Superiority of postoperative epidural over intravenous patient-controlled analgesia in orthopedic oncologic patients

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Background. Surgery for bone malignancy is associated with intense postoperative pain. Patient-controlled epidural analgesia (PCEA) and intravenous patient-controlled analgesia (IV-PCA) are used currently for postoperative pain control.

Methods. The degree of pain control after resection of bone malignancy under combined general and epidural anesthesia followed postoperatively by prospectively randomized PCEA (ropivacaine 3.2 mg + fentanyl 8 μg/dose) or IV-PCA (morphine 2 mg/dose) (n = 35/group) was assessed. Postoperative analgesia delivery continued for up to 96 h; intramuscular rescue with diclofenac 75 mg was also available.

Results. The mean hourly pain score among the PCEA patients was 3.0 ± 0.9, compared with 4.7 ± 0.6 (P < .01) among the IV-PCA patients. All mean hourly pain scores in the PCEA patients, except for the first 2 hours of treatment, were less than 4/10, but they were higher in the IV-PCA patients. The demand for diclofenac was 2 times (n = 10) lower for the PCEA patients, compared with their IV counterparts (n = 20, P < .01); the same difference applied to the overall side effects (n = 15 vs n = 30, P < .01). Self-rated wakefulness and feelings of well-being were better in the PCEA patients.

Conclusions. Postoperative ropivacaine + fentanyl via PCEA reduces pain better and affords better subjective feelings than IV morphine via PCA after resection of bone malignancy carried out under combined general and epidural anesthesia. (Surgery 2005;138:869-76.)

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The quality of recovery after major surgical procedures depends on various factors, prominent among them being the quality of postoperative pain relief, and respiratory and hemodynamic conditions, as well as minimal anti-nociceptive-associated side effects (eg, nausea, vomiting). Opioids remain the cornerstone for the treatment of postoperative pain. Despite advances in the understanding of mechanisms of acute pain and the commercial availability of new drugs for its control, the management of acute pain is often ineffective, especially immediately after operations and/or on the ward, patients often demand additional rescue drugs (eg, nonsteroidal anti-inflammatory drugs [NSAIDs]).

Intravenous patient-controlled analgesia (IV-PCA) with morphine and patient-controlled epidural analgesia (PCEA) using opioids alone or in combination with local anesthetics are 2 major advances in the management of pain after major surgical procedures. These techniques allow patients to self-administer small boluses of analgesics, thus providing better titration and enhancing responsiveness to their analgesic requirements. IV-PCA has been used for pain control after general or orthopedic procedures in the lower extremities and the spine, and was shown to be an effective and safe means of controlling pain.

Epidural infusion or PCEA of an opioid with or without local anesthetics has been shown to be
highly effective in controlling postoperative pain after lower extremity operations. Some of the benefits include excellent pain control despite the decrease in the total amount of opioids, with minimal respiratory depression, decreased somnolence, and early ambulation, although pruritus, nausea, urine retention, and rare neuroaxial disturbances were still described.

Oncologic orthopedic patients comprise a special population. They characteristically suffer varying degrees of pain or discomfort long before operation, and it has been suggested that this might cause worse postoperative pain. Their operation is largely destructive and painful, particularly if it involves long bones. All major oncologic orthopedic procedures in Tel Aviv Medical Center are currently carried out under combined general and epidural anesthesia (whenever appropriate). This technique allows for optimal pain control, especially during prolonged procedures, thus minimizing the amounts of intraoperative general anesthetics that are the main cause of postoperative sedation, respiratory depression, and disorientation.

The aim of the present study was to compare patient-administered postoperative pain control by intravenous morphine versus epidural ropivacaine plus fentanyl analgesia in patients undergoing lower-body oncologic orthopedic procedures attributed to bone malignancy under standardized, combined, general, and epidural anesthesia.

**MATERIAL AND METHODS**

**Patient selection.** Seventy patients classified as American Society of Anesthesiologists (ASA) physical status I-III (ie, healthy patients, those with mild systemic disease, and those with nonincapacitating severe systemic disease) were enrolled in this controlled, prospective study, which had been approved by the institutional human research and ethics committee. All patients experienced preoperative, cancer-associated pain that was controlled satisfactorily by NSAIDs in most of them. The patients were enrolled randomly (by using an identification number randomization method) into the 2 postoperative techniques of analgesia regimen, IV-PCA and PCEA (35 patients/group). All participants signed a Helsinki-approved informed consent and were given a full explanation of the IV-PCA and PCEA devices and techniques, as well as the linear visual analog scale (VAS, see below) by the anesthetist 24 hours before operation. Exclusion criteria included allergy to opioids, bupivacaine, ropivacaine, or NSAIDs; a history of chronic pain unrelated to the neoplasm or psychiatric disorders; and the use of centrally acting drugs of any sort. Patients younger than 18 years and pregnant women also were excluded from the study.

On the day of the procedure, patients were assigned randomly into 1 of the 2 anesthetic techniques. Randomization consisted of numbered sealed envelopes that were prepared in advance by a secretary who was not involved in the study. The envelopes were opened in the Post-Anesthesia Care Unit (PACU) when patients demanded postoperative analgesia. The entire data collection was done by the institutional acute pain service nurse.

**Anesthesia and surgery protocols.** All 70 patients were given standardized, combined general and epidural anesthesia during operation. While the patients were awake and in a lateral position, 0.5% bupivacaine 12 to 14 mL was injected into the epidural space, always at the level of L3-S1, aiming at obtaining analgesia up to dermatomes T8-T10. A Portex (SIMS Portex Ltd, Hythe, Kent, UK) epidural catheter was inserted epidurally and secured in place to enable both additional intraoperative administrations of the local anesthetic, on the basis of clinical signs and the judgment of the anesthetist, as well as postoperative PCEA administration (as applicable).

After sensory block was confirmed and hemodynamic conditions were stable, general anesthesia was induced by fentanyl and propofol IV; succinylcholine was given to enable endotracheal intubation. Anesthesia was maintained by a 1:1 mixture of oxygen and nitrous oxide, propofol infusion, and atracurium as necessary to facilitate artificial respiration and surgical maneuvers. The administration of atracurium was stopped approximately 10 minutes before the end of operation, as was nitrous oxide. Neuromuscular relaxation was not reversed pharmacologically and the patients resumed spontaneous respiration and were extubated when appropriate, on the basis of normal train-of-four and clinical criteria.

The same surgical and anesthesia teams performed all the procedures. Operations consisted of resection of bone neoplasms and local curettage, with or without segmental resection and with or without tissue transfer, and reconstruction in all patients. The procedures were also done on a single muscle or a single muscle group with no reconstruction, or on soft tissue neoplasms of less than or equal to 8 cm in diameter with minimal bone involvement. Operations necessitated less than or equal to 3 units of blood. Intra- and postoperative fluid administration and blood replacement were dictated by hemodynamic...
The patients who later received IV-PCA. Follow-up. The epidural catheters were removed in the patients who later received IV-PCA.

The perioperative and study-long monitoring plan included the measurement of heart rate by a 5-lead electrocardiograph, systolic and diastolic blood pressures, respiratory rate, and fingertip pulse oximetry (AS/3; Datex-Ohmeda, Helsinki, Finland).

Postoperative analgesia protocols. Upon the patient’s first postoperative complaint of pain intensity greater than 4/10 on a numerical VAS, a PCA device was attached to the epidural or intravenous line and activated by the anesthetist who attended to all the patients in the PACU. We chose this cutoff score on the basis of previous experience in acute pain control. The attending anesthetist administered the first 2 mL (1 mg/mL morphine) dose IV in the IV-PCA group, after which the device was turned on. The IV device was preset to deliver similar boluses whenever the patient activated it, controlled by a 7-minute lockout period. In the PCEA group, the physician also administered the first 2 mL (ie, ropivacaine 1.6 mg/mL plus fentanyl 4 μg/mL) bolus epidurally, followed by self-administration of similar boluses by the patient, with a lockout time of 15 minutes. The PCEA analgesia protocol also consisted of a background infusion dose of 2 mL/h. Although the background infusion was used in only the PCEA patients, both protocols were found safe and effective for controlling postoperative pain and were therefore comparable. During the patients’ stay in the PACU, 2 additional IV-PCA or PCEA boluses could be administered manually by the attending anesthetist upon the patient’s demand; further requests to relieve pain were satisfied with intramuscular diclofenac 75 mg.

Patient assessment. The amounts of all analgesics delivered in the PACU and on ward were recorded. The number of times a request for self-administration (activation of the device’s button) occurred was also recorded with the intent to distinguish between a true low requirement and a high demand for analgesics, which might not have been met because the button could have been pressed during the lockout period of the device. Mean hourly morphine, ropivacaine, and fentanyl consumptions were later calculated.

The attending physician also assessed the parameters below every 15 minutes for the first hour and every 30 minutes thereafter during the patients’ stay in the PACU. On the ward, the self-rated scores were recorded every 4 hours. The patients’ self-rated, numerical linear VAS applied a 10-cm chiroscience gauge:

1. Subjective pain intensity during rest, using a numerical VAS from 0 (no pain) to 10 (unbearable pain)
2. Subjective sedation, on the basis of a numerical VAS from 1 (fully awake) to 10 (heavily sedated)
3. Subjective feeling of well-being, on the basis of a numerical VAS from 1 (feeling bad) to 10 (feeling content)

The patients remained in the PACU for 4 hours to ensure recognition of possible late-onset pain or sedation. They were then transferred to the Orthopedic Oncology Unit in accordance with the PACU discharge regulations. The PCA device was available continually to each patient for a maximum of 96 hours after operation unless the patient had not used it for 12 consecutive hours, whereupon it was disconnected. The time each patient left his bed for the first time, the day of discharge home, and the number of patients who required urine catheterization after the first 24 postoperative hours were recorded. Upon disconnection from the device, all patients were asked to score their overall maximal pain intensity throughout the study period and were queried on the occurrence of side effects according to a checklist of known adverse reactions attributed to the given drugs.

Statistical analysis. The analyses were performed at the Statistical Laboratory of the School of Mathematics, Tel-Aviv University, with the use of SPSS Release for Windows, version 11.01 (SPSS, Inc, Chicago, Ill). A prestudy power table where delta (representing the mean difference in pain score recorded in a pilot study) equals 2.3, alpha equals 0.05, and power equals 0.97 resulted in the need for a minimum of 15 patients in every group. The demographic data (age, weight) and background characteristics (baseline heart and respiratory rates, pulse oximetry, systolic and diastolic blood pressures), the ASA physical class, duration of operation and intraoperative drug dosages, administration of fluids and blood, and the end-operation upper thoracic sensory block limits were compared with the use of 1-way analysis of variance (ANOVA). Distribution of patient gender was analyzed with the chi-square test. The rates of hourly application of PCEA or IV-PCA devices were transformed to square roots to obtain their normal distribution and analyzed by 1-way ANOVA with repeated measures. The number of times the
Table I. Demographic, anesthesia, and surgery data, and baseline vital signs (mean ± SD or absolute values)*

<table>
<thead>
<tr>
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<th>PCEA</th>
<th>IV-PCA</th>
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<tbody>
<tr>
<td>Age (y)</td>
<td>40 ± 15</td>
<td>45 ± 16</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>70 ± 16</td>
<td>69 ± 13</td>
</tr>
<tr>
<td>Gender (male/female)</td>
<td>15/20</td>
<td>14/21</td>
</tr>
<tr>
<td>ASA (class)</td>
<td>2.1 ± 0.9</td>
<td>2.2 ± 0.7</td>
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<tr>
<td>Intraoperative propofol infusion (mg)</td>
<td>298 ± 27</td>
<td>317 ± 57</td>
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<tr>
<td>Intraoperative fentanyl (µg)</td>
<td>197 ± 101</td>
<td>189 ± 93</td>
</tr>
<tr>
<td>Intraoperative bupivacaine (mL)</td>
<td>45 ± 12</td>
<td>41 ± 13</td>
</tr>
<tr>
<td>Intraoperative fluid administration (mL)</td>
<td>3650 ± 348</td>
<td>3595 ± 214</td>
</tr>
<tr>
<td>Intraoperative blood replacement (units)</td>
<td>2.9 ± 1.3</td>
<td>2.5 ± 1.1</td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>165 ± 45</td>
<td>148 ± 83</td>
</tr>
<tr>
<td>End-operation sensory block upper limit (T)</td>
<td>8.5 ± 0.7</td>
<td>8.9 ± 0.9</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>82 ± 15</td>
<td>78 ± 21</td>
</tr>
<tr>
<td>Respiratory rate (breaths/min)</td>
<td>12.3 ± 1.9</td>
<td>11.7 ± 2.0</td>
</tr>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>145 ± 28</td>
<td>157 ± 26</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>79 ± 22</td>
<td>85 ± 15</td>
</tr>
<tr>
<td>SpO2 (%)</td>
<td>98 ± 1</td>
<td>99 ± 1</td>
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PCEA, Patient-controlled epidural analgesia; IV-PCA, intravenous patient-controlled analgesia; ASA, American Society of Anesthesiologists physical class; T, thoracic dermatome; SpO2, pulse-derived arterial blood oxygen saturation.

*Including data of the 7 excluded patients (intent-to-treat analyses).

There were no statistical differences between groups.

patients received a rescue drug, the rate of side effects, and the number of patients who needed urinary catheterization for more than 24 hours after operation were analyzed with the use of the Fisher exact test. The effects of type of analgesia on the patients’ self-rated pain, sedation, and feelings of well-being (VASs), as well as the hourly amounts of analgesic use, were also analyzed with the use of ANOVA with repeated measures. Statistical analyses of the time of first ambulation and the day of discharge in the 2 groups were carried out with the use of ANOVA. The ANOVA tests were always followed by the post hoc Tukey’s method test. All values are expressed as mean ± SD, with significance defined as *P* ≤ 0.05.

RESULTS

Of the 70 patients originally enrolled in the study, 3 members of the IV-PCA group and 4 members of the PCEA group were excluded because of violation of protocol or because they required prolonged postoperative ventilation. Table I lists the demographic, surgical, and anesthesia data, the postanesthesia upper limit sensory block, and the baseline values of the vital signs; there were no significant differences between the groups. The baseline vital signs remained stable and within physiologic ranges throughout anesthesia and the study period (data not shown). At no time were there signs of respiratory depression among the patients (ie, respiratory rate < 6 breaths per minute, pulse oximetry < 92% on 40% oxygen). In no individual did regional block fail, and none exhibited a combative or incoherent state postoperatively while demanding analgesia. At the end of the 4 hours stay in PACU, all included patients were discharged to the ward uneventfully.

Subjectively rated pain intensity (Fig 1) was always less (ie, better controlled) in the PCEA group, compared with the IV-PCA group (*P* = .001). Pain was not steady during days 2 and 3 of the study, in correlation with the first postoperative ambulation. The overall maximal self-rated pain score recorded by the patients by the end of the fourth day of the study (or when the patient was disconnected from the PCA device; Table II) was greater for the IV-PCA patients than the corresponding PCEA patients.

By the time the devices were disconnected from the patients, PCEA had still been in use by 11 of 31 patients, compared with 19 of 32 IV-PCA patients (*P* = .01). Other indicators of the level of pain...
sustained by the 2 groups of patients are the mean 12-hour and 24-hour usage of the devices during lockout time and the overall demand for diclofenac. The aborted activation in the IV-PCA group was 2-fold greater than that in the PCEA patients, both at 12 hours and 24 hours postoperatively (Table II). The overall demand for the rescue drug in addition to the preestablished doses available to the patients by the 2 techniques was greater in the IV-PCA group, compared with the PCEA group ($P < .01$; Table II); the greater demand was more prominent during postoperative day 1 (data not shown).

The patients’ self-rated levels of sedation and feeling of well-being (Fig 2, lower and upper planes, respectively) for the PCEA group were better than those of the IV-PCA group ($P < .01$; Table II); the greater demand was more prominent during postoperative day 1 (data not shown).

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There was an overall difference ($P < .05$) in the incidence of side effects between the groups, mostly consisting of nausea, vomiting, and pruritus, which were alleviated by appropriate medications. The higher rate of side effects was recorded in the IV-PCA set, compared with the PCEA set (Table II). There was no local skin infection at the site of the introduction of the catheter among the PCEA patients.

The PCEA patients left their bed for the first time at a similar time after operation as did the IV-PCA patients (Table II). Importantly, no patient with PCEA had motor blockade of the lower limbs that could have prevented early ambulation. Indwelling catheterization was required in a similar number of patients in both groups. The duration of hospital stay for the PCEA patients did not differ ($P = .12$) from that of the IV-PCA patients.

**DISCUSSION**

This study compared patient-administered postoperative pain control by intravenous morphine versus epidural ropivacaine plus fentanyl analgesia in orthopedic patients undergoing oncologic operative procedures attributed to bone malignancy under standardized combined general and epidural anesthesia. The results demonstrated a clear antinociceptive superiority of the epidural over the intravenous patient-controlled mode. This indication resulted from a lesser (by $45\%$) amplitude of pain intensity, a $33\%$ lesser overall maximal pain intensity score, $50\%$ fewer aborted activations of the devices at 12 and 24 hours and rescue drug requirements, and $37\%$, compared with $67\%$, users of the devices at the end of the 4-day treatment period. Better scores on levels of wakefulness and feeling of well-being, and a $50\%$ lower overall incidence of side effects were also registered. It is noteworthy that the antinociceptive effects of PCEA were greater despite the already existing preoperative pain and its known effect on postoperative pain intensity and analgesic consumption.

The depicted data are in accordance with the results of other studies, which claimed advantages of PCEA over morphine IV-PCA, which continues to be today’s “gold standard” technique of

<table>
<thead>
<tr>
<th></th>
<th>PCEA ($n = 31$)</th>
<th>IV-PCA ($n = 32$)</th>
<th>$P$ value*</th>
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<tbody>
<tr>
<td>Maximal pain intensity (VAS)</td>
<td>5.0 ± 1.2</td>
<td>7.1 ± 1.6</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>12-h aborted PCA applications</td>
<td>9 ± 4</td>
<td>15 ± 4</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>24-h aborted PCA applications</td>
<td>5 ± 2</td>
<td>9 ± 2</td>
<td>.001</td>
</tr>
<tr>
<td>Diclofenac use (n)</td>
<td>10</td>
<td>20</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Total side effects (n)</td>
<td>15</td>
<td>30</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>5</td>
<td>15</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Pruritus</td>
<td>7</td>
<td>9</td>
<td>.73</td>
</tr>
<tr>
<td>Urinary catheterization &gt; 24 h (n)</td>
<td>18</td>
<td>17</td>
<td>.83</td>
</tr>
<tr>
<td>Mean hourly morphine (mg)</td>
<td>4.2 ± 3.2</td>
<td></td>
<td></td>
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<tr>
<td>Mean hourly ropivacaine (mg)</td>
<td>4.4 ± 4.2</td>
<td></td>
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<tr>
<td>Mean hourly fentanyl (µg)</td>
<td>11 ± 10</td>
<td></td>
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<tr>
<td>First day out of bed</td>
<td>1.8 ± 0.9</td>
<td>2.0 ± 0.8</td>
<td>.9</td>
</tr>
<tr>
<td>Discharge home (d)</td>
<td>5.1 ± 3.3</td>
<td>6.2 ± 5.0</td>
<td>.12</td>
</tr>
</tbody>
</table>

*By ANOVA, $t$ test, or Fisher exact test.

The number of times the device was activated ineffectively during the lockout time.

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postoperative antinociception. Of note, the morphine sulphate:fentanyl potency equivalent is 1.0:0.0125. A postoperative analgesic dose of morphine would amount to 1 to 2 mg versus 25 to 40 g if fentanyl was given; both drugs act centrally within 1 to 2 minutes. The morphine epidural peak effect ranges between 5 to 6 hours because of its hydrophilic characteristics, whereas that of fentanyl is approximately 1 to 2 hours because of its lipophilicity; efficacy should be reached at 18 to 24 hours and 5 to 8 hours, respectively. A single bolus dose of morphine deposited epidurally would be 3 to 5 mg, compared with 25 to 50 g of fentanyl. The lines of evidence showing the superiority and the associated advantages were comparable because both the IV and the epidural analgesia protocols used a PCA-based technique and because each protocol is currently used satisfactorily in this and other institutions. The present data are innovative insofar as this 4-day PCEA administration is one—if not the only—of the few studies in which epidural ropivacaine has been used for so long; most of the studies were short-term (24-hour protocol). The reported lesser motor block and fewer cardiotoxic effects of ropivacaine than bupivacaine were the major reasons for its postoperative use rather than bupivacaine. This study also supplements the findings of previous studies in which only epidural ropivacaine 2 mg/mL was satisfactorily analgesic after major orthopedic procedures and abdominal operations. Also, the lack of any sign of central nervous system toxicity in the present patients and the relatively few minor and temporary side effects, as reported in other patients, support the present contention that prolonged PCEA with ropivacaine 1.6 mg/mL up to 12 mL/h is an efficient and safe postoperative analgesic protocol for oncologic orthopedic patients who start strenuous and sometimes painful physiotherapy soon after operation. Finally, the potential sympatholytic and cardiotoxic effects of ropivacaine did not affect the patients in whom preoperative cardiotoxic chemotherapy is the rule, despite the 96-hour treatment, which is encouraging.

The incidence of side effects is indicative of the clinical inapplicability of an analgesic regimen. The overall high number of side effects in the IV-PCA patients is apparently related to the relatively high doses of morphine they received. These findings were reported by others and support the previous contention that morphine (and general anesthetics) were the main causes of side effects during the first 2 postoperative days. It must be mentioned, however, that the recorded untoward effects are not to be simply and arithmetically compared between the groups because they are expected to differ in each treatment; rather, they should be compared to depict correlation and prevalence with each technique. Finally, the lower sedation level and lack of respiratory depression in the PCEA group, as well as the 50% lower use of the PCA device at 12 and 24 hours, may be of importance, especially in patients with upper or lower airway obstruction.

The statistical similarity of the 2 sets of patients with regard to the time of first ambulation is especially important to the current patient population, in view of the different scores of sedation and feelings of well-being. Early ambulation followed by immediate (days 5-12) rehabilitation is a requisite in almost all of these patients and also helps in preventing postoperative thromboembolism and respiratory complications. This was one of the concerns when embarking upon this study; the IV-morphine-PCA patients might have been able to ambulate earlier than the PCEA patients because of a possible motor effect of ropivacaine. It was gratifying that all the patients left their beds and were discharged home after a similar time period. Indeed, in a previous study, it was shown that a similar group of patients given IV-morphine-PCA left their beds slightly earlier than the present group, probably because the operative procedure was less extensive. Also, previous attempts have
failed to demonstrate significant differences between IV-PCA and PCEA in this regard,\textsuperscript{27} despite the fact that regional anesthesia seems to reduce surgical morbidity.\textsuperscript{3,28} Furthermore, whereas the superior analgesia of epidural versus systemic analgesia during the postoperative period, at least after intra-abdominal and intrathoracic procedures, was confirmed quickly by multiple randomized trials,\textsuperscript{29} it was much more difficult to show benefit in terms of improvement in surgical outcome; early trials had mixed results.\textsuperscript{30} It is possible that the reason for the lack of difference in the duration of hospitalization, despite the higher well-being scores in the PCEA group, seems to be the complexity of the patients’ conditions, the extensiveness of the procedures themselves, and the overall need for a qualified rehabilitation program that most of the patients had to undergo and which started in the ward,\textsuperscript{11} prolonging ward stay and limiting group variability.

This study has several limitations. First, only rest pain intensity was reported because these patients remained immobile during a period ranging between 24 to 72 hours. Also, the improvement in pain, sedation, and well-being would invariably and favorably affect long-term rehabilitation, but it was not assessed; neither was the cost of an epidural PCA, which is probably higher than IV-PCA. Within the limited postoperative period (days) of observation, it was noted, as did Ballantyne\textsuperscript{30} and Rose et al,\textsuperscript{31} that improvement in pain management does not result automatically in an advantage in other outcome variables, such as early ambulation or home discharge.

Finally, the issue of antithrombotic treatment when patients receive PCEA should be mentioned. Many centers in the United States would avoid epidural catheters in lower-limb salvage procedures so as not to limit the use of effective low molecular weight heparin (LMWH) antithrombotic prophylaxis. In the present patients, LMWH was used subcutaneously (SC) in the presence of PCEA without complications, starting 5 to 6 hours postoperatively, provided the operative site was bloodless. Data show\textsuperscript{32} that a neuroaxial block can be performed 12 hours and 24 hours after the last SC LMWH administration of 40 mg or 60 mg, respectively. When epidural analgesia is no longer needed, the antithrombotic agent is withheld for 12 to 18 hours before the catheter can be removed; sensory and motor integrity should be reevaluated 6 hours after either the application of the block or the removal of the catheter.\textsuperscript{32}

CONCLUSION

The administration of PCEA for the maximum of 96 hours after operation for bone malignancy helped to reduce pain intensity, minimized sedation, and spared the use of the rescue drug more than the IV-PCA. There was no apparent negative effect of the continuous administration of either of the described techniques, but ambulation or home discharge did not occur earlier.

The author thanks Esther Eshkol for editorial assistance and the staff of the Post-Anesthesia Care Unit, the Israeli National Unit of Orthopedic Oncology and the Acute Pain Service, Tel Aviv Sourasky Medical Center, for their important contribution and generous collaboration.

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Surgery
Volume 138, Number 5
Weinbroum 875


