

## Low-dose spinal anaesthesia provides effective labour analgesia and does not limit ambulation

T Anabah<sup>a\*</sup>, A Olufolabi<sup>a,b,d</sup>, J Boyd<sup>c</sup> and R George<sup>c,d</sup>

<sup>a</sup>School of Medicine and Health Sciences, University for Development Studies, Tamale, Ghana

<sup>b</sup>Duke University Medical Centre, Durham, NC, USA

<sup>c</sup>IWK Health Centre, Dalhousie University, Halifax, Canada

<sup>d</sup>Kybele Inc., Winston-Salem, NC, USA

\*Corresponding author, email: [dranabah@gmail.com](mailto:dranabah@gmail.com)

**Background:** While epidural analgesia for labour pain is standard in high-resource countries, minimal to no analgesia is usually provided in low-resource countries. Intrathecal local anaesthetics provide good pain relief, but the potential impact on ambulation is of concern. Our objective was to determine if a low-dose local anaesthetic combined with an opioid would provide reasonable pain relief, while allowing ambulation in a low-resource setting.

**Method:** This prospective, observational study was conducted at the Tamale Teaching Hospital in Tamale, Ghana. Spinal analgesia was administered to healthy women in labour using a pencil-point 25-G spinal needle at the L3–L4 or L4–L5 interspace, with patients in the sitting position. The intrathecal mixture contained 25 µg of fentanyl, 2.5 mg of bupivacaine and 0.2 mg of morphine. The patient's ability to ambulate following the administration of a low-dose spinal injection was the primary outcome measured. Pain ratings, blood pressure, nausea, vomiting, pruritus, headaches and foetal bradycardia were also recorded.

**Results:** Three hundred and thirty-two parturients consented to participate. Following spinal injection, 328 women (98.8%) experienced mild to no pain, and 4 (1.2%) moderate pain. The administration of spinal analgesia had no effect on ambulation in 291 (87.7%) patients, and a mild effect in 41 (12.3%) patients. Intrathecal analgesia did not severely limit ambulation in any of the patients.

**Conclusion:** Low-dose intrathecal analgesia can provide effective analgesia for labouring patients in low-resource settings without limiting ambulation.

**Keywords:** ambulation, intrathecal, low-dose, low-resource, mobility

### Introduction

Epidural analgesia has been established as a highly effective method of providing pain relief during labour.<sup>1,2</sup> Unfortunately, access to epidural analgesia during labour is limited in low-resource countries.<sup>3</sup> While 85% of surveyed women in a developing country indicated they would request labour analgesia if available, only 40% received any analgesia in practice.<sup>4</sup> The cost of staff and supplies associated with providing epidurals can be prohibitive, with morphine costing up to 10 times more in low-resource settings than in the developed world.<sup>5,6</sup> With limited resources for epidural analgesia, spinal analgesia may be a useful alternative for relief from labour pain.<sup>7</sup> It has been suggested that spinal opioids provide effective analgesia during labour, with no adverse impact on the incidence of neonatal complications.<sup>8</sup>

A diverse body of literature exists on the potential advantages and disadvantages of spinal analgesia on patient ambulation. While ambulation is generally regarded as an important outcome to maximise parturient comfort and satisfaction, it also increases the intensity of uterine contractions and may improve the progression of labour.<sup>9–12</sup> Concern for patient safety regarding ambulation after regional analgesia is an important consideration owing to the potential reduction in lower limb power, as well as limitations in proprioception and subjective perception of ability.<sup>13–15</sup> This is supported by evidence that spinal analgesia limits ambulation more than epidural analgesia in non-pregnant patients.<sup>16,17</sup> However, low-dose combined spinal epidural for labour analgesia have been shown to protect muscle power and

improve patient satisfaction, compared to standard epidural analgesia.<sup>11,18</sup> Further evidence suggests that combined spinal-epidural analgesia does not impair balance function in labouring women.<sup>19,20</sup>

The suitability of intrathecal narcotics for labour analgesia in low-resource settings has been examined in previous reports, but their impact on mobility has not been considered.<sup>21,22</sup> Ambulation is particularly relevant in low-resource countries that often have separate labour and delivery rooms, requiring patients to walk from one to the other. Currently, an understanding of the impact of differing dosages of spinal analgesics alone on parturient ambulation is limited. We hypothesised that low-dose spinal analgesia would provide effective pain relief, while allowing ambulation in labouring parturients.

### Method

#### Patients

This prospective, observational study was performed at the Tamale Teaching Hospital in Tamale, Ghana. Ethics approval was obtained from the Northern Regional Health Directorate of the Ghana Health Service in Tamale. Labouring parturients without co-morbidities who requested labour analgesia were invited to participate. There were no exclusions in relation to maternal age, parity or gestational age, but patients were required to have a minimum 4 cm of cervical dilatation to participate. All patients provided informed, written consent prior to taking part in the study.

### Protocol

The anaesthetic technique was standardised. Spinal analgesia was administered using a pencil-point 25-G spinal needle at the L3–L4 or L4–L5 interspace, with the parturients in the sitting position. Patients were then placed in the left lateral position to minimise aortocaval compression and hypotension. The intrathecal mixture included 25 µg of fentanyl, 2.5 mg of bupivacaine and 0.2 mg of morphine. If, after the initial spinal injection, patients complained of pain and reported a Numeric Rating Scale (NRS) score of > 4, a second dose of spinal analgesia was available. The second spinal dose was made up of 25 µg of fentanyl and 2.5 mg of bupivacaine with no morphine, and was only administered at least four hours after the initial injection. A 2 µg/kg dose of naloxone hydrochloride was administered intravenously, as needed, to limit morphine-induced pruritus or nausea.<sup>23</sup> Hypotension was treated with 5–10 mg boluses of ephedrine, if needed. Patients were helped out of their beds by two people, and assisted when taking their initial steps. If they had no difficulty, they were cautioned to walk with care.

### Measures

Various demographic data were collected, including age, gravidity, parity and cervical dilatation. Blood pressure was recorded before, and five minutes after, the administration of spinal analgesia. The intensity of pain was assessed using an 11-point NRS (0 being no pain, and 10 being the worst possible pain) before and after the administration of spinal analgesia and categorised as “none” (0), “mild” (1–3), “moderate” (4–7) or “severe” (8–10). Pain was determined before the administration of an intrathecal injection and five minutes afterwards. Subsequent assessments were conducted when the patient reported significant pain. The effect of spinal analgesia on mobility was gauged 15 minutes after administration, both with a subjective assessment of numbness by the patient, and physical testing. The physical assessment required patients to raise each leg against gravity, while maintaining the knee extended to assess motor power. The ability of the patient to walk with or without assistance from the first-stage holding area to the second-stage room was also used to objectively determine the effect of the spinal injection on ambulation. The spinal injection was then categorised as having either “no effect”, “a mild effect”, or a “severe effect” on ambulation. A mild effect was defined as a feeling of numbness in the legs, but not interfering with the ability to walk; and a severe effect was defined as the inability to walk or ambulate.

The presence of nausea and/or pruritus were defined as an intensity of > 3/10 on the 11-point NRS scale (0 being no nausea or pruritus, and 10 being nausea or pruritus “as bad as you can imagine”). Episodes of foetal bradycardia were measured before birth using a foetal Doppler® ultrasound monitor. Foetal bradycardia was considered to be mild if the foetal heart rate (HR) was < 110 beats per minute, but ≥ 100 beats per minute; and severe if the foetal HR < 100 beats per minute. Foetal bradycardia was managed with additional oxygen, 500 ml saline boluses, salbutamol, and repositioning to the left lateral decubitus, as appropriate. Instances of a post-dural puncture headache and vomiting were recorded. The baby’s weight was recorded upon delivery. The data collection ended after the recording of an Apgar (appearance, pulse, grimace, activity and respiration) score at five minutes post delivery.

### Statistical analysis

Descriptive statistics are expressed as mean ± standard deviation, median (interquartile range), or *n* (%). The Student’s *t*-test was used for a comparison of the means of the continuous variables.

Statistical analysis was performed by the investigators using GraphPad Prism® version 5.0, and  $\alpha$  set at 0.05.

## Results

### Patients

Three hundred and thirty-five patients were enrolled in the study from 16 August 2010 to 11 October 2010. Three hundred and thirty-two completed the protocol. Three were excluded as they underwent Caesarean delivery. Therefore, data from 332 patients were included in these analyses. Twenty-eight patients (8.4%) required a second spinal anaesthetic. The patient demographic characteristics are shown in Table 1.

### Ambulation

The administration of spinal analgesia had no effect on ambulation in 291 (87.7%) patients, and a mild effect in 41 (12.3%) patients. The administration of spinal analgesia did not severely effect ambulation in any of the patients (Figure 1).

### Pain

Prior to the administration of spinal analgesia, 331 patients (99.7%) experienced severe pain, and 1 (0.3%) patient moderate pain. Following administration, 328 (98.8%) patients reported mild pain, and 4 (1.2%) moderate pain. None of the patients experienced severe pain (Table 2).

Table 1: Patient characteristics\*

Measure	Value
<i>n</i>	332
Age (years)	26.4 ± 5.6
Weight (kg)	69.7 ± 7.4
Cervical dilation (cm)	6 (5–7)
Gravidity	2 (1–3)
Parity	1 (0–2)
Received second injection	28 (8.4%)
Apgar (1 minute)	8 (7–8)
Apgar (5 minutes)	9 (9–9)

Apgar: appearance, pulse, grimace, activity and respiration  
\*: Values presented as mean ± standard deviation, median (interquartile range) or *n* (%)

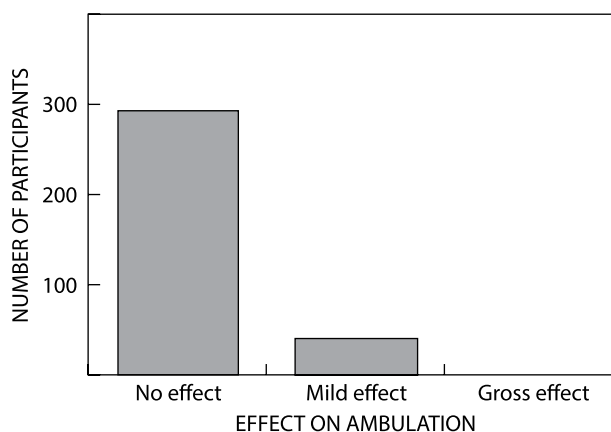


Figure 1: Ability to ambulate following the administration of spinal analgesia

**Table 2:** Intensity of pain before and after the administration of spinal analgesia

Time point	Mild, n (%)	Moderate, n (%)	Severe, n (%)
Pre administration	0 (0)	1 (0.3)	331 (99.7)
Post administration	328 (98.8)	4 (1.2)	0 (0)

### Side-effects

One hundred and four patients (31.3%) experienced pruritus, and 89 patients (26.8%) nausea following the administration of spinal analgesia. Thirteen patients (3.9%) experienced both pruritus and nausea. Of the 28 patients who received a second intrathecal injection, 18 (64.3%) reported either pruritus or nausea, or both. This subgroup did not experience side-effects at a statistically or clinically significantly different frequency from the 162 (53.3%) (of the 304) patients who received only one injection.

Forty-eight patients (14.5%) required the use of naloxone to treat pruritus or nausea, or both. Foetal bradycardia, following spinal analgesia, occurred in 12 cases (3.6%). There were no occurrences of a post-dural puncture headache (Table 3).

### Blood pressure

Systolic blood pressure was significantly ( $p < 0.001$ ) decreased from  $121.5 \pm 7.5$  mmHg before spinal analgesia to  $113.4 \pm 9.0$  mmHg post spinal anaesthesia. Similarly, diastolic blood pressure was significantly ( $p < 0.001$ ) decreased from  $78.1 \pm 9.2$  prior to spinal analgesia to  $71.0 \pm 7.7$  post-spinal analgesia (data not shown). Although the variations in blood pressure were statistically significant, they were not clinically significant, and did not require ephedrine therapy.

### Discussion

This study attempted to determine if low-dose spinal analgesia could provide effective relief from labour pain without limiting mobility. Although epidural analgesia is the standard of care in the developed world, spinal analgesia can be an appropriate substitute in low-resource settings.<sup>1,7</sup> Ghana, the site of this research project, is defined as a developing country.<sup>24,25</sup> Spinal analgesia is a relatively safe, easy and cost-effective procedure, when administered by an appropriate health practitioner, such as an anaesthetist. In addition, most anaesthetists are familiar with the spinal technique owing to its common use in operative deliveries. The caveat with respect to intrathecal narcotics for labour is that it is important to find an optimal dose that provides sufficient analgesia, while maximising mobility and minimising the side-effects.

This is the first study to consider the impact of spinal anaesthesia on parturient ambulation in a low-resource setting. Owing to limited resources, many hospitals in developing countries have separate labour and delivery rooms, and require patients to walk from one to the other immediately prior to giving birth. Thus,

**Table 3:** Side-effects following the administration of spinal analgesia

Measure	n (%)
Pruritus	104 (31.3)
Nausea and vomiting	89 (26.8)
Foetal bradycardia	12 (3.6)
Naloxone use	48 (14.5)
Post-dural puncture headache	0 (0)

mobility is of utmost importance. In addition to helping patients maintain their autonomy in the hospital setting and improving their satisfaction with labour, preserving patients' ambulation relieves hospital staff with few resources of a significant burden.<sup>9–12</sup> Spinal analgesia had no effect on ambulation in 291 of our patients, and only a mild effect on ambulation in the remaining 41 patients. None of the patients experienced a major impairment of their ambulation. Therefore, our results suggest that a low-dose intrathecal narcotic can provide sufficient analgesia, without being detrimental to parturient ambulation.

Most patients experienced severe pain before they requested for labour analgesia. This was reduced to pain of mild intensity (0–3/10) in almost all of the patients following the administration of low-dose spinal analgesia. Thus, we can extrapolate that generally this dose was largely effective in providing analgesia in this patient cohort. Previous reports on the use of a comparable intrathecal analgesic dose have shown and suggested the duration of analgesia to be approximately 110 minutes.<sup>5,26,27</sup> Although we did not explicitly record the duration of analgesia in this trial, only 28 (8.4%) patients in this study required a second intrathecal injection containing 25 µg of fentanyl and 2.5 mg of bupivacaine. This was administered a minimum of four hours after the initial injection and prior to delivery. Future studies should address current limitations of the specific duration of effective analgesia.

In this study, pruritus was the most common side-effect following an intrathecal injection, and experienced by 104 patients (31.3%). This is somewhat less than the > 50% prevalence reported in similar research.<sup>5,27</sup> In addition, 89 patients (26.7%) reported feeling nauseous, a frequency considerably higher than that suggested in previous reports.<sup>5,21,28</sup> However, of the 89 patients who reported nausea, only 21 requested naloxone treatment, suggesting that these patients did not experience excessive discomfort. Although a low-dose opioid or lipophilic opioid in the intrathecal injection might have reduced the patients' nausea ratings, it was important to maintain effective analgesia in these distressed patients.<sup>23,29</sup> None of the patients reported a post-dural puncture headache. Taken together, the relatively minor nature of the side-effects associated with the intrathecal narcotic injection support its feasibility as a safe and effective form of labour analgesia.

While only 12 (3.6%) of our patients experienced foetal bradycardia, each instance was treated vigilantly. Management included additional oxygen delivered via a face mask, 500 ml saline boluses, and repositioning into the left lateral decubitus position, as appropriate. Oxytocin infusions were decreased, if applicable, and salbutamol was available, although never required. Uterine hypertonia and maternal hypotension were suspected causes of foetal bradycardia. The manual palpation of the abdomen for uterine contraction was used to assess an improvement in uterine hypertonia. Vaginal examinations were performed to exclude cord prolapse. The abdominal tone was assessed to exclude uterine hypertonia.

The observational, prospective nature of this study limited our ability to make inferences about the findings. A similar study group receiving a higher or lower dose of an intrathecal narcotic would be a useful comparator to give more context to our findings with respect to ambulation. Also, as all of the intrathecal injections were performed by our team of four nurse anaesthetists, we are not able to comment on the generalisability of our findings to local clinicians. This may take on added relevance in a

low-resource setting, where analgesia may be provided by alternative health practitioners, such as anaesthetists and nurse anaesthetists.

### Conclusion

Our results suggest that low-dose intrathecal bupivacaine and intrathecal opioids can provide sufficient pain relief without reducing ambulation in labouring parturients. The intrathecal mixture used here, 25 µg of fentanyl, 2.5 mg of bupivacaine and 0.2 mg morphine, appeared to provide effective analgesia and mobility. However, there were significant side effects, mainly attributable to the intrathecal morphine. Future research could employ a reduced morphine dose to improve the side-effect profile of this analgesic regimen. In trained hands, spinal analgesia is a relatively simple and cost-effective procedure that can be used for labour analgesia in place of epidural anaesthesia in low-resource settings.

**Conflict of interest** — The authors declare that they have no financial or personal relationships which may have inappropriately influenced them when writing this paper.

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