Effectiveness of acute postoperative pain management: I. Evidence from published data

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Background. This review examines the evidence from published data concerning the incidence of moderate-severe and of severe pain after major surgery, with three analgesic techniques; intramuscular (i.m.) analgesia, patient controlled analgesia (PCA), and epidural analgesia.

Methods. A MEDLINE search of the literature was conducted for publications concerned with the management of postoperative pain. Over 800 original papers and reviews were identified. Of these 212 papers fulfilled the inclusion criteria but only 165 provided usable data on pain intensity and pain relief. Pooled data on pain scores obtained from these studies, which represent the experience of a total of nearly 20,000 patients, form the basis of this review.

Results. Different pain measurement tools provided comparable data. When considering a mixture of three analgesic techniques, the overall mean (95% CI) incidence of moderate-severe pain and of severe pain was 29.7 (26.4–33.0)% and 10.9 (8.4–13.4)%, respectively. The overall mean (95% CI) incidence of poor pain relief and of fair-to-poor pain relief was 3.5 (2.4–4.6)% and 19.4 (16.4–22.3)%, respectively. For i.m. analgesia the incidence of moderate-severe pain was 67.2 (58.1–76.2)% and that of severe pain was 29.1 (18.8–39.4)%. For PCA, the incidence of moderate-severe pain was 35.8 (31.4–40.2)% and that of severe pain was 10.4 (8.0–12.8)%. For epidural analgesia the incidence of moderate-severe pain was 20.9 (17.8–24.0)% and that of severe pain was 7.8 (6.1–9.5)%. The incidence of premature catheter dislodgement was 5.7 (4.0–7.4)%. Over the period 1973–1999 there has been a highly significant (P<0.0001) reduction in the incidence of moderate-severe pain of 1.9 (1.1–2.7)% per year.

Conclusions. These results suggest that the UK Audit Commission (1997) proposed standards of care might be unachievable using current analgesic techniques. The data may be useful in setting standards of care for Acute Pain Services.

Keywords: analgesic techniques, intramuscular; analgesia, patient-controlled; anaesthetic techniques, epidural; pain, postoperative

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The Acute Pain Service is a relatively recent innovation, developed to improve the management of postoperative pain. Among the earliest services were those in Kiel and in Seattle. The concept was given impetus in the early 1990s in the UK by the publication of a joint report by the Royal Colleges of Surgeons and Anaesthetists and in USA by the publication of protocol for Investment in Health Gain such that 73% of US hospitals had a pain service by 1994 whilst in the UK 88% of hospitals had an established pain service by 1999. There is evidence that pain services affect morbidity and duration of hospital stay. However, despite the vast amount published on acute pain there have been few if any attempts to establish standards of care for acute postoperative pain services, although a number of large audits have been published. In a brief reference to postoperative pain in 1997 the Audit Commission (UK) proposed a standard whereby less than 20% of patients should experience severe pain following surgery after 1997, and that this should ideally reduce to less than 5% by 2002. It is not clear from the
Audit Commission document how these figures have been arrived at, nor how valid this standard might be. In the light of this recommendation we decided to review the published literature on acute pain management in order to establish the validity of the Audit Commission’s proposed standard.

In the past, pain relief has been provided mainly by ‘as required’ intramuscular (i.m.) injections of opioids. More recently, intravenous (i.v.) patient-controlled analgesia (PCA) and epidural analgesia have become popular, as they are perceived as being more effective. However, pain and pain relief are just one aspect of the wide range of outcome variables with which pain services are interested. For a review to be comprehensive it should consider three broad areas of outcome, such as effectiveness, safety, and tolerability. Effectiveness can be inferred from pain scores and pain relief reports. The incidence of respiratory depression and hypotension may be indicative of the safety of the techniques whilst tolerability is reflected by the occurrence of nausea and vomiting, sedation, itching, and the need for urinary catheterization. Psychological effects such as nightmares/hallucinations and panic attacks may also be important.

Methods

Search strategy

We used MEDLINE (1966 onwards) to search the literature for all English language publications concerned with the management of postoperative pain and in particular measures of effectiveness. Keywords selected included analgesia, postoperative pain, pain therapy, i.v. PCA, and epidural analgesia. The computerized search identified keywords in the title, abstract, and medical subject headings (MESH). As standard bibliographic databases label incorrectly nearly 50% of published trials, we also ‘hand searched’ the full reference lists from review articles and individual relevant papers in peer-reviewed English language journals. Finally, a hand search of four anaesthetic journals (Anaesthesia, British Journal of Anaesthesia, Acta Anaesthesiologica Scandinavica, and Anesthesiology) from 1980 to 1999 was performed to cross check the quality of the retrieval method.

All publications identified by the search strategy were categorized according to the level of evidence obtained, based broadly on the criteria of the US Preventive Task Force (Appendix I). Subsequent analysis was not confined to randomized controlled clinical trials but included cohort studies, case control studies, and audit reports; that is level 2 and level 3 evidence. Case reports were not included, nor were authors approached for raw or unpublished data. No attempt was made to grade individual papers according to quality. All of the studies used in the analysis were given equal value. Data extraction was undertaken by one author (S.D.). Figure 1 summarizes the methodology.

Selection criteria

We included articles relating to abdominal, major gynaecological, major orthopaedic, and thoracic surgery. The shortest period of observation was 24 h. Initial observations
Definitions

We were interested in obtaining, from the published literature, the incidence of analgesic ‘failure’ after major surgery. Defining analgesic ‘failure’ would involve making a number of assumptions, and may differ between patients and medical staff. We have simply calculated the overall incidence of pain intensity in two categories: the percentage of patients who experienced moderate-severe pain and the percentage of patients who experienced severe pain at some time during the first 24 h. We calculated these incidences for each of the three analgesic techniques in common practice: i.m. analgesia, PCA, and epidural analgesia.

Information was extracted from published studies, which reported pain scores using any one of three different measures; visual analogue scale (0–100 mm), numerical rating scale (0–10), and verbal rating scales (mild/moderate/severe). The different measurements have been recorded and where studies involved comparison between drugs using the same technique (e.g. epidural opioids vs epidural local anaesthetics) the results have been pooled, to reflect what happens in clinical practice, such as a mixture of drug regimens. Where the study has compared analgesic techniques (PCA vs epidural) results have been recorded separately under each technique.

Studies used either contemporaneous pain assessments and/or retrospective pain assessments. For contemporaneous pain scores the worst score in the first 24 h was used, excluding recovery room. The percentage of patients with moderate-severe pain and with severe pain was recorded from each study and this figure was weighted by the number of patients in the study. Moderate-severe pain was taken as a visual score greater than 30/100 or a numerical score greater than 3/10 in this review, in common with most authors. In many but not all studies it was possible to obtain a separate figure for the percentage of patients experiencing severe pain, which was taken as pain intensity score of greater than 70/100 or 7/10. Only when pain intensity scores were reported as raw data, as percentages with moderate or severe pain, or as histograms were we able to extract incidence data. The commonest reason not to include pain intensity data was when pain scores were presented as mean and standard deviation. As the pain scores were unlikely to be normally distributed it was impossible to obtain the percentage of patients experiencing moderate-severe pain and severe pain. Commonly, a single verbal score was recorded after 24 h, whereas visual scores were often recorded contemporaneously at intervals during the 24 h period.

Several studies reported not only pain but also pain relief. Escape criteria such as the need for additional ‘rescue’ analgesia was also reported in some studies. Most studies reported pain/pain relief at rest but there are some scales that combine pain at rest and on movement; these have been analysed separately.

A number of studies reported the incidence of premature catheter dislodgement, and as this was relevant to analgesic ‘failure’ this was included in the study. Occasionally the incidence of missed segments or unilateral blocks was reported, but this was insufficient for formal analysis.

Statistics

The mean percentage reporting a given level of pain was found by the method of weighted mean, weighting by the number of subjects in the group. When patients were grouped by analgesic technique, some studies contributed subjects to more than one group. The presence of a few studies in more than one analgesic technique was ignored in the analysis, possibly resulting in a small loss of power. Where appropriate groups were compared using analysis of variance. The percentage of patients reporting pain was weighted by the number as described previously and this figure was used in the analysis rather than any other statistical transformation. This is because our main aim was to estimate the percentage reporting pain for the whole population. All analyses were done using Stata 5.0 (Stata Corp., College Station, TX).

Results

We identified over 800 original papers and reviews, 410 of which contained data that were suitable for the meta-analysis as a whole. Papers which fulfilled our inclusion and exclusion criteria, and from which we were able to extract usable data on pain intensity and pain relief (several papers had data on both) data totalled 212. Some papers contributed both pain intensity and pain relief data. This resulted in 222 papers as follows: i.m. analgesia 45 papers (Appendix II), PCA 73 papers (Appendix III), and epidural analgesia 104 papers (Appendix IV). Pain intensity results were obtained from 123 papers, which included a total of 19,909 patients, published between 1973 and 1999. Pain relief results were obtained from 53 papers, which included 9,068 patients published between 1972 and 1998. The incidence of premature epidural catheter dislodgement was obtained from 32 papers, which included 13,629 patients, published between 1975 and 1998 (Appendix V).
Effectiveness of postoperative pain management

Pain intensity

We initially analysed visual and verbal scales separately. Visual or verbal scales produced similar distributions for the percentage of patients having moderate or greater pain (Fig. 2). The corresponding distributions for severe pain are shown in Figure 3. Visual and verbal pain scales were compared using analysis of variance and there were no significant differences between the distributions.

Table 1 shows the percentage of patients experiencing moderate-severe and severe pain for both visual and verbal scales, and when both scales were combined. These results were similar for both scales and when considered together with the analysis of the distributions in Figures 2 and 3, we felt that it was statistically valid to regard the distributions of visual and verbal scales as coming from the same population. Subsequent analysis was therefore conducted on the combined data, allowing the maximum possible number of studies to be used.

The overall mean percentages reporting pain in the three analgesic techniques, weighted for study size, are shown in Table 2: the percentage reporting moderate-severe pain at rest is thus estimated to be between 26 and 33%. Severe pain was reported by between 8 and 13% of patients in the first 24 h after major surgery.

As part of the analysis we looked at how the incidence of pain altered between 1973 and 1999. The analgesic technique reported varied with year of publication (Table 3). In the early part of the period of the analysis, i.m. analgesia was the most frequently reported technique, whereas in the later part epidural analgesia was the most frequent. Between 1973 and 1999 there was a significant fall in the overall incidence of moderate-severe pain at rest (P<0.0001), by 1.9% per annum (95% CI 1.1–2.7). When the relationship between percentage reporting moderate-severe pain and year of publication was adjusted for analgesic technique, the relationship with time was no longer significant (P=0.7) and the estimated fall was reduced to 0.2% per annum (95% CI –0.6 to 0.9). The effect of analgesic technique was highly significant (P<0.0001), indicating that as epidural analgesia was introduced postoperative analgesia improved over time.

The incidence of moderate-severe pain and severe pain by analgesic technique is shown in Table 4. Epidural analgesia resulted in the smallest percentage reporting both moderate-severe incidence for pain and severe pain, while i.m. analgesia resulted in the highest percentage. Moderate-severe pain on movement was unreliable, because pain on movement was not commonly reported except in studies of epidural analgesia, with resulting wide confidence intervals. There were no differences between analgesic techniques in the relative numbers of studies based on type of surgery (gynaecological, abdominal, orthopaedic, and thoracic).

Pain relief

Nearly all pain relief was recorded using a verbal rating scale (good, fair, poor) and were generally retrospective, so we have not separated the methods of recording. The results are shown in Table 5.

Overall, between 2 and 5% of patients reported poor pain relief and between 16 and 22% reported only fair-to-poor pain relief. While poor pain relief was most frequently reported by patients receiving epidural analgesia, the numbers of papers was small with wide confidence intervals.

Over the period 1972–1998 significantly fewer patients reported poor pain relief (P<0.04), a decrease of 0.4 (95% CI 0.1–0.6) percentage points per year. When adjusted for analgesic technique the relationship was no longer significant. However, the proportion reporting fair-to-poor pain relief was unchanged over time.
Table 1 Percentage of patients reporting moderate-severe pain or severe pain as measured by the three different pain scales, unweighted for study size. VAS=visual analogue scale; VRS=verbal rating scale

<table>
<thead>
<tr>
<th></th>
<th>Number of studies</th>
<th>Mean (%) reporting pain</th>
<th>Standard deviation</th>
<th>Range</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VAS pain score only</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate-severe at rest</td>
<td>64</td>
<td>35</td>
<td>26</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Moderate-severe on movement</td>
<td>25</td>
<td>44</td>
<td>31</td>
<td>0</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>31</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td><strong>VRS pain score only</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate-severe at rest</td>
<td>73</td>
<td>39</td>
<td>28</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Moderate-severe on movement</td>
<td>9</td>
<td>38</td>
<td>29</td>
<td>0</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>47</td>
<td>13</td>
<td>16</td>
<td>0</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td><strong>Combined VAS and VRS pain score</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate-severe at rest</td>
<td>136</td>
<td>37</td>
<td>27</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Moderate-severe on movement</td>
<td>33</td>
<td>41</td>
<td>30</td>
<td>0</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>78</td>
<td>11</td>
<td>14</td>
<td>0</td>
<td>73</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Percentage of patients reporting moderate-severe pain or severe pain, as measured by all three pain scales combined, weighted for study size. VAS=visual analogue scale; VRS=verbal rating scale

<table>
<thead>
<tr>
<th>Combined VAS and VRS pain score</th>
<th>Number of studies</th>
<th>Mean (%) reporting pain</th>
<th>Standard error</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate-severe at rest</td>
<td>136</td>
<td>29.7</td>
<td>1.7</td>
<td>26.4-33.0</td>
</tr>
<tr>
<td>Moderate-severe on movement</td>
<td>33</td>
<td>32.2</td>
<td>3.7</td>
<td>24.8-39.6</td>
</tr>
<tr>
<td>Severe</td>
<td>78</td>
<td>10.9</td>
<td>1.3</td>
<td>8.4-13.4</td>
</tr>
</tbody>
</table>

Premature epidural catheter dislodgement

We have confined our analysis to the incidence of catheter loss as we felt that unilateral block and missed segment represented technical difficulties with instigating the block. The overall mean (95% CI) incidence of premature epidural catheter dislodgement based on 13 629 patients from 32 studies was 5.7 (4.0-7.4)%.

Discussion

How much pain is acceptable after surgery? The evidence from this review indicates that the overall incidence of severe pain reported in the literature is 11%. This contrasts with the Audit Commission’s (UK) recommendation that by 2002 less than 5% of patients should experience severe postoperative pain. However, when considering a standard of care for pain intensity case mix is important. Day surgery pain can result in mild or no pain that can be managed by relatively simple techniques and procedures including take-home oral analgesia and advice. This review was limited to those operations after which moderate-severe postoperative pain could be expected, namely major abdominal gynaecological surgery, major orthopaedic surgery, and any laparotomy or thoracotomy. Importantly, these operations would all be in the remit of the pain service and would generally require postoperative analgesia by i.m. analgesia, PCA, or epidural analgesia.

This review differs from a formal systematic review with meta-analysis in a number of respects. We did not confine ourselves to randomized controlled trials and no attempt was made to grade individual papers according to quality. All of the studies used in the analysis were given equal value as we were not concerned with the conclusion of the individual study merely the incidences of pain intensity. We feel that this approach is justified as we were not considering the results of published studies but were concerned with extracting the data from them. However, we did confine our search to English language publication because of the necessity to read in detail both the methods and results sections of each paper. This might be considered as a flaw although the large number of publications included will tend to reduce any tendency to bias. The hand search performed on four anaesthetic journals was designed to cross check the completion of the electronic search. As few new papers were picked up by this search method it was not extended to

Table 3 Numbers of published studies by year of publication. i.m.=intramuscular; PCA=patient-controlled analgesia

<table>
<thead>
<tr>
<th>Publication date</th>
<th>Method of analgesia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i.m.</td>
<td>PCA</td>
</tr>
<tr>
<td>1974</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1975-1979</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1980-1984</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>1985-1989</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>1990-1994</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>1995-1999</td>
<td>0</td>
<td>16</td>
</tr>
</tbody>
</table>
Effectiveness of postoperative pain management

Table 4 Percentage of patients reporting moderate-severe pain or severe pain by analgesic technique, weighted for study size. *Cannot be estimated as numbers are too small. i.m.=intramuscular; PCA=patient-controlled analgesia

<table>
<thead>
<tr>
<th>Analgesic technique</th>
<th>Number of studies</th>
<th>Mean (%) reporting pain</th>
<th>Standard error</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate-severe pain at rest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.m.</td>
<td>29</td>
<td>67.2</td>
<td>4.4</td>
<td>58.1–76.2</td>
</tr>
<tr>
<td>PCA</td>
<td>45</td>
<td>35.8</td>
<td>2.2</td>
<td>31.4–40.2</td>
</tr>
<tr>
<td>Epidural</td>
<td>62</td>
<td>20.9</td>
<td>1.6</td>
<td>17.8–24.0</td>
</tr>
<tr>
<td>Moderate-severe pain on movement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.m.</td>
<td>1</td>
<td>78.0</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>PCA</td>
<td>10</td>
<td>25.3</td>
<td>7.5</td>
<td>8.4–42.1</td>
</tr>
<tr>
<td>Epidural</td>
<td>22</td>
<td>37.9</td>
<td>3.6</td>
<td>30.4–45.4</td>
</tr>
<tr>
<td>Severe pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.m.</td>
<td>21</td>
<td>29.1</td>
<td>4.9</td>
<td>18.8–39.4</td>
</tr>
<tr>
<td>PCA</td>
<td>27</td>
<td>10.4</td>
<td>1.2</td>
<td>8.0–12.8</td>
</tr>
<tr>
<td>Epidural</td>
<td>30</td>
<td>7.8</td>
<td>0.8</td>
<td>6.1–9.5</td>
</tr>
</tbody>
</table>

Table 5 Percentage of patients reporting fair-to-poor pain relief or poor pain relief by analgesic technique, weighted for study size. *Cannot be estimated as numbers are too small. i.m.=intramuscular; PCA=patient-controlled analgesia

<table>
<thead>
<tr>
<th></th>
<th>Number of studies</th>
<th>Mean (%) reporting pain relief</th>
<th>Standard error</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>All subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>38</td>
<td>3.5</td>
<td>0.5</td>
<td>2.4–4.6</td>
</tr>
<tr>
<td>Fair-to-poor</td>
<td>47</td>
<td>19.4</td>
<td>1.5</td>
<td>16.4–22.3</td>
</tr>
<tr>
<td>% reporting poor pain relief</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.m.</td>
<td>5</td>
<td>1.6</td>
<td>1.3</td>
<td>*</td>
</tr>
<tr>
<td>PCA</td>
<td>17</td>
<td>3.6</td>
<td>0.8</td>
<td>1.8–5.4</td>
</tr>
<tr>
<td>Epidural</td>
<td>16</td>
<td>5.2</td>
<td>0.7</td>
<td>3.7–6.8</td>
</tr>
<tr>
<td>% reporting poor or fair pain relief</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.m.</td>
<td>12</td>
<td>21.3</td>
<td>3.5</td>
<td>13.6–29.1</td>
</tr>
<tr>
<td>PCA</td>
<td>16</td>
<td>16.7</td>
<td>2.2</td>
<td>12.1–21.3</td>
</tr>
<tr>
<td>Epidural</td>
<td>19</td>
<td>19.4</td>
<td>2.1</td>
<td>15.0–23.7</td>
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</tbody>
</table>

other journals. Data extraction was undertaken by one author, because we did not need to confer over quality of each study, simply extract reported incidence. A degree of heterogeneity is inevitable in a review of this type. However, we feel that the large numbers of studies included and the small number of differences sought will reduce the likelihood of statistical heterogeneity. Also, we were mindful of the dangers of over interpretation inherent in searching for causes of heterogeneity. Indeed, it has been suggested that over investigating heterogeneity may be likened to subgroup analysis in individual trials.13 Nevertheless, we have simply reported incidences of pain intensity, and refrained from formal statistical comparisons between analgesic techniques. With respect to clinical heterogeneity we found that the surgical case mix of the studies used was not only very similar between the three analgesic techniques but was also similar to that reported by Moriarty and colleagues14 and to the case mix of the Acute Pain Service in one of the authors' hospitals (Table 6). We feel confident therefore that these findings mirror 'clinical practice'.

The evaluation of pain after surgery is complex. It is generally accepted that the visual analogue scale is more sensitive and more accurate in representing pain intensity than other single dimension pain scales. Nevertheless, verbal rating scales (mild/moderate/severe) are widely used clinically and have the advantage of reflecting some of the multidimensional nature of pain. There is evidence that visual and verbal scales are moderately well correlated.15 Other pain scores such as Magill Pain Questionnaire are rarely used for acute postoperative pain.

Analgesic 'failure' has been described in various terms in different studies depending on which pain scale was used. Many studies using verbal rating scales regarded moderate

Table 6 Surgical case mix of studies used in review: percent of papers published in each surgical discipline by analgesic technique compared with audit data. *Results of St George's Hospital Acute Pain Service audit 1998–1999 (unpublished)

<table>
<thead>
<tr>
<th>Analgesic technique</th>
<th>Surgical discipline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General (%)</td>
</tr>
<tr>
<td>i.m.</td>
<td>59</td>
</tr>
<tr>
<td>PCA</td>
<td>69</td>
</tr>
<tr>
<td>Epidural</td>
<td>56</td>
</tr>
<tr>
<td>Moriarty et al.14</td>
<td>69</td>
</tr>
<tr>
<td>Audit data* (n=1571)</td>
<td>34</td>
</tr>
</tbody>
</table>

414
or severe pain in the postoperative period as representing inadequate analgesia. In studies that have used visual scales, scores more than 30/100 or 3/10, respectively, were the most frequently used scores indicative of inadequate analgesia. 17 18 Rarely lower scores (more than 20/100) 19 or higher scores (more than 50/100) 20 were used as endpoints to define inadequate analgesia. A visual score more than 70/100 was the most common endpoint to define severe pain, although more than 50 has been used. 21 Another group has proposed that moderate pain on verbal score equates to a mean visual score of 49 mm, whilst severe pain equates to a mean visual score of 75 mm. 16 Nevertheless, by analysing both visual and verbal scales separately we were able to demonstrate that, in this way, these two scoring systems give broadly similar results, and can be used interchangeably.

A number of studies recorded pain both at rest and on movement. It is unclear whether patients distinguish between pain at rest and pain on movement. This may be influenced by such factors as presence of persistent cough, need for physiotherapy, dressing changes, etc. It is probable that, when patients are asked to rate pain over the previous 4 h or at the end of 24 h, they may not distinguish between pain at rest and pain on movement, but may give an overall assessment. It was interesting to note that measurement of pain on movement occurred mostly in studies involving epidural analgesia and seemed of less concern to authors reporting results for other techniques. There were sufficient data to calculate an overall incidence only for pain on movement for moderate-severe pain, but not for severe pain alone. It seems from the literature that pain on movement was reported relatively infrequently and the calculated incidence of pain was associated with wide confidence intervals. For this reason we have limited conclusions and recommendations to pain at rest, 3 which was available for both moderate-severe pain and severe pain, and was associated with narrower confidence intervals.

A number of studies report not only pain intensity but also pain relief. Escape criteria such as the need for additional ‘rescue’ analgesia have also been reported in some studies. The literature on pain relief after major surgery reports a wide range of effectiveness of analgesic techniques. It was unclear how to interpret the incidence of pain relief, as opposed to pain intensity. There were sufficient studies to calculate incidence of fair-to-poor pain relief and poor pain relief but confidence intervals were relatively wide. The incidences of pain relief do not match the incidences of pain intensity, either overall or for each analgesic technique. It is possible that the incidence of pain intensity is a more direct measure, as pain relief will presumably vary with initial pain intensity.

Our findings that i.m. analgesia was associated with the highest percentage of patients experiencing inadequate analgesia support the general view that it is the least effective of the three techniques studied. Although using strict criteria for administration, i.m. analgesia can be an effective technique, 22 23 the literature suggests this does not occur in clinical practice. The rate of analgesia ‘failure’ after i.m. analgesia has received relatively scant attention in the literature; there were only 45 published articles (many acting as control groups for other techniques) with no large prospective studies as exist for both PCA and epidural analgesia. Epidural analgesia is generally considered more effective than PCA. Large prospective studies of epidural analgesia such as Scott report 17.4% epidural failure 22 and Stenseth reported 24–37% of patients after laparotomy experienced epidural failure by their criteria. 25 Our review indicates a lower incidence of moderate-severe pain and severe pain when epidural was used (20.9 and 7.8%, respectively) compared with PCA (35.8 and 10.4%, respectively). The epidural figures are undoubtedly confounded by technical failures such as premature epidural catheter displacement, which we found to have an incidence of 5.7%. Epidural analgesia does present some particular challenges to pain services. The rate of technical failure has been reported as high as 18.7% in the first 72 h. 26 In addition to premature catheter dislodgement, problems include unsuccessful placement, unilateral block, and missed segments. When these problems occur on postoperative wards there may be no back-up analgesia provided, and it may take time for the problem to be recognized and an appropriate response initiated.

We avoided any measures of patient satisfaction in this review, although some studies did report satisfaction rates. Satisfaction is complex and probably has contributions from many aspects of postoperative care, including effectiveness of analgesia, and perceived safety of analgesic technique and side-effects of treatment. While a number of studies have assessed patient satisfaction and measuring post-operative pain intensity, there was generally a poor correlation between the two. Patient satisfaction remains high even in the presence of moderate to severe pain. 17 26 27 The reasons for this are complex. Patients appear to expect some pain after surgery. Furthermore, in the presence of pain, patients are apparently satisfied by the fact that their health carers are attempting to provide pain relief even if the results are not always successful, as judged by postoperative pain scores. Satisfaction does not actually measure what happened after surgery, but only how satisfied the patient was about what happened. If patients are not aware that excellent postoperative pain relief is achievable then they may well be satisfied with less. Patients may not seek complete pain relief and so self-administer PCA to only moderate levels of pain relief. 28 In addition patients may report higher satisfaction for fear of offending those providing their postoperative care. Measuring patient satisfaction will, it seems, nearly always show high levels of satisfaction for pain relief after surgery, and it is not a particularly discriminating measure of success of a pain service.

In summary, we present a review of published data on the effectiveness of acute postoperative pain management from...
which it has been possible to calculate the incidence of moderate-severe pain and of severe pain after major surgery for each of the three commonly used analgesic techniques. Assuming a mixture of analgesic techniques the overall incidence of moderate-severe pain was 30% and the overall incidence of severe pain was 11%. For i.m. analgesia the incidence of moderate-severe pain was 67% and that of severe pain was 29%. For PCA, the incidence of moderate-severe pain was 36% and that of severe pain was 10%. For epidural analgesia the incidence of moderate-severe pain was 21% and that of severe pain was 8%. The incidence of premature epidural catheter dislodgement was 6%. These incidences of pain are calculated weighted means and so it is possible to propose reasonable targets. We suggest that individual pain services should aim to achieve figures better than the above mean incidences. However, despite the significant reduction in the incidence of pain over time we would suggest that, based on these data, the UK Audit Commission’s standard of less than 5% of patients experiencing severe pain after major surgery by 2002 may not be achievable.

Appendix I

United States Preventive Task Force levels of evidence

Level 1
Evidence obtained from systematic review of relevant randomized controlled trials with meta-analysis where possible (review with secondary data analysis).

Level 2
Evidence from one or more well-designed randomized clinical trial (RCT).

Level 3
Evidence from well-designed, non-controlled studies (prospective longitudinal study with/without specific intervention) or from well-designed case-controlled studies (retrospective study of a cohort with information pursued backwards in time).

Appendix II

References used to obtain incidences of moderate or greater pain—i.m.


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Appendix V

References used to calculate incidence of premature catheter dislodgement


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