SHORT COMMUNICATION

Chronobiology of labour pain perception: an observational study


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Background. Circadian variation may affect many biological and pharmacological phenomena.

Methods. To assess circadian variations in labour pain perception, 222 consecutive nulliparous women with uncomplicated pregnancy, spontaneous labour, cervical dilatation (3–5 cm), ruptured membranes and normal fetal heart rate tracings were studied. Visual analogue pain scores (VAPS) were analysed and divided into four periods: night (1:01 a.m. to 7:00 a.m.), morning (7:01 a.m. to 1:00 p.m.), afternoon (1:01 p.m. to 7:00 p.m.) and evening (7:01 p.m. to 1:00 a.m.). VAPS were also compared between daytime (morning+afternoon) and nocturnal (evening+night) periods.

Results. Daytime mean VAPS were lower than nocturnal scores [75.6 (15.1) vs 85.7 (14.1), P<0.0001]. VAPS were lower in the morning than in the afternoon, evening and night periods (ANOVA, P<0.0001).

Conclusion. Labour pain perception appears to be chronobiological, and this might be taken into account when enrolling parturients in studies designed to assess or treat labour pain.


Keywords: analgesia, obstetric; analgesic techniques, extradural; measurement techniques, visual analogue; pain, acute; pain, mechanism; pain, psychological variables; pregnancy

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Circadian variations have been shown in several biological and pharmacological phenomena, including pharmacokinetics, duration of action and the toxicity of local anaesthetics.¹ ² For example, the duration of action of epidural ropivacaine was shown to vary according to the hour of administration,³ whereas labour pain intensity scores did not vary with the time of day. However, circadian changes in stimulus threshold have been observed in dental surgery in humans.⁴ In addition, we have reported previously a higher risk of unintended dural puncture in night-time epidural labour analgesia.⁵ While we have pointed out the role of operators in that finding, it could be argued that parturients may have moved more during the night, as a result of more severe labour pain. In the present study, we address the hypothesis that labour pain perception may vary according to a circadian rhythm.

Methods and results

The study was approved by the institutional Ethics Committee and all parturients gave informed consent. Over a 1-yr period, consecutive term nulliparous women carrying a singleton vertex pregnancy were enrolled, provided they had uncomplicated pregnancy, spontaneous-onset labour, cervical dilatation (3–5 cm), ruptured membranes and normal fetal heart rate tracings. Patients with diabetes or taking medications that may influence pain perception or who had already been given opioids or inhalational anaesthetics for labour analgesia were not included.

On inclusion, each parturient was given a visual analogue scale ruler and asked to quantify her pain intensity on a 100-mm straight line printed on one side of the ruler, using a cursor. The left end of the line represented no pain, whereas the right end represented the worst pain imaginable. The other side of the ruler was graduated, so that the anaesthetist could read and record visual analogue pain scores (VAPS), which was the primary study measurement. Parturients’ VAPS were observed by the anaesthetist at the time of referral for epidural analgesia. Because contractions may vary in strength, VAPS were obtained for each parturient as the mean of scores recorded for three consecutive uterine contractions. Each pain score was measured immediately after the
corresponding uterine contraction and was referred to the pain of that contraction. Demographic data and obstetrical parameters were also studied.

For statistical analysis, parturients made up four groups corresponding to four periods of the day: night (from 1:01 a.m. to 7:00 a.m.), morning (from 7:01 a.m. to 1:00 p.m.), afternoon (from 1:01 p.m. to 7:00 p.m.) and evening (from 7:01 p.m. to 1:00 a.m.). In addition, VAPS were compared between daytime (7:01 a.m. to 7:00 p.m.) and nocturnal (7:01 p.m. to 7:00 a.m.) periods.

All variables were expressed as mean (SD). One-way analysis of variance followed by Bonferroni’s correction was used for group comparisons. An unpaired t test was used for comparison of VAPS between daytime and nocturnal periods. With an SD of 18 and assuming \( \alpha = 0.05 \), we calculated that at least 35 parturients per group were required to detect a difference of 20 in VAPS with a 99% power (ANOVA). \( P < 0.05 \) indicated statistical significance.

Two hundred and twenty-two women were consecutively enrolled in the study. Parturients’ characteristics and obstetrical data were comparable in all four study groups (Table 1). The mean VAPS were lower (\( P < 0.0001 \)) in the daytime period [75.6 (15.1)] compared with the nocturnal period [85.7 (14.1)]. Furthermore, when the four groups were compared, VAPS were lower in the morning compared with the other time groups (Table 1).

Comment
The study by Debon and colleagues\(^3\) was the first to assess the duration of action of a local anaesthetic in the setting of labour analgesia. The authors showed a longer duration of action of ropivacaine during the morning and afternoon compared with the evening and night. In that study, VAPS did not vary from one group to another. However, the authors did not control for obstetrical factors that could influence the intensity of labour pain, such as rupture of the membrane, and whether the labour began spontaneously or was induced pharmacologically. Furthermore, the study population included both nulliparous and multiparous women; parity was shown to influence labour pain perception, nulliparous women reporting significantly higher pain scores.\(^6\) In the present study, an attempt was made to control these factors. Therefore, we included only nulliparous women with spontaneous onset labour in the first stage and with ruptured membranes at the time of pain assessment. With this design, we showed a difference in VAPS between day and night periods, especially lower VAPS in the morning. This disagrees with the findings of Debon and colleagues,\(^3\) and it can be suggested that the longer duration of action of ropivacaine in daytime periods reported by these authors could be due, at least in part, to lower analgesic requirements during these periods, as a result of lower pain intensity. This could be explained partly by the fact that the release of antinociceptive hormones and peptides (ACTH, cortisol, \( \beta \)-endorphin) is increased during pregnancy, leading to elevation of pain tolerance with advancing gestation.\(^7\)\(^8\) Since these substances have diurnal variations with higher plasma concentrations in the morning,\(^9\) this could have contributed to the diurnal variation in pain perception observed in our study. In addition, exhaustion and sleep deprivation have been shown to decrease the pain perception threshold,\(^10\) and this could have contributed to the high pain scores observed at night. It should be noted, however, that several other covariates, such as educational or socioeconomic states (e.g. support from partner, effective midwifery care), that also influence labour pain perception were not controlled either in the present study or in others, and could complicate the assessment of the chronobiology of labour pain. Noteworthy in our study and the study by Debon and others\(^3\) is also the fact that, although statistical differences were observed, these differences probably have little clinical relevance as all the women reported severe pain.

In summary, the present study suggests that circadian variations may exist in labour pain perception, and this should be taken into account when enrolling parturients in comparative studies designed to assess or treat labour pain.

Acknowledgement
The authors thank Margaret Manson for editorial assistance.

References

### Table 1 Patient characters and obstetric data, and pain scores throughout the 24-h period. Data are mean (range) for age or mean (SD)

<table>
<thead>
<tr>
<th></th>
<th>Night</th>
<th>Morning</th>
<th>Afternoon</th>
<th>Evening</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n )</td>
<td>49</td>
<td>75</td>
<td>55</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Age (yr)</td>
<td>26 (21–34)</td>
<td>27 (19–35)</td>
<td>26 (20–38)</td>
<td>25 (18–36)</td>
<td>0.411</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>73 (11)</td>
<td>73 (10)</td>
<td>74 (12)</td>
<td>73 (12)</td>
<td>0.709</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163 (8)</td>
<td>164 (6)</td>
<td>165 (7)</td>
<td>165 (7)</td>
<td>0.668</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>39 (2)</td>
<td>39 (1)</td>
<td>39 (2)</td>
<td>39 (1)</td>
<td>0.870</td>
</tr>
<tr>
<td>Cervical dilatation (cm)</td>
<td>3.7 (0.6)</td>
<td>3.5 (0.8)</td>
<td>3.5 (0.9)</td>
<td>3.6 (1.0)</td>
<td>0.847</td>
</tr>
<tr>
<td>Neonatal weight (g)</td>
<td>3474 (549)</td>
<td>3292 (489)</td>
<td>3148 (363)</td>
<td>3140 (380)</td>
<td>0.220</td>
</tr>
<tr>
<td>Cephalic circumference (cm)</td>
<td>34.3 (1.6)</td>
<td>34.4 (1.8)</td>
<td>34.1 (1.1)</td>
<td>34.2 (1.1)</td>
<td>0.955</td>
</tr>
<tr>
<td>VAPS (mm)</td>
<td>83.5 (13.7)</td>
<td>72.9 (14.9)</td>
<td>84.2 (15.9)</td>
<td>87.6 (14.6)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>