

REVIEW ARTICLE

**Tolerability of acute postoperative pain management: nausea, vomiting, sedation, pruritis, and urinary retention. Evidence from published data**

S. J. Dolin<sup>1</sup> and J. N. Cashman<sup>2\*</sup>

<sup>1</sup>*Pain Clinic, St Richard's Hospital, Chichester PO19 6SE, UK.* <sup>2</sup>*Department of Anaesthesia, St George's Hospital, London SW17 0QT, UK*

\*Corresponding author. E-mail: [jeremy.cashman@stgeorges.nhs.uk](mailto:jeremy.cashman@stgeorges.nhs.uk)

This review examines the evidence from published data concerning the tolerability (indicated by the incidence of nausea, vomiting, sedation, pruritis, and urinary retention), of three analgesic techniques after major surgery; intramuscular analgesia (i.m.), patient-controlled analgesia (PCA), and epidural analgesia. A MEDLINE search of publications concerned with the management of postoperative pain and these indicators identified over 800 original papers and reviews. Of these, data were extracted from 183 studies relating to postoperative nausea and vomiting, 89 relating to sedation, 166 relating to pruritis, and 94 relating to urinary retention, giving pooled data which represent a total of more than 100 000 patients. The overall mean (95% CI) incidence of nausea was 25.2 (19.3–32.1)% and of emesis was 20.2 (17.5–23.2)% for all three analgesic techniques. PCA was associated with the highest incidence of nausea but the emesis was unaffected by analgesic technique. There was considerable variability in the criteria used for defining sedation. The overall mean for mild sedation was 23.9 (23–24.8)% and for excessive sedation was 2.6 (2.3–2.8)% for all three analgesic techniques (significantly lower with epidural analgesia). The overall mean incidence of pruritus was 14.7 (11.9–18.1)% for all three analgesic techniques (lowest with i.m. analgesia). Urinary retention occurred in 23.0 (17.3–29.9)% of patients (highest with epidural analgesia). The incidence of nausea and excessive sedation decreased over the period 1980–99, but the incidence of vomiting, pruritis, and urinary retention did not. From these published data it is possible to set standards of care after major surgery for nausea 25%, vomiting 20%, minor sedation 24%, excessive sedation 2.6%, pruritis 14.7%, and urinary retention requiring catheterization 23%. Acute Pain Services should aim for incidences less than this standard of care.

*Br J Anaesth* 2005; **95**: 584–91

**Keywords:** analgesia, intramuscular; analgesia, epidural; analgesia, patient-controlled; pain, postoperative

We have published previously two comprehensive reviews of analgesic effectiveness and safety of acute postoperative pain management after major surgery.<sup>4,6</sup> In this third and final review we address aspects of tolerability of acute postoperative pain management. We suggest that the tolerability of the various analgesic techniques is reflected by the occurrence of nausea and vomiting (PONV), sedation, pruritis, and the need for urinary catheterization. Psychological effects such as nightmares, hallucinations and panic attacks may also be important, but are infrequently reported in publications and so have not been addressed by this review.

As with the previous reviews we have examined the evidence from published data with regard to a variety of

possible clinical endpoints that could be considered in establishing standards of care. We have examined how to establish standards of care, in respect of the tolerability of the analgesic technique, after major surgery.

## Methods

### *Search strategy*

Full details of the study methodology have been described in previous publications.<sup>4,6</sup> A MEDLINE search of the literature for all publications concerned with the management of postoperative pain was conducted [key words in the title,

abstract, and Medical Subject Headings (MESH): analgesia, postoperative pain, pain therapy, PCA, epidural analgesia]. Once identified publications were scrutinized for parameters relating to tolerability of the three analgesic techniques. A 'hand search' of the full reference lists from review articles and individual relevant papers in four peer reviewed English language anaesthetic journals (*Anaesthesia*, *British Journal of Anaesthesia*, *Acta Anaesthesiologica Scandinavica*, and *Anesthesiology*), was also performed in order to cross check the quality of the computer 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 United States Preventive Task Force. We confined our analysis to cohort studies, case controlled studies, and audit reports only (i.e. level 2 and level 3 evidence). Case reports were not included, nor were authors approached for raw data 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, as we were interested in predetermined end points rather than the findings of individual studies. One author (S.J.D.) undertook the data extraction. Figure 1 gives a flow diagram of the review methodology.

#### Selection criteria

We included articles relating to abdominal, pelvic, major orthopaedic, and thoracic surgery. The minimum period of observation was 24 h. We excluded articles relating to operative obstetrics, paediatric, day stay, and minor surgery and where the period of observation was less than 24 h. We did not utilize any study where a mixed or unusual analgesic technique was described. We also excluded regional analgesic techniques such as interpleural, paravertebral, and lumbar plexus blocks. Nor did we include studies of combined spinal/epidural analgesia or regional techniques.

#### Definitions

Information was extracted from published studies, which reported variables indicative of patient acceptance for each of the three analgesic techniques in common practice: intramuscular injections (i.m.), patient-controlled analgesia (PCA), and epidural analgesia as outlined previously. Where the study compared two or more analgesic techniques, results have been entered separately under each form of analgesia. Descriptive studies that reported any parameter indicative of patient tolerability/comfort/acceptance of the three analgesic techniques in the first 24 h after surgery were used.

#### Statistical methodology

The mean percentage reporting a given incidence was found by the method of weighted mean weighting by the number of subjects in the group.<sup>1</sup> When patients were grouped by method of analgesia, some studies contributed subjects to more than one group. This was ignored in the analysis,

possibly resulting in a small loss of power. Analysis was by estimation of the confidence interval of the log odds ratio and its confidence interval. The standard error from which the confidence interval is estimated was adjusted for the clustering of the individual clusters within the study and treatment groups, thus allowing for the extra variation, which exists between studies. The log odds was then converted to a percentage by:

$$P=100/[\exp(-\log \text{odds})+1].$$

The effects of modality and year were tested using logistic regression adjusted for clustering. Modality is represented by two dummy variables, representing PCA and epidural. Both are zero for i.m.. The significance of the modality effect is tested using the overall  $\chi^2$  statistic. To test for modality adjusted for year, we took the difference between the  $\chi^2$  statistics and associated degrees of freedom for the model with modality and year and for that with year only.

All analysis was done using Stata 5.0 (Stata Corporation, College Station, TX).

## Results

We report on 183 studies relating to postoperative nausea and vomiting, 89 studies relating to sedation, 166 studies relating to pruritis, and 94 studies relating to urinary retention. A number of studies reported data for more than one analgesic technique, as a result the total number of study groups may exceed the number of studies in any particular category. A full list of the studies used in the analysis is included as Appendices in Supplementary data to the on-line version at [www.bja.oxfordjournals.org](http://www.bja.oxfordjournals.org). Some studies, although considered appropriate for analysis, were not used because data were not accessible. Details of the excluded studies are available from the authors.

#### PONV

Studies that reported data on postoperative nausea and/or vomiting were used in this analysis with data on the incidence of nausea and of vomiting analysed separately. Studies where nausea and vomiting were reported as a single figure were not used. Data on the influence of anti-emetic medication were also recorded.

#### Nausea

There were 181 study groups that reported data on nausea. This represents the experience of 23 782 patients (5773 patients had i.m. analgesia; 12 171 patients had PCA; 5838 patients had epidural analgesia). In studies that included male and female patients the overall mean (95% CI) incidence of nausea was 25.2 (19.3–32.1)%. The incidence of nausea was higher in studies that included only female patients, 53.0 (44.6–61.2)%. The effect of analgesic technique was statistically significant ( $P<0.03$ ) and persisted after controlling for year of publication ( $P<0.01$ ); PCA was

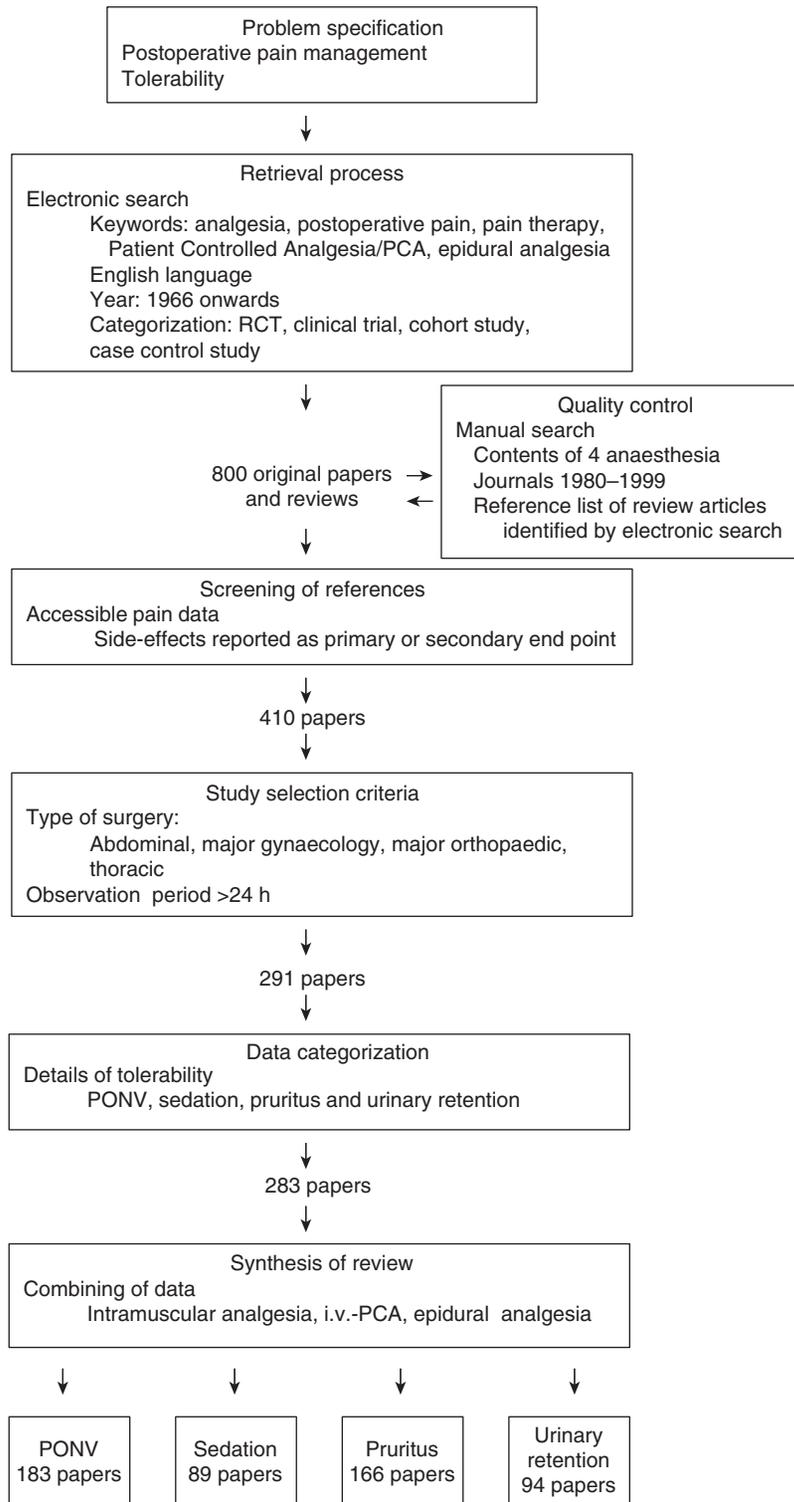


Fig 1 Tolerability of postoperative pain management: data retrieval flow diagram.

associated with the highest incidence of nausea. Over the time period of the analysis there was a statistically significant decrease in the incidence of nausea ( $P < 0.001$ ; Table 1). The overall incidence of nausea in patients who received concurrent anti-emetic medication was slightly

higher, 31.5 (21.0–44.3)%, but the number of patients studied was small.

#### Vomiting

There were 153 study groups that reported data on emesis. This represents the experience of 14 719 patients (6086

patients had i.m. analgesia; 5714 patients had PCA; 2919 patients had epidural analgesia). In studies that included male and female patients the overall mean (95% CI) incidence of emesis was 20.2 (17.5–23.2)%. The incidence of emesis was higher in studies that included only female patients, 34.2 (25.3–44.4)%. The incidence of emesis was unaffected by analgesic technique and there was no significant change in the incidence of emesis over the time period of the analysis ( $P=0.5$ ; Table 2). The overall incidence of emesis in patients who received concurrent anti-emetic medication was slightly higher, 28.7 (20.6–38.6)%, but again the number of patients studied was small.

### Sedation

Data on sedation were presented in a variety of ways. For the present analysis data were divided into two groups: mild sedation and excessive sedation. Visual analogue scores of less than 3-out-of-10 and the terms 'somnia', 'sleepy/easily rouseable' were taken as indicating mild sedation. Whereas visual analogue scores of greater than 3-out-of-10, and the terms 'oversedated', 'extreme somnolence', 'deeply asleep/hard to rouse' were taken as indicating moderate-to-severe or excessive sedation. A number of studies merely reported sedation as present/absent or gave no definition at all; these studies were not used in the analysis.

### Mild sedation

There were 55 study groups that reported the incidence of mild sedation. This represents the experience of 9451

patients (352 patients had i.m. analgesia; 1822 patients had PCA; 7277 patients had epidural analgesia). The overall mean (95% CI) incidence of mild sedation was 23.9 (23.0–24.8)%. The effect of analgesic technique was statistically significant ( $P<0.001$ ); epidural analgesia was associated with the lowest level of sedation whilst i.m. analgesia and i.v.-PCA were associated with greater sedation (Table 3).

### Excessive sedation

There were 57 study groups that reported the incidence of excessive sedation, as defined above. This represents the experience of 15 522 patients (1528 patients had i.m. analgesia; 3763 patients had PCA; 10 231 patients had epidural analgesia). The overall mean (95% CI) incidence of excessive sedation was 2.6 (2.3–2.8)%.

The effect of analgesic technique was statistically significant ( $P<0.01$ ); epidural analgesia was associated with the lowest level of excessive sedation. There was a significant reduction in the incidence of severe sedation over the time period of the analysis ( $P<0.0001$ ), which persisted when the introduction of epidural analgesia was allowed for.

### Pruritus

There were 196 study groups that reported data on pruritus. This represents the experience of 28 881 patients (2161 patients had i.m. analgesia; 5259 patients had PCA; 21 461 patients had epidural analgesia). The majority of studies reported the incidence of itching but a few studies reported pruritus as itching requiring treatment. The overall mean (95% CI) incidence of pruritus was 14.7 (11.9–18.1)% of patients. The effect of analgesic technique was statistically significant ( $P<0.001$ ) and persisted after controlling for year of publication ( $P<0.001$ ); i.m. analgesia was associated with the lowest incidence of pruritus. However, there was no significant change in the incidence of pruritus over time period of the analysis ( $P=0.4$ ; Table 4).

### Urinary retention

There were 142 study groups that reported data on retention of urine. This represents the experience of 12 513 patients (2482 patients had i.m. analgesia; 2674 patients had PCA;

**Table 1** Incidence of nausea; estimated mean percentage (95% CI)

	Number of study groups	Total number of patients	Mean (%)	95% CI
Male and female				
All	140	20 607	25.2	19.3–32.1%
I.M./S.C.	24	4639	17.0	6.6–37.4%
I.V.-PCA	46	10 580	32.0	26.8–37.6%
Epidural	70	5388	18.8	14.0–24.8%
Females only				
All	41	3175	53.0	44.6–61.2%
I.M./S.C.	12	1134	58.2	27.3–72.7%
I.V.-PCA	24	1591	53.2	36.6–63.4%
Epidural	5	450	39.1	26.3–53.7%

**Table 2** Incidence of vomiting; estimated mean percentage (95% CI)

	Number of study groups	Total number of patients	Mean (%)	95% CI
Male and female				
All	109	11 423	20.2	17.5–23.2%
I.M./S.C.	24	4724	21.9	17.1–27.6%
I.V.-PCA	36	4270	20.7	17.1–24.8%
Epidural	49	2429	16.2	12.5–20.7%
Females only				
All	44	3296	34.2	25.3–44.4%
I.M./S.C.	14	1362	49.3	36.0–62.6%
I.V.-PCA	24	1444	21.3	14.1–30.9%
Epidural	6	490	30.2	24.3–36.9%

**Table 3** Incidence of sedation; estimated mean percentage (95% CI)

	Number of study groups	Total number of patients	Mean (%)	95% CI
Mild sedation				
All	55	9451	23.9	23.0–24.8%
I.M.	4	352	53.7	48.3–59.0%
I.V.-PCA	24	1822	56.5	54.2–58.8%
Epidural	27	7277	14.3	13.5–15.1%
Excessive sedation				
All	57	15 522	2.6	2.3–2.8%
I.M.	7	1528	5.2	4.1–6.4%
I.V.-PCA	24	3763	5.3	4.6–6.4%
Epidural	26	10 231	1.2	0.9–1.4%

**Table 4** Incidence of pruritus; estimated mean percentage (95% CI)

	Number of study groups	Total number of patients	Mean (%)	95% CI
All	196	28 881	14.7	11.9–18.1%
I.M.	24	2161	3.4	1.6–6.9%
I.V.-PCA	48	5259	13.8	10.7–17.5%
Epidural	124	21 461	16.1	12.8–20.0%

**Table 5** Incidence of urinary retention (all patients male and female); estimated mean percentage (95% CI)

	Number of study groups	Total number of patients	Mean (%)	95% CI
All	142	12 513	23.0	17.3–29.9%
I.M.	27	2482	15.2	9.3–23.8%
I.V.-PCA	32	2674	13.4	6.6–25.0%
Epidural	83	7357	29.1	21.5–38.1%

7357 patients had epidural analgesia). Urinary retention occurred in 23.0 (17.3–29.9)% of patients. The effect of analgesic technique was statistically significant ( $P=0.02$ ) and persisted after controlling for year of publication ( $P=0.3$ ); epidural analgesia was associated with the highest incidence of urinary retention. However, there was no significant change in the incidence of urinary retention over the time period of the analysis ( $P=0.3$ ; Table 5).

## Discussion

Nausea and emesis are common problems after general anaesthesia with well-defined risk factors, which may be independent of postoperative pain. Although the type of analgesia may affect the incidence of PONV, there have been conflicting reports about the incidence of PONV in patients receiving epidural opioids compared with PCA or i.m. opioids.<sup>3,26</sup> This review found the overall incidence of nausea reported in the literature to be 25.2% and the overall incidence of vomiting to be 20.2%. In reviewing the literature, we encountered two distinct approaches to expressing the incidence of PONV; studies reported either the incidence of patients suffering PONV or recorded measures of the severity of PONV using scoring systems. In the literature surveyed, nausea was commonly reported separately from vomiting. We found that few studies attempted to grade nausea (using either categorical or rating scales), but simply recorded it as being present or absent. We confined our analysis to the 24-h incidence of PONV as this was the most commonly reported and also probably the most clinically relevant time interval. A high incidence of PONV has been reported after day-case procedures where lower pain scores would be expected.<sup>11</sup> In addition, many studies use day-case procedures such as laparoscopy as a standard surgical stimulus likely to result in a high incidence of PONV. Such studies were not included in the present analysis, which concentrated solely on major surgery.

There have been a number of large surveys of Acute Pain Service practice<sup>8,9,12,13,18,20–23,25</sup> and, although some are retrospective, the large numbers involved do provide valuable information about the incidence of nausea and vomiting. Thus Schug and Fry reported on the experience of 2630 patients treated by their Acute Pain Service.<sup>21</sup> They found an overall incidence of nausea and vomiting of 9.8% for PCA and regional techniques combined. In a series of 2696 patients after major surgery, Flisberg and colleagues reported an overall incidence of nausea and/or vomiting for epidural and intravenous analgesia of 2 and 3.7% respectively.<sup>8</sup> Meanwhile, de Leon-Casasola and colleagues, in a study of 4227 patients following major surgery, reported an overall incidence of nausea and vomiting with epidural analgesia of 22%.<sup>13</sup> Stenseth and colleagues reported a series of 1085 cases, including a mixture of major surgical procedures, using epidural catheters.<sup>23</sup> They found an overall incidence of nausea and vomiting of 34%. Ready and colleagues reported a series of 1106 patients treated with epidural morphine after surgery with an overall incidence of nausea and vomiting of 29%.<sup>18</sup> Scott and colleagues reported a series of 1014 patients who received postoperative epidural analgesia with an overall incidence of nausea and vomiting of 4.8%.<sup>20</sup> In these large series there was often a wide case mix, including day-case surgery, as well as a failure to document the incidences of nausea and vomiting separately, which excluded them from our analysis. Nevertheless, there have been a number of surveys that have considered the incidence of nausea and vomiting separately. Thus, Tsui and colleagues published a large series of 2509 consecutive patients under the care of their Acute Pain Service.<sup>25</sup> Patients had undergone major surgery and received postoperative opioids, by either the systemic or epidural route. For the two routes combined, the overall reported incidence for nausea was 28.8% and for vomiting was 15.1%. Koivuranta and colleagues in a survey of 1107 patients reported a 24-h incidence of nausea of 52% (8% severe) and vomiting of 25%.<sup>12</sup> Forrest and colleagues reported an overall incidence of nausea of 13.4% and of vomiting of 20% in 17 201 patients.<sup>9</sup> Sidebotham and colleagues reported on PCA use in 6000 patients and noted an incidence of nausea of 28% on day 1, reducing to 14.3 and 4.7% on the next 2 days.<sup>22</sup> Unfortunately, the incidence of vomiting was not reported in this study. However, in all of these studies, with the exception of the Sidebotham study, the case mix included minor procedures as well as major surgery and so were not used in our analysis. Finally, Werner and colleagues conducted a large review, similar to this one, in which they focused on publications relating to the influence of Acute Pain Services. These authors recorded an overall incidence of PONV of 14%.<sup>27</sup>

The true incidences of nausea and vomiting may only really be obtained by considering smaller randomized controlled trials of patients undergoing major surgery that distinguish between nausea and vomiting. Many studies that were included in our analysis were investigations into the

pharmacology of anti-emetic drugs and, as such, often included a placebo group. It then became possible to calculate the true incidence of PONV and to gauge how the incidence could be decreased by treatment. Although the numbers involved in these studies were small, it would appear that anti-emetics were relatively ineffective in treating PONV, a finding that is in agreement with at least one other comparative study.<sup>14</sup>

We suggest that for the purposes of setting standards of care for acute pain services it is important to focus on the incidence of PONV after major surgery only. The overall incidence of PONV for an acute pain service will reflect the balance between the use of the three postoperative analgesic techniques, and incidence may vary slightly between acute pain services. Although it has been postulated that the incidence of PONV may be greater when opioids are used (especially with PCA) there have been few direct comparisons between PCA and epidural analgesia. One such study supports the contention that the incidence was increased after PCA.<sup>10</sup> In another study, the incidence of PONV after intermittent opioid analgesia was reported as 20%.<sup>15</sup> When the incidence of PONV with PCA administered opioid was compared with i.m. opioid the latter was generally lower, but not significantly.<sup>3,5,19</sup>

Sedation occurs frequently in the postoperative period and can cause distress. In a Europe-wide survey, sedation was routinely assessed by 82% of Acute Pain Services,<sup>16</sup> so it would be helpful to be able to obtain an incidence of sedation from the literature. Clearly, excessive sedation is clinically more important than mild sedation. This review found the overall incidence of severe sedation reported in the literature to be 2.6%. However, there was little agreement in the literature on how to measure sedation. Sedation was generally divided into two broad categories. Studies either reported all patients with sedation or mentioned only those patients who were excessively sedated such that they required medical intervention. Some studies included figures for both mild and excessive sedation. The methods used for measuring sedation in different studies included; recording sedation as either present or absent, a three-, four- or five-point sedation scale, or (rarely) a Visual Analogue Scale. Other studies used descriptive terms to indicate severity of sedation; excessive sedation was described as 'oversedated', 'deeply asleep', 'hard to wake', 'confused', or 'disorientated'. Despite the variety of terms used, it was possible to come up with an incidence for mild sedation (which was relatively common and probably of little clinical significance) and a separate incidence for excessive sedation. It is the latter problem that is likely to be clinically important. Excessive sedation was considered by Ready and colleagues to be a clinical sign of impending respiratory depression.<sup>17</sup> The incidence in previous reports of sedation has varied widely. In the publications that we reviewed, excessive sedation with i.m. analgesia ranged from 0.6 to 48%, with PCA ranging from 0 to 25.7%, and with epidural analgesia ranging from 0 to 46%. In a review of publications relating to

Acute Pain Services, an overall incidence of sedation of 0–7% was recorded, but the authors commented on the heterogeneity of the data.<sup>27</sup> It is questionable, therefore, whether or not it is worth setting an independent standard of care for excessive sedation, although it remains an important clinical endpoint.

Pruritis can be difficult to manage and may be resistant to conventional treatment, such as antihistamines. This review found the overall incidence of pruritus reported in the literature to be 14.7%. Eisenach and colleagues reported that PCA and intermittent opioid analgesia were associated with an incidence of pruritus of 10%, while epidural analgesia was associated with an incidence of 30%.<sup>7</sup> A systematic review of epidural analgesia recorded an incidence of itching related to epidural opioids of 8.5%.<sup>2</sup> In a large series, Flisberg and colleagues reported an incidence of 4.4% with epidural analgesia and of 1.9% with i.v. analgesia.<sup>8</sup> Other large audits of acute pain services do not necessarily distinguish between analgesic techniques. Thus, Tsui and colleagues reported an incidence of pruritis of 7%.<sup>25</sup> These larger audit studies gave lower incidences of pruritis than we obtained. The reason for this difference is not clear. In our review, the incidence of pruritis with i.m. analgesia was lower than with either PCA or epidural analgesia. Our previous study on effectiveness indicated that i.m. analgesia was associated with poorer quality pain relief<sup>1</sup> and the lower incidence of pruritis may simply reflect inadequate dosing.

It is difficult to ascertain exactly what contribution the analgesia technique makes to the incidence of urinary retention as there may well be a number of other factors. This review found the overall incidence of urinary retention reported in the literature to be 23%, with a tendency for epidural analgesia to be associated with a higher incidence of urinary retention. There were fewer publications that included data on urinary retention than for the other indices of tolerability. A large study of 5220 patients by Tammela and colleagues reported an overall incidence of 3.8% (males 4.7% and females 2.9%),<sup>24</sup> but involved a wide variety of surgical procedures including some intermediate surgery that would not have required postoperative opioids. The large review by Werner and colleagues of all publications relating to Acute Pain Services recorded an overall incidence of urinary retention of 9%.<sup>27</sup> These authors also observed that the incidence of urinary retention was six times greater with PCA than with i.m. analgesia. In contrast to Werner's findings, we found the incidence of urinary retention was very similar with PCA and i.m. analgesia. The only other direct comparison of techniques indicated that urinary retention was similar with PCA and epidural, although the numbers in that study were small.<sup>10</sup>

In previous publications we have highlighted the differences between our analyses and a formal systematic review with meta-analysis.<sup>4,6</sup> We did not confine our analysis to randomized controlled trials, no attempt was made to grade individual papers according to quality and all of the

studies used in the analysis were given equal weight. We feel that our approach is justified but concede that variability in the analgesic regimens, surgical procedures and indeed in the data presented means that a degree of heterogeneity is inevitable in our review. However, we also detailed why we felt that both statistical heterogeneity and clinical heterogeneity would be minimized in our analysis.<sup>4,6</sup> Since we began our analysis, one subsequent large observational study has reported incidences of sedation and pruritus with epidural and i.v. opiate analgesia not dissimilar to our own.<sup>8</sup> Also, a similar review of publications by Werner and colleagues, which concentrated on the impact of Acute Pain Services, also reported incidences of PONV, sedation urinary retention not dissimilar to ours.<sup>27</sup> We feel, therefore, that our figures are valid. However, we would again reiterate the observation that there has been a rapid evolution of Acute Pain Services. Many of the studies analysed were reports of the initial experiences of individual centres' Pain Service and it is likely that, as these services have evolved, many of the rates will have decreased.

In summary, we have undertaken a review of published data on the tolerability of three analgesic techniques commonly used for acute postoperative pain management. The mean percentage incidences of patients experiencing nausea, vomiting, sedation, pruritus, and urinary retention after major surgery are presented. Allowing for the variety of definitions, as well as the heterogeneity of the data, the following suggestions for clinical practice can be made. Overall Acute Pain Services should expect an incidence of nausea related to analgesic technique of less than 25% and for vomiting of less than 20%. PCA is associated with the highest incidence of nausea whilst epidural analgesia is associated with the lowest incidence of vomiting. Over the time period of the analysis, there has been a significant decrease in the incidence of nausea but the incidence of vomiting was unchanged. Mild sedation is common (incidence 24%) but is probably of little clinical significance alone; although it may be distressing for the patient. Excessive sedation is less common with an incidence of 2.6%. I.M. opioid analgesia and PCA are associated with a similar incidence of sedation, whilst epidural analgesia is associated with the lowest incidence of sedation. As excessive sedation may be a sign of impending respiratory depression, it may not be worth setting an independent standard of care for it, and the standard for low respiratory rate may suffice.<sup>4</sup> Pruritus is relatively common with an incidence of 14.7%; i.m. analgesia is associated with the lowest incidence of pruritus. Although distressing for the patient, pruritus is probably not an important clinical endpoint. Simple explanation and reassurance are often sufficient. Urinary catheterization after major surgery is also common with an incidence of 23%; epidural analgesia is associated with the highest incidence of urinary retention. Given the relatively high rate of urinary retention, it is probably worth inserting a urinary catheter in advance of surgery in certain situations particularly where it is desirable to minimize bacteraemia. In conclusion, we

suggest that these figures may be helpful to Acute Pain Services in setting standards of care for postoperative pain management, although the exact figures could vary depending on the mix of analgesic techniques used.

## Supplementary Data

A full list of the studies used in the analysis is included as Appendices in Supplementary Data to the on-line version of this article at [www.bja.oxfordjournals.org](http://www.bja.oxfordjournals.org).

## Acknowledgements

We wish to thank the Dunhill Trust c/o Postgraduate Medical Centre, St Richard's Hospital, Chichester who supported S.J.D. for a sabbatical, which allowed time for data collection. Also, Mr Bernie Higgins, Mathematics Department, University of Portsmouth for his assistance in the statistical analysis of the data.

## References

- 1 Armitage P, Berry G, Mathews JNS. *Statistical Methods in Medical Research*, 4th Edn. Oxford: Blackwell, 2002; 215–18
- 2 Ballantyne JC, Loach AB, Carr DB. Itching after epidural and spinal opiates. *Pain* 1988; **33**: 149–60
- 3 Boulanger A, Choiniere M, Roy D, et al. Comparison between patient-controlled analgesia and intramuscular pethidine after thoracotomy. *Can J Anaesth* 1993; **40**: 409–15
- 4 Cashman JN, Dolin SJ. Respiratory and haemodynamic effects of acute postoperative pain management: evidence from published data. *Br J Anaesth* 2004; **93**: 212–23
- 5 Dahl JB, Daugaard JJ, Larsen HV, Mouridsen P, Nielsen TH, Kristoffersen E. Patient-controlled analgesia: a controlled trial. *Acta Anaesthesiol Scand* 1987; **31**: 744–7
- 6 Dolin SJ, Cashman JN, Bland JM. Effectiveness of acute postoperative pain management: I. Evidence from published data. *Br J Anaesth* 2002; **89**: 409–24
- 7 Eisenach JC, Grice SC, Dewan DM. Patient-controlled analgesia following caesarean section: a comparison with epidural and intramuscular narcotics. *Anesthesiology* 1988; **68**: 444–8
- 8 Flisberg P, Rudin A, Linner R, Lundberg CJF. Pain relief and safety after major surgery. A prospective study of epidural and intravenous analgesia in 2896 patients. *Acta Anaesthesiol Scand* 2003; **47**: 457–65
- 9 Forrest JB, Cahalan MK, Rehder K, et al. Multicenter study of general anesthesia. II. Results. *Anesthesiology* 1990; **72**: 262–8
- 10 George KA, Wright PM, Chisakuta AM, Rao NV. Thoracic epidural analgesia compared with patient-controlled intravenous morphine after upper abdominal surgery. *Acta Anaesthesiol Scand* 1994; **38**: 808–12
- 11 Kenny GN. Risk factors for postoperative nausea and vomiting. *Anaesthesia* 1994; **49**: 6–10
- 12 Koivuranta M, Laara E, Snare L, Alahuhta S. A survey of postoperative nausea and vomiting. *Anaesthesia* 1997; **52**: 443–9
- 13 de Leon-Casasola OA, Parker B, Lema MJ, Harison P, Massey J. Postoperative epidural bupivacaine-morphine. Experience with 4227 surgical cancer patients. *Anesthesiology* 1994; **81**: 308–15
- 14 Loeser EA, Bennett G, Stanley TH, Machin R. Comparison of droperidol, haloperidol and prochlorperazine postoperative antiemetics. *Canad Anaesth Soc J* 1979; **26**: 125–7

- 15** Rawal N, Sjostrand U, Christoffersson E, Dahlstrom B, Arvill A, Rydman H. Comparison of intramuscular and epidural morphine for postoperative analgesia in the grossly obese. *Anesth Analg* 1984; **63**: 583–92
- 16** Rawal N, Allvin R. Epidural and intrathecal opioids for postoperative pain management in Europe: a 17 nation questionnaire study of selected hospitals. Euro Pain Study Group on Acute Pain. *Acta Anaesthesiol Scand* 1996; **40**: 1119–26
- 17** Ready LB, Oden R, Chadwick HS, et al. Development of an anesthesiology-based postoperative pain management service. *Anesthesiology* 1988; **68**: 100–6
- 18** Ready LB, Loper KA, Nessly M, Wild L. Postoperative epidural morphine is safe on surgical wards. *Anesthesiology* 1991; **75**: 452–6
- 19** Robinson SL, Fell D. Nausea and vomiting with use of a patient controlled analgesia system. *Anaesthesia* 1991; **46**: 580–2
- 20** Scott DA, Chamley DM, Mooney PH, Deam RK, Mark SA, Hagglof B. Epidural ropivacaine infusion for postoperative analgesia after major lower abdominal surgery—a dose finding study. *Anesth Analg* 1995; **81**: 982–98
- 21** Shug SA, Fry RA. Continuous regional analgesia in comparison with intravenous opioid administration for routine postoperative pain control. *Anaesthesia* 1994; **49**: 528–32
- 22** Sidebotham D, Dijkhuizen MR, Schug SA. The safety and utilization of patient controlled analgesia. *J Pain Symptom Manage* 1997; **14**: 202–9
- 23** Stenseth R, Sellevold O, Breivik H. Epidural morphine for postoperative pain: experience with 1085 patients. *Acta Anaesthesiol Scand* 1985; **29**: 148–56
- 24** Tammela T, Kontturri M, Lukkarinen O. Postoperative urinary retention. I. Incidence and predisposing factors. *Scand J Urol Nephrol* 1986; **20**: 197–201
- 25** Tsui SL, Irwin MG, Wong CM, et al. An audit of the safety of an acute pain service. *Anaesthesia* 1997; **52**: 1042–71
- 26** Watcha MF, White PF. Postoperative nausea and vomiting. *Anesthesiology* 1992; **77**: 162–184
- 27** Werner MU, Soholm L, Rotboll-Nielsen P, Kehlet H. Does an acute pain service improve postoperative outcome? *Anesth Analg* 2002; **95**: 1361–72