THE USE OF BUPIVACAINE IN LABOUR*

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THE USE OF CONTINUOUS LUMBAR EPIDURAL BLOCK for pain relief during the 1st and 2nd stages of labour was first described by Flowers, Hellman and Hingson in 1949.¹ Today, some twenty years later, this technique is commonly used in Canada in the majority of the larger hospitals dealing with obstetrical cases. It has been in use at the Hamilton Civic Hospitals over the past five years, and a description of this has been given by Catton (1969).² Approximately 65 per cent of our patients now receive this form of pain relief in labour.

It is essential to differentiate the pain of the first stage of labour, which is transmitted mainly by afferents which travel with the sympathetic nerves and enter the spinal cord between T-10 and L-1 segments, from the pain of the second stage which is relayed by somatic nerves (mainly S-2, 3 & 4), but also by L-1 and L-2 (ilioinguinal and genito-femoral nerves).

Pain of the first stage can be relieved by relatively small volumes of local anaesthetic drugs (5-7 cc). The drug commonly used at the Hamilton Civic Hospitals is Lignocaine in concentration 0.5-1 per cent; thus producing block of these sympathetic "c" fibres. Pain of the 2nd stage requires blocking of somatic nerves and therefore higher concentration (1 per cent - 1.5 per cent Lignocaine) and larger volumes (10-15 cc) in order to achieve satisfactory perineal analgesia for episiotomy and forceps delivery. It is the custom in this institution to deliver patients routinely by episiotomy and forceps, and it has been observed that a block extending from mid-thigh to umbilicus is adequate for this.

Recently, a new local anaesthetic called Bupivacaine (LAC-43) has been introduced. This drug was synthesized by Af Ekerstam, Egner, and Patterson³ in 1957, and its clinical use described by Widman⁴ in 1964.

Henn and Brattsand⁵ gave this drug by various routes in mice, guinea-pigs and rabbits and concluded that its acute toxicity was equivalent to that of Amethocaine and four times that of Mepivacaine. In regional block (local, epidural, and caudal) they stated that Bupivacaine and Amethocaine were approximately three times more potent than Mepivacaine. It is the Hydrochloride of 1-n-butyl-DL Piperidine-2-Carboxylic Acid-2-6-dimethylanilide, being similar in structure to Mepivacaine, but differs from it in that a Methyl group in the piperidine ring has been replaced by a butyl group.

This drug is still undergoing clinical trial in Canada, but has been used in Europe over the past 3 to 4 years. The great virtue claimed for this local

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anaesthetic is its long duration of action. (Dhuner⁶; Watt, Ross & Atkinson⁷; Duthie, Wyman & Lewis⁸)

The purpose of this paper is to present work carried out in an effort to assess the value of its use for continuous epidural analgesia in labour. We consider that for this drug to be considered satisfactory, certain criteria must be fulfilled, namely (1) it should provide good pain relief to the mother during the first and second stages of labour and for forceps delivery and repair of episiotomy. (2) It should provide good operating conditions for the occasional patient who may proceed to Caesarean Section. (3) It should be associated with the delivery of good babies with high Apgar Scores. (4) Full recovery of muscle power and sensation should occur within a few hours of delivery.

A study was carried out of 120 patients who received a continuous epidural block with Bupivacaine during labour and delivery.

METHOD

A Skinner⁹ epidural catheter was introduced into the epidural space through a No. 17 Tuohy needle. The space was identified by the loss of resistance test using a 10-cc syringe loaded with air or saline.

The block was started when the patient was becoming distressed from the uterine contractions and the cervix was 5-6 cm dilated, tending to be earlier in the multipara than in the primigravida.

An initial dose of 5-7 cc of 0.5 per cent Bupivacaine was injected into the epidural space. In 39 of the cases adrenaline (1:200,000) was added to the Bupivacaine solution. The patient was placed on her back until pain relief had occurred, when she was turned on to one or the other side in order to improve the quality and efficiency of the uterine contractions.

The level of sensory block to pinprick was then determined. Blood pressure estimations were carried out at five minute intervals for 15 minutes after the block, and after each subsequent injection.

Injections of 5-7 cc were repeated when uterine contractions again became painful, and a terminal dose of 10-15 cc was given for perineal analgesia just before delivery, if required.

If, during the course of labour, uterine contractions slowed down markedly, then uterine stimulation was carried out with a Syntocin nasal spray or intravenous infusion (10 units to 250 ml solution).

RESULTS

The analgesia obtained by the mother was classified into 3 grades as follows:

(1) Excellent - mother comfortable from onset of the epidural block until at least the end of labour and for suturing of the episiotomy.

(2) Satisfactory - slight pain felt by the mother, but no additional analgesia required.

(3) Unsatisfactory - Additional analgesia required or general anaesthesia required for delivery.

Results are shown in Table I.

TABLE I
CLASSIFICATION OF ANALGESIA

GRADE	NUMBER OF CASES	PERCENTAGE
EXCELLENT	90	75.0
SATISFACTORY	24	20.0
UNSATISFACTORY	6	5.0

Ninety-five per cent of the patients in this study achieved at least satisfactory pain relief, and of these 75 per cent were excellent. Five per cent were unsatisfactory and required either additional narcotic analgesics or general anaesthesia for delivery. These patients experienced patchy analgesia for no obvious reason.

After injection of Bupivacaine, the onset of analgesia occurred in 10–15 minutes, with maximum effect in 15–20 minutes. This was considered to be satisfactory and comparable with that of Lignocaine.

With the small doses used during the first stage of labour (5–7 cc) the upper level of analgesia obtained as tested by pinprick varied between T-8 and T-11 segments. Numbness usually first appeared in the legs, then crept upward to reach its maximum level in 15–20 minutes.

A moderate degree of muscular weakness in the legs was usually observed, but its exact extent was not noted.

In the majority of patients, uterine contractions progressed satisfactorily and were not associated with pain, so that the mother was comfortable. However, in a few cases it was considered that uterine stimulation was required as labour appeared to be slowed. Thus 13 patients (10.8 per cent) received Syntocin in either the form of a nasal spray or by intravenous infusion (10 units to 250 ml solution). This appeared to work well and in these cases soon produced efficient but painless contractions.

In the other 107 patients (89.2 per cent) labour progressed spontaneously.

Duration of labour

The duration of labour was taken as the time from the start of uterine contractions to delivery of the baby. This is illustrated in Table II.

This time is composed of (1) from the start of uterine contractions until the epidural analgesia was started, and (2) the period of the epidural until delivery of the baby. A total of 46.7 per cent of the patients were in labour for over 12 hours, 30 per cent between 8 and 12 hrs. 18.3 per cent between 4 and 8 hrs, and only 5 per cent for less than 4 hrs.

Duration of epidural analgesia

The period of epidural analgesia was divided into 2 phases: (1) that from the start of the epidural block to the end of the delivery, plus (2) the period of analgesia during the early post-partum period.

TABLE II
DURATION OF LABOUR

DURATION (hrs)	NUMBER OF CASES	PERCENTAGE
< 4	6	5.0
4 - 8	22	18.3
8 - 12	36	30
12 +	56	46.7

TABLE III
DURATION OF EPIDURAL ANALGESIA BEFORE DELIVERY

DURATION (hrs)	NUMBER OF CASES	PERCENTAGE
0 - 1	5	4.2
1 - 3	19	15.8
3 - 6	20	16.8
6 - 12	46	38.3
12 +	30	25.0

The first period is illustrated in Table III. There were 38.3 per cent of the epidurals in use for 6-12 hours when delivery occurred. In 36.8 per cent of cases the epidural was in use for less than 6 hours before delivery.

The second period will be discussed later.

Presentation

In 85.8 per cent of cases the presentation was occipito-anterior, while the occiput presented posteriorly in 7.5 per cent and transversely in 4.2 per cent. (Table IV)

Laxity of the muscles of the pelvic floor as a result of the epidural block probably contributed to the incidence of abnormal vertex presentations. These were corrected by forceps rotation.

Method of delivery

Table V illustrates the method of delivery. Ten per cent delivered spontaneously while 84.2 per cent were by forceps.

TABLE IV
BABY'S PRESENTATION

PRESENTATION	NUMBER OF CASES	PERCENTAGE
OCCIPITO-ANTERIOR (LOA OR ROA)	103	85.8
OCCIPITO-POSTERIOR (LOP OR ROP)	9	7.5
OCCIPITO-TRANSVERSE (LOT OR ROT)	5	4.2
BREECH (SA OR SP)	3	2.5

TABLE V
METHOD OF DELIVERY

METHOD OF DELIVERY	NUMBER OF CASES	PERCENTAGE
SPONTANEOUS	12	10.0
LOW FORCEPS	91	75.8
MID FORCEPS	10	8.3
FORCEPS ROTATION	14	11.6
CAESAREAN SECTION	6	5.0

All six of the Caesarean Sections were carried out under epidural analgesia, continued from the first stage of labour. These were satisfactory.

Infant Apgar scores

The Apgar score of the babies was noted one minute after birth (Table VI). Scores of 7-8 upward were considered satisfactory, and these comprised 96.7 per cent of infants who were born in good condition.

Maternal hypotension

Any fall in the mother's blood pressure to 100 mm Hg (systolic) or below was carefully noted. Seven patients (5.8 per cent) had a fall of blood pressure to a level between 80 and 100 mm Hg systolic. None sustained a fall below 80 mm Hg. In no case was a vasopressor required, as turning the patient on to her side corrected any hypotension present.

Duration of each injection

It was found that in patients who received many injections, the duration of each was approximately the same, except for the terminal dose just before delivery. It was therefore decided to assess the length of action of (1) the first

TABLE VI
INFANT APGAR

APGAR	NUMBER OF BABIES	PERCENTAGE
9 - 10	84	70.0
7 - 8	32	26.7
5 - 6	2	1.7
4 or less	2	1.7

TABLE VII
DURATION OF EACH INJECTION

BUPIVACAINE 0.5%	AVERAGE DURATION 1st INJECTION (mins)	AVERAGE DURATION TERMINAL INJECTION (mins)
PLAIN	110	222
WITH 1:200,000 ADRENALINE	160	300

injection given, and of (2) the terminal injection, - until perineal discomfort appeared in the post-partum period.

For this purpose the cases were divided into 2 groups, (a) when 0.5 per cent Bupivacaine with 1:200,000 adrenaline was used (39 cases), (b) when plain 0.5 per cent Bupivacaine was injected (81 cases). Table VII illustrates the increased duration of the analgesic effect when adrenaline was added both in the case of the first and terminal injections.

The increased period of analgesia during the post mortem period probably represents the overwhelming relief of the mother in having got the labour over, so that she relaxes and does not readily complain.

Number of injections required

The number of injections required is important from the point of view of the work which is imposed on the nursing staff in the checking of blood pressures, and also in toxic accumulation of the drug. Table VIII illustrates the results. Over 50 per cent of patients required three or more injections.

COMPLICATIONS

(1) *Hypotension*. A fall in blood pressure occurred in 7 patients (5.8 per cent) to a level between 80 and 100 mm Hg systolic. There are two main reasons for this: (a) Sympathetic block due to the epidural (b) inferior vena caval com-

TABLE VIII
NUMBER OF INJECTIONS REQUIRED

NUMBER OF INJECTIONS	NUMBER OF CASES	PERCENTAGE
1	9	7.5
2	46	38.3
3 +	65	54.2

pression by the gravid uterus. This was managed by putting the patient on to her side, to remove the inferior vena caval compression. This was enough to raise the blood pressure above 100 mm Hg. In no case was the use of a vasopressor required. It should be noted that the use of a vasopressor is to be avoided if possible, because these tend to cause vasoconstriction in the splanchnic area and so may reduce the blood supply to the placenta. (Greiss and Wilkes;¹⁰ Vasicka, Hutchinson, Erig and Allen¹¹)

(2) *Slowing of labour.* Diminution of uterine contractions may occur if the block goes above T-10, thus interfering with the motor supply of the uterus. A total of 10.8 per cent of the patients received Syntocin to speed up labour.

(3) *Abnormal vertex presentation.* The incidence of persistent occipito-posterior positions was 7.5 per cent (9 cases), of Occipito-transverse positions was 4.1 per cent (5 cases), a total of 11.7 per cent. These were managed by forceps rotation. The increased incidence of this is well recognized (Catton, 1969).²

(4) *Shivering.* Mild shivering occurred frequently but did not present any great problem. It was often associated with vasoconstriction of the upper part of the body, presumably a compensatory sympathetic reaction in areas not blocked.

(5) *Spottiness of analgesia.* Scattered areas where pain sensation was retained during uterine contraction occurred in six cases, so that the block was considered unsatisfactory. There was no obvious reason for this.

DISCUSSION

Bupivacaine (0.5 per cent) produced efficient analgesia in 95 per cent of the patients studied. It appeared that the addition of 1:200,000 adrenaline prolonged its action by approximately 1 hour, when it was used in small doses of 5-7 cc. There were no serious complications associated with its use, and there appeared to be a longer action than that produced by Lignocaine (approximately two and one-half times).

The very long duration of action (over 4 hours) associated with some forms of surgery was not observed (Watt *et al.*⁷) except with the terminal injection, possibly due to (1) The excitable state of most mothers during labour, or (2) The relatively small doses given.

The nursing staff were very impressed with the reduced frequency of injections required as compared with Lignocaine when used, and consequently the reduced number of blood pressure readings to be taken.

Reynolds and Taylor (1970)¹² studied blood concentration of Lignocaine and Bupivacaine during labour and found that the rise in concentration with Bupivacaine was much less than with Lignocaine. They suggested that this was due to fewer injections required. This is therefore an advantage as it reduces toxicity to mother and baby.

CONCLUSIONS

We consider that Bupivacaine is a safe and very efficient local anaesthetic for continuous epidural analgesia in obstetrics.

Its long duration of action is particularly useful in obstetrical cases.

RÉSUMÉ

Au cours des cinq dernières années, à l'Hôpital Civique Hamilton, nous avons utilisé le blocage lombaire épidural continu comme analgésie au cours de l'accouchement (Catton 1969²).

Les douleurs de la première phase sont transmises par les nerfs sympathiques qui entrent dans la moëlle entre T-10 et L-2; à la deuxième phase, les douleurs passent par les segments S 2, 3, et 4. Pour que l'accouchement soit satisfaisant, il faut une analgésie périnéale. On a décrit, dernièrement, un nouvel anesthésique local: la Bupivacaine (1-n-butyl- π 1 piperidine-2-acide carboxylique-2-6-diméthyl-anilide); sa structure est semblable à celle de la mépivacaine à l'exception d'un groupe méthyl dans l'anneau piperidine qui a été remplacé par un groupe butyl.

Nous avons fait une étude chez 120 malades à qui nous avons fait un blocage épidural continu durant le travail et l'accouchement avec de la Bupivacaine 0.5 pour cent.

Lorsque le col avait une dilatation de 5-6 cms, nous avons placé un catheter portex dans l'espace épidural. Nous avons injecté dans l'espace épidural de 5 à 7 ml de Bupivacaine à 0.5 pour cent et, à la réapparition des douleurs, nous avons répété l'injection. Nous avons pris la pression artérielle à toutes les cinq minutes durant les 15 minutes qui suivaient l'injection et, si nécessaire, juste avant l'accouchement, pour l'analgésie du périnée nous injectons 10 à 15 ml.

Si les contractions ralentissaient, nous stimulons l'utérus avec de la syntocine (en vaporisation nasale ou par injection endoveineuse).

Résultats

Nous avons classifié l'analgésie en trois catégories: (1) excellente, (2) satisfaisante, (3) non satisfaisante (Table I). Soixante-quinze pour cent furent excellentes.

Le début de l'analgésie commençait au bout de 10 à 15 minutes pour atteindre un effet maximal en 15 à 20 minutes; chez 10.8 pour cent des malades, le travail a ralenti et l'on a dû recourir à la syntocine pour stimuler les contractions.

Il y avait 46.7 pour cent des malades qui sont demeurées en travail au-delà de 12 heures et 5 pour cent, moins de 4 heures (Table II).

A l'accouchement, 38.3 pour cent des épidurales étaient en marche depuis 6 à 12 hrs (Table III).

Il y avait 11.7 pour cent des présentations qui étaient soit des occipito-postérieures, soit des occipito-transverses (Table IV); elle étaient corrigées par des rotations au forceps (Table V).

Le score Apgar était pris 1 minute après la naissance; 96.7 pour cent des enfants sont nés en bon état (Apgar au-dessus de 7) (Table VI).

Il y avait 5.8 pour cent des malades qui ont présenté une chute de la pression artérielle touchant un niveau de 80 à 100 mm Hg mais cette chute a été corrigée en tournant la malade sur le côté. Nous n'avons pas été dans l'obligation de recourir à des vasopresseurs.

Lorsque nous avons ajouté de l'adrénaline (1:200,000) à la Bupivacaine, la durée de l'analgésie a été prolongée aussi bien à la première injection qu'aux dernières (Table VII).

Au-delà de 50 pour cent des malades ont eu besoin de trois injections ou plus (Table VIII).

Complications

(1) Il peut survenir de l'hypotension à cause: (a) du blocage sympathique, (b) de la compression de la veine cave par l'utérus gravide. Cette éventualité est survenue chez 5.8 pour cent des malades et a été traitée en tournant la malade sur le côté. Nous n'avons pas utilisé de vasopresseur et il faut éviter leur emploi si possible (Greiss and Wilkes⁸); (Vasicka, Hutchinson, Erig and Allen¹¹).

(2) Il peut arriver que le travail ralentisse si le blocage dépasse T-10. Il y avait 10.8 pour cent des malades qui ont reçu de la Syntocine pour accélérer le travail.

(3) Il peut survenir des présentations anormales parce que le tête ne fait pas de mouvement de rotation sur le plancher pelvien. Il y avait 11.7 pour cent des malades qui ont présenté ce problème et ont eu une rotation au forceps.

(4) Nous avons observé des frissons assez fréquents, mais ils n'ont pas présenté de problèmes.

(5) Chez six malades (5 pour cent) nous avons observé une analgésie en taches; nous avons jugé le blocage non satisfaisant (cause inconnue).

Discussion

La Bupivacaine (0.5 pour cent) a produit une analgésie efficace chez 95 pour cent des malades étudiées. L'adrénaline peut prolonger son action d'une heure.

Sa durée d'action semble être approximativement de deux fois et demie plus longue que la lignocaine.

Reynolds et Taylor (1970)¹² ont trouvé que la teneur sanguine de la Bupivacaine était inférieure à celle de la lignocaine, probablement à cause du plus petit nombre d'injections.

Nous sommes d'avis que la Bupivacaine est un anesthésique local efficace et sûr pour faire de l'analgésie épidurale continue en obstétrique.

REFERENCES

1. FLOWERS, C. E.; HELLMAN, L. M.; & HINGSON, R. A. Peridural Anaesthesia and Analgesia for Labour, Delivery and Caesarean Section - Continuous. *Curr. Res. Anes. and Anal.* 28:4181 (1948).
2. CATTON, D. V. Epidural Analgesia for Labour and Delivery. *Anesth. & Anal.* 48:587 (1969).
3. AF EKERSTAM, B.; EGNER, B.; & PETTERSON, G. N-Alkyl Pyrrolidine and n-Alkyl Piperidine Carboxylic Acid Amides. *Acta Chem. Scand.* 22:1183 (1957).
4. WIDMAN, B. Clinical trial of a new local anaesthetic (LAC-43) with the aid of the pinprick and ninhydrin methods in finger blocks. *Acta Anesth. Scand.* 8:219 (1964).
5. HENN, F. & BRATTSAND, R. Some Pharmacological and Toxicological Properties of a new Long-Acting Local Analgesic, LAC-43 (Marcaine), in comparison with Mepivacaine and Tetracaine. *Acta Anesth. Scand. Suppl.* 21:9 (1966).
6. DHUNER, K. G. Clinical Experience with Marcaine (LAC-43), a new Local Anaesthetic. *Acta. Anesth. Scand. Suppl.* 23:395 (1966).
7. WATT, M. J.; ROSS, D. M.; & ATKINSON, R. S. A clinical Trial of Bupivacaine, a preliminary report on a new local Analgesic Agent in Extradural Analgesia. *Anaesthesia* 23:2 (1968).
8. DUTHIE, A. M.; WYMAN, J. B.; & LEWIS, G. A. Bupivacaine in Labour, its use in Lumbar Extradural Analgesia. *Anaesthesia* 23:20 (1968).
9. SKINNER, B. S. A new epidural cannula. *Canad. Anesth. Soc. J.* 13:622 (1966).
10. GREISS, F. C., & WILKES, D. V. Effects of sympathomimetic drugs and angiotension on the uterine vascular bed. *Obstet. and Gynec.* 23:925 (1964).
11. VASICKA, A.; HUTCHINSON, H. T.; ERIC, M.; & ALLEN, C. R. Spinal and epidural anaesthesia, fetal and uterine response to acute hypo- and hyper-tension. *Amer. J. Obstet. Gynec.* 90:900 (1964).
12. REYNOLDS, F., & TAYLOR, G. Maternal and Neonatal Blood Concentration of Bupivacaine - A comparison with Lignocaine during continuous extradural analgesia. *Anaesthesia* 25:14 (1970).