Extradural analgesia in labour: complications of three techniques of administration

S. TAN, J. REID AND J. THORBURN

Summary

We have studied the complications associated with three techniques used to maintain extradural analgesia in labour: midwife top-up doses of 0.25% bupivacaine 10 ml, continuous infusion of 0.125% bupivacaine 10 ml h⁻¹ and patient-controlled extradural analgesia (PCEA) with self-administered 3-ml bolus doses of 0.25% bupivacaine. A significantly higher intervention rate by an anaesthetist was required in the continuous infusion group. There was no difference in the mode of delivery between the three groups, although some women in the continuous infusion group had significantly denser motor block. There was a similar incidence of rectal pressure, unilateral block and missed segments in the three groups. Uneventful hypotension occurred in three women; two receiving PCEA and one receiving continuous infusion. Ten women experienced sensory blocks extending above T7 with no ill effects; seven receiving PCEA and three continuous infusion. (Br. J. Anaesth. 1994; 73:619-623)

Key words
Anaesthesia, obstetric. Anaesthetic techniques, extradural.

Extradural analgesia is administered usually by bolus top-up injection but a continuous infusion technique is effective and gaining popularity. More recently, patient-controlled extradural analgesia (PCEA) has been evaluated and has been shown to be equally effective in providing good pain relief [1]. The present study investigated the complications of extradural analgesia administered by these three techniques.

Patients and methods

After obtaining hospital Ethics Committee approval, we studied 237 primigravidae who requested extradural analgesia in labour and who had consented to participate in this randomized, prospective study.

Using the technique described previously by Purdie and colleagues [2] and under full aseptic conditions with patients in the sitting or lateral position, the extradural space at L2-3 or L3-4 was detected by loss of resistance to saline and a catheter inserted 3–4 cm. A test dose of 0.25% plain bupivacaine 3 ml was administered and the patient placed in either the full lateral or modified supine position. Maternal arterial pressure (AP) was monitored 5 min later and, in the absence of any untoward sensory or motor effects, a further 7 ml of 0.25% plain bupivacaine was administered by the anaesthetist to establish block. For a further 20 min, AP was measured at 5-min intervals and recorded by the attending midwife. When the patient was pain-free, she was allocated randomly to one of three groups.

MIDWIFE TOP-UPS

Extradural top-ups were administered by midwives, on request, at intervals of at least 50 min and comprised an initial 3-ml bolus followed by 0.25% bupivacaine 7 ml after a 5-min interval if no untoward effects had occurred. This is the standard technique used at the Queen Mother’s Hospital.

CONTINUOUS INFUSION

Patients in this group received a continuous extradural infusion of 0.125% bupivacaine 10 ml h⁻¹ via an IVAC pump.

PATIENT-CONTROLLED EXTRADURAL ANALGESIA (PCEA)

Patients were allowed to self-administer 3-ml boluses of 0.25% bupivacaine up to a maximum of 12 ml in 1 h. A Graseby patient-controlled analgesia system was used with a 5-min lockout period. Patients were instructed not to use the pump unless there was a midwife or doctor present.

The midwife monitored maternal heart rate and AP at 5-min intervals for 20 min following all top-ups administered by a midwife, anaesthetist or patient, and at 30-min intervals thereafter. In the absence of top-ups, maternal AP in the infusion group was measured every 30 min.

The T7 level was marked on the abdomen using adhesive tape and the midwife assessed the height of block using ice. If sensory block extended above T7, the anaesthetist was informed and, in the case of the infusion group, the rate was reduced or stopped as appropriate.

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Motor block was measured by the attending midwife on a five-point scale (0–4) at hourly intervals (0 = complete motor block, that is unable to move legs or feet, 1 = ankle movement only, 2 = able to slide legs up the bed, 3 = able to pull knees up to 45° and 4 = no weakness). Both sensory level and motor block were assessed at hourly intervals by the attending midwife.

For each of the three techniques the number of hourly assessments in each grade (0–4) was summed and then expressed as a percentage of the total number of hourly observations for that technique. This allowed an overview of the degree of motor block produced by each technique and also comparison between the three techniques.

The duration of the second stage of labour (obtained from obstetric notes), mode of delivery, duration of extradural and total dose of bupivacaine were recorded also. Complications were defined as hypotension (systolic AP < 90 mm Hg), unilateral block, unblocked segment, rectal pressure and postpartum catheterization. Efficacy was assessed also and has been reported previously [2].

If analgesia was considered inadequate, the anaesthetist was asked to assess the block. Anaesthetist interventions were defined as requirement for a supplementary dose of bupivacaine, or bupivacaine and fentanyl, resizing the catheter or withdrawal of the catheter by the anaesthetist.

Analysis of the results was performed on an Amstrad 1640 PC using Minitab (version 7). Where appropriate, analysis of variance, Kruskal–Wallis and chi-square tests were used. P < 0.05 was taken as significant. For clarity, some of the results are expressed as a percentage but statistical calculations were always performed on actual numbers.

**Results**

There was no significant difference between the three groups in patient characteristics, duration of extradural analgesia and type of labour, whether spontaneous, accelerated (spontaneous onset requiring additional Syntocinon infusion) or induced (tables 1–4). Analgesic efficacy and maternal satisfaction with the techniques have been reported previously [2].

**ANAESTHETIST INTERVENTIONS**

Patients in the infusion group received significantly larger doses of bupivacaine and had the greatest number of anaesthetist interventions (120 interventions in the infusion group compared with 44 in the midwife top-up group and 49 in the PCEA group) (table 5). The high number of interventions in the infusion group reflects the fact that, if the infusion was unsatisfactory, immediate anaesthetist intervention was necessary unlike in the two other groups where additional top-ups could be given and pain relieved by the midwife or mother alone. For each technique, patients who had received anaesthetist intervention were more likely to have experienced distressing pain compared with those who did not require intervention (38.9% vs 15.8% in the PCEA group, 50% vs 26.9% in the midwife top-up group and 50% vs 6.3% in the infusion group). In those who had received anaesthetist intervention and who were unhappy with their pain relief, pain was most

![Table 1](image1)

<table>
<thead>
<tr>
<th>MWT</th>
<th>PCEA</th>
<th>Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>78</td>
<td>75</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>25.07 (16–37)</td>
<td>25.28 (16–34)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>68.66 (13.59)</td>
<td>71.51 (13.36)</td>
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<tr>
<td>Height (m)</td>
<td>1.62 (0.01)</td>
<td>1.62 (0.05)</td>
</tr>
</tbody>
</table>

![Table 2](image2)

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<th>MWT</th>
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<th>Infusion</th>
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<td>75</td>
</tr>
<tr>
<td>Labour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spontaneous</td>
<td>22 (28.2%)</td>
<td>11 (14.7%)</td>
</tr>
<tr>
<td>Induced</td>
<td>26 (33.3%)</td>
<td>26 (34.7%)</td>
</tr>
<tr>
<td>Accelerated</td>
<td>30 (38.5%)</td>
<td>38 (50.7%)</td>
</tr>
</tbody>
</table>

![Table 3](image3)

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<th>MWT</th>
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<th>Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>59</td>
<td>60</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>96.98 (58.8)</td>
<td>94.15 (50.90)</td>
</tr>
</tbody>
</table>

![Table 4](image4)

<table>
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<tr>
<th>MWT</th>
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<th>Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>78</td>
<td>75</td>
</tr>
<tr>
<td>Extradural duration (min)</td>
<td>369.1 (152.9)</td>
<td>383.5 (158.4)</td>
</tr>
<tr>
<td>Mean bupivacaine dose (mg)</td>
<td>110.24 (57.0)</td>
<td>109.55 (58.1)</td>
</tr>
</tbody>
</table>

![Table 5](image5)

<table>
<thead>
<tr>
<th>No. interventions</th>
<th>MWT</th>
<th>PCEA</th>
<th>Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>66.7%</td>
<td>50.7%</td>
<td>19.0%</td>
</tr>
<tr>
<td>1</td>
<td>16.7%</td>
<td>38.7%</td>
<td>45.2%</td>
</tr>
<tr>
<td>2</td>
<td>12.8%</td>
<td>8.0%</td>
<td>19.0%</td>
</tr>
<tr>
<td>3</td>
<td>2.6%</td>
<td>0.0%</td>
<td>10.7%</td>
</tr>
<tr>
<td>4</td>
<td>0.0%</td>
<td>2.7%</td>
<td>2.3%</td>
</tr>
<tr>
<td>5</td>
<td>1.3%</td>
<td>0.0%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Total No. interventions</td>
<td>44</td>
<td>49</td>
<td>120</td>
</tr>
<tr>
<td>Total No. women</td>
<td>78</td>
<td>75</td>
<td>84</td>
</tr>
</tbody>
</table>
often caused by complications such as rectal pressure, unblocked segment or unilateral block, rather than block regression.

**COMPLICATIONS**

The incidence of rectal pressure was similar in all three groups (midwife top-up group 21.8%, PCEA group 25.7% and infusion group 23.8%). It was unrelieved in 8.8%, 8.1% and 9.5%, respectively, despite the use of 0.5% bupivacaine or fentanyl during the second stage of labour. There were no significant differences between the groups.

The incidence of unilateral block was 15.3% in the midwife top-up group, 17.6% in the PCEA group and 23.8% in the infusion group (ns). Unilateral block persisted in only 2.7% of the midwife top-up group and in 1.6% of the infusion group, but was more difficult to eliminate in the PCEA group (8.1%), even with 0.5% bupivacaine.

The incidence of unblocked segments was 5.1% in the midwife top-up group, 8.1% in the PCEA group and 5.9% in the infusion group. Unblocked segments in the PCEA and infusion groups were relieved but persisted in 3.8% of the midwife top-up group. No patient in the midwife top-up group had a block extending above T7. In the PCEA group, seven (9.4%) had a high block compared with three (3.6%) in the infusion group. All patients, with the exception of two in the PCEA group, had received supplementary doses of bupivacaine from the anaesthetist. None with blocks exceeding T7 became hypotensive or experienced any untoward effects.

Only three patients (one PCEA group and two infusion group) experienced mild hypotension (systolic AP < 90 mm Hg). These episodes were unrelated to extradural top-ups and responded to adopting the full lateral position and increasing the rate of infusion of i.v. fluids.

The majority of patients experienced some degree of leg muscle weakness during extradural analgesia (92.3% in the midwife top-up group, 85.3% in the PCEA group and 91.7% in the infusion group (table 6). Those in the PCEA group had a significantly higher proportion of score 4 (no weakness) compared with the two other groups (20.2% compared with 17.9% in the midwife top-up group and 11.6% in the infusion group). Conversely, the infusion group had a significantly higher proportion of score 0 (4.5% vs 2.2% in the midwife top-up group and 2.9% in the PCEA group). In all three groups the most common score was 3.

There was no statistically significant difference in the proportion of spontaneous and assisted deliveries between the three groups (table 7), although the percentage of spontaneous vertex deliveries in the midwife top-up group was lower (19.2% vs 32% in the PCEA group and 29.8% in the infusion group), which was complemented by a slightly higher incidence of assisted vaginal deliveries in the midwife top-up group (ns). The number of emergency Caesarean sections was similar in all groups.

Motor block scores were compared in each group for mothers with a spontaneous vertex delivery and those who had an assisted delivery. Only in the infusion group was there a statistically significant association between degree of motor block and type of delivery, twice as many women with score 2 (unable to flex to 45°) in the assisted delivery group compared with spontaneous vertex delivery group (P < 0.05). In addition, there was a significantly smaller proportion of score 4 (no weakness) in the
motor block was not assessed. In a study comparing
and 32% in the infusion group. However, the second
stage was allowed to extend to 3 h in this study and
1
who received either 0.125% bupivacaine 10 ml h
supplementary doses are given.

Discussion
Extradural analgesia using local anaesthetic agents is
considered by many as the gold standard in pain
relief, but the analgesia provided is often discon-
tinuous and patchy in the face of an increasingly
painful stimulus. In addition, the technique is
invasive and while relatively free of major compli-
cations, it carries a significant number of minor
complications, especially motor block [3, 4]. This
explains to a large extent the plethora of extradural
regimens used in current obstetric anaesthetic prac-
tice in an attempt to maximize analgesia and
minimize complications.

We have compared PCEA with two other more
established techniques. PCEA has been shown to be
an effective method of administering extradural
analgesia and has the additional benefits of giving
women control over their analgesia and reducing the
midwife workload. In this study PCEA had advan-
tages over the infusion system in that it required
fewer anaesthetist interventions and caused less
motor block. The higher proportion of score 4 may
represent women being more sparing with their top-
up doses in order to retain motor function and
hopefully the ability to push in the second stage of
labour. However, while the PCEA group had the
highest proportion of spontaneous vertex deliveries,
this was not statistically significant.

The PCEA system was not associated with a
higher incidence of rectal pressure, unilateral block
or missed segment, but unilateral block was more
difficult to eliminate, perhaps because of the smaller
volume bolus delivered by the pump. Alerting the
anaesthetist as soon as these problems arise may
improve analgesia. It is important to note that a
sensory block exceeding level T7 occurred in 9.4%
of the PCEA group (seven patients) and regular
monitoring of sensory level is advisable, especially if
supplementary doses are given.

The midwife top-up technique has been used for
the past 9 yr at the Queen Mother’s Hospital. It is
reasonably safe (no high blocks or hypotension
occurred in this group) and efficacious. Despite a
similar degree of motor block in the PCEA group,
there was an overall lower proportion of spontaneous
vertex deliveries (19.2%). This contrasts with the
study of Lamont and colleagues [5] of 381 women,
who received either 0.125% bupivacaine 10 ml h
1
or 0.25% bupivacaine, where the spontaneous vertex delivery rate was 55% in both
groups and the forceps rate 29% in the top-up group
and 32% in the infusion group. However, the second
stage was allowed to extend to 3 h in this study and
motor block was not assessed. In a study comparing
0.125% bupivacaine 10 ml h
1
with top-up doses of
0.5% bupivacaine [6], there was an assisted delivery
rate of 52% in the infusion group and 46% in the
top-up group, similar to the findings of this study.
Similarly, the infusion group in the study of Bogod,
(64%, of women were unable to move their legs
compared with 44% of the top-up group (P < 0.05)).
However, direct comparison is difficult as the method
of measuring weakness was different.

Cheesnut and colleagues [7] found an increased
incidence of assisted delivery in patients receiving a
continuous infusion of 0.125% bupivacaine com-
pared with those whose infusion was stopped at 8 cm
dilation (53% vs 28%). However, women whose
infusion was stopped had poor analgesia at delivery.
Similarly, there was a lower assisted delivery rate
(and poorer analgesia) in women receiving top-ups of
0.25% bupivacaine 6–8 ml compared with 0.5%
bupivacaine 6–8 ml or 0.25% bupivacaine 10–14 ml
[8].

Mode of delivery is affected by the choice,
concentration and method of administration of the
local anaesthetic agent. Continuous infusion appears
to produce more profound motor block and some-
what denser analgesia but does not necessarily prejudice the mode of delivery, as was found in this
study. This suggests that muscle weakness, as
assessed in our study, is only one small, and perhaps
not very significant, element in the complex pattern
of events which influence mode of delivery. Com-
parison between studies is fraught with problems as
management of the extradural and second stage
varies widely. In addition, methods of measurement
of motor block vary. We used a modification of
Bromage’s scale which assesses power in L1 to S5
but it may be more appropriate to measure power in
the abdominal muscles (T5–12) which are used in
pushing. However, motor block in the lumbo–sacral
region correlates with lax pelvic floor muscles which
could delay rotation of the fetal head and increase the
need for forceps delivery. Also, loss of sensation in
the pelvis obtunds Ferguson’s reflex, reducing oxytocin secretion in the second stage and hence the
strength of second stage contractions, and removing
the urge to push [9]. Future studies should perhaps
assess maternal urge and ability to push.

Many women experience painful episodes during
labour despite continuous extradural analgesia.
Much of the pain is related to rectal pressure,
unblocked segments or unilateral block [2].

The incidence of unblocked segments in this study
was approximately 6%, which is similar to that
found in two other large studies [8, 10]. However,
Ducrow’s study showed a much lower incidence
of unilateral block (1.5% of which only 0.54% were
persistence). Narang and Linter described an in-
cidence of 1.5–21% and suggested that unilateral
block may be caused by straying from the midline
plane during insertion of the extradural catheter
[11]. Thorburn and Moir demonstrated a reduced
incidence of unilateral block using top-up doses of
0.25% bupivacaine 10–14 ml compared with smaller
volumes of either 0.25% or 0.5% bupivacaine [8].
Extradural analgesia in labour

and, in this study, unilateral block took longer to eliminate with the smaller volume boluses from PCEA.

Catheterization for urinary retention after extradural analgesia is a well recognized complication and extradural block increases the incidence of hypotonic bladder [12]. The incidence of postpartum catheterization varies widely and may reflect obstetric policy rather than extradural effect.

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References