Does Labor Pain And Labor Epidural Analgesia Impair Decision Capabilities Of Parturients

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Citation

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Abstract

The objectives in this study were two folds: First to assess intellectual function of the parturient during the first stage of labor, before and after labor epidural analgesia. Second was to evaluate the effects of neuraxial fentanyl on cognitive functions, immediately after its administration and after several hours of continuous epidural infusion.

Forty-one patients admitted with the diagnosis of intrauterine pregnancy
(IUP) in labor were selected. Patients were in the first stage of labor (latent or active) with moderate to severe labor pain, and requested epidural analgesia. Twenty three patients had combined spinal epidural (CSE) and eighteen patients had epidural analgesia (EA). Patients remained in the study if they delivered vaginally. Cesarean deliveries were excluded since the surgical intervention itself could impair cognitive functions.

Each patient performed a Mini Mental Status Examination (MMSE) before the combined spinal epidural or epidural analgesia. Pain score on visual analog scale (VAS) was also recorded. The MMSE was repeated after analgesia administration, when the patient was comfortable, and again at the end of the labor when removing the epidural. A MMSE of 24 or higher was considered normal.

Statistical analysis was performed using the primer of biostatistics software. The
unpaired student's t test was used to analyzed data for age, height, weight, and estimated gestational age. Repeated measures ANOVA were used to analyze MMSE scores before and after CSEA or LEA and at the time of removal of catheter.

Thirty patients completed the study. There was no statistical difference in MMSE scores before and after CSEA or LEA, and at the time of removal of epidural catheter.

INTRODUCTION

The ability of patients to make informed healthcare decisions, including the decision to undergo potentially invasive forms of treatment has been an ethical issue in obstetric anesthesia. Timing of consent for peridural labor analgesia is considered by some to be an ethical dilemma, postulating that pain clouds a patient's ability to make a rational decision. Furthermore, the use of opioids during all forms of labor analgesia has called into question the ability of a patient to then make a ration decision to undergo cesarean section or tubal ligation.

Acute pain invokes deleterious physiologic changes, including disturbances of respiratory, cardiac, renal, gastrointestinal and central nervous system functions ([1]). Kewman and Brown demonstrated a strong relationship between pain and poor cognitive function ([2], [3]). Iezzi reported that pain patients with high emotional distress experienced more neurocognitive difficulties with intellectual tasks, immediate and delayed recall of verbal and nonverbal material, abstract thinking and problem solving, and cognitive efficiency than those with low emotional distress ([4])

Labor pain is severe and acute with both visceral and somatic components. As labor progresses from latent to active phase, the pain increases. Parturients demonstrate correlating pain-related behaviors if analgesia is not provided. ([5]). A common method of labor analgesia is either traditional labor epidural (LEA) or combined spinal epidural analgesia (CSEA). Both techniques may employ lipophilic opioids such as sufentanil and fentanyl administered with local anesthetics. Opioids have been implicated in impaired cognitive function, particularly secondary memory retrieval ([6]). Fentanyl even at low plasma concentrations (2.5 ng/ml) may impair memory and behavioral performance ([7]).

Our objectives in this study were two folds: First to assess intellectual function of the parturient during the first stage of labor, before and after labor epidural analgesia. Second was to evaluate the effects of neuraxial fentanyl on cognitive functions, immediately after its administration and after several hours of continuous epidural infusion.

METHOD

Forty-one patients admitted with the diagnosis of intrauterine pregnancy (IUP) in labor were selected. The patients were in the first stage of labor (latent or active) with moderate to severe labor pain, and requested epidural analgesia. Twenty three patients had combined spinal epidural (CSE) and eighteen patients had epidural analgesia (EA). Baseline systolic, diastolic and mean arterial pressure, heart rate, and fetal heart rate were recorded. All patients received 500 ml of IV lactate ringer prior to administration of CSEA and LEA.

The patients remained in the study if they delivered vaginally. Cesarean deliveries were excluded since the surgical intervention itself could impair cognitive functions.

CSEA GROUP

Twenty-three patients had CSEA utilizing a needle-through-needle technique. Twenty mcg of fentanyl was injected intrathecally after which an epidural catheter was placed. Patients were then positioned supine with left uterine displacement (LUD). Three ml of 1.5% Lidocaine with 1:200,000 epinephrine was injected through the epidural catheter to rule out intravascular or intrathecal injection. Following a negative test dose, a continuous infusion of 0.1% of Levobupivicaine with 3.33 mcg of fentanyl/ml was started at a rate of 8-10 ml/hour. Six patients in the CSEA group were excluded from the study because of cesarean section secondary to arrest of active phase or nonreassuring fetal heart rate.

LEA GROUP

Eighteen patients had epidural analgesia only, using loss of resistance to air technique. After epidural catheter placement, patients assumed a supine position with LUD. Following a negative test dose, a total of 3 to 10 ml of 0.25% Levobupivicaine was titrated incrementally through the epidural catheter until patients achieved comfort. A continuous infusion of 0.1% of Levobupivicaine and 3.33 mcg of fentanyl/ml was started at a rate of 10 ml to 12 ml/hour. Five patients in the LEA group delivered by cesarean and were excluded from the study. Diagnoses for cesarean section in this group were arrest of active phase and non-reassuring fetal heart rate.

All study patients requiring additional pain medication received 3-10 ml of 0.25% Levobupivicaine through the epidural catheter. Decreases in systolic blood pressure 20% less than baseline or with symptoms were promptly treated with IV lactated ringers and ephedrine. Each patient performed a Mini Mental Status Examination (MMSE) before the combined spinal epidural or epidural analgesia (See table 1). Pain score on visual analog scale (VAS) was also recorded. The MMSE was repeated after analgesia administration, when the patient was comfortable, and again at the end of the labor when removing the epidural. A MMSE of 24 or higher was considered normal.

Figure 1

Table 1: MMSE

Question	Maximum Scores
Orientation What is the (year) (season) (date) (day) (month)? Where are we? (State) (County) (Town) (Hospital) (Floor)	One point for each correct answer, maximum of five. One point for each correct answer, maximum of five
Registration: Name three objects: One second to say each. Then ask the patient all three after you have said them	One point each correct answer, maximum of three
Attention and Calculation: Serial 7's: Subtracts 7 from 100 and keep doing it backward until five answers. Alternatively, spell "world" backward or name all the twelve months backward	One point for each correct answer, maximum of five.
Recalls: Ask for the three objects repeated above	One point for each correct answer, maximum three
Language: Name a pencil, and watch Repeat the followings: No if;s, and's or but's. Follow a 3-stage command: Take a paper in your right hand, fold it in half, and put it on the floor. **Read and Obey the following:** Close your eyes Write a sentence Copy the following design	One point for each correct answer, maximum two One point One point each, maximum of three One point One point One point if copied all ten surfaces and ten angles.

Statistical analysis was performed using the primer of biostatistics software. The unpaired student's t test was used to analyzed data for age, height, weight, and estimated gestational age. Repeated measures ANOVA was used to analyze MMSE scores before and after CSEA or LEA and at the time of removal of catheter.

RESULTS

Thirty patients completed the study. All patients were ASA I or II, with ages ranging from 19 to 34 years. There were no significant differences between the groups. (See table 2 for demographic data). Two patients (one patient from each group) were in latent phase stage one while all the others were in active first stage at the time CSEA or LEA. Latent phase begins with maternal perception of regular contractions, accompanied by progressive slow cervical dilatation and ends between 3 to 5 cm of dilatation. Rapid change in cervical dilatation defines active stage one, generally beginning when the cervix is 3 to 4 cm dilated. (See table 3)

Figure 2

Table 2: Demographics

	CSE	LA
Age (yr.)	23.28 +9.02	26.23 + 7.48
Height (cm)	150.42 + 38.07	156 + 7.45
Weight (kg)	80.83 + 20.94	84.38 + 4.82
ASA status I II	N 06 (35.29%) N 11 (64.70%)	N 7 (53.84%) N 6 (46.15%)
EGA (weeks)	38 + 0.90	38.21 + 0.69
Primagravidity	N 5 (29.41%)	N 5 (38.64%)
Multiparity	N 12 (70.58%)	N 8 (61.53%)

Figure 3

Table 3: Cervical dilatation

	CSE	LA
Cervical Dilatation		
1 – 3 cm	N 1	N 1
4 – 7 cm	N 13	N 10
8 – 10 cm	N 3	N 2

The average length of first stage labor in primigravida was 13.6 + 1.2 hours whereas in multipara it was 10.3 ± 1.45 hours. The average pain scores on VAS in both groups were 8,2, and 2 before, after, and at the time of catheter removal, respectively (see figure 1). The average time length of epidural infusion was ten hours in both group (see figures 2&3).

Figure 4

Figure 1:

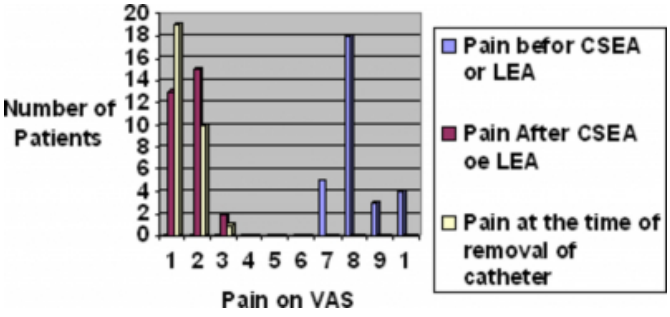


Figure 5

Figure 2:

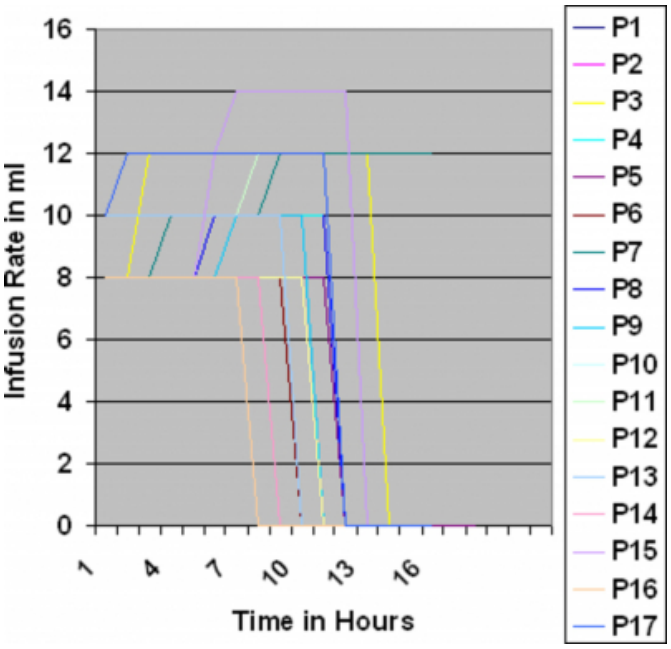
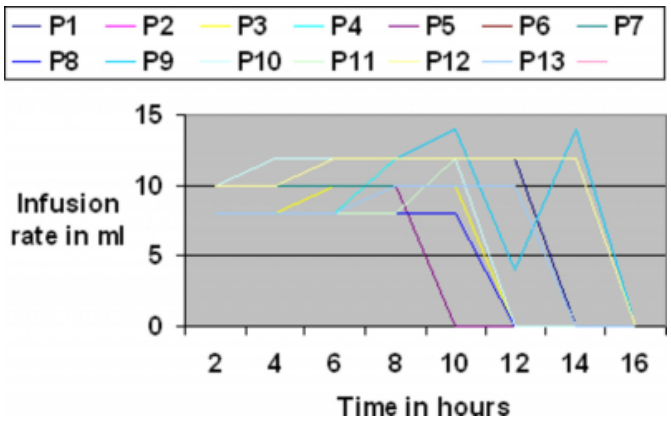


Figure 6

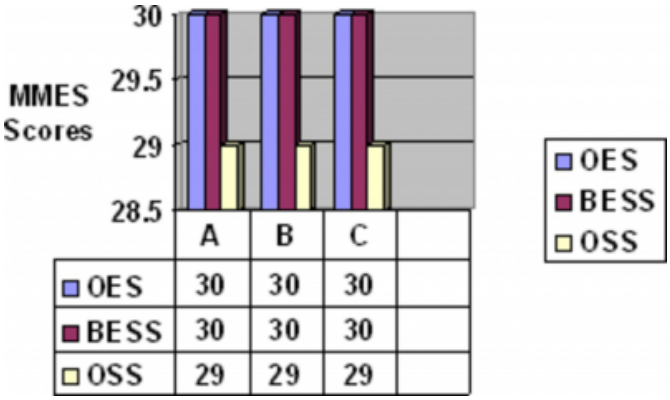
Figure 3:



Patients who spoke, read, and wrote English only, both English and Spanish, and Spanish only were 3, 9, and 5 respectively in CSEA group. In LEA group 2, 6, and 5 patients spoke, read, and wrote English only, both English and Spanish, and Spanish respectively. There was no difference in MMSE scores among them. Furthermore, there was no statistical difference in MMSE scores before and after CSEA or LEA, and at the time of removal of epidural catheter. (See figures 4 & 5).

Figure 7

Figure 4:

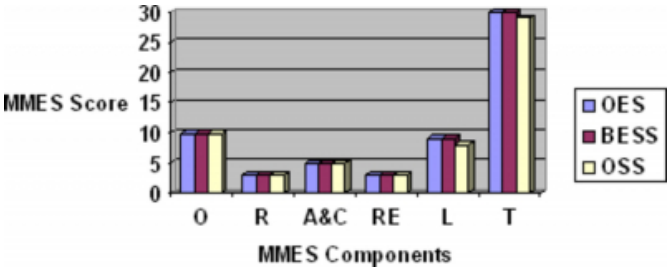


	A	B	C
OES	30	30	30
BESS	30	30	30
OSS	29	29	29

BESS = Both English & Spanish speaking
OSS = Only Spanish speaking
A = MMES scores before CSEA or LEA
B = MMES scores after CSEA or LEA
C = MMES scores at the time of removal of catheter
OES = Only English speaking

Figure 8

Figure 5:



MES Scores before CSEA or LEA
MMES Scores after CSEA or LEA
MMES at the time of removal of catheter
O = Orientation, R =Registration, A&C = Attention & Calculation, RE = Recall, L = Language, T = Total Score

The Spanish only in both CSE and LEA group scored 29 out of 30, because all had difficulty with repeating the “No ifs, and's or but's” language task. In the attention and calculation parts, equal numbers of patients ($_9$) in both CSEA and LEA had difficulty in completing Serial7's (that is subtracting 7 from 100,5 times) before, and after the labor analgesia. But all were able to successfully complete the alternatives, such as spell “world” backward or name all twelve months in reverse order within 15 seconds.

DISCUSSION

Pain is a complicated dynamic process, beginning with tissue injury leading to pain, suffering and eventually pain-

behaviors ([8]) . Nociception is a physiological process with a well-defined neural basis. Although pain is usually perceived in response to noxious stimuli, nociception does not necessarily lead to pain, nor does all pain rely upon nociception. Suffering, a negative affective response starts after the patient perceives pain. However suffering may not always require the presence of pain. Pain behaviors such as moaning, screaming, splinting, complaining of pain, seeking compensation and attention, are results of suffering but may occur in the absence of pain or conversely may not occur in the presence of pain. ([9])

Pain has long been considered a central experience of labor while its mechanism is complicated and perhaps not well understood. It results from a complex interaction of hormones, neuronal network (particularly the autonomic nervous system), and local Ischemic/hypoxic changes in the uterus. Labor pain begins with contractions and ends with fetal/placental delivery. Melzack reported that in primiparas, 60% had severe or extremely severe pain, 30% had moderate pain and only 10% had mild pain. In multiparas 45% had severe or extremely severe pain, 30% had moderate pain and only 25% had mild pain ([10]). Another study on labor pain intensity in Scottish women who are known for their stoicism, reported that 60% had the most intense pain that they had ever experienced ([11]).

Cognitive functions impairment during pregnancy and postpartum periods have been documented. One study found a pregnancy related decline in memory during third trimester ([12]) while another reported that pregnant women have normal cognitive capabilities, but may be more affected than usual by high cognitive loads ([13]). Parturients increasingly express pain behavior and agitation as the labor progresses from latent to active phase, but after the administration of peridural analgesia such behavior substantially decreases ([5]). Studies have also found a relationship between subjective pain and distress with cognitive activities, particularly in latent labor ([5,14]).

In this study we tried to determine if labor pain and neuraxial fentanyl affect intellectual functions of the patient. We used MMSE to evaluate orientation, registration, attention, calculation, recall, and language.

Orientation to time and place is a function of a complex interaction between cortex and limbic system. The limbic system includes hippocampus, amygdala, anterior and medial nuclei of the thalamus, medial and basal parts of the striatum, and the hypothalamus. This area coordinates emotion, motivation, autonomic tone and endocrine function. Despite the fact that laboring parturients display highly emotional behavior, none of our participants failed to answer questions regarding orientation for time and place. One animal study showed that fentanyl decreases the cerebral blood flow particularly to the limbic system structures ([15]). Schneider and Bevilacqua reported that fentanyl in concentrations commonly used in out-patient surgical procedures produces pronounced cognitive impairment (auditory reaction time, signal detection, sustained attention, recognition) in comparison to placebo ([16]). We did not find any sign of impairment of orientation to time and place secondary to neuraxial fentanyl.

Registration is an assessment of global mental status. Intense emotional stimulus or psychological exertion can cause transient global amnesia, which is characterized by sudden onset of anterograde memory and learning ability loss. ([17]) In our study most patients had labor pain-related intense psychological exertion but none had any signs of registration failure to new information. Fentanyl can affect cholinergic neurons decreasing release of acetylcholine (ACh) particularly in the hippocampus, which is related to memory ([18]).Our study failed to show impairment of registration function with neuraxial use of fentanyl.

Attention and calculation broadly assesses the frontal lobe. Frontal lobe function includes maintenance of transient on-line information (working memory), concentration span, verbal fluency, scanning and retrieval of stored information, inhibition of immediate inappropriate responses, and mental flexibility .One study found significantly lower scores on working memory tested in primigravid and primiparous patients ([19]). In our study we did not find any evidence of working memory impairment .All parturients in both groups successfully completed the attention and calculation task. Although nine patients in each group failed to do serial 7' s, they were able to recite the twelve months in reverse within 15 seconds. Despite the fact that IV fentanyl impairs cognitive functions, we could not find the same effects with the neuraxial fentanyl. Recent or secondary memory is retentive memory and requires proper limbic system function.

Sharp showed that during pregnancy there is a significant impairment of memory as tested by recall ([20]) .Our results refute impairment of short-term recent memory by recall during labor pain and after the use of neuraxial fentanyl.

The neural network for language is distributed in the

perisylvian region of the left hemisphere, the anterior and posterior parts of which are known as Broca's and Wernicke's areas respectively. Language examination on MMSE includes assessment of naming, spontaneous speech, comprehension, repetition, reading and writing. None of our patients failed the language tasks although the Spanish-only patients had difficulties in repeating the English axiom portion of the MMSE.

The MMSE is not designed to detect specific mental impairment and it may be influenced by culture and education, it is an easily administered and accepted cognitive function screening test.

In conclusion, neither labor pain nor neuraxial fentanyl interfere with higher intellectual functions of parturients. We did not find any correlation between labor pain and impairment of cognitive function on MMSE.

References

1. Crews JC. Acute pain syndromes. In Raj PP. 3rd ed Practical management of
pain. Mosby St. Louis 2000 pp 170 -171.
2. Kewman DG, Vaishampayan N et al. Cognitive impairment in
musculoskeletal pain patients. Int J Psychiatry Med 1991; 21:253-62
3. Brown SC, Glass JM, Park DC. The relationship of pain and depression to cognitive function in rheumatoid arthritis patients. Pain 2002; 96: 279-84.
4. Iezzi T, Archibald Y, Barnett P et al. Neurocognitive performance and
emotional status in chronic pain patients. J Behav Med 1999; 22: 205-16.
5. Wuitchik M, Bakal D. Relationships between pain, cognitive activity and
epidural analgesia during labor. Pain 1990; 41: 125 -132.
6. Hanks GW, O'Neill WM et al. The cognitive and psychomotor effects of
opioid analgesics. II. A randomized controlled trial of single doses of
morphine, lorazepam and placebo in healthy subjects. Eur J Clin Pharmacol
1995; 48: 455- 60.
7. Veselis RA, Reinsel et al. Impaired memory and behavioral performance with
fentanyl at low plasma concentrations. Anesth Analg 1994; 79: 952 -60.
8. Loeser ill, Cousins MI .A conceptual approach to the components of pain.
Contemporary pain management. Med. I. Aust. 1990; 153: 208.
9. Bonica II, Haddox ID. Evolution of the specialty of pain medicine and the
multidisciplinary approach to pain. In Cousins MI. 3rd ed. Neural blockade in
clinical anesthesia and management of pain. Philadelphia Lippincott-Raven.
1998, pp 1116-1117.
10. Melzack R, Taenzer P. et al. Labor is still painful after prepared childbirth
training. Can. Med. Assoc. 1.1981; 125:357.
11. Niven C., Gijsbers K. Obstetric and non-obstetric factors related to pain. I.
Reprod.lnfant Psychol., 1984; 2:61.
12. Keenan P A, Yaldoo DT. Explicit memory in pregnant women. Am I Obstet
Gynecol1998; 179: 731- 7.
13. Casey P, Huntsdale C. Memory in pregnancy. II: Implicit, incidental, explicit,
semantic, short term, working and prospective memory in primigravid,
multigravid and postpartum women. I Psychom Obstet Gynaecol
1999; 20: 158- 64.
14. Wuitchik M, Bakal D. The clinical significance of pain and cognitive activity
in latent labor. Am I Obstet & Gynecol1989; 73:35-42.
15. Safo Y, Young ML, Smith DS. Et al Effects of fentanyl on local cerebral
blood flow in the rat. Acta Anaesthesiol Scand 1985 Aug;29(6):594-8.
16. Schneider U, Bevilacqua C, et al. Effects of fentanyl and low doses of alcohol
on neuropsychological performance in healthy subjects. Neuropsychobiology
1999; 39:38-43.
17. Mesulam MM. Aphasia and other focal cerebral disorders. In Harrison. TR
15th ed. Harrison's Principle of Intemals Medicine. McGraw-Hill New York
2001,pp152-154.
18. Sakai M, Fukuyama H. et al Effects of fentanyl on acetylcholine release from
hippocampus and righting reflex in rat: an in vivo brain microdialysis study
Masui 2002; 51:118-23.
19. lanes C, Casey P et al. Memory in pregnancy. I: Subjective experiences and
objective assessment of implicit, explicit and working memory in
primigravids and primiparous women. 1 Psychosom Obstet Gynaecol
1999; 20: 80-7.
20. Sharp K, Brindle PM. et al. Memory loss during pregnancy. Br 1 Obstet
Gynaecol1993; 100: 209 -15.

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