A qualitative systematic review of incisional local anaesthesia for postoperative pain relief after abdominal operations

S. MOINICHE, S. MIKKELSEN, J. WETTERSLEV AND J. B. DAHL

Summary

In a qualitative systematic review, we have evaluated randomized controlled trials (RCT) of incisional local anaesthesia compared with placebo or no treatment in the control of postoperative pain after open abdominal operations. Twenty-six studies with data from 1211 patients were considered appropriate for analysis. Five RCT considered inguinal herniotomy, four hysterecomy, eight cholecystectomy and nine studies a variety of surgical procedures. Outcome measures were pain scores, supplementary analgesics and time to first analgesic request. Efficacy was estimated by significant difference (P<0.05), as reported in the original investigation. All studies of herniotomy showed a 2–7-h duration of clinically relevant improved pain relief. Results of hysterecomy studies were inconclusive, with two being negative. Five of the cholecystectomy studies showed significant differences but questionable clinical importance and validity in three. In various other procedures results were inconsistent and in some of minor clinical importance. Except for hysterecomy, there was a lack of evidence for effect of incisional local anaesthesia on postoperative pain and further standardized studies are needed before recommendations can be made. (Br. J. Anaesth. 1998; 81: 377–383).

Keywords: anaesthesia, audit; anaesthetics local; surgery, laparotomy; surgery, herniotomy; pain, postoperative

The use of wound infiltration with local anaesthesia for postoperative pain relief may be an attractive method because of its simplicity, safety and low cost. However, despite widespread use, wound infiltration is still inconsistently and randomly used by many surgeons and anaesthetists. Even though a great number of original articles and some reviews have been published on this issue, there is little consensus available on when and after which surgical procedures incisional local anaesthesia may provide clinically relevant alleviation of postoperative pain. Of special interest may be to what extent differences in surgical procedure or involvement of visceral components influence efficacy.

In this systematic review, we have investigated the effect of wound infiltration with local anaesthesia for postoperative pain control, assessed using pain scores, need for and use of supplementary analgesics and/or time to first request for analgesics, using the evidence from all relevant randomized controlled and blinded studies. We have also examined trial methodology.

Methods

Reports of prospective, randomized, controlled trials (RCT) with or without open therapeutic control of wound infiltration with local anaesthesia were sought systematically. Reports were identified using the Cochrane Library, issue 4, and MEDLINE 1966–1997, without language restriction. Search terms included “wound infiltration”, “incisional”, “postoperative pain”, “local anaesthesia”, “bupivacaine”, “lidocaine”, “mepivacaine”, “ropivacaine”, “surgery”. Reference lists of retrieved reports and review articles were also searched systematically for articles concerning local anaesthesia and postoperative pain. No abstracts or unpublished observations were included. Authors were not contacted for original data. Reports included were double-blinded, randomized comparisons of local anaesthesia with placebo (saline) or non-placebo (no treatment). Only articles dealing with abdominal incisions, that is laparotomies and herniotomies, and only those describing administration of incisional local anaesthesia were included. Incisional local anaesthesia was defined as infiltration, topical administration or instillation of local anaesthesia of, for example, skin, subcutaneous tissue, fascia, muscle and/or the parietal peritoneum. Furthermore, only reports considering adult patients (age >15 yr) were included.

Reports not included were those not stating pain outcome and reports of studies not randomized and double-blind. Studies of laparoscopic surgery and other surgical procedures, such as thyroidectomy, hemilaminectomy, haemorrhoidectomy, odontological surgery, tonsillectomy and arthroscopy were not considered. Also, studies where nerve blocks or intraperitoneal local anaesthetic instillation, or infiltration of viscera were performed were excluded. Finally, reports of comparisons of local anaesthetic wound infiltration with other treatments were not considered.

Each report which met the inclusion criteria was read independently by each of the authors and scored using a three-item, 1–5 score quality scale. Consensus was then achieved. If the reports were described as randomized, 1 point was given, and an
additional point given if the method of randomization was described and considered adequate (computer-generated, table of random numbers, etc) but 1 point was deducted if randomization was inappropriate (alternate randomization, randomization according to weekday, etc). If studies were described as double-blind, 1 point was given. An additional point was given if blinding was described and considered appropriate (blinded pharmacy manufactured ampoules, etc) but 1 point was deducted if blinding was inappropriate (comparisons of catheter treatment vs no treatment, etc) Finally, reports which described the numbers and reasons for withdrawals were given 1 point. By definition, studies without randomization and blinding were excluded. Thus the minimum score of an included RCT was 2 and the maximum score was 5. Information on type of anaesthesia (general or regional), number of patients enrolled and adverse effects was taken from each report.

Postoperative effectiveness was evaluated by significant difference (\(P < 0.05\), as reported in the original investigation) in pain relief, assessed using pain scores (visual analogue score or similar scores), time to first request for supplementary analgesia and consumption of supplementary analgesics compared with control. The sensitivity of evaluated non-significant studies (power of statistical tests) was considered. Any statistical power analysis of individual studies was noted.

### Results

We identified 34 reports of incisional local anaesthesia. Of these, eight studies were excluded because of inappropriate blinding or randomization. In appendix A, a list of excluded studies is given. The remaining 26 reports were divided into those considering inguinal herniotomy (five), abdominal hysterectomy (four), open cholecystectomy (eight) and various types of abdominal surgery (nine). A total of 1211 patients of whom 650 received local anaesthesia, were studied. The range of numbers of patients included in the studies was 20–130. The median quality score was 3 (range 2–5). Details of the included studies are shown in tables 1–4.

### INCISIONAL LOCAL ANAESTHESIA FOR POSTOPERATIVE PAIN AFTER ABDOMINAL HYSTERECTOMY

Two of four studies on abdominal hysterectomy compared incisional local anaesthesia with saline and two with no treatment (table 2). In the study of Sinclair and colleagues, 500 mg of lidocaine treatment (table 1). Bupivacaine 0.25% 40 ml or 0.5% bupivacaine 15 ml was used in three studies. Lidocaine 200 mg in one study and 0.25% and 0.5% ropivacaine 40 ml in the last study. All five studies showed significantly lower pain scores, with VAS reductions of approximately 25–50 mm (fig. 1). In three studies, pain scores were reduced at 1–7 h after surgery but not later. In the study of Sinclair and colleagues, pain scores were reduced over the first 24-h period but not during 24–48 h. In the study of Tverskoy and colleagues, pain scores were reduced up to 48 h after operation. In the four studies where time to first analgesic request was evaluated, significant prolongation in pain relief was observed at 2–7 h. In the study of Tverskoy and colleagues, postoperative analgesia was thereafter fixed by study design, but supplementary analgesic consumption was significantly reduced by approximately 50% compared with control in the four other studies.

### Figure 1

Mean or median visual analogue scale pain score (VAS, mm) for incisional local anaesthesia (LA) vs control in studies of inguinal herniotomy at the specific times shown. Each square represents an individual study. In all studies VAS was significantly \((P < 0.05)\) lower in the LA group compared with controls.
aerosol administered subcutaneously caused a significant reduction of approximately 50% in pain scores and supplementary analgesic consumption during the first 24 h of the study, but not later. In the study of Hannibal and co-workers, 0.25% bupivacaine caused a significant reduction in analgesic consumption but not in pain scores or time to first analgesic request. In contrast, subcutaneous infiltration of 0.5% bupivacaine caused a 50% reduction in analgesic consumption on the first and second days after operation. However, there was no effect on pain scores, total analgesic consumption or time to first analgesic request in any of these studies. In contrast, Johansson and co-workers observed significantly reduced pain scores, time to first analgesic request and reduced supplementary analgesic consumption (P = 0.051) at 6 h only. Furthermore, there was a significant dose–response relationship between saline 70 ml, and 0.125% and 0.25% ropivacaine.

INCISIONAL LOCAL ANAESTHESIA FOR POSTOPERATIVE PAIN AFTER VARIOUS MAJOR AND MINOR SURGICAL PROCEDURES

Nine studies considered various major and minor procedures (table 4). In the three studies on Caesarean section, 0.25% or 0.5% bupivacaine 20 ml caused a 20–50% reduction in analgesic consumption. However, this effect lasted for only 4 h.

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**Table 2** Abdominal hysterectomy. P < 0.05 = significant difference between local anaesthetic group and control group, ns = no significant difference, — = not evaluated

<table>
<thead>
<tr>
<th>Study</th>
<th>Quality score</th>
<th>No. of patients active/control</th>
<th>Pain score</th>
<th>Suppl. analgesic consumption</th>
<th>Time to first analgesic request</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinclair and colleagues, 1996</td>
<td>3</td>
<td>15/15</td>
<td>P &lt; 0.05</td>
<td>P &lt; 0.05</td>
<td>—</td>
<td>Significant over first 24 h period, not later</td>
</tr>
<tr>
<td>Hannibal and colleagues, 1996</td>
<td>4</td>
<td>20/21</td>
<td>ns</td>
<td>P &lt; 0.05</td>
<td>—</td>
<td>Significant over 24 h observation periods, at day 1, 2, and 3</td>
</tr>
<tr>
<td>Cobby and Reid, 1997</td>
<td>2</td>
<td>20/20</td>
<td>ns</td>
<td>ns</td>
<td>—</td>
<td>Observed for 6 h</td>
</tr>
<tr>
<td>Victory and colleagues, 1995</td>
<td>3</td>
<td>18/19/19</td>
<td>ns</td>
<td>ns</td>
<td>—</td>
<td>Pre-vs postoperative vs no treatment observed 4, 8, 24, 48 and 96 h, analgesic consumption over 24 h periods</td>
</tr>
</tbody>
</table>

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**Table 3** Open cholecystectomy. P < 0.05 = significant difference between local anaesthetic group and control group, ns = no significant difference, — = not evaluated

<table>
<thead>
<tr>
<th>Study</th>
<th>Quality score</th>
<th>No. of patients active/control</th>
<th>Pain score</th>
<th>Suppl. analgesic consumption</th>
<th>Time to first analgesic request</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patel and colleagues, 1983</td>
<td>4</td>
<td>17/23</td>
<td>—</td>
<td>P &lt; 0.05</td>
<td>—</td>
<td>Significant over 24 h periods, day 1–3</td>
</tr>
<tr>
<td>Thomas and colleagues, 1983</td>
<td>4</td>
<td>10/10/10</td>
<td>—</td>
<td>(P &lt; 0.05)</td>
<td>—</td>
<td>Significant over a 0–48 h observation period, when compared with no treatment but not compared with placebo</td>
</tr>
<tr>
<td>Levack and colleagues, 1997</td>
<td>2</td>
<td>25/25</td>
<td>P &lt; 0.05</td>
<td>P &lt; 0.05</td>
<td>—</td>
<td>Significant at day 1 and day 2</td>
</tr>
<tr>
<td>Chester and colleagues, 1992</td>
<td>3</td>
<td>15/15</td>
<td>P &lt; 0.05</td>
<td>P &lt; 0.05</td>
<td>—</td>
<td>Observed over 24 h periods from day 1–4</td>
</tr>
<tr>
<td>Van Raay and colleagues, 1992</td>
<td>3</td>
<td>25/25</td>
<td>ns</td>
<td>—</td>
<td>—</td>
<td>Observed over 24 h and 72 h</td>
</tr>
<tr>
<td>Adams and colleagues, 1991</td>
<td>3</td>
<td>40/40</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>Observed over 24 h</td>
</tr>
<tr>
<td>Russell and colleagues, 1993</td>
<td>4</td>
<td>14/16</td>
<td>ns</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Johansson and colleagues, 1994</td>
<td>3</td>
<td>22/22/22</td>
<td>P &lt; 0.05</td>
<td>P = 0.051</td>
<td>P &lt; 0.05</td>
<td>Significant for 0.25 %, not 0.125 %, at 6 h but not later</td>
</tr>
</tbody>
</table>

INCISIONAL LOCAL ANAESTHESIA FOR POSTOPERATIVE PAIN AFTER OPEN CHOLECYSTECTOMY

Seven of eight studies compared 0.25–0.5% incisional bupivacaine 40–55 ml as a single dose or infusion of 10–16 ml every 4–12 h, or with saline or no treatment (table 3). One study compared 0.125% and 0.25% incisional ropivacaine with saline. In three studies there were no data on pain assessment but all three showed a decrease in supplementary analgesic consumption after incisional bupivacaine, although in one study the clinical significance was questionable as methadone requirements over a 78-h period were reduced only from 84 mg in the control group to 61 mg in the treatment group. Furthermore, in the study by Thomas, Lambert and Lloyd Williams, incisional local anaesthesia was compared with both placebo and no treatment, and an effect was observed only in comparison with no treatment. In another study, a bolus dose followed by continuous infusion of 0.5% bupivacaine 4 ml h$^{-1}$ via a subfascially placed catheter caused significantly decreased pain scores and a 50% reduction in analgesic consumption on the first and second days after operation. However, there was no effect on pain scores, total analgesic consumption or time to first analgesic request in three other studies. Information on statistical power was not provided in any of these studies. In contrast, Johansson and co-workers observed significantly reduced pain scores, time to first analgesic request and reduced supplementary analgesic consumption (P = 0.051) at 6 h only. Furthermore, there was a significant dose–response relationship between saline 70 ml, and 0.125% and 0.25% ropivacaine.
Furthermore, in only one study\textsuperscript{28} were pain scores reduced compared with control. Two studies\textsuperscript{32,33} considered a combination of several major surgical procedures (stomach, hepatic, biliary, pancreatic and ventral hernia, etc) and one investigated abdominal aortic surgery.\textsuperscript{34} In these studies, 0.25% bupivacaine 30–40 ml was infiltrated subcutaneously and subfascially.\textsuperscript{32–34} No firm evidence of a beneficial effect of local anaesthesia was obtained. In one study,\textsuperscript{30} only a slight reduction in daily morphine ingestion (10 mg) was noted, and a reduction in VAS only during mobilization was recorded (50 mm).\textsuperscript{31} In another study,\textsuperscript{32} a 30% reduction in VAS and a reduction in opioid ingestion (pethidine 150 mg) was reported.\textsuperscript{33} There was no analgesic effect after aortic surgery\textsuperscript{34} (0.25% bupivacaine 40 ml). Furthermore, in two studies of appendectomy\textsuperscript{30,31} where 1.5% lidocaine 15 ml was infiltrated into the skin, subcutaneous tissue and subfascia\textsuperscript{30} before or after operation compared with saline, or a mixture of 1% lidocaine and 0.25% bupivacaine 44 ml was infiltrated into all layers of the surgical incision,\textsuperscript{31} no effect was observed in pain scores or supplementary analgesic consumption in the recovery room\textsuperscript{31} and over 12-h periods.\textsuperscript{30} Finally, a reduction in pain scores was observed at 2 h only after operation but there were no differences in total analgesic consumption after minor gynaecological operations.\textsuperscript{31} Power analysis was not performed in any of the negative studies.

**ANAESTHESIA AND ADVERSE EFFECTS**

Surgical procedures were performed under general anaesthesia in all except for one study (Caesarean section, spinal anaesthesia).\textsuperscript{24} In one study major upper abdominal procedures\textsuperscript{15} were performed under combined thoracic extradural and general anaesthesia. However, regional anaesthesia in these studies did not seem to mask the effect of incisional local anaesthesia as both showed improved pain relief.

No adverse effects attributable to incisional local anaesthesia were reported.

**Discussion**

In this systematic review, we have evaluated the effect of incisional local anaesthesia for control of postoperative pain. More than 90 studies of incisional and peripheral administration of local anaesthesia have been published in a variety of surgical procedures and surgical populations. Because of the large variability in study design, where incisional local anaesthetic infiltration has been combined with, for example, visceral local anaesthetic infiltration, nerve block or other treatments, results are inconclusive. In order to eliminate as many confounding factors as possible, we chose to review only those studies where inclusion and exclusion criteria described, in order to evaluate the effect of incisional local anaesthesia per se. Abdominal incisions performed for laparoscopic surgery (trocar and port-sites) where not considered because of the possible confounding effect of perioperative irritation after carbon dioxide insufflation. We selected 26 RCT with data analysed from more than 1200 patients. Even though aiming to standardize surgical procedure, interpretation was difficult, especially because of the small number of studies (e.g. only four studies of hysterectomy, two studies of appendectomy, etc).

However, data consistently showed a statistical in addition to a clinically significant effect after inguinal herniotomy. However, in most studies the effect was short-lived (2–7 h). These data reflect the fact that

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**Table 4** Various major and minor procedures. $P<0.05 =$ statistical significant difference between local anaesthetic group and control group, ns $=$ no significant difference between local anaesthetic group and control group, — $=$ not evaluated

<table>
<thead>
<tr>
<th>Study</th>
<th>Surgical procedure</th>
<th>Quality score</th>
<th>No of patients active/control</th>
<th>Pain score</th>
<th>Suppl. analgesic consumption</th>
<th>Time to first analgesic request</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trotter and colleagues, 1991</td>
<td>Caesarean section</td>
<td>4</td>
<td>14/14</td>
<td>ns</td>
<td>$P&lt;0.05$</td>
<td>—</td>
<td>Significant at 4 h only, not later</td>
</tr>
<tr>
<td>Mecklem and colleagues, 1995</td>
<td>Caesarean section</td>
<td>5</td>
<td>35/35</td>
<td>ns</td>
<td>$P&lt;0.05$</td>
<td>—</td>
<td>Significant over 24 h, Pain score ns except at 24 h, Significant at 4 h and 12 h, not at 8 h</td>
</tr>
<tr>
<td>Ganta and colleagues, 1995</td>
<td>Caesarean section</td>
<td>3</td>
<td>20/21</td>
<td>$P&lt;0.05$</td>
<td>$P&lt;0.05$</td>
<td>—</td>
<td>Pain score significant only in recovery room, Analgesic consumption significant over 24 h</td>
</tr>
<tr>
<td>Partridge and colleagues, 1990</td>
<td>Major upper/lower</td>
<td>4</td>
<td>10/10</td>
<td>$P&lt;0.05$</td>
<td>$P&lt;0.05$</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Bartholdy and colleagues, 1994</td>
<td>Major upper abdominal</td>
<td>4</td>
<td>19/21</td>
<td>$P&lt;0.05$</td>
<td>$P&lt;0.05$</td>
<td>—</td>
<td>Pain score significant up to 12 h, not later. Analgesic consumption significant over 24 h periods from day 1–3</td>
</tr>
<tr>
<td>Pfeiffer and colleagues, 1991</td>
<td>Abdominal aortic</td>
<td>3</td>
<td>37/33</td>
<td>ns</td>
<td>ns</td>
<td>—</td>
<td>Observed over 24 h and 72 h</td>
</tr>
<tr>
<td>Turner and Chalkiadis, 1994</td>
<td>Appendectomy</td>
<td>3</td>
<td>29/32/29</td>
<td>ns</td>
<td>ns</td>
<td>—</td>
<td>Pre- vs postoperative vs no treatment, Day 1 and day 2, evaluated at 12, 24 and 36 h</td>
</tr>
<tr>
<td>Willard and Blair, 1997</td>
<td>Appendectomy</td>
<td>3</td>
<td>21/22</td>
<td>ns</td>
<td>ns</td>
<td>—</td>
<td>Evaluated in recovery room and every day until day 5</td>
</tr>
<tr>
<td>Holst and colleagues, 1992</td>
<td>Minor gynaecological</td>
<td>3</td>
<td>12/12</td>
<td>$P&lt;0.05$</td>
<td>ns</td>
<td>—</td>
<td>Significant at 2 h only, not later</td>
</tr>
</tbody>
</table>
inguinal herniotomy may be performed under local anaesthetic infiltration only. It is difficult to explain the long-lasting pain reducing effect observed in the study of Tverskoy and colleagues. Although claimed to be a result of a pre-emptive effect, many have disputed this hypothesis.

Interpretation of the differences in results after hysterectomy is difficult. However, wider application of local anaesthesia (subcutaneously and subfascial), as in the study of Hannibal and colleagues, may be important. Furthermore, a possible masking effect of a rather large dose of intraperitoneal opioid in the study of Victory and colleagues may also have played a role.

The large variability in study design after open cholecystectomy hindered interpretation. Some studies only considered intraoperative administration of local anaesthesia while others investigated postoperative infusion or repeated injections of local anaesthetic.

Five of eight studies on open cholecystectomy were positive for at least one of the evaluated pain outcome measures. However, in three of these positive studies, there were no data on pain assessment making validation difficult, and in one study only the comparison with no treatment but not with placebo was positive. There is no clear explanation for this disparity. In most studies the local anaesthetic was distributed widely to the cut surfaces of the peritoneum, fascia and subcutaneous tissue. Furthermore, there were no major differences in dose of local anaesthetic (volume and concentration).

The same applies to the two studies after appendectomy. However, the lack of analgesic effect may be a result of a significant inflammatory visceral component which may have masked any beneficial effect of the somatic neural block. Nevertheless, no evidence for improved pain relief after appendectomy has been observed in adult patients, although improved pain relief has been shown after paediatric appendectomy.

The clinical beneficial effect observed after various other major procedures may be questionable as only small reductions in supplementary analgesics were observed. Of importance may be that different surgical procedures were studied within these investigations and that severe visceral pain after the major trauma of some of these procedures (e.g. aortic surgery, Whipple) may have masked any minor beneficial somatic effect of incisional local anaesthesia.

Of a total of 26 studies, eight were unequivocally negative. Even though the majority of studies showed significant differences in at least one pain measure, several were of questionable clinical importance. It is surprising that local anaesthesia was not associated with more consistent positive results. There may be several explanations for this.

First, when analysing study quality, in 50% of the positive studies, quality scores were 4 or 5 whereas in only one of the eight negative studies the score was more than 3 (fig. 2). This is in contrast with a recent review of the analgesic efficacy of peripheral opioids where studies of lower quality were more likely to over-estimate the efficacy of treatments. Nevertheless, the general quality of studies examined in this review was relatively high, with only one negative and one positive study having the minimum score of 2.

Second, another point worth emphasizing is the sample size of the individual studies. Risk of bias exists when comparing studies of a large number with those of a small number. The risk of a type II error depends partly on study size. In only two of the negative studies was a power analysis performed. However, the mean number of patients per study was approximately 55 for the negative studies and approximately 40 patients for the positive studies. With these numbers, we consider the risk of major bias on this account small. Eventually, as stated in a recent study by Tramèr and colleagues, quantitative analysis was impossible because the studies examined constituted a variety of different study designs, drugs, doses and application sites.

Third, of greater importance may be the technique used for administration of local anaesthesia. Only few studies addressed the importance of the relative contribution of different anatomical structures to postoperative pain. For example, a recent study showed that lidocaine was more effective when applied subfascially compared with subcutaneously after hernia repair. Furthermore, it would not be unreasonable to expect improved pain relief if visceral structures are also infiltrated with local anaesthesia, as shown in studies of laparoscopic surgery where viscerally applied local anaesthetics, in addition to port-site wound infiltration alone, caused improved pain relief. Finally, in the studies of Johansson and colleagues after herniotomy and cholecystectomy, a significant dose–response relationship
of incisional local anaesthesia was observed where the largest dose (highest concentration) of the local anaesthetic caused the most pronounced pain relief. Not surprisingly, it may be of importance where and how much local anaesthetic is used.

With the exception of herniotomy, this review revealed an overall lack of evidence for any important effect (rather than evidence for a lack of effect) of incisional local anaesthesia in most abdominal procedures despite the numerous studies available. Therefore, the use of incisional local anaesthesia should be reserved for herniotomy until further well-designed studies with a strictly standardized methodology are available. The literature provides no support for an analgesic effect outlasting the pharmacological effect of incisional local anaesthesia.44-51

Appendix

Table 1A Excluded studies

<table>
<thead>
<tr>
<th>Excluded study</th>
<th>Reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hashemi and Middleton, 1983</td>
<td>Not blinded as only the treatment group had a subcutaneous catheter inserted</td>
</tr>
<tr>
<td>Gibbs and colleagues, 1988'</td>
<td>No information on blinding</td>
</tr>
<tr>
<td>Egan and colleagues, 1988'</td>
<td>No information on blinding of observer</td>
</tr>
<tr>
<td>Eriksson-Mjöberg and colleagues, 1997</td>
<td>Single-blinded, only blind to the patients</td>
</tr>
<tr>
<td>Cameron and Cross, 1985</td>
<td>Not blinded as only the treatment group had a subcutaneous catheter inserted</td>
</tr>
<tr>
<td>Huang and colleagues, 1997</td>
<td>No information on blinding of patients</td>
</tr>
<tr>
<td>Bielecki and Szepietowski, 1989</td>
<td>No information on blinding</td>
</tr>
<tr>
<td>Ben-David and colleagues, 1995</td>
<td>Inappropriate randomization as a result of alternating allocation to study groups</td>
</tr>
</tbody>
</table>

References

Local anaesthetic wound infiltration


