Clinical effects of epidural block during labour

A prospective study

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Summary

The aim of this study was to evaluate the clinical effects of epidural block for pain relief during labour in an obstetric unit which manages mainly high-risk pregnancies. In the majority of the 62 patients studied only 5 ml of a 0,5% solution of bupivacaine was sufficient for effective pain relief. In 75% of patients total pain relief was obtained. Complications of the procedure were hypotension in 32% of patients and bladder atony needing catheterization in 19%. The mean fall in blood pressure was greater in patients with pre-existing hypertension. The incidence of instrumental delivery was 40%, inadequate bearing-down effort being the indication in 54% of these cases. An abnormal fetal heart rate pattern on cardiotocography developed in 13 of 58 fetuses who were monitored internally, while in 3 cases an abnormal pattern became even more abnormal (in one-third of these cases this followed hypotension in the mother). The only statistically significant change in fetal heart rate patterns on cardiotocography was a decrease in the beat-to-beat variability. Epidural block is a very effective form of pain relief during labour but has potentially serious effects, especially in high-risk pregnancies. Precautions to minimize the risk of complications include the administration of intra-venous fluid before the procedure and careful monitoring of the patient and her unborn baby. A cardiotocographic monitor is essential for the latter purpose.

Epidural block (EB) is at present the most effective method of pain relief during labour available, and is therefore used by many obstetric units. Since 1973 all EBs carried out in the labour ward of Tygerberg Hospital have been done by obstetric consultants or registrars. In most obstetric units the procedure is performed by anaesthetists — only occasional reports of an evaluation of the procedure in the hands of obstetricians have appeared in the literature.[1-3] The aim of this study was to evaluate this type of pain relief when given by obstetricians in an obstetric unit which manages mainly high-risk pregnancies.

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Patients and methods

Sixty-two consecutive patients who had an EB for pain relief during labour were included in the study. Twenty-one of them had a raised blood pressure before the procedure, usually because of pre-eclampsia. None of the patients had an absolute contraindication to EB such as a supine hypotension syndrome, antepartum haemorrhage or eclampsia.

In 58 cases a Rüttgers spiral electrode was applied to the fetal scalp and connected to a Hewlett Packard cardiotoco-graphic monitor. In the remaining 4 cases the fetal heart rate was monitored externally with the same type of monitor (these 4 cases were not included in the statistical analysis of the effect of epidural block on fetal heart rate patterns). Uterine contractions were monitored externally in most cases and the study was therefore not used for an evaluation of the effect of EB on uterine contraction patterns. Cervical dilatation in all cases was at least 4 cm.

A graphic record of the fetal heart rate was obtained for at least 30 minutes before EB. The maternal brachial artery pressure was measured with a sphygmomanometer 10 minutes before EB and again after it every minute for 5 minutes, and thereafter every 5 minutes for another 25 minutes.

The EB was carried out at the T12-L1 vertebral interspace level and the tip of the epidural catheter advanced to a point approximately opposite spinal cord segments T11-12. A 0,5% solution of bupivacaine hydrochloride without adrenaline was used. The block was performed with the patient in the sitting position, after which she was immediately turned onto her back to ensure bilateral spread of the local anaesthetic.

In all cases an intravenous infusion of balanced electrolyte solution was commenced before the EB. If hypotension developed after the block, 500 ml of fluid was immediately rapidly infused and the patient was turned onto her left side. Hypotension was defined as a fall in systolic blood pressure to below 100 mmHg.

In 8 patients a test dose of 1 - 2 ml 0,5% bupivacaine was injected through the epidural catheter. In 53 patients a test dose was not given and 4 - 6 ml 0,5% bupivacaine was used for the EB (most patients had a first dose of 5 ml). One patient who had previously had two caesarean sections was admitted in early labour, and a further caesarean section was carried out under EB using 12 ml 0,5% bupivacaine.

The following data were recorded on a form designed for computer analysis: (*i*) patient's name and hospital number; (*ii*) millilitres of bupivacaine administered with each dose (up to a maximum of 4 doses) and the time of administration; (*iii*) the patient's blood pressure 10 minutes before the EB (and before knowing that she was going to receive epidural pain relief); (*iv*) blood pressure readings in the first half-hour after the epidural; (*v*) in hypertensive cases, whether any other treatment for hypertension was necessary after the EB; (*vi*) the time at which a fall in blood pressure occurred and the treatment given; (*vii*) maternal complications in the first half-hour after the epidural; (*viii*) maternal complications in the following 24 hours; (*ix*) the cardiotocographic pattern half an hour before

TABLE I. MEAN BLOOD PRESSURE (mmHg) (± SD)				
	Before EB		20 - 30 minutes after EB	
	Systolic	Diastolic	Systolic	Diastolic
Non-hypertensive group	120 ± 10,1	76 ± 9,7	110 ± 10,6	70 ± 8,6
Hypertensive group	142 ± 12,4	95 ± 6,3	124 ± 11,9	80 ± 10,1

SD = standard deviation.

the EB, and the pattern after treatment of a fall in blood pressure; (x) the presence of meconium in the amniotic fluid in the half-hour before and after the EB; (xi) the method of delivery; (xii) the extent of the patient's bearing-down effort in the second stage of labour; (xiii) whether any other pain relief was necessary during labour after the EB; (xiv) whether any other pain relief was necessary during delivery; (xv) the physician's impression of the pain relief; (xvi) the patient's opinion of the degree of pain relief; (xvii) whether the patient would like another EB in the future; and (xviii) maternal complications, possibly caused by the EB, noted at the postnatal clinic.

To prevent bias the forms were completed by a second doctor or by a student intern. Blood pressure readings before and after the EB were taken by the student intern or midwife looking after the patient.

In all cases the patient's informed consent was obtained and the EB was only carried out if painful contractions were present to such a degree that the patient requested pain relief. The procedure was, however, offered before labour became very active and painful.

In statistical analysis Student's t-test was used to compare the means of two continuous variables. The hypothesis of independence between two discrete variables was investigated using the chi-square test, while McNemar's test for symmetry was used to assess change around the diagonal in 2 x 2 tables.

Results

The mean size of the first dose of bupivacaine was 4,7 ml. The median interval between the first and second dose was 140 minutes. Thirty-five patients (56%) needed only one dose, 15 (24%) needed two doses, 10 (16%) three doses and 2 (3%) four doses. There was no statistically significant difference between hypertensive and non-hypertensive patients regarding the total number of doses.

Twenty patients (32%) developed hypotension after the EB. The mean largest drop in blood pressure occurred 4 minutes after the EB and the median time from the EB to treatment was 4,5 minutes. In all cases treatment promptly returned the blood pressure to normal. The mean blood pressure 20 - 30 minutes after EB was, however, still lower than before it (Table I). The blood pressure 20 - 30 minutes after the EB showed very little variation, and the mean of the 20-, 25- and 30-minute values was therefore taken as representative for this period.

An important finding was the greater mean fall in the systolic and diastolic blood pressures in patients with pre-existing hypertension (Tables II and III). There was, however, no statistically significant difference between the non-hypertensive and the hypertensive groups regarding the mean fall in the systolic and diastolic blood pressures 4 minutes after EB. For the 20 - 30 minutes after EB the difference in diastolic blood pressure fall was significant on t-testing (P < 0,01). The differences in mean blood pressure values in

TABLE II. MEAN BLOOD PRESSURE FALL 4 MINUTES AFTER EB (mmHg) (± SD)		
	Systolic	Diastolic
Non-hypertensive group	12 ± 14,3	9,3 ± 15,4
Hypertensive group	16,6 ± 15,9	17,2 ± 16

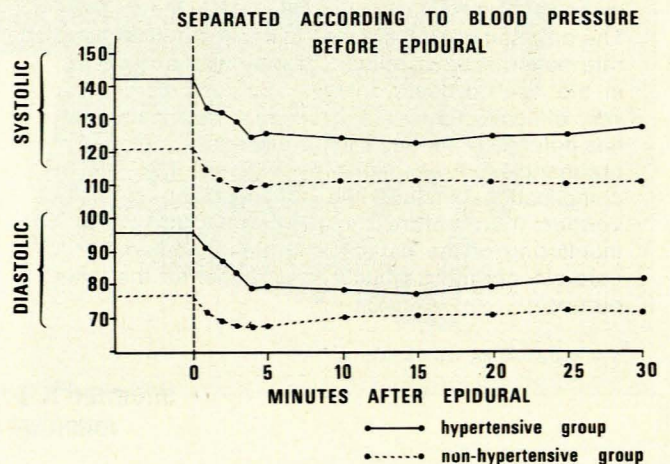| TABLE III. DIFFERENCE BETWEEN MEAN ORIGINAL BLOOD PRESSURE AND MEAN BLOOD PRESSURE 20 - 30 MINUTES AFTER EB (mmHg) (± SD)		
	Systolic	Diastolic
Non-hypertensive group	10,8 ± 12,2	5,4 ± 10,7
Hypertensive group	17,2 ± 11,6	15,7 ± 12,2

Fig. 1. Differences in mean blood pressure values in hypertensive and non-hypertensive patients after EB.

hypertensive and non-hypertensive patients is illustrated graphically in Fig. 1.

Eight patients (13%) developed late hypotension (10 minutes or longer after the EB; in 2 patients it occurred 20 minutes after the EB and in 1, 25 minutes after).

Seventeen of the 21 patients with pre-existing hypertension needed no other antihypertensive treatment during labour after the EB. In the 4 patients who needed further treatment a dihydrallazine infusion was used in 2, 1 patient was already receiving methyldopa and this was continued, and intravenous magnesium sulphate was used in the fourth.

Bladder atony was the only other complication noted in the first half-hour after the EB. This occurred in 12 patients (19%) and was diagnosed if catheterization was necessary for bladder-

emptying. In the 24 hours after the EB bladder atony was present in 2 patients, urinary incontinence in 1 patient and backache in 1 patient. These complications all cleared up spontaneously within 48 hours. Two patients had a retained placenta which was manually removed under epidural pain relief. (No complications associated with EB were discovered at the postnatal clinic.)

Fifty-eight fetuses were monitored internally by cardiotocography, and there was no change in the heart rate pattern in 37 (64%). In 5 cases (9%) the pattern changed to a more favourable one — all these fetuses had had an abnormal pattern before the EB. In 13 fetuses (22%) a normal pattern became abnormal after the EB, and in 3 (5%) an abnormal pattern became even more abnormal; 6 (37%) of these 16 cases were associated with maternal hypotension. After treatment for hypotension the fetal heart rate was normal in 4 of the latter 6 cases. The only statistically significant change in the fetal heart rate after EB was a decrease in the beat-to-beat variability (Table IV).

TABLE IV. EFFECT OF EB ON FETAL HEART RATE PATTERNS ON CARDIOTOCOGRAPHY

Cardiotocogram	30 min before	30 min after	P value
Normal	45	37	< 0,01
Decrease in beat-to-beat variability	4	10	< 0,01
Other abnormalities	9	11	NS*

*Not significant — McNemar test.

After the EB an abnormal fetal heart rate pattern developed in the fetuses of 6 of the 21 patients with hypertension. In 3 the beat-to-beat variability decreased, 1 developed a temporary basal bradycardia and in 2 temporary variable decelerations occurred. Only the case of bradycardia was associated with maternal hypotension, and the fetal heart rate returned to normal when the hypotension was treated.

In 2 cases meconium appeared in the amniotic fluid in the half-hour after the EB. In 1 case meconium was present in the amniotic fluid before and after the EB.

Methods of delivery were as follows: (i) normal vertex — 25 cases; (ii) vacuum extraction — 11; (iii) forceps — 11; (iv) caesarean section — 12; (v) breech — 4 (including twins, both delivered with the aid of Piper forceps). Thirteen (54%) of the instrumental deliveries were necessary because of inadequate bearing-down efforts by the patient. The indications for the 12 caesarean sections were as follows: inadequate progress of labour caused by cephalopelvic disproportion — 7 cases; failed trial of labour — 1; pre-eclampsia associated with inadequate progress of labour — 1; two previous caesarean sections — 1; previous caesarean section associated with inadequate progress of labour — 1; and fetal distress in the first stage of labour —1. The fetal distress in the latter case was not related to the EB. Five of these caesarean sections were done under EB, with excellent results. The main reason for general anaesthesia in the other 7 cases was that the anaesthetist preferred it.

The effectiveness of EB is summarized in Table V.

Discussion

That only 5 ml 0,5% bupivacaine was sufficient for effective pain relief in the majority of patients can be ascribed to the relatively high level at which the procedure was carried out

TABLE V. EFFECTIVENESS OF EB DURING LABOUR

	No.	%
Patients' opinion of pain relief		
No pain relief	1	2
Minimal pain relief	2	3
Moderate pain relief	5	8
Good, but remaining area of pain	7	11
Total pain relief	47	76
Attending physicians' impression of the pain relief		
No pain relief	0	
Minimal pain relief	1	2
Moderate pain relief	8	13
Good, but remaining area of pain	4	6
Total pain relief	46	74
Question not answered	3	5
Other pain relief also necessary during labour	2	3
Other pain relief also necessary during delivery	23	37
Would the patient like to have an EB during her next labour?		
Yes	59	95
No	2	3
Question not answered	1	2

(T12-L1 vertebral interspace level). Epidural catheters have a tendency to curl back when inserted,[4] and this is increased with EB at a lower level because the catheter has to be inserted deeper in order to position the tip opposite the correct spinal cord segments.

The 32% incidence of hypotension is important and supports the finding of Collins et al.[5] that it is preferable to administer intravenous fluid before the EB in order to minimize the risk of hypotension. This study clearly indicates that where the administration of intravenous fluid is delayed until a fall in blood pressure occurs, the incidence of hypotension is still unacceptably high. To minimize the risk of hypotension and diminution of placental perfusion, the following technique of EB is preferred. After earlier fluid loading, only the test dose is given with the patient in the sitting position. The patient is then turned onto her right side and 2 ml 0,5% bupivacaine is injected through the epidural catheter. After a few minutes have been allowed for the drug to act, she is turned onto her left side and a further 2 ml 0,5% bupivacaine is injected to block the contralateral nerve roots.

This study also indicates the importance of frequent blood pressure measurements after EB. These should be taken at least every 5 minutes, and for a minimum period of 30 minutes in order to diagnose late falls in blood pressure, which appear to occur more commonly than is generally realized (in 40% of the hypotensive cases in this study).

An important finding was the greater fall in mean blood pressure in patients with pre-existing hypertension. This is possibly related to the reduced plasma volume and increased vasomotor sensitivity present in pre-eclampsia.[6] It is therefore important to guard against too sudden or too large a blood pressure fall in this group of patients who already have an intravascular hypovolaemia, as this could impede placental perfusion. An interesting finding was that 81% of hypertensive patients needed no other antihypertensive treatment during labour. This indicates the therapeutic possibilities of EB in pre-eclamptic patients in labour; this aspect of the procedure should be further investigated.

The occurrence of heart rate abnormalities in 6 of the fetuses of the 21 patients with hypertension should be noted.

In only 1 of these cases was there was an association with hypotension, but the vasodilator effect of the block superimposed on the intravascular hypovolaemia of pre-eclampsia could have resulted in decreased placental perfusion in the other 5 cases. It may therefore be important partially to correct the intravascular hypovolaemia of pre-eclampsia before EB by the intravenous infusion of a crystalloid solution, as advocated by Crawford.[7] Further research is needed in this regard.

The second most frequent maternal complication was bladder atony (19%). The attending staff should be made aware of the frequency of this complication, and overdistension of the bladder should be prevented by timely catheterization since this not only delays the progress of labour but may also result in chronic disturbance of bladder function.[8]

Whether the 2 cases of retained placenta were related to EB or not is uncertain. There is no reference in the literature to this as a complication of EB.

The 28% of cases in which abnormal fetal heart rate patterns on cardiotocography developed is lower than the 43% found by Zaaijman and Slabber.[9] A gradual slowing of the fetal heart rate, observed in 21% of their cases, did not occur in this study, where the only statistically significant change in fetal heart rate pattern was a decrease in beat-to-beat variability. These findings may be related to the fact that these researchers[9] used a much larger bupivacaine dosage, which also contained adrenaline (10 - 12 ml of a 0,5% solution of bupivacaine hydrochloride with adrenaline 1 : 200 000). It would therefore appear advisable to avoid the use of adrenaline and to restrict the bupivacaine dosage to the minimum necessary for effective pain relief.

The improved fetal heart rate pattern on cardiotocography which occurred in 5 cases may be related to the vasodilator effect of the block, with an increase in intervillous-space blood flow; it requires further research.

A higher incidence of instrumental deliveries has been associated with EB.[10,11] However, a difference of opinion exists whether the EB as such is responsible for this, or whether the underlying abnormal labour may be responsible. The fact that 54% of the instrumental deliveries in this study were related to inadequate bearing-down indicates that the EB may be directly responsible.

The effectiveness of EB during labour is clearly demonstrated by the 75% of cases in which total pain relief was obtained. The fact that 37% of patients needed other pain relief during delivery can probably be ascribed to a selective block of spinal cord segments T10-L1 brought about by the small volume of bupivacaine injected. Most pain fibres from the perineum (S2, S3 and S4) were therefore not blocked. This can be prevented by giving a top-up dose just before the onset of the second stage with the patient in the sitting position. She should remain in this position for a few minutes to allow time for the local anaesthetic to reach the sacral spinal cord segments. A pudendal block is, however, a simpler procedure with fewer potential side-effects; this makes it preferable for pain relief in the second stage of labour.

The effectiveness of the selective block is an indirect verification of Bonica's[12] findings that pain fibres from the cervix travel with those from the uterus to spinal cord segments T10-L1.

Conclusion

EB is a very effective form of pain relief during labour, but the procedure has potentially serious side-effects, especially in high-risk pregnancies. The necessary precautions must therefore be taken to minimize the risk of complications and to diagnose them as early as possible. These precautions include the administration of intravenous fluid before the procedure and careful monitoring of the patient and her unborn baby. A cardiotocographic monitor is essential for the latter purpose in view of the fact that the usual fetal heart abnormality caused by EB is not detectable by auscultation.

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