Caudal Epidural Catheters with Fluoroscopy

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Background

Epidural analgesia for infants undergoing abdominal or thoracic procedures can provide adequate post-operative analgesia while reducing opioid requirements. Thoracic epidural catheters can be difficult to position accurately.

Aims:
- Compare fluoroscopy for placement of radiopaque caudal epidural catheters in comparison to radiolucent catheter.
- Compare the radiation exposure of the epidurogram technique vs radiopaque catheter (Arrow FlexTip Plus®, Teleflex, Reading, PA) with fluoroscopy.
- Compare accuracy of catheter position between epidurogram and radiopaque catheter techniques.

Methods

- IRB approval
- Queried the pain service database for patients younger than 1 year who had epidural catheters placed from 2010-2011.
- Reviewed anesthesia records and radiographic images
- Documented tip location at time of radiograph or fluoroscopy, comparing actual to desired location.

- Documented settings allowed calculation of radiation dose using a validated algorithm (PCXMC standard infant computer model, Monte Carlo X-ray dosimetry software, PCXMC 2.0, 2011, STUK, Helsinki, Finland) to estimate the effective tissue dose of radiation for each patient, using skin dose (mGy), Dose Area Product (DAP mGycm²) or exposure technique (kV, mAs).
- Results are expressed as mean +/- SD, and t-test was used to determine significance.
- Fischer’s Exact test used to compare accuracy of catheter placement between the two techniques.

- Radiopaque/Fluoroscopy Technique:
  - Prone position to facilitate imaging and catheter manipulation.
  - Radiopaque catheter modification: The tail end of the catheter was cut by 2cm. The stylet was reinserted in the catheter ensuring the stylet does not extend beyond the tip of the catheter.
  - Exclusion criteria: Incomplete data (x-ray dose information).

- Exclusion criteria:
  - Inadequate tip location during surgery, leading to catheter removal or replacement after surgery in two patients (though not statistically significant with the number of patients in our study).

Results

<table>
<thead>
<tr>
<th>Location</th>
<th>Radiopaque Catheter (n=20)</th>
<th>Radiolucent Catheter (n=26)</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laparotomy</td>
<td>13</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Thoracotomy</td>
<td>13</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Age (months)</td>
<td>3.4 (+/- 2.0)</td>
<td>2.9 (+/- 2.8)</td>
<td>0.54</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>5.7 (+/- 1.8)</td>
<td>5.1 (+/- 2.2)</td>
<td>0.38</td>
</tr>
<tr>
<td>Effective Radiation Dose (mSv)</td>
<td>0.061 (+/- 0.068)</td>
<td>0.498 (+/- 0.407)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

For reference, a standard baby-gram radiation dose is 0.02 mSv with the portable x-ray machines in use at The Children’s Hospital of Philadelphia.

Discussion

- We screened 81 patients, yielding 26 with radiolucent catheters and 20 with radiopaque catheters in our study set.
- Excluded 15 patients due to incomplete data.
- No statistical differences in terms of age and weight between the groups.
- Radiation group consisted of 15 laparotomies and 5 thoracotomies while the radiolucent group consisted of 13 laparotomies and 3 thoracotomies.
- Use of radiopaque catheters resulted in inadequate tip location during surgery, leading to catheter removal or replacement after surgery in two patients (though not statistically significant with the number of patients in our study).

- Fluoroscopy use in combination with a radio-opaque catheter allows real-time localization of the catheter tip.
- The epidurogram technique identified the tip location only after securing the catheter, and did not allow adjusting of the location prior to securing the catheter.
- The advantage of fluoroscopy is the ability to monitor subsequent radiographs during insertion.
- Furthermore, radiopaque catheters can be monitored on subsequent radiographs during postoperative care.

References