Extensive extradural spread in the elderly may not relate to decreased leakage through intervertebral foramina

K. SAITOH, Y. HIRABAYASHI, R. SHIMIZU, H. MITSUHATA AND H. FUKUDA

Summary
It has been suggested that the extensive longitudinal extradural spread of local anaesthetics in the elderly is attributed to decreased leakage through the intervertebral foramina. We have examined radiologically, in 53 patients, the relationship between leakage of iohexol through the thoracic intervertebral foramina and age. Iohexol was injected through an extradural catheter advanced 5 cm cephalad from one of the interspaces between T6 and T12. A significant correlation was observed between longitudinal spread of iohexol and age, but there was no correlation between leakage of iohexol through the intervertebral foramina and age. Our data suggest that longitudinal extradural spread of local anaesthetics in the elderly may not be attributed to decreased leakage through the intervertebral foramina. (Br. J. Anaesth. 1995; 75: 688–691)

Key words
Anaesthetic techniques, extradural. Measurement techniques, extradural radiography. Age factors.

The spread of local anaesthetic solutions in the extradural space is influenced by many factors, including volume and concentration of anaesthetic solution, site and speed of injection, and position of the patient. The spread is influenced also by several intrinsic physical and anatomical factors such as the patient’s age, height, gestational stage and arteriosclerosis [1, 2], with age being one of the most important factors [1, 2]. A linear negative relationship between age and segmental dose requirements has been found in adults [1, 3, 4]. Several factors related to increasing age may contribute to the extensive spread of local anaesthetics, especially in the elderly, including arteriosclerosis, decreased neural population [2, 5], increased compliance of the extradural space [6] and decreased patency of the intervertebral foramina serving as escape routes [7–10]. The more extensive longitudinal spread of local anaesthetics in the older patients has been attributed to decreased leakage through the intervertebral foramina because of progressive occlusion [7–10]. However, the influence of leakage on the spread of analgesia has not been investigated fully.

We have investigated the relationship between leakage of iohexol through the intervertebral foramina and age, and between the degree of leakage and the extent of longitudinal spread.

Patients and methods
The study was approved by the Ethics Committee of our institution and informed consent was obtained from each patient. Patients were excluded if they were pregnant or were found to have the following abnormalities: diabetes, neurological disease, abnormalities of the vertebral column, abdominal distension from intestinal obstruction, ascites, tumour, a bleeding tendency, a history of allergy to iodine, seizure disorder or lumbar disc herniation. We studied 53 adult patients (31 males), ASA I–II, undergoing thoracic extradural anaesthesia for scheduled thoracic or upper abdominal surgery. Ages ranged from 25 to 84 yr and heights from 145 to 172 cm (table 1).

The extradural space was identified by loss of resistance to air using a 17-gauge Tuohy needle inserted into one of the interspaces between T6 and T11. An extradural catheter was inserted through the needle and advanced 5 cm cephalad. All patients were given 8 ml of iohexol 240 mg iodine ml⁻¹ via the extradural catheter over 1 min in the supine position on a horizontal operating table. A chest abdominal x-ray film was taken immediately after iohexol was injected.

The radiograph was used to evaluate the extent of longitudinal spread, measured from the number of vertebral bodies, and leakage of iohexol judged from the number of sites in which iohexol existed beyond the lateral borders of the vertebral body. The extent of leakage was divided into three grades as follows: grade 1, no leakage; grade 2, one or two sites; and grade 3, several sites of leakage from the intervertebral foramina. All assessments were performed by one investigator who was unaware of the patient’s age or height.

Spearman’s rank correlation test was used for statistical analysis, with the level of significance at 0.05.

Results
The levels of insertion of the extradural catheters are shown in table 2 and the extent of iohexol leakage in table 3. Typical radiographs for each grade of leakage

KAZUHIKO S AITOHO, MD, YOSHIIRO HIRABAYASHI, MD, REIJU SHIMIZU, MD, HIROMASA MITSUHATA, MD, HIROKAZU FUKUDA, MD, Department of Anaesthesiology, Jichi Medical School, Tochigi, 329-04 Japan. Accepted for publication: June 30, 1995.

Correspondence to K.S.
Thoracic extradural radiography and age

are shown in figures 1–3. In figure 1, no leakage of iohexol is seen (indicating grade 1). In figure 2, one site of iohexol leakage is seen (indicating grade 2). In figure 3, several sites of iohexol leakage are seen (indicating grade 3). There was no correlation between the sites of leakage and the level of insertion.

Iohexol spread within the extradural space over a mean of 9.5 (SD 2.2) vertebrae. There was no correlation between longitudinal spread of iohexol and level of insertion. A significant negative correlation was observed between longitudinal spread of iohexol and height (Spearman’s rank correlation test: height vs longitudinal spread, \( p = -0.374 \)) (table 4). In addition, significant correlation was observed between longitudinal spread of iohexol and age (age vs longitudinal spread, \( p = 0.314 \)) (table 4). There was no correlation between the sites of iohexol leakage through the intervertebral foramina and age or between the sites of leakage and longitudinal spread (table 4, fig. 4). There were no complications related to injection of iohexol.

Table 1 Summary of extradural radiography in 53 patients (mean (SD) [range])

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD) [range]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>59.3 [25–84]</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158.8 (8.5) [145–172]</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>55.8 (8.9) [40–74]</td>
</tr>
<tr>
<td>Longitudinal spread (vertebral bodies)</td>
<td>9.5 (2.2) [6–15]</td>
</tr>
</tbody>
</table>

Table 2 Insertion levels of extradural catheters

<table>
<thead>
<tr>
<th>Level of interspace</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>T6–T7</td>
<td>7</td>
</tr>
<tr>
<td>T7–T8</td>
<td>15</td>
</tr>
<tr>
<td>T8–T9</td>
<td>18</td>
</tr>
<tr>
<td>T9–T10</td>
<td>12</td>
</tr>
<tr>
<td>T10–T11</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3 Number of patients with each grade of leakage

<table>
<thead>
<tr>
<th>Leakage</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>19</td>
</tr>
<tr>
<td>Grade 2</td>
<td>13</td>
</tr>
<tr>
<td>Grade 3</td>
<td>21</td>
</tr>
</tbody>
</table>

Figure 1 Extradural radiograph defined as grade 1 in a 44-yr-old man. No leakage of contrast medium is seen and spread of contrast is symmetrical.

Figure 2 Extradural radiograph defined as grade 2 in a 42-yr-old woman. Leakage is seen from one intervertebral foramen.

Figure 3 Extradural radiograph defined as grade 3 in a 76-yr-old man. Leakage is seen from several intervertebral foramina.
Weight
Height
Leakage
Weight

The long-held concept that such leakage influences the spread of local anaesthetics through the intervertebral foramina in the thoracic region. However, the results of the present study cast doubt on this hypothesis. We have reported elsewhere that the more extensive analgesia observed in the elderly may be attributed to increased extradural compliance and decreased extradural resistance because of degeneration of fatty tissue with increasing age [6].

Radiography has been used to investigate disc herniation [11–13] and to confirm the position of an extradural catheter in procedures for long-term pain relief [14–16]. Only ionic, water-soluble or oily contrast media were available for extradural radiography until 1978. Thereafter, the ionic contrast media were known to cause significant tissue injury because of their high osmolarity [11]. Subsequently, iohexol, a non-ionic, highly water-soluble radiopaque dye with reduced osmolarity and viscosity was introduced [17]. This is a better contrast medium for extradural radiography and is safe even when injected into the subarachnoid space [18]. A concentration of 240 mg iodine ml⁻¹ provides better contrast of the extradural space.

Extradural radiography can be used to see leakage of contrast medium through intervertebral foramina [8–10]. The volume of 8 ml used in this study corresponded to that generally used for local anaesthesia, although a range of local anaesthetics and contrast dyes with different physical and chemical properties are available. Several other factors, such as viscosity and pH, are important. X-rays were obtained immediately after injection of dye, rather than during the 15–20-min interval between injection of local anaesthetic and testing of sensory block, as radiopaque dye can be seen only immediately after injection because of rapid reabsorption [19]. The exact position of the catheter tip in the extradural space was not confirmed because the catheter was hidden by the spread of dye, and injection was performed manually. When evaluating the results of the present study, there are also some problems regarding the use of contrast medium instead of local anaesthetic. However, the results of this study cast doubt on the long-held ideas on the influence of leakage on spread of analgesia, which are based on extradural radiography [9].

Discussion

We have found a significant correlation between longitudinal spread of contrast medium with age, but no correlation between leakage and longitudinal spread or age. These findings suggest that leakage of local anaesthetics through the intervertebral foramina does not play an important role in determining the extent of longitudinal spread of local anaesthetics in the thoracic region.

It has been suggested that leakage of local anaesthetics may be reduced by the presence of sclerotic obstruction of intervertebral foramina in the elderly, resulting in extensive longitudinal spread [7–10]. However, no definite evidence of decreased leakage was found in this study. The long-held concept that such leakage influences the spread of anaesthesia is based on radiographic observations using oily contrast medium [9]. The results of the present study cast doubt on this hypothesis. We have reported elsewhere that the more extensive analgesia observed in the elderly may be attributed to increased extradural compliance and decreased extradural resistance because of degeneration of fatty tissue with increasing age [6].

References

Thoracic extradural radiography and age 691


