# Clinical Experience of Epidural Fentanyl for Labor Pain

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Several opiate receptor sites have been identified in the substantia gelatinosa in the dorsal horn grey matter of spinal cord by autoradiography[1]. Since then, it has been shown that the transmission of pain can be blocked at a spinal cord level by intrathecally[2] and epidurally[3] injected opiates. Thereafter, intrathecal and epidural injection of morphine has been used widely to relieve acute and chronic pain. Interest has focused recently on the efficacy of intrathecal and epidural morphine in relieving the labor pain. For example, Scott et al.[4] and Abboud et al.[5] reported that intrathecal administration of morphine eliminated the labor pain. In contrast Hughes et al.[6] and Husemeyer et al.[7] reported that the epidurally administered morphine did not abolish labor pain. These findings were attributed to the increased vascularity of the epidural space in pregnancy is causing rapid clearance of epidurally injected morphine so that effective concentrations of morphine in the cerebrospinal fluid and spinal cord are not reached. Moreover, these have been also attributed to low lipid solubility of morphine. Epidural and intrathecal administration of morphine are associated with high incidence of pruritus, nausea, vomiting and somnolence. Fentanyl, being more lipophilic than morphine, can diffuse readily across the dura into the subarachnoid space[8] and hence may produce better analgesia. Also, being less hydrophilic than morphine, it is less likely to remain in the cerebrospinal fluid in concentrations capable of producing side effects. In the present clinical trial we investigated the efficacy and safety of smaller doses of fentanyl for relieving labor pain.

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## Materials and Methods

Five healthy parturients, free of maternal or pregnancy associated disease were invited to participate in the study. The study was approved by the Human Research Committee and informed consents were obtained from all patients. During the active phase of labor, all parturients received 50 μg of fentanyl in 10 ml of normal saline through a lumbar epidural catheter. All the patients had ruptured membranes and had direct, electronic monitoring of the fetal heart rate. Uterine activity was evaluated by an intrauterine fluid-filled catheter connected to a pressure transducer. Pain intensity and relief were evaluated using the visual linear analogue scale, also an investigator independently assessed pain intensity and relief. Maternal vital signs and the incidence of side effects were recorded just before injection of fentanyl, then post injection every 15 min for 1 hr, and every 30 min until delivery. Thereafter, hourly observations were made up to 24 hours. Maternal venous blood gases were obtained prior to fentanyl injection and every 4 hours after infection

Table 1. Acid base and blood gas data

| | |
|---|---|
| Maternal vein | |
| No. | 4 |
| pH | 7.43 ± 0.01 |
| $Po_2$ (mmHg) | 61.5 ± 11.8 |
| $Pco_2$ (mmHg) | 24.0 ± 2.1 |
| Base excess (mEq/l) | −7.8 ± 0.6 |
| Umbilical vein | |
| No. | 4 |
| pH | 7.36 ± 0.02 |
| $Po_2$ (mmHg) | 29.0 ± 2.9 |
| $Pco_2$ (mmHg) | 30.3 ± 4.2 |
| Base excess (mEq/l) | −7.5 ± 2.5 |
| Umbilical artery | |
| No. | 4 |
| pH | 7.30 ± 0.01 |
| $Po_2$ (mmHg) | 18.0 ± 1.6 |
| $Pco_2$ (mmHg) | 38.3 ± 2.0 |
| Base excess (mEq/l) | −6.0 ± 1.4 |

Values are mean ± SE.

until time of delivery. At the time of delivery, blood was drawn from a maternal vein and from the umbilical artery and vein of a doubly clamped segment of the umbilical cord for the analysis of blood gas tensions.

Neonates were evaluated by Apgar scores at 1 and 5 min, umbilical venous and arterial blood acid-base status, and by the Neurologic and Adaptive Capacity Scoring System (NACS) at 15 min, 2 hr and 24 hr after birth, according to previously described protocol.[9]

## Results

Maternal age was 22.2 ± 1.7 ($\bar{X}$ ± SE), weight 68.7 ± 3.6 kg. Two patients were primigravida and 3 were multigravida.

All parturients had good pain relief with an onset of 8 ± 2 min ($\bar{X}$ ± SE) and duration of 134.3 ± 19.8 min (fig. 1). Two patients received second doses of 50 μg of fentanyl in saline with a duration of analgesia of 60 min in both cases. Analgesia was maintained as necessary using 2 ml increments of either 0.5% bupivacine or 1.5% lidocaine in all patients.

## Maternal Side Effects

None of the patients experienced any side effects or changes in vital signs. Respiratory depression (less than 10 breaths/minutes or blood gases indication hypoventilation) was not observed in any patient (table 1).

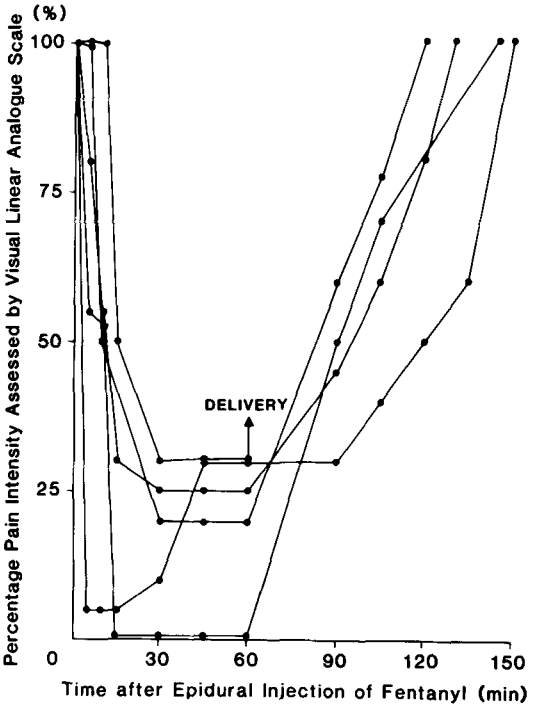


Fig. 1. Maternal pain relief after epidural administration of 50 μg of fentanyl in 10 ml of saline

## Effects on Newborn

All of the neonates had Apgar scores of 7 or more at 1 and 5 minutes. Umbilical artery and vein acid-base and blood gas status were within normal limits in all cases (table 1). All infants tested were neurologically vigorous at 24 hours, that is the NACS were 35 or more (maximum score being 40).

## Discussion

Epidural administration of morphine has been widely used to relieve acute and chronic pain. However, the epidural injection of morphine did not abolish labor pain[6,7]. On the contrary, intrathecal administration of morphine eliminated labor pain[4,5]. Morphine has three polar groups, one basic and two weakly acidic and has a low lipid solubility resulting in slow lipid membrane penetration. Therefore, morphine has been effective when given intrathecally in obstetrics thus bypassing the dura. Fentanyl was chosen because of its high lipid solubility and high receptor affinity. Fentanyl

is much less hydrophilic than morphine so it is less likely to remain in the cerebrospinal fluid in concentrations capable of producing delayed respiratory depression. In this study, 50 μg of epidural fentanyl provided good pain relief with rapid onset, relatively short duration of action and no maternal or neonatal side effects. However, epidural fentanyl alone does not seem to be adequate for labor analgesia due to its short duration of action. Justins et al.[10] reported that epidural fentanyl combined with small doses of local anesthetics can produce good analgesia of long duration during the first stage of labor. We conclude that epidural administration of fentanyl was safe and effective in providing good pain relief with rapid onset, relatively short duration of action, and without any adverse effect on the mother, fetus or the neonate. These findings might have implications in high risk patients in which a hypotensive response after epidural local anesthetics might be detrimental to the mother and the neonate.

Work was done at the Departments of Anesthesiology, and Obstetrics and Gynecology, Los Angeles County-University of Southern California Medical Center.

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