Postoperative epidural analgesia in obese patients undergoing liver resection surgery

Zoka Milan1, Naresh Rajasekar2, Sarah Hudson-Phillips2, Heidi Pane2, Henry Procter2, Richard Simpson2, Mitko Kocarev3, Claire Biercamp1, Mark Bellamy1

1Department of Anesthesia, St James’s University Hospital, 2Leeds School of Medicine, Leeds, 3Harrogate District Hospital, Harrogate

ABSTRACT

Aim To investigate the relation of body mass index (BMI) with postoperative pain scores and volume of local anaesthetic (LA) administered epidurally in patients undergoing liver resection surgery.

Methods Retrospective data from 167 patients who had epidural analgesia (EA) for liver resection surgery were analysed: 123 with BMI<30kgm⁻² and 44 with BMI>30kgm⁻².

Results Total volume of intraoperative bolus of epidural analgesia (EA) was not different between the BMI>30 kgm⁻² and BMI<30 kgm⁻² groups (p>0.05). Mean rate of infusion (8.2±2.7 ml/h vs. 7.9±1.9 ml/h, p=0.0018), pain scores immediately after extubation of the trachea (0.91±0.9 vs. 0.55±0.7, p=0.017) and that before removal of epidural catheter (0.7±0.55 vs. 0.7±0.95, p=0.015) were higher in the BMI > 30kgm⁻² group when compared with the BMI ≤ 30kgm⁻² group. However, there was no significant difference between the numbers of segments blocked.

Conclusion The patients with BMI > 30 kgm⁻² undergoing liver resection experienced more postoperative pain on the day of surgery and before epidural catheter removal than patients with BMI < 30 kgm⁻², despite a higher rate of epidural infusion. Further studies are necessary to confirm these findings in order to determine adequate local anaesthetic dosing for thoracic epidural analgesia in obese patients.

Key words: epidural, analgesia, obesity, liver resection surgery
INTRODUCTION

With obesity levels in England increasing every year, the number of patients with a Body Mass Index (BMI) over 30 kg m$^{-2}$ undergoing non-obstetric surgery is also rising (1). Neuraxial blockade is the preferred form of anesthesia in these patients (2). However, there is almost no data on pain intensity and dosing of local anesthetics in these patients (3). Epidural analgesia (EA) is a well-established method for intra- and postoperative analgesia in patients undergoing liver resection (4).

This retrospective study was therefore attempted to determine the relation, if any, of Body Mass Index (BMI) with postoperative pain scores and volume of epidurally-administered LA, in patients undergoing liver resection.

PATIENTS AND METHODS

The present study analysed the data from a cohort of patients who underwent liver resections (segmentectomies, metastasectomies, and hemihepatectomies) under general and epidural anesthesia between January 1st 2009 and June 1st 2011 at St James’s University Hospital, Leeds.

General anesthesia was induced with propofol in combination with fentanyl, followed by neuromuscular block with atracurium to facilitate endotracheal intubation. Anesthesia was maintained with inhalational anesthetic using one of isoflurane, sevoflurane, or desflurane. Muscle relaxants and additional opioids were used when needed.

All patients had epidural catheters inserted, a bolus injection of 0.25% bupivacaine following induction of anesthesia, and continuous infusion of 0.125% bupivacaine with fentanyl, 2mcg/mL. The doses and rates of infusion of the LA intraoperatively were at the discretion of the clinicians who administered the general anesthesia. Data regarding intra- and postoperative epidural analgesia were recorded in anesthetic charts and also electronically in an epidural database known as APIS. The level of epidural block was assessed in the recovery room by trained nurses and recorded in patients’ notes.

All patients spent at least 24 hours in the high dependency unit (HDU), where pain scores were assessed hourly and changes to epidural infusion rate made accordingly. The decision about the rate of epidural infusion was based purely on clinical grounds and represented standard clinical practice in the hospital. The acute pain team visited patients with epidural catheters on a daily basis and made amendments based on clinical judgement.

Several variables, apart from BMI (from the anesthetic chart, APIS database, and medical notes), were recorded: age, sex, American Society of Anesthesiologists (ASA) score, extent of liver resection (whether major-right lobe resection, or segmentectomy involving three or more segments or minor-left lobe resection), epidural interspace, depth of epidural space, type/volume/concentration of LA, number of segments involved, duration of surgery, pain scores assessed on a scale of 0-3, with 0=no pain, 1=mild pain, 2=moderate pain, and 3=severe pain immediately after surgery and on the last day of the EA, and duration of intra-hospital stay.

For statistical analysis, Graph Pad Prism 4.01 (GraphPad Software, Inc., San Diego) was used. Student t-test was used for parametric data, Mann-Whitney U-test for non-parametric data, and Fisher’s test for categorical data. A two-tailed p-value<0.05 was considered statistically significant.

RESULTS

A total of 167 patients were analysed in this study, 123 with BMI<30 and 44 with BMI>30 (Figure 1).

Figure 1. Flow diagram of data collection
**Table 1. Demographic and surgical data from the two groups of patients**

<table>
<thead>
<tr>
<th>Group BMI &lt;30kgm-2</th>
<th>Group BMI &gt;30kgm-2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kgm-2)</td>
<td>25.2±3.1</td>
<td>33.2±2.9</td>
</tr>
<tr>
<td>Age (years)</td>
<td>64.1±12.8</td>
<td>66.5±10</td>
</tr>
<tr>
<td>Male/female ratio</td>
<td>79/44</td>
<td>24/20</td>
</tr>
<tr>
<td>ASA</td>
<td>2.1±0.7</td>
<td>2.3±0.5</td>
</tr>
<tr>
<td>Major/minor surgery</td>
<td>50/47</td>
<td>13/19</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>158±74</td>
<td>173±76</td>
</tr>
</tbody>
</table>

There was no difference between the two observed groups in respect to age, male/female sex ratio, major/minor resection ratio, and duration of surgery. Patients from the BMI >30 kgm-2 group had significantly higher ASA scores (p=0.0001) (Table 1).

The epidural T7-T9 interspace was chosen in 152 (91%) of cases, while in the remaining 15 (9%) of patients T10-T12 was used. The mean depth of the epidural space was significantly bigger in the BMI >30 kgm-2 group (Table 2).

**Table 2. Data related to epidural analgesia**

<table>
<thead>
<tr>
<th>Group BMI &lt;30kgm-2</th>
<th>Group BMI &gt;30kgm-2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidural space depth (cm)</td>
<td>5.6±1</td>
<td>6.3±1.2</td>
</tr>
<tr>
<td>Intraoperative bolus (mL)</td>
<td>15.7±10</td>
<td>19.6±25</td>
</tr>
<tr>
<td>Infusion rate (ml/h)</td>
<td>7.9±1.9</td>
<td>8.2±2.7</td>
</tr>
</tbody>
</table>

With regard to the relation of BMI to volume of LA and pain scores the total volume of intraoperative bolus of EA analgesia was not different between the BMI >30 kgm-2 and BMI <30 kgm-2 groups (19.6±25 vs. 15.7±10 ml/h vs. NS). Mean rate of infusion (8.2±2.7 ml/h vs. 7.9±1.9 ml/h, p=0.0018) and pain scores immediately after extubation of the trachea (0.91±0.9 vs. 0.55±0.7, p=0.017) and before removal of epidural catheter (0.7±0.55 vs. 0.7±0.95, p=0.015) were statistically significantly higher in the BMI >30 kgm-2 group when compared with the BMI ≤30 kgm-2 group (Table 3). However, there was no significant difference between the number of segments blocked (9±3.2 vs. 7.9±3.8, p=0.1).

There were no significant differences in the duration of epidural analgesia between the BMI >30 kgm-2 and BMI <30 kgm-2 groups (3.1±1 days vs. 2.9±1 respectively) and duration of intra-hospital stay (11±6.7 vs. 10.3±8.6 days respectively).

**Table 3. Pain scores immediately after extubation and before epidural catheter removal**

<table>
<thead>
<tr>
<th>Group BMI &lt;30kgm-2</th>
<th>Group BMI &gt;30kgm-2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain score 1</td>
<td>0.55±0.7</td>
<td>0.91±0.9</td>
</tr>
<tr>
<td>Pain score 2</td>
<td>0.7±0.7</td>
<td>0.7±0.25</td>
</tr>
</tbody>
</table>

**DISCUSSION**

In our study almost one-third (26.5%) of patients undergoing liver resection for primary or metastatic tumour were obese, with a BMI over 30 kgm-2. These patients had significantly higher ASA grades when compared with patients with a BMI <30 kgm-2. Their epidural space was significantly deeper when compared with BMI <30 kgm-2 patients. This can potentially make epidural catheter removal technically more difficult, as previously described in the literature (5).

In our study, there were no differences in the type and quantity of local anaesthetic injected as a bolus intraoperatively and the rate of intraoperative infusion of local anaesthetic. However, there was a higher rate of infusion in those with a BMI <30 kgm-2. The interesting observation was that despite this they experienced higher pain scores both immediately post-operatively and over the last day of epidural activity.

Generally, the dosing of local anesthetics is based on patient weight (6). In obese patients, there are no studies or guidelines to define what the maximum safe doses for local anesthetics are, or the body weight (total, ideal, or lean) to be used for local anesthetic dosage calculations (3). According to our study, although patients with a BMI >30 kgm-2 had higher rates of continuous infusion of LA, they still had higher pain scores than less obese patients. Was it a fear of side effects of high dose of local anesthetics, a belief that obese patients do not need more analgesia, or both, that prevented clinicians from giving larger doses of LA (7). Clearly, safe dosing cannot be based on actual patient weight for very large patients, as this practice may result in extremely large amounts of local anesthetic being given (3).

As mentioned earlier there is no data available for dosing of obese patients undergoing non-obstetric surgery. The only data available is that for local anaesthetic dosage for epidural analgesia in obese patients undergoing obstetric surgery. The observation in this prospective study on the correlation between epidural requirements and BMI in obstetric patients in labour, which contrasts with our findings, indicates that patients in the higher BMI category required lower doses of EA to achieve pain scores similar to those in the lower BMI category (8). Several explanations have
been proposed for this phenomenon. One is that, in pregnant women with a high BMI, increased intra-abdominal pressure causes a reduction in the volume of the epidural space (8). This in turn may allow the LA injected into the epidural space to reach a higher level (8), and thus smaller amounts would be required to provide sufficient analgesia. This proposal was confounded, however, by the discovery that postoperative blocks were found to be significantly higher in the high-BMI patients, despite their having received less local anaesthetic volumes for spinal anaesthesia (9).

Obese non-pregnant patients may have increased intra-abdominal pressure, but not to the same extent as pregnant patients. Our patients were not pregnant, and they also had thoracic EA, not lumbar EA as in the obstetric study. Different anatomy of the epidural space may be the reason for the different findings in our study. In addition, the maximum BMI in our group was only 43 kgm⁻². The obstetric population may have had higher BMIs.

The logical explanation for our finding is based on the fact that patients with increased BMI and weight have increased fat in the posterior and anterior epidural space. Local anesthetic injected into the epidural space can be rapidly partially absorbed in fat tissue, which can result in a need for more local anesthetic in order to achieve the same clinical effect as in patients with lower BMI.

The main limitation of our study is that it is retrospective and related only to liver resection surgery. Theoretically, a decrease of liver mass postoperatively could have affected the metabolism of local anaesthetics and opioids, although some studies found no change in drug metabolism following liver resection surgery. Pain scoring from 0-3, which is routinely used in our hospital, is less sensitive than the Visual Analogue Pain Scale that measures pain intensity on a scale from 0-10. Although there was a difference in the number of patients between the two observed groups, post hoc analysis of the power of the study was done by using postoperative pain score as the main outcome; this was found to be 78%.

This study raised our awareness that patients with BMI>30 kgm⁻² who have thoracic epidural analgesia may suffer more pain than patients with BMI<30 kgm⁻². Further prospective studies involving obese patients in different areas of surgery have to be carried out to investigate pain scores and the quantity of local anesthetics and opioids required for adequate postoperative analgesia.

REFERENCES