of etomidate used was 21.1 mg, range 16 - 28 mg, and that of thiopentone 247 mg, range 28 mg, and that of thiopentone 247 mg, range 20 - 35 (P<0.05).

The mean time to sustained respiration with a narrower range (Table I). This finding is in agreement with our clinical impression that infants delivered after etomidate were younger than those whose mothers had been given thiopentone. The groups were comparable with regard to body mass. In group I the mean mass was 70.8 kg, range 53.0 - 84.5 kg and 70.0 kg, range 50.0 - 88.5 kg in group II. The women in group I were, however, younger than their counterparts in group II. In group I the mean age was 23.7, range 17 - 36, and 26.8 in group II, range 20 - 35 (P<0.05).

The mean dosage of etomidate used was 21.1 mg, range 16 - 28 mg, and that of thiopentone 247 mg, range 20 - 35 (P<0.05).

Table 1 shows the mean blood gas/acid-base results are shown in Table II. The average maternal hydrogen ion concentration was significantly higher in group I than in group II as a result of the greater level of metabolic (lower base excess) acidosis present in group I. Mean carbon dioxide tensions (Pco2) were comparable in the two groups.

Umbilical venous and arterial blood gas values in the two groups of infants reflected those of the mothers, but differed statistically only with respect to the umbilical venous base excess values. Mean Pao2 levels, on both the maternal and fetal side of the placenta, were similar in the two groups. Average percentage saturations of haemoglobin with oxygen in the umbilical arterial and venous blood samples were also comparable.

The average maternal arterial to umbilical venous and arterial blood gas gradients are also presented in Table II. The average maternal arterial to umbilical venous and arterial blood gas/acid-base results are shown in Table II. The average maternal hydrogen ion concentration was significantly higher in group I than in group II as a result of the greater level of metabolic (lower base excess) acidosis present in group I. Mean carbon dioxide tensions (Pco2) were comparable in the two groups.

Umbilical venous and arterial blood gas values in the two groups of infants reflected those of the mothers, but differed statistically only with respect to the umbilical venous base excess values. Mean Pao2 levels, on both the maternal and fetal side of the placenta, were similar in the two groups. Average percentage saturations of haemoglobin with oxygen in the umbilical arterial and venous blood samples were also comparable.

The average maternal arterial to umbilical venous and arterial blood gas gradients are also presented in Table II. Base excess gradients were significantly narrower in group I than in group II (P<0.05). All the mean blood gas/
acid-base values reported here, for both mothers and infants, and the maternal-to-fetal gradients presented, are within the expected normal values for patients undergoing elective caesarean section.

The findings obtained from patient interviews after anaesthesia appear in Table III. There was no statistical difference in the incidence of awareness or dreaming in the two series. Of the patients receiving etomidate, 5 admitted to postoperative nausea and vomiting compared with only 2 in the thiopentone group.

### TABLE III. INCIDENCE OF SIDE-EFFECTS IN THE MOTHERS

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dreams</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Pleasant</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Unpleasant</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nausea and/or vomiting postoperatively</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

### DISCUSSION

Drug-induced cardiovascular depression of the mother at caesarean section is undesirable, since placental perfusion and fetoplacental exchange may be jeopardized by a fall in maternal cardiac output. Etomidate, a new imidazole hypnotic agent, causes minimal cardiac and respiratory depression, in contrast to other currently used intravenous anaesthetics.

In a pilot study performed in this department (P. J. Allen — unpublished data) etomidate was found to be a useful induction agent. However, two factors militated against its wide acceptance at the time, namely pain on intravenous injection and excessive involuntary patient movement during induction of anaesthesia. For the present investigation, a new preparation of etomidate incorporating a different solvent, polyethylene glycol, was used, the injection of which has proved painless. The second complication, excessive movements during narcotic induction, is of no consequence during obstetric anaesthesia, as the essence of our anaesthetic technique is the rapid attainment of complete paralysis, allowing speedy endotracheal intubation within 30 seconds of the induction agent and muscle relaxant being injected.

On the basis of the results presented here, etomidate appears to offer some advantage over thiopentone as an induction agent for caesarean section. Etomidate proved an effective and rapid hypnotic. The drug may also favour more efficient fetoplacental exchange of fixed acids across the placenta, as judged from the narrower maternal-to-fetal base excess gradients encountered in this study. In addition, the infants whose mothers had used etomidate were usually extremely lively after delivery, and sustained respiration generally in a shorter time than those whose mothers received thiopentone (Table II).

The incidence of maternal complications noted in the two series was statistically similar. There was, however, a tendency for patients to experience more nausea and vomiting after etomidate. The reasons underlying the greater degree of maternal metabolic acidosis noted in this study are obscure, but were not related to maternal hypotension.

In conclusion, no anaesthetic agent investigated to date in this department has proved significantly superior to thiopentone. Even lumbar epidural analgesia cannot be preferred to thiopentone, gas, oxygen and relaxant anaesthesia supplemented by low concentrations of a volatile agent.

Consequently, this report of etomidate is the first suggesting that current obstetric general anaesthetic techniques might be improved by substituting etomidate for thiopentone. We believe that for the fetus at risk of intrauterine biochemical asphyxiation, fetal blood gas/acid-base status may be better sustained by the use of etomidate. An independent study of this new agent for obstetric use is urgently needed to substantiate or repudiate this viewpoint.

### REFERENCES