Paracervical block is a method of providing analgesia during labour which has achieved widespread use. It has been acclaimed as being simple to perform, and being free from risk to mother and child, in spite of the fact that there is an incidence of foetal heart abnormalities, most commonly bradycardia, although tachycardia is also found. Many publications have asserted the safety of the method and for a long time the foetal bradycardia was dismissed as quite benign (Cooper, Gilroy and Hurry, 1968; Davis et al., 1964; Page, Kamm and Chappell, 1961). There then began to appear in the literature a few reports of foetal death following the use of paracervical block, and this led to the decision in some centres to abandon its use altogether, although in others it continued to be used enthusiastically (Nyirjesy, 1964; Rosefsky and Peteriel, 1968; Murphy, Wright and Fitzgerald, 1970). The foetal heart changes were then examined more critically. They were reported in association with the use of several different local anaesthetic agents, namely lignocaine, bupivacaine and mepivacaine, both with and without the use of adrenaline in the local anaesthetic solution (Teramo, 1969).

The frequency of occurrence of foetal heart abnormalities ranged greatly according to different reports and has varied from 2% to 70%. These wide variations are no doubt accounted for by the differences in the methods of monitoring the foetal heart. Only with continuous monitoring can the true frequency of occurrence of abnormalities be determined. Foetal bradycardia, when it does occur, has been shown to be associated with foetal acidosis (Asling et al., 1970; Kubli and Rutgers, 1971; Teramo, 1969).

The cause of foetal bradycardia is still not clear but it has been suggested that it is related to high systemic levels of local anaesthetic in the foetus (Asling et al., 1970). The present study was undertaken to assess the level of local anaesthetic and changes in acid-base status of the foetus just after paracervical block.

**METHOD**

Paracervical block was carried out in twelve labouring patients. Using a standard paracervical needle, 20 ml of 1% lignocaine without adrenaline was injected, 10 ml being injected at the 3 o'clock position and 10 ml at the 9 o'clock position of the cervix in the lateral fornix. In all the total dosage was 200 mg of lignocaine hydrochloride (173 mg lignocaine base). Before the injection a sample of capillary blood was taken from the foetal scalp for pH estimation. The foetal heart was monitored continuously before and after the institution of the block, using a scalp electrode or a microphone placed on the abdomen (Hewlett-Packard Cardiotocograph). Seven to 24 minutes after the block had been performed a further foetal capillary sample was taken. One heparinized capillary tube containing approximately 0.2 ml of blood was used for the determination of blood lignocaine levels, and a second for pH estimation. Simultaneously, a sample of maternal venous blood was obtained for estimation of maternal plasma lignocaine levels.

The procedure was explained to each patient and her permission was obtained. None had shown...
LIGNOCAINE LEVELS AFTER PARACERVICAL BLOCK

previous clinical signs of foetal distress. None was in premature labour, nor did any have a history of antepartum haemorrhage, severe pre-eclampsia, or a possible small-for-dates syndrome. All had been given opiates for sedation. The cervical dilatation varied from 4 to 8 cm.

At birth routine Apgar scores were carried out at 1 and 5 minutes.

For technical reasons maternal plasma levels were determined as against foetal blood levels. Gas chromatographic method of Keenaghan (1968) was used with a minor modification.

RESULTS

The results are summarized in table I.

Foetal heart rate changes.
The foetal heart rate was considered abnormal when it fell to less than 120 or rose above 160 beats/min for more than 5 minutes. According to these criteria half the foetuses had an abnormality of heart rate after paracervical block, bradycardia developing in three and tachycardia in three. In five of these the foetal heart rate returned to normal within half an hour. In the sixth a profound bradycardia was followed by the appearance of "Type II" dips and tachycardia before return to normal over 1 hour later. Figure 1 shows part of the tracing of the foetal heart pattern in this patient.

pH.
Satisfactory estimations were obtained in only eight of the twelve patients. In those patients in whom abnormalities of the foetal heart rate were found there was a fall in the pH, whereas there was little change in those who did not show such changes. Although the numbers are small, the difference between the two groups as regards pH change was statistically significant (P<0.05).

TABLE I. Foetal scalp blood pH before and after paracervical block (PCB) together with the maternal venous plasma level and the foetal scalp blood level after the block.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>pH before PCB</th>
<th>pH after PCB</th>
<th>Time after PCB (min)</th>
<th>Foetal heart abnormality</th>
<th>Maternal venous plasma lignocaine concentration (µg/ml)</th>
<th>Foetal capillary blood lignocaine concentration (µg/ml)</th>
<th>Maternal/foetal difference (µg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>-</td>
<td>7.39</td>
<td>24</td>
<td>None</td>
<td>0.95</td>
<td>0.25</td>
<td>0.70</td>
</tr>
<tr>
<td>3</td>
<td>7.45</td>
<td>7.31</td>
<td>13</td>
<td>None</td>
<td>1.25</td>
<td>0.34</td>
<td>0.91</td>
</tr>
<tr>
<td>4</td>
<td>7.28</td>
<td>7.25</td>
<td>13</td>
<td>None</td>
<td>1.17</td>
<td>0.30</td>
<td>0.87</td>
</tr>
<tr>
<td>5</td>
<td>7.30</td>
<td>7.31</td>
<td>7</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>7.31</td>
<td>10</td>
<td>None</td>
<td>1.4</td>
<td>0.34</td>
<td>1.06</td>
</tr>
<tr>
<td>Mean</td>
<td>7.34</td>
<td>7.32</td>
<td>12.23</td>
<td></td>
<td>1.21</td>
<td>0.37</td>
<td>0.84</td>
</tr>
<tr>
<td>±SE</td>
<td>0.04</td>
<td>0.03</td>
<td>2.58</td>
<td></td>
<td>0.07</td>
<td>0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Fig. 1. Part of the foetal heart tracing in patient No. 4 after paracervical block. The time of the block is indicated by the arrow. The vertical lines on the graph paper are 1 minute apart. The printed numbers refer to foetal heart rate.
**FOETAL LEVELS**

**FIG. 2.** Foetal capillary and maternal venous levels of lignocaine plotted graphically (see text for details). They are divided into two groups; cases with foetal heart rate abnormality and cases without foetal heart rate abnormality. The numbers refer to the patients detailed in table I.

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**Lignocaine levels.**

Figure 2 shows the foetal blood and maternal venous plasma lignocaine levels, the results being grouped according to the presence or absence of heart rate abnormalities. All measurements were reported in terms of lignocaine base and are in µg/ml. In all cases the maternal levels were much greater than the foetal levels, even allowing for the fact that plasma levels and not blood levels were measured in the maternal samples. It should be remembered that because of differences between the erythrocyte concentration and the plasma concentration, adult blood levels are only about 80% of the plasma level. Only eleven samples were available for analysis because the twelfth maternal sample, unfortunately, clotted.

There was no significant difference in the mean foetal lignocaine levels or the mean maternal lignocaine levels between the group in which there was no foetal heart rate abnormality and the group with foetal heart rate abnormality.

If, however, the differences between the foetal and maternal lignocaine concentrations in the two groups are compared, there is a significant finding. Cases in whom signs were detected showed a significantly greater maternal-foetal difference than did those in whom no signs were apparent (P<0.05).

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**Pain relief.**

This was graded into "good", "moderate" or "poor". Seven cases had good pain relief, three had moderate relief and two poor relief.

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**Condition of babies at birth.**

All infants were quite vigorous and healthy at birth and had Apgar scores of 9 or 10 at 5 minutes.

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**DISCUSSION**

Considerable controversy surrounds the question of the safety of paracervical block in obstetrics. There seems little doubt that the technique is followed in a substantial number of cases by changes in foetal heart rate. These are liable to escape detection unless continuous monitoring is carried out. In reported series of continuous monitoring, the incidence of bradycardia (which varies according to the definition given by the individual authors) varies from 2% (Gomez, 1969) to around 50% (Vasicka, 1971; De Mot et al., 1970; Espinoza et al., 1970). Tachycardia is less common, seldom exceeding 10% in reported series. From the present very small series of twelve cases, bradycardia (below 120 beats/min) occurred in three cases, and tachycardia (above 160 beats/min) occurred in three cases.

There is considerable evidence that foetal heart rate changes following paracervical block are invariably associated with foetal acidosis (Asling et al., 1970; Kubli and Ruttgers, 1971; Teramo and Rajamaki, 1971). Our results support this association. In the great majority of cases, the heart rate returns to normal in a short time and the babies appear none the worse at birth. However, intrauterine deaths have been reported and emergency Caesarean section is sometimes required in cases with persistent bradycardia. It is extremely difficult in most cases to determine a causal relationship between intrauterine death and paracervical block, but the fact that foetal acidosis virtually always accompanies the heart rate changes must be viewed with some apprehension. Thiery and Vroman (1972), in a very extensive review of more than
70,000 published cases, were unable to decide on the degree of foetal hazard.

The aetiology of foetal heart rate changes is still uncertain. The most likely causes are either a direct toxic action on the foetus by the local anaesthetic or an effect of the injection upon the placental circulation.

When local anaesthetics are injected at other sites, the foetal blood level is always considerably lower than the maternal level. With paracervical block the difficulty is to obtain foetal blood in sufficient quantity soon after the injection when any heart rate changes will be apparent. With foetal scalp blood sampling enough blood to allow analysis by gas chromatography can be withdrawn.

Using this technique, Asling and associates (1970) found blood levels in the foetus higher than those in the mother when bradycardia occurred, the reverse of the situation when no change in heart rate was seen. Levels in the foetus which are higher than those in the mother (excluding cases of direct injection into the foetus) can only occur if a highly abnormal route of absorption is operative in the paracervical tissues. Asling and associates (1970) suggest mechanisms such as absorption across arterial walls whereby this could happen. Careful consideration of those mechanisms, however, suggests that the only feasible one would be direct injection into a main uterine artery, an event most unlikely to occur in up to 50% of injections.

Our observations do not support those of Asling and associates (1970) and agree with those of Thiery and Vroman (1972). Beazley, Taylor and Reynolds (1972) were able to obtain foetal cord blood within 30 minutes of paracervical block by making the injections just prior to elective Caesarean section. All foetal blood levels (of bupivacaine) were considerably lower than the maternal venous levels. In the present series, the foetal/maternal ratio was very similar to that shown after epidural block (Thomas, Climie and Mather, 1969).

It is pertinent to point out that very high blood levels of local anaesthetics are required to produce myocardial depression. In adults with lignocaine and mepivacaine, for example, blood levels in excess of 10 \( \mu \text{g/ml} \) are required. The highest level recorded by Asling and associates (1970) was less than half this value. Accidental direct injection into the foetus is associated with very high levels, but in two instances survival has been recorded, the blood levels of mepivacaine being 31 and 75 \( \mu \text{g/ml} \) (Finster et al., 1965). The foetal concentrations obtained in the present series would certainly not be responsible for the heart rate changes observed.

Interference with the placental circulation is a more likely cause of the alterations in foetal heart rate seen following paracervical block. Changes in both uterine contractility and uterine tone have been recorded. De Mot and associates (1970) put forward a theory that the placental circulation might be adversely affected by hypertonus following the block. Kubli and Ruttgers (1971) have produced experimental evidence in support of this theory. They demonstrated a statistically significant increase in the basal tone of the uterus after paracervical block and when this occurred it was associated with a very high incidence (82%) of foetal heart rate abnormalities. Similar results were presented by Vasicka and associates (1971).

The part played by inferior vena caval occlusion must also be considered as these patients are kept lying on their back (in the lithotomy position) for some time before and after the block. Any resultant fall in cardiac output would affect the placental circulation.

A reduction in placental flow could cause a lower level of local anaesthetic in the foetus than when the circulation is normal. This indeed was observed in the present series, although Gordon (1968) showed the reverse. This author, however, used a colorimetric method for determining mepivacaine which is unsuitable for microsamples taken from the foetal scalp. Teramo and Rajamaki (1971) found no statistically significant difference between the levels in those foetuses who developed heart rate changes and those who did not. These workers also used a colorimetric method for determining mepivacaine.

While substantially safe for the mother, paracervical block does present a hazard to the foetus and should only be undertaken where continuous monitoring and all the facilities for modern obstetric and anaesthetic care are available.

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