Epinephrine reduces the sedative side effects of epidural sufentanil for labour analgesia

[L'épinéphrine réduit les effets secondaires sédatifs du sufentanil épidural administré pour l'analgésie pendant le travail]

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Purpose: The use of opioids in labour analgesia has primarily been as an adjuvant to local anesthetics. For early labour, satisfactory analgesia with epidural sufentanil alone is possible. This study evaluates the impact of epinephrine on sedative side effects and analgesia related to the latter technique.

Methods: After Institutional Review Board approval and informed consent this prospective, randomized, double-blind study evaluated 43 nulliparous subjects requesting epidural analgesia. The study site, a tertiary care obstetric unit, accommodates 3500–4500 deliveries annually. Group selection was randomized and blinded by selection of a sealed envelope containing a number which corresponded to a premixed labelled syringe of saline or epinephrine ($100 \mu\text{g}\cdot\text{mL}^{-1}$). An epidural catheter was placed in a standardized fashion. All subjects received $40 \mu\text{g}$ of sufentanil and 0.5 mL from the premixed syringe, diluted to 10 mL with NaCl . A blinded observer collected data on maternal sedation, lightheadedness, hemodynamics, oxygenation, and fetal heart rate over a one-hour period following sufentanil injection.

Results: The addition of epinephrine significantly ($P < 0.05$) reduced the incidence of sedation and lightheadedness after epidural sufentanil at all data collection points, except two. Analgesic duration was also significantly prolonged by this addition (120 ± 56 vs $84 \pm 32 \text{ min}$). Maternal satisfaction was high regardless of solution.

Conclusion: Forty micrograms of epidural sufentanil produces satisfactory analgesia in early labour. The addition of epinephrine improves the side effect profile of this technique while prolonging the duration of analgesia. Epidural sufentanil requires attention to maternal monitoring of oxygenation as maternal desaturation occurred in both groups.

Objectif: L'usage des opioïdes pour l'analgésie obstétricale a d'abord été un auxiliaire des anesthésiques locaux. Une analgésie satisfaisante peut être obtenue avec du sufentanil épidural employé seul au début du travail obstétrical. La présente étude évalue l'impact de l'épinéphrine sur les effets secondaires sédatifs et l'analgésie reliés à cette dernière technique.

Méthode : Après avoir obtenu l'accord du Comité de révision de l'hôpital et le consentement éclairé des participantes, l'étude prospective, randomisée et à double insu a évalué 43 femmes nullipares nécessitant une analgésie épidurale. L'étude s'est déroulée dans une unité obstétricale tertiaire où ont lieu de 3 500 à 4 500 naissances chaque année. La sélection des groupes a été faite au hasard et l'objectivité était assurée par une enveloppe scellée contenant un nombre correspondant à une seringue identifiée d'une solution salée ou d'épinéphrine déjà préparée ($100 \mu\text{g}\cdot\text{mL}^{-1}$). Un cathéter épidural a été inséré de façon standardisée. Tous les sujets ont reçu $40 \mu\text{g}$ de sufentanil et $0,5 \text{ mL}$ du mélange de la seringue, dilué à 10 mL avec du NaCl . Pendant une heure après l'injection de sufentanil, un observateur impartial a recueilli les données sur la sédation de la mère, les étourdissements, l'hémodynamique et la fréquence cardiaque fœtale.

Résultats : L'ajout d'épinéphrine a significativement réduit ($P < 0,05$) l'incidence de sédation et les étourdissements après l'administration épidurale de sufentanil et tous les paramètres notés, sauf deux. La durée de l'analgésie a aussi été prolongée de façon significative par cet ajout (120 ± 56 vs $84 \pm 32 \text{ min}$). La satisfaction des mères a été importante sans égard à la solution utilisée.

Conclusion : Quarante microgrammes de sufentanil épidural produisent une analgésie satisfaisante au début de l'accouchement. L'ajout d'épinéphrine améliore le profil des effets secondaires et prolonge la durée de l'analgésie. L'administration épidurale de sufentanil exige un monitoring attentif de l'oxygénation maternelle, la désaturation étant survenue dans les deux groupes.

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EPIDURAL opioids continue to be an integral part of labour analgesia. Sufentanil has been evaluated in combination with local anesthetics in the epidural^{1,2} and intrathecal space.^{1,3,4} As a sole epidural agent, its use is less prevalent but studies have evaluated its analgesic effectiveness and pharmacokinetics in the obstetric^{2,5,6} and non-obstetric^{7,8} populations. Dunn *et al.* concluded that 40 µg of sufentanil administered epidurally, after a test dose of lidocaine and epinephrine, is as effective as 10 µg of intrathecal sufentanil.⁹

Based on previous experience at our institution, we found that 40 µg of sufentanil, diluted to 10 mL with normal saline, provided good analgesia when injected epidurally. However, lightheadedness and sedation were noted to be significant. Central nervous system (CNS) side effects^{2,10} and respiratory depression,^{11,12} have been described after intrathecal sufentanil. We postulated that this alteration in CNS status was due to systemic uptake of sufentanil via the epidural vasculature.^{8,13} Thus we hypothesized that the addition of 50 µg of epinephrine would reduce absorption and decrease CNS side effects. Our secondary hypothesis was that reduced systemic uptake would lead to a greater delivery of sufentanil to the cerebrospinal fluid (CSF), resulting in an increase in the duration as well as the intensity of analgesia.

Methods

With Ethics Board approval, a prospective, randomized, and double-blind trial was undertaken. After informed consent, 43 nulliparous women requesting epidural labour analgesia were randomized to receive either epidural sufentanil alone (Group C), or epidural sufentanil with epinephrine (Group E). The Family Birthing Centre at St. Joseph's Health Care London was the lone site during this investigation. This centre is a high-risk obstetric unit with 3500–4500 deliveries per year; the nulliparous epidural rate is approximately 80%. Subject inclusion criteria were nulliparity, ASA I or II, age greater than 18 yr, weight less than 100 kg, gestational age greater than 34 weeks, no use of oral or *im* opioids, a normal fetal heart rate (FHR) tracing, and no contraindication to an epidural. A sufentanil solution was then prepared. Forty micrograms (0.8 mL) of sufentanil were combined with 8.7 mL of normal saline and 0.5 mL of a numbered study solution, to bring the final volume to 10 mL. The study solution contained either NaCl or one in 10 000 epinephrine (100 µg·mL⁻¹). The study solutions were prepared in sterile syringes and randomized by the Department of Pharmacy. Each syringe was numbered, and the code was known only to the

Department of Pharmacy. The syringes were kept on the labour ward and replaced every seven days.

An epidural was established at the L2–3 or L3–4 interspace by loss of resistance to air. The absence of CSF or blood in the catheter after negative aspiration, and to gravity flow was taken to indicate that the catheter was not in the intrathecal or vascular space. Monitors were then applied [blood pressure (BP), pulse oximetry, and FHR monitor], baseline readings taken, and the sufentanil solution injected in two 5-mL doses. This was considered to be time zero (T0). For each subject there were seven data points recorded for most variables, time zero (baseline) and then five, ten, 15, 30, 45 and 60 min post-injection. Data were collected and subsequently entered into a database for future analysis.

Measurement of primary outcomes included the presence of sedation, lightheadedness, the duration and intensity of analgesia, respiratory depression, motor blockade, pruritus, nausea and/or vomiting. Sedation was assessed using a visual analog scale for sedation (VASS). A score of 0 indicated the subject felt fully awake; a score of 100 meant the subject was unable to keep her eyes open or did not respond. Scores were recorded at T0, T5, T10, T15, T30, T45, and T60. An increase of 50% from baseline or an absolute score of 55 was considered to be of clinical relevance. Pain relief was measured similarly using the visual analog scale for pain (VASP) where 0 indicated no pain and 100 the worst pain imaginable. Scores were recorded at the same intervals as for VASS. A decrease in VASP of 50% from baseline or an absolute score of less than 25 was considered to be clinically significant pain relief. The presence or absence of lightheadedness, pruritus, and nausea were determined by direct questioning at the above time intervals. Treatment was available on request for pruritus, nausea, or vomiting. Duration of analgesia was measured as the time between epidural initiation (T0) and the subject's request for additional analgesia.

Motor blockade was assessed using the modified Bromage score, where 0 indicated no perceivable motor blockade and 3, no motor function in the lower limb. FHR was recorded continually for 45 min prior to epidural initiation and for 60 min after time 0 (T0). BP, respiratory rate (RR) and oxygen saturation (O₂ Sat) were measured throughout the study period. The lowest saturation in an interval was recorded for each data point. An O₂ Sat of less than 93% was considered clinically meaningful,¹⁴ less than 90%, hypoxemia.

Secondary data consisted of oxytocin use, time to 5 and 10 cm cervical dilation, time and method of delivery, and neonatal APGAR scores at one and five min-

utes. A maternal questionnaire to assess satisfaction was administered on the first post-partum day. The questionnaire attempted to determine the effectiveness of pain control, the presence of side effects, and whether or not the subject would choose this method of pain relief in the future.

Statistical analysis

Data are reported as mean $\pm$ standard deviation for continuous variables and the frequency of occurrence for categorical variables. The student two-sample t test was used to analyze group differences for continuous measures and Fisher's exact test was used for categorical data. A *P*-value of 0.05 was considered significant. All tests of significance were two tailed. All analyses were performed with SPSS 8.0 (Chicago IL, USA).

Results

Between March 1998 and April 1999, 44 subjects were recruited into the study; 22 in Group C and 22 in Group E. One subject in the epinephrine group was omitted and no data gathered after a recognized intravascular injection of half the dose. No ill effects resulted. Three subjects required a second epidural (inserted after the one hour study period) because of inadequate pain relief after a "rescue" dose of 10 mL of 0.25% bupivacaine. Two of these parturients were in Group E and one in Group C. Data from these subjects are included in the final analysis. Four mothers

did not complete the maternal questionnaire; three of these in Group C. Forty-three of the 44 subjects recruited contributed data for final analysis. There were no demographic differences between the groups, with respect to maternal age, use of oxytocin, cervical dilation at epidural insertion, number of subjects requiring Cesarean delivery, or neonatal depression as determined by Apgar score (Table I).

Sedation

CNS side effects, namely, sedation (VASS) and lightheadedness were greater in the subjects receiving sufentanil alone (Group C). At each data point there was a statistical difference in the number of subjects reporting a greater than 50% increase in sedation by VASS in Group C (*P* < 0.034; Figure 1). Having defined clinically significant sedation at an absolute VASS of greater than 55,¹⁵ more subjects in the control group exceeded this threshold statistically (*P* < 0.001; Figure 2). A comparison of the subjects that exceeded this VASS is presented in Table II. Similarly, the incidence of lightheadedness was significantly more frequent in Group C, at each time point, with the exception of T15 (Figure 3).

Pain control

The addition of epinephrine to epidural sufentanil statistically and clinically extended the duration of pain control. Time to request for additional analgesia after initiation of the epidural was significantly (*P* = 0.012) longer in the epinephrine group (30%). The duration in Group E was 120 $\pm$ 56 min while in Group C it was 84 $\pm$ 32 min (Figure 4). There was no difference in the reduction of VASP between groups. The results are presented in Figure 5.

Maternal questionnaire

Thirty-nine mothers (19 in Group C, 20 in Group E) completed a maternal questionnaire on the first post-partum day. They rated their satisfaction with pain control, the presence of side effects and if these side effects

TABLE I Subject demographics

	Group C (n=22)	Group E (n=21)
Age in yr $\pm$ SD	26.1 $\pm$ 5.3	27.6 $\pm$ 4.6
Cesarean section	5	5
APGAR <7 (at one or five minutes)	4	3
Dilation >5 cm at analgesia	6	8
Oxytocin use	16	16

Results show the number of subjects or neonates in which the condition occurred. There were no inter-group differences.

TABLE II Deep sedation (VASS >55) and the relationship to initial sedation (VASS at T0)

Group	Number of subjects reporting a VASS > 55 at any time during the study	Number of subjects reporting both a VASS >55 and a VASS >40 at T0	Number of subjects reporting both a VASS >55 and a 50% increase in VASS over T0	Mean VASS at T0 for those reporting a VASS >55 (group mean)	
Epinephrine	9	6	3	40 $\pm$ 23	(25 $\pm$ 25)
Control	21	5	17	22 $\pm$ 17	(24 $\pm$ 22)

All subjects in this Table reported a visual analog scale for sedation (VASS) >55 during the study period. Mean VASS was calculated by summing VASS scores at time 0 and averaging the totals.

FIGURE 1 Number of subjects reporting a greater than 50% increase in visual analog scale for sedation following epidural sufentanil.

FIGURE 2 Number of patients experiencing significant sedation, a visual analog scale for sedation greater than 55.

were tolerable. The final question asked whether or not they would choose this method of pain relief in the future. The results are presented in Table III.

Maternal and fetal monitoring

During the study, maternal O_2 Sat, RR, and BP were measured. There was no difference in RR, BP, pruritus, nausea, maternal O_2 Sat or fetal bradycardia between groups. These results are presented in Table IV. Maternal desaturation to 93% or less occurred in five subjects (23%) from Group C and six (28%) of Group E subjects. FHR decelerations were observed in five Group C subjects (23%) and four subjects (19%) from Group E. Table V shows the association of maternal desaturation and FHR decelerations. Back pain on injection of sufentanil was significantly greater ($P < 0.021$) in Group E (five in Group E vs 0 in Group C).

TABLE III Results of maternal questionnaire on the first post-partum day

Question (n=21)	Group C (n=20)	Group E
Maternal satisfaction with analgesia (adequate or good)	19	21
The presence of undesirable side effects	14	9
Subjects would choose this method again (yes)	15	18

To assess analgesia subjects were asked to rate their pain relief as 1=inadequate; 2=adequate; and 3=good. A response of 2 and 3 were combined to indicate those satisfied with their analgesia. The presence of side effects was determined by asking if undesirable side effects were 1=present, 2=absent, or 3=present but tolerable; 1 and 3 were combined to indicate the presence of undesirable side effects. To assess whether or not the subject would choose this method again, the subject could choose between 1=yes, 2=no, or 3=not sure; 2 and 3 were combined to indicate no. Not all subjects completed a questionnaire.

TABLE IV Effects and side effects of epidural sufentanil for labour analgesia

	Group C (n=22)	Group E (n=21)
VASS >55*	21	9
O_2 Saturation <93%	5	6
FHR <100	5	4
Restart of epidural	1	2
VASP < 25	13	16
Pruritus	15	14
Nausea	2	4
Back pain on injection**	0	5

Results show the number of subjects or neonates in which the condition occurred. Clinically significant sedation was set as a visual analog scale of sedation (VASS) >55/100. Effective pain control was set as a visual analog scale of pain (VASP) <25/100. There was more back pain on injection of sufentanil in Group E. FHR=fetal heart rate. * P value <0.001. ** P value <0.021.

Discussion

Both sufentanil and epinephrine have been utilized in epidural labour pain management.^{2,4,16-18} In this study the addition of epinephrine to sufentanil reduced the number of subjects reporting sedation and lightheadedness in the first 45 min after epidural initiation. The number of subjects reporting a greater than 50% increase in VASS was significantly higher in the control group. The same was seen for an absolute VASS greater than 55. The degree of sedation between the groups is further highlighted by the fact that in the subset of those subjects that exceeded a VASS of 55, there was a difference in the mean VASS at T0 between the study groups. The mean VASS at T0 in the epinephrine group is 40 ± 23 compared to 22 ± 17 in the control group. The mean VASS at T0 for each

FIGURE 3 Number of subjects reporting lightheadedness after epidural sufentanil.

FIGURE 4 Duration of analgesia following epidural sufentanil with or without epinephrine.

population was 25 ± 25 in Group E and 24 ± 22 in Group C. A VASS of 55 was chosen to indicate deep sedation because subjects in another study assessing propofol sedation for regional anesthesia reported this VASS (55) when a $0.7 \text{ mg} \cdot \text{kg}^{-1}$ bolus was given followed by a $4 \text{ mg} \cdot \text{kg}^{-1} \cdot \text{hr}^{-1}$ infusion. This VASS of 55 correlated to an observer VASS of 73.¹⁵ We attribute the measured increase in sedation to be secondary to higher systemic absorption of sufentanil in the control group. This is of significance if patients wish to be ambulatory. Additionally, deep sedation may alarm the parturient or her labour partner(s).

Sufentanil administered into the epidural space potentially exerts its analgesic effect through spinal cord receptors located in the substantia gelatinosa,^{17,19} but the possibility of supraspinal action, via CSF or

FIGURE 5 Patients reporting a 50% reduction in visual analog scale for pain following epidural sufentanil with and without epinephrine.

systemic circulation, needs to be considered.¹⁰ Stevens *et al.*, using dogs²⁰ has shown a rapid rise in lumbar and cisterna magna CSF levels of sufentanil following large epidural doses. The investigators concluded that high levels of sufentanil in the central CSF cannot be explained by systemic uptake, since concentrations in the cisterna magna were 1/12 that of lumbar levels, but six times greater than those of the plasma. This suggests that analgesia (and side effects) may occur at the supraspinal level and are due to cephalad migration in the CSF, not vascular delivery. Klepper *et al.* studied the impact of epinephrine on epidural sufentanil in human volunteers.⁷ No difference in plasma sufentanil levels was evident whether epinephrine was used or not. They concluded that there was no change in systemic levels when epinephrine was utilized. Our data supports decreased systemic uptake and less central CNS effect, since side effects actually decreased and analgesia improved with the addition of epinephrine. Neither the Klepper⁷ nor the Stevens²⁰ study involved pregnant subjects, where an increased epidural vasculature may explain the effect of epinephrine in our study. Furthermore, the decrease in CNS side effects with epinephrine does not suggest CSF migration of sufentanil as in the dog study, but this may be explained on the basis of the larger dose of sufentanil per kilogram used by Stevens.

Studies in postoperative subjects have demonstrated that significant plasma levels occur following epidural administration of sufentanil. The investigators were unable to demonstrate any difference in pain scores when the same dose of sufentanil was given

TABLE V Association of maternal hypoxia and fetal heart rate decelerations

Group	Number of subjects with at least one recorded O_2 Sat <93%	Total number of data points where O_2 Sat <93%	Number of subjects with at least one recorded FHR <100	Coincident O_2 Sat <93% and FHR <100
Epinephrine	6	6	4	1
Control	5	11	5	1

Total number of data points refers to total number of entries where the oxygen saturation (O_2 Sat) was recorded as less than 93%. For each individual there were 7 data points for each variable. FHR=fetal heart rate.

either intravenously or epidurally.^{8,21} These findings have led some clinicians to question the concept of a spinal cord effect with lipid soluble epidural opioids, and suggest that any improvement in analgesia is secondary to systemic uptake. To distinguish between systemic effect and direct spread in CSF, and any impact the addition of epinephrine has on systemic levels, plasma sufentanil levels would be required. We decided against this because of the lack of acceptability to subjects.

It is common for sedation to occur following epidural initiation, especially when opioids are used.¹³ The proposed mechanisms for these side effects include, 1) systemic uptake^{2,7,11,21,22} or 2) cephalic spread in the CSF.^{13,23} Individually or together, these two mechanisms can also lead to respiratory depression as sufentanil reaches opioid receptors in the respiratory centre. The resulting rise in carbon dioxide may itself lead to sedation.¹³ Our study suggests systemic uptake to be the mechanism responsible in the pregnant subject.

If epinephrine, through its vasoactive properties, decreases the systemic uptake there are four potential outcomes: 1) sufentanil is absorbed into the epidural fat resulting in less systemic side effects but little or no change in analgesia; 2) increased delivery of sufentanil to the CSF with decreased side effects and increased analgesia; 3) increased delivery of sufentanil to the CSF; and decreased side effects, but no change in analgesia, because of a “ceiling effect” to increasing dose; and 4) increased delivery of sufentanil to the CSF with improved analgesia, but paradoxically, an increase in CNS depressive side effects secondary to high supraspinal concentrations of sufentanil. Our data suggest the second outcome was occurring.

Duration of analgesia was prolonged (84 vs 120 min) with a trend towards greater intensity, and faster onset at the various data points. This suggests that epinephrine increases sufentanil concentrations available to the spinal cord. The number of subjects reaching an absolute VASP of less than 25 appears to be greater in Group E. The lack of a statistical difference between

groups on pain scores five to 45 min post-injection, may indicate that epidural sufentanil with or without epinephrine will produce good analgesia, or that a larger sample size is required. Other causes of poor analgesia include technical failure, that is, the epidural catheter is not in the epidural space. There was one restart of an epidural in Group C and two in Group E. Advanced or rapid labour²⁴ requires more intense analgesia. Six subjects in Group C and eight in Group E had their epidural placed with a cervical dilation of greater than 5 cm. Can sequestration of sufentanil in the epidural fat produce less than satisfactory analgesia? Hansdotir *et al.* provided some evidence for this when they found lower than expected CSF levels when plasma concentrations were taken into account and inferred that the unaccounted sufentanil was bound in the epidural space.²⁵

It is possible that any changes in VASP may be due to the α_2 agonist effect of epinephrine.^{3,17} We are aware of one animal study²⁶ which concluded that epidural epinephrine is metabolized by the dura of pigs and monkeys therefore limiting its transfer into the CSF. This finding makes it seem unlikely that the added epinephrine had any impact on the recorded pain scores.

Oxyhemoglobin desaturation to less than 93% occurred in each group, five in Group C and six in Group E with no clear correlation to sedation. An O_2 Sat of 93% is clinically relevant because manufactures of these monitors report an error of $\pm 2\%$.¹⁴ Therefore a reading of 93% may represent a real O_2 Sat of 91%. At 90% the PaO_2 approximates 60 mmHg. This is the steep part of the oxygen dissociation curve where small decreases in PaO_2 result in relatively large decreases in hemoglobin saturation. A potential consequence of this reduced oxygen content is a subsequent decrease in delivery of oxygen to the uteroplacental unit. This degree of desaturation occurred in both groups, but the number of data points recorded where the O_2 Sat was less than 93% is greater in the control group. No subject had a recorded RR of less than 12 beats·min⁻¹. Other investigators have demonstrated that RR is a less

sensitive measure of respiratory depression^{1,3} than the carbon dioxide response curve. However, the carbon dioxide response curve is not easily applied in the clinical situation. O₂Sat monitoring is not a routine part of labour analgesia but Porter *et al.*²⁷ have shown maternal desaturation occurs during epidural labour analgesia when fentanyl (2.5 µg·mL⁻¹) is used compared to bupivacaine alone. Bourne *et al.*²⁸ were able to show that 25% of pregnant non-labouring subjects desaturate to an O₂ Sat <90% at night. This suggests that oxygen desaturation may occur on labour and delivery wards, especially when epidural opioids are used.

Muscle rigidity or leg pain has been reported with intrathecal sufentanil.^{29,30} The mechanism of this is unknown. In our study, five parturients in the epinephrine group described moderately severe back pain on injection of the sufentanil dose. On further questioning, it appears that the pain was in the lumbar region and was coincident with a contraction. In some subjects there was a subjective sense of increased uterine activity, possibly indicating a hypertonic state. However, there was no demonstration of fetal bradycardia associated with this back pain. We are uncertain of the significance of these findings, but epinephrine may accentuate the action of sufentanil with respect to this side effect.

Fetal bradycardia following epidural/CSE analgesia has been described with an incidence of approximately 10 to 25%.^{31,32} The etiology of these events during times of stable maternal hemodynamics remains unclear. Rapid pain relief and decreased endogenous epinephrine relative to norepinephrine has been suggested as the mechanism for uterine hypertonus leading to fetal bradycardia.³¹ In this study, if fetal bradycardia occurred, it did so without a fall in BP and no definitive evidence of a hypertonic state by uterine tocometry. Fetal bradycardia may also be due to fetal hypoxia secondary to maternal hypoxemia. In this study O₂ Sat was recorded continually for one hour. A total of 11 mothers, five in Group C and six in Group E, had at least one recorded O₂ Sat of less than 93%. Two subjects in this subset had a deceleration in FHR with a coincident low O₂ Sat. Subject nine in Group E had an O₂ Sat of 92% recorded in the T30–T45 interval. At this time, variable FHR decelerations to 80 beats·min⁻¹ were recorded. O₂ Sat and FHR recovered with positional change and supplemental O₂ as per the protocol for fetal bradycardia. Subject 36 in Group C experienced a fall in O₂ Sat to 90%, observed over the T15–T45 min interval; there were also variable FHR decelerations to 90 beats·min⁻¹. Treatment included supplemental O₂, positional change and cessation of oxytocin. There were no operative deliveries as a result of FHR changes within the study period.

The maternal questionnaire administered on the first post-partum day confirmed that the majority of subjects in our study were satisfied with their pain management, and that the side effects, when present, were tolerable to the parturients.

Epidural sufentanil as a sole agent for labour analgesia raises some interesting issues. At present, methods of labour analgesia are capable of producing safe, high quality pain control with minor side effects while maintaining motor function. Epidural sufentanil in the dose we have used, produced good pain control, maintained motor function, and had a side effect profile that was acceptable to parturients. Additional advantages include: 1) no necessity for dural puncture; 2) a useful alternative for short-term pain relief in patients allergic to local anesthetics; 3) a means of improving analgesia in a less than satisfactory epidural; or 4) an aid in managing first to second stage transition of labour. However, large doses of such a potent medication deserves special consideration with respect to intravascular or intrathecal injection. Injection must be done carefully, in divided doses and with oxyhemoglobin saturation monitoring. Ten micrograms of intrathecal sufentanil will produce rapid analgesia in someone with first stage labour.⁹ Ten micrograms of intravascular sufentanil will also have a rapid analgesic effect and may itself serve as a test for intravascular injection, as Morris demonstrated with fentanyl.^{3,3} This same 2.5 mL bolus contains 12.5 µg of epinephrine and will increase maternal heart rate. Like any technique involving relatively large doses of opioid in neuraxial analgesia, an opioid antagonist must be readily available.¹²

We conclude that the addition of 50 µg of epinephrine to 40 µg of sufentanil diluted to 10 mL for epidural labour analgesia increases intensity and duration of analgesia while decreasing side effects, specifically the incidence of lightheadedness and sedation. This provides a good level of analgesia for the parturient without motor blockade and avoids the necessity for dural puncture. In addition, a marker for intravascular injection is available. It is, however, not without its drawbacks. Most significant is the short-lived mild hypoxia noted in 25% of our subjects. We therefore recommend that this technique requires O₂ Sat monitoring and the availability of naloxone. The incidence of side effects was tolerable to the majority of mothers in our study.

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