Preoperative Multimodal Analgesia Facilitates Recovery After Ambulatory Laparoscopic Cholecystectomy

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Laparoscopy approach to cholecystectomy has shortened the recovery period, reducing discharge times from 1 to 3 days to same-day discharge. We hypothesize that the use of more than one modality to prevent postoperative pain may be more efficacious than single modality. Patients were randomized to a treatment (n = 24) or control (n = 25) group and studied using a prospective, double-blind design. Preoperatively, at 45 min before induction of anesthesia, the treatment group received an intramuscular (IM) bolus injection of meperidine 0.6 mg/kg and ketorolac 0.5 mg/kg. The control group received two bolus IM injections of placebo (normal saline). Ten minutes before incision, local anesthesia (treatment group) or saline (control group) was infiltrated into the skin of each patient. Anesthetic management, postoperative pain, and nausea treatment were standardized. Pain and nausea assessment were done 1 h preoperatively, 0, 0.5, 1, 2, 3, and 4 h postoperatively, at discharge, and 10, 24, and 48 h postoperatively. Patients were discharged by scoring criteria. Postoperatively, significantly more patients in the treatment group were without pain on arrival in the postanesthesia care unit (PACU), 12/21 (57.1%) vs 1/24 (4.2%) in the control group ($P < 0.001$). Similarly, the severity of pain was sixfold less in the treatment group than in the control group. The incidence of nausea in the PACU was significantly less in the treatment group; 4.7% vs 29.5% in the control group ($P < 0.05$). Patients from the treatment group satisfied Postanesthesia Discharge Score significantly earlier than those in the control group (281 ± 12 min vs 375 ± 19 min; $P < 005$). The concomitant use of local anesthetic and nonsteroidal antiinflammatory and opioid drugs proved to be highly effective in our patients, resulting in faster recovery and discharge.

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The laparoscopic approach to cholecystectomy has shortened the recovery period, reducing discharge times from 1 to 3 days to same-day discharge (1–3). However, there are few published reports of laparoscopic cholecystectomy performed on an outpatient basis (4).

Discharge time is dependent, in part, on the rate of recovery from anesthesia and the provision of appropriate postoperative analgesia. Acute pain from surgery has three major components: 1) tissue injury; 2) nociceptor sensitization; and 3) activation of central pathways (5). Current postoperative pain management relies strongly on the use of opioid analgesics, which have delayed onset and significant side effects.

The present study hypothesized that the use of more than one modality (6,7) to prevent postoperative pain may be more efficacious. For example, peripheral pain can be treated using nonsteroidal antiinflammatory drugs and local anesthesia, and central pain by using opioids. In addition, we hypothesize that the application of a multimodal approach may even reduce or prevent the development of significant postoperative pain in patients undergoing elective laparoscopic cholecystectomy, thereby facilitating same-day surgery in this patient population. Accordingly, the present study investigates whether prophylactic treatment with multimodal nociceptive blockade will delay the onset of postoperative pain, decrease analgesic requirements, speed recovery time, and facilitate same-day discharge in this surgical population.

Methods

With approval from the institutional human ethical committee, informed consent was obtained from 49 ASA physical status I and II patients between 18 and 60 yr of age scheduled to undergo elective cholecystectomy via laparoscopy. Patients with significant cardiac, respiratory, hepatic, renal or hematologic

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disorders, contraindications to administration of the study drugs, or histories including gastrointestinal bleeding, monoamine oxidase inhibitor therapy, or alcohol abuse were excluded from study, as were patients with previous upper abdominal or recent surgery and those with preexisting pain.

Patients were randomized by a computer-generated list to either a treatment (n = 24) or control (n = 25) group and studied using a prospective, double-blind design. Preoperatively, at 45 min before induction of anesthesia, the treatment group received an intramuscular (IM) bolus injections of meperidine, 0.6 mg/kg, and ketorolac, 0.5 mg/kg. The control group received two bolus IM injections of placebo (normal saline). Anesthesiologists providing intraoperative care were blinded to the preoperative drug regimen.

Anesthesia was induced with droperidol, 0.5-1 mg intravenously (IV), propofol, 2.5 mg/kg, and fentanyl, 1.5 μg/kg. Atracurium, 0.5 mg/kg, was administered to achieve muscle relaxation prior to tracheal intubation. Lungs were mechanically ventilated with P_{ETCO_2} maintained at 35–40 mm Hg. Anesthesia was maintained with a continuous propofol infusion, 120–160 $\mu g \cdot kg^{-1} \cdot min^{-1}$, and 60% nitrous oxide in oxygen in a semiclosed circle system using intermittent positive-pressure ventilation. After tracheal intubation, and orogastric tube was inserted and left in place until just before extubation. Usual monitoring was used. Noninvasive arterial blood pressure was measured every minute during induction (0–10 min) and then every 3 min.

Ten minutes before the intraumbilical and suprapubic incision, local anesthetic (0.5% bupivacaine for the treatment group) or saline (the control group) was infiltrated into the skin of each patient using a 22-gauge spinal needle. The skin and subcutaneous tissue overlying the peritoneum were infiltrated with either local anesthetic (20 mL 0.5% bupivacaine, the treatment group) or saline (the control group) at the site of puncture and around the gallbladder. In both groups, 20 min before the end of surgery, metoclopramide, 0.15 mg/kg IV, was administered.

Patients manifesting clinical signs of inadequate analgesia (e.g., sweating, lacrimation) received a supplemental bolus dose of propofol, 0.3 mg/kg IV, followed by an increase of the propofol infusion rate to 0.16 $mg \cdot kg^{-1} \cdot min^{-1}$. If additional analgesia was required, fentanyl was administered in doses of 25–50 μg until 10 min before the end of surgery. Criteria for supplemental administration included heart rate and/or mean arterial blood pressure values exceeding 20% of baseline values, and sweating or lacrimation.

Routine postanesthesia care unit (PACU) management included recording of vital signs and admission and discharge scores (8). Oxygen (40% F_{IO_2}) was administered on admission and discontinued half an hour before discharge. Oxygen saturation monitoring was continuous during the entire PACU stay. If oxygen saturation in the PACU decreased to less than 90% at any time, intervention included increased oxygen concentration or continued oxygen therapy after discharge from PACU.

Postoperative pain was assessed using a self-rating visual analog scale (VAS) ranging from 0 to 10, where 0 = no pain and 10 = worst possible pain. Pain intensity was assessed using a verbal pain score (VPS) ranging from 0 to 5, where 0 = no pain, 1 = mild, 2 = discomforting, 3 = distressing, 4 = horrible, and 5 = excruciating (9). Pain scores were obtained 1 h preoperatively before analgesic premedication (baseline), on arrival at the PACU (time 0), and at 30 min, 1, 2, 3, and 4 h after PACU arrival, discharge, and 10, 24, and 48 h after discharge by an independent physician-observer (CM).

Nausea was assessed subjectively using a VAS ranging from 0 to 10, where 0 = no nausea and 10 = worst possible nausea (10) and clinically using a scale ranging from 0 to 3, where 0 = no nausea; 1 = mild nausea not requiring treatment; 2 = moderate nausea requiring 10–20 mg of metoclopramide; and 3 = severe nausea requiring more than 25–50 mg of dimenhydrinate. Nausea scores were obtained preoperatively (baseline) and nausea was assessed clinically at the same predischarge intervals as postoperative pain, thereafter subjectively at the same intervals as pain until 48 h after surgery by an independent physician-observer (CM).

Postoperative recovery was evaluated by the same independent physician-observer (CM) blinded to the patient's study group and using the following criteria: 1) orientation time—time until the patient was oriented to person, place, and time, as indicated by response to specific questions, this is evaluated every 5 min until orientation; 2) time from PACU admission to first request for postoperative analgesic medication; 3) time to reach PACU discharge criteria as defined by an Aldrete score (8) of 9, the Aldrete score is recorded every 15 min; 4) total amount of meperidine, ketorolac, and dimenhydrinate administered, and total number of patients requiring these drugs; 5) time to tolerate oral fluids and food; 6) time to void; 7) time to ambulation, and 8) time of discharge, as defined by a Post-Anesthetic Discharge Scoring System (PADSS) ≥9 (11). The PADSS is based on five main criteria: 1) vital signs, i.e., blood pressure, heart rate, temperature, and respiratory rate; 2) ambulation; 3) pain; 4) nausea/vomiting ; 5) surgical bleeding (Appendix 1). Each of the main criteria is graded from 0 to 2 and a summated score of 9 to 10 indicates that the patient is fit for discharge. The time to tolerate oral fluids, ambulation, and discharge is evaluated every 30 min.

If patients complained of pain in the PACU, they received meperidine, 10–20 mg IV, every 10 min until pain relief was satisfactory. For nausea/vomiting, metoclopromide, 10 mg IV, was given, supplemented by dimenhydrinate, 25–50 mg IV, if nausea persisted 20 min after initial treatment. After PACU discharge to the ward (ambulatory surgical unit), pain was treated by oral administration of ketorolac (10 mg), supplemented by a second 10-mg dose if pain persisted for 30 min after initial treatment. Continuing pain was treated by an IM bolus injection of an additional dose of 10–30 mg of ketorolac. Persistent nausea after PACU discharge was treated by administration of dimenhydrinate, 50 mg IM.

At discharge from the hospital, patients were given prescriptions for oral ketorolac, 10 mg, every 4 or 6 h and dimenhydrinate suppositories, 50 mg, both to be taken as needed. All patients also received a questionnaire in a preaddressed, stamped envelope with instructions to answer all questions and return the questionnaire to the investigators immediately after a 48-h interval. The questionnaire was divided into three parts, containing the same questions, to be completed at 10, 24, and 48 h, respectively, after surgery (Appendix 2). The questionnaire was comprised of VAS for self-assessment of pain and nausea at each of these intervals, and questions regarding the presence of any other procedure- or anesthesia-related complications, the time of first bowel movement, and the time to return to normal daily activity. The level of functional activity was defined by asking the patient to rate his or her activities on a scale of 1 to 10, 1 being no activity and 10 being back to normal activity. Patients also were asked to specify whether they would again undergo the same operation on an ambulatory basis.

Patients were admitted to the hospital for the following reasons: surgical complications, failure to achieve a postanesthesia discharge score of 9, surgical follow-up, and social reasons. Surgical follow-up was defined as the surgeon requesting that the patient stay in the hospital for further observation. Social reasons were defined as patients requesting to stay in the hospital, although objective assessment indicated that the patients were suitable for discharge.

Table 1. Demographic Data and Intraoperative Anesthetic Management of the Two Study Groups

	Control (n = 24)	Treatment (n = 21)
Age (yr)	47 ± 3	45 ± 2
Weight (kg)	72.5 ± 3	71.4 ± 4
Sex (M/F)	5/19	9/12
ASA class I/II	15/9	11/10
Propofol (mg)	629 ± 27	550 ± 36
Total fentanyl (μg)	170 ± 14	130 ± 8*
Anesthesia time (min)	66 ± 3	76 ± 5

Values are mean ± SE where appropriate.
* $P < 0.05$ compared to control.

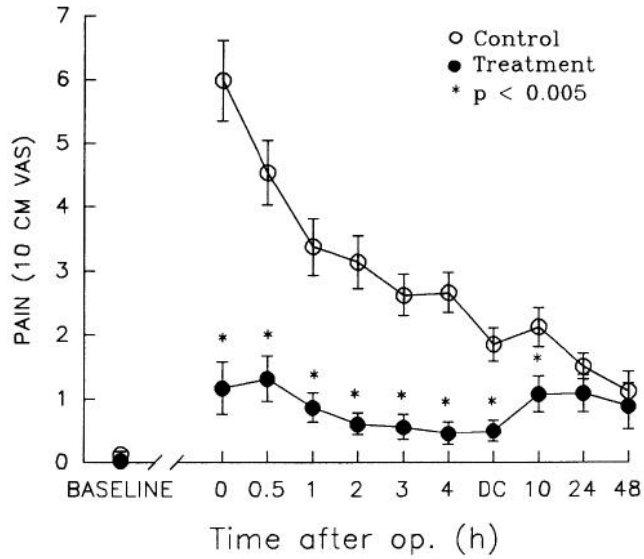


Figure 1. The visual analog score (VAS) (mean ± SD) for pain in the treatment group of 21 patients measured at different time intervals after operation (time after op.). DC = on discharge. *$P < 0.005$ vs control group of 24 patients.

Pain score (VAS and VPS) data for the treatment and control groups were compared using the Wilcoxon rank-sum test. An independent t-test was used to compare recovery and discharge times, and the χ^2 test, with Fisher correction, to analyze differences between groups in demographics and the incidence and severity of nausea/vomiting and procedure- or anesthesia-related complications. A P value of ≤0.05 was considered statistically significant. All data were recorded as mean ± SEM.

Results

There were no significant differences between the two study groups in age, sex, weight, ASA class, duration of surgery, or total dose of propofol administered (Table 1). Four patients were excluded from the study due to surgical complications, three from the treatment group and one from the control group: two required placement of subhepatic drains at the operative site, and two required conversion to open cholecystectomy. Thus, data from 45 patients were analyzed.

The baseline and preinduction VAS and VPS scores for pain were similar in the two study groups (Figures 1 and 2). Intraoperatively, the mean total amount of fentanyl required by the treatment group was significantly lower than that for the control group ($P < 0.05$) (Table 1).

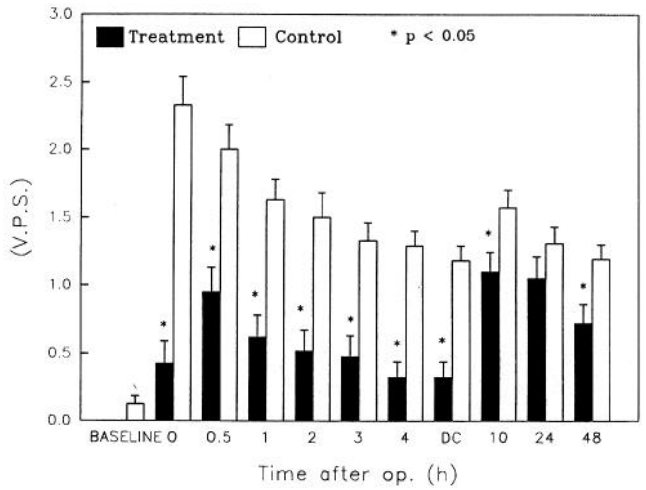


Figure 2. The verbal pain score (V.P.S.) in the treatment group of 21 patients measured at different time intervals after operation (time after op.). DC = on discharge. *$P < 0.05$ vs control group of 24 patients.

Postoperatively, significantly more patients in the treatment group were without pain on arrival in the PACU, 12/21 (57.1%) vs 1/24 (4.2%) in the control group ($P < 0.001$). Similarly, the severity of pain was sixfold less in the treatment than in the control (saline) group (Figure 1). One hour after surgery, pain remained fourfold less in the treatment group than in the control group (Figure 1). Significantly fewer patients in the treatment group required meperidine or ketorolac postoperatively, resulting in significantly lower total mean analgesic consumption ($P < 0.001$, Table 2). The difference in mean time to first demand for analgesic was significant—6 h in the treatment group vs 20 min in the control group ($P < 0.001$).

Four patients in the control group developed Sao_2 desaturation less than 92% after receiving IV meperidine for pain in the PACU, and required either increased oxygen concentration or supplemental oxygen.

VAS pain scores were significantly lower at all measurement intervals in the treatment group than in the control group, until 24 and 48 h postoperatively when the scores of the two groups became similar (Figure 1). Pain intensity, as indicated by the verbal pain score, also was significantly less in the treatment than in the control group at all measurement intervals, except at 24 h postoperatively. (Figure 2). At discharge, a significantly smaller number of patients in the treatment group had mild pain (as defined by postanesthesia discharge score) 5/21 (23.8%) vs 19/24 (79.2%) in the control group ($P < 0.001$).

Preoperatively, the baseline VAS scores for nausea were similar in the two groups. Postoperative VAS scores for nausea also were similar in the two study groups, but the incidence of nausea in the PACU was

Table 2. Predischarge Postoperative Pain and Nausea in the Two Study Groups

	Control ($n = 24$)	Treatment ($n = 21$)
Patients requiring meperidine in postanesthesia care unit (PACU) (n/%)	22 (91.7%)	6 (28.6%)*
Patients requiring ketorolac on ward (n/%)	18 (75%)	5 (23.8%)*
Time to first analgesic (min)[a]	24 ± 9	340 ± 99*
Patients with nausea in PACU (n/%)	7 (29.7%)	1 (4.7%)*
Patients with nausea on ward (n/%)	8 (33.3%)	5 (23.8%)

[a] Values are expressed as mean ± SE.
* $P < 0.001$ compared to control.

significantly lower in the treatment group, i.e., 4.7% vs 29.7%, in the control group in the PACU ($P < 0.05$; Table 2).

The times to first sit-up, oral intake of fluids and solid food, and ambulation were significantly shorter in the treatment group, as was the duration of PACU stay which was determined by the Aldrete score (Figure 3). Patients from the treatment group satisfied postanesthesia discharge score significantly earlier than those in the control group (281 ± 12 min vs 375 ± 19 min; $P < 0.05$). More patients from the treatment group (19/21, 90.5%) were discharged on the day of surgery than from the control group (17/24, 70.8%; Table 3), but this difference was not significant. Overall, 80% of all patients were discharged on the day of surgery.

A total of nine patients required hospital admission, seven from the control group and two from the treatment group. Two of seven patients in the control group were admitted for anesthesia/analgesia-related complications i.e., one for persistent pain and one for persistent nausea, compared with none in the treatment group (Table 3). Among the remaining seven patients, five were admitted for "social reasons," three (12.5%) in the control group and two (9.5%) in the treatment group, and two in the control group (8%) were admitted for surgical follow-up.

Forty-three patients (97.7%) returned study questionnaires, 21/21 (100%) of the treatment group and 22/24 (91.6%) of the control group. Of these, 80.9% in the treatment group and 72.7% of the control group were prepared to undergo the procedure again on an ambulatory basis ($P < 0.05$, Table 3). Seven patients from the control group complained of discomfort from abdominal distention at 10, 24, and 48 h postoperatively, compared with three patients from the treatment group at 24 h; two additional patients from the treatment group complained of headache at 24 h. Functional activity at 48 h was significantly higher in

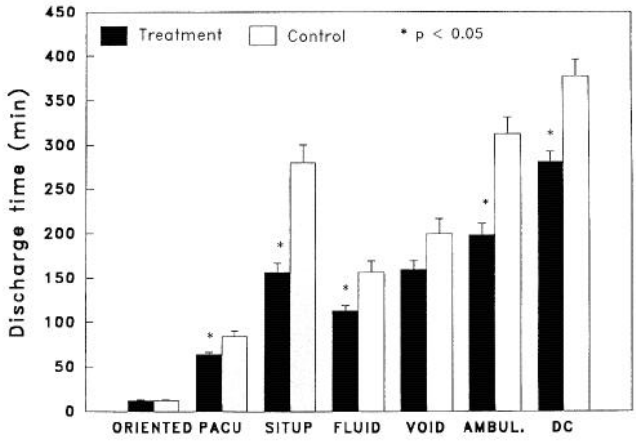


Figure 3. Different stages of recovery of patients after laparoscopy cholecystectomy in the treatment group of 21 patients vs control group of 24 patients. Oriented-time to orient to person, place, and time. PACU = time of post anesthesia care unit discharge; SITUP = time to first sit up; FLUID = time to tolerate oral fluids; AMBUL. = time to ambulate; VOID = time to void; DC = time of discharge by postanesthesia discharge score. Values are expressed as mean ± SE. *$P < 0.05$ compared to control.

Table 3. Recovery in the Two Study Groups

	Control (n = 24)	Treatment (n = 21)
Time to postanesthesia care unit PACU discharge (min)[a]	85 ± 21	63 ± 10*
Time to home discharge (min)[a]	375 ± 19	281 ± 12*
Functional activity % (48 h)[a, b]	46 ± 5	60 ± 4*
Patient satisfaction (n/%)[b]	16/22 (72.7%)	17/21 (80.9%)
Same-day discharge (n/%)	17/24 (70.8%)	19/21 (90.5%)
Admission: anesthesia/analgesia-related complications (n/%)	2 (8.0%)	0
Admission: total (n/%)	7 (29.2%)	2 (9.5%)

[a] Values are expressed as the mean ± SE.
[b] These data are obtained from patient questionnaire responses at 48 h after the procedure.
* $P < 0.05$ compared to control.

the treatment group vs the control group ($P < 0.05$, Table 3).

Discussion

Postoperative pain and nausea are the most common complications of laparoscopic surgery, including cholecystectomy (12–14). Both, particularly pain, prolong recovery and discharge times and contribute to unanticipated admission after ambulatory surgery. Pain also contributes to postoperative nausea and vomiting which, after cholecystectomy, can cause inflammation or local irritation around the gallbladder bed, liver, diaphragm and/or peritoneum, further exacerbating pain. Referred pain may radiate to the epigastrium or right shoulder. The intensity of pain is most severe during the first 2–3 h after the procedure (15,16).

Several investigators (17,18) have proposed that preempting painful stimuli by administering a long-acting analgesic preoperatively could prevent or reduce postoperative pain. Successful prophylaxis would result not only from residual effects during recovery but also from inhibition of noxious stimuli which would minimize hyperexcitability in the central nervous system (17,18). Others (6,7) have suggested concurrent administration of several long-acting analgesics preoperatively, based on the hypotheses that pain resulting from laparoscopic cholecystectomy has multiple etiologies which multimodal therapy could address, and that intervention at different levels in the central nervous system would facilitate a synergism between classes of drugs that would permit the use of lower effective doses of each drug thereby also reducing associated side effects.

The results of the present study indicate that, for patients undergoing laparoscopic cholecystectomy, a preoperative regimen combining local anesthetic (bupivacaine) infiltration with systemic administration of low doses of a nonsteroidal antiinflammatory drug (ketorolac) and an opioid drug (meperidine) provides near-complete pain relief in the immediate postoperative period. The intensity of pain was sixfold greater in patients given only saline preoperatively. One hour after surgery, pain remained fourfold greater in the control group, despite administration of sixfold higher doses of meperidine, resulting in a longer PACU stay. The difference in the time to first request for analgesic was dramatic—6 h in the treatment group vs 20 min in the control group—as was the difference in total analgesic consumption in the PACU and on the ward.

Four patients in the control group had Sao_2 desaturation <92% on room air before discharge from the PACU. Desaturation likely was caused by the greater severity of pain experienced by these patients relative to other control patients, resulting in greater mean opioid consumption.

The incidence of nausea in the PACU and on the ward was significantly higher in our control group, 29.7% vs 4.7% in the PACU, most likely due to more severe pain (19) and greater intraoperative and postoperative opioid consumption (Table 2). However, the overall incidence of postoperative nausea and vomiting for the two groups was low, in contrast to previous reports of a high incidence (50%–60%) of these effects in the same surgical population (12,14). We believe the

reduction in the overall incidence and severity of nausea and vomiting to be due to pretreatment with droperidol and metoclopramide, the use of propofol and routine decompression of the stomach after the operation in all patients.

Patients in the treatment group satisfied the PADSS 1-5 h earlier than the control group (280.5 ± 11.5 vs 377.1 ± 18.6 min, $P < 0.05$) and 90.5% were discharged as ambulatory patients, compared with 70.8% of the control group. Postoperative daily living function was also better in the treatment group than in the control group, as indicated by questionnaire responses at 48 h (Table 2). The difference between groups may have been influenced by the presence of a residual analgesic effect in the treatment group; the duration of blockade with bupivacaine infiltration usually lasted for 4 h and the analgesic effect has been reported to last longer (20).

One reason the approach in this study may have succeeded is that pain after laparoscopy is complex, potentially the result of several causes. Tissue injury, nociceptor sensitization, and activation of central pain pathways can result from 1) wound-related factors, 2) abdominal distention due to the residual volume of intraperitoneal insufflated CO_2, 3) local trauma secondary to gallbladder bed dissection, and 4) bile spillage causing chemical peritonitis.

A relatively light level of general anesthesia, presently a common practice, probably cannot prevent the creation of a sustained hyperexcitability in the central nervous system, which most likely is involved in determining the intensity and duration of postoperative pain. By giving premedication, such as meperidine or ketorolac, therapeutic plasma levels are attained before tissue damage and may prevent or reduce painful inputs.

The choice of ketorolac for this surgical population was based on its lack of effect on intrabiliary pressure (21). Ketorolac's mode of action as a cyclooxygenase inhibitor further suggests that it should be given preoperatively to achieve optimum effect before tissue damage.

Local anesthetics induce antinociception by acting on the nerve membranes. However, they affect many membrane-associated proteins in any tissue, and can inhibit the release and action of agents (e.g., prostaglandins or lysosomal enzymes) that sensitize or stimulate the nociceptors and contribute to inflammation (22). The choice of bupivacaine for local anesthetic infiltration and the decision to induce blockade prior to skin incision were based on reports of improved postoperative analgesia using this approach (23,24).

Meperidine was chosen as the synthetic opioid because it causes less smooth muscle spasm and less increase in intrabiliary pressure than morphine. Thus it is the analgesic of choice in the treatment of biliary colic (25). In this study, reduced dosage was given to avoid its side effects.

A second reason this combined regimen might have succeeded is that the effectiveness of individual analgesics was enhanced by the additive or synergistic effect of two or more drugs that relieve pain by different mechanisms (26,27). For example, previous combinations have included a local infiltration with bupivacaine and epidural bupivacaine and morphine for upper abdominal surgery (26), and systemic morphine, indomethacin, and a nerve block for thoracotomy (27). Intergroup differences in postoperative pain scores and in the cumulative amount of ketorolac consumption in the treatment group patients remained long after the reported clinical duration of action of bupivacaine blockade, suggesting that the effects of preemptive analgesia outlasted clinically manifest levels of the drugs *per se*. Finally, the finding of reduced side effects in the present study likely derives from the administration of doses lower than conventional postoperative doses made possible by the concurrent administration of several drugs.

Such effective, near-complete pain relief has not been reported previously for patients undergoing laparoscopic cholecystectomy under similar anesthetic conditions. Most investigators have focused on the prophylactic benefit of only one drug (12). In one study, wound pain was abolished by local infiltration of bupivacaine at the end of the procedure, but pain due to other causes remained, resulting in a mean duration of hospital stay of 2.9 days (12). Among patients premedicated with opioids prior to laparoscopic cholecystectomy, 63.7% still required narcotics in the PACU (28). The present study indicated that fewer patients (28.6% in the treatment group) required narcotics in the PACU. In nonpremedicated patients undergoing this procedure, VAS scores of 5.5 and 3.8, respectively, have been reported on arrival in the PACU and at 4 h postoperatively. The duration of hospital stay was reported to be 2.7 days (29). These VAS scores are similar to the results obtained in the control group and much higher than the treatment group in this study.

Eighty percent of patients in this study were discharged on the same day, but an additional 10% could have been discharged as five patients were admitted for social reasons. This suggests that patient education is an important component of the success of same-day discharge for laparoscopic procedures.

In summary, good pain relief facilitates mobility and recovery. As economic pressures to perform major surgical procedures on an ambulatory basis increases, any strategy for pain management that can decrease the period of hospitalization and disability

clearly will have significant implications for the overall cost of treatment and loss of income often sustained by patients during hospitalization. In the present study, the concomitant use of local anesthetics, nonsteroidal antiinflammatory drugs, and opioids proved to be highly effective in our patients.

In appropriate patients, laparoscopic cholecystectomy may be performed safely on an outpatient basis. Laparoscopy is performed routinely on an ambulatory basis for gynecologic diseases, and the lack of major abdominal incision in laparoscopic cholecystectomy makes outpatient surgery for gallstones a reality. The use of the multimodal approach to analgesia appears to be effective, offering high-quality anesthesia with fewer side effects and resulting in faster recovery and discharge. These results suggest that same-day discharge for selected patients undergoing laparoscopic cholecystectomy is attainable using a multimodal pain management strategy.

Appendix 1

A Modified Post-Anesthesia Discharge Scoring System (PADSS)

1. Vital signs
   2 = within 20% of preoperative value
   1 = 20% to 40% of preoperative value
   0 = 40% of preoperative value
2. Ambulation
   2 = Steady gait/no dizziness
   1 = With assistance
   0 = None/dizziness
3. Nausea/vomiting
   2 = minimal
   1 = moderate
   0 = severe
4. Pain
   2 = minimal
   1 = moderate
   0 = severe
5. Surgical bleeding
   2 = minimal
   1 = moderate
   0 = severe

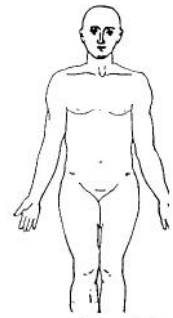
Note: maximum total score is 10; patients scoring 9 or 10 are considered fit for discharge home.

Appendix 2

Home; 48 h After Surgery

Time:_____

1. Please place a slash (/) through the line at the point that best indicates the amount of pain you have now.
   No pain _____Worst pain
2. I need to know which word describes your pain now.
   ☐ 0 → none
   ☐ 1 → mild
   ☐ 2 → discomforting
   ☐ 3 → distressing
   ☐ 4 → horrible
   ☐ 5 → excruciating
3. Please mark the location of pain



4. What kind is your pain? (if you have)
   superficial ☐, or deep ☐; sharp ☐, or aching ☐
5. How many tablets of ketorolac have you taken from yesterday at the same time until now?___
6. Did you experience any episode of vomiting?
   Yes ☐, No ☐ How many?_____
7. Have you taken medication for nausea or vomiting?
   Yes ☐, No ☐ How many?_____
8. Please place a slash (/) through the line at the point that best indicates the nausea, you have now
   No nausea_____Worst possible nausea
9. Do you have any other complications? (fever, abdominal distention, malaise, wound infection, bleeding, vomiting, etc.)_____
10. Assuming that your level of activity before operation was equal to 100%, what do you believe your present level of activity is now in terms of percentage?_____
11. How much physical activity is involved in your daily work?
    Mild____ Moderate____ Heavy_____
    When do you think you may be able to return to work?_____days

References

1. The Southern Surgeons Club. A prospective analysis of 1518 laparoscopic cholecystectomies. N Engl J Med 1991;324:1073–8.
2. Grace PA, Quereshi A, Coleman J, et al. Reduced postoperative hospitalization after laparoscopic cholecystectomy. Br J Surg 1991;78:160–2.
3. Berci G, Sackier JM. The Los Angeles experience with laparoscopic cholecystectomy. Am J Surg 1991;161:382–4.
4. Reddick EJ, Olsen DO. Outpatient laparoscopic laser cholecystectomy. Am J Surg 1990;160:485–7.
5. Woolf CJ. Recent advances in the pathophysiology of acute pain. Br J Anaesth 1989;63:139–46.
6. Dahl JB, Rosenberg J, Dirkes WE, et al. Prevention of postoperative pain by balanced analgesia. Br J Anaesth 1990;64:518–20.
7. Dahl JB, Kehlet H. Non-steroidal anti-inflammatory drugs: rationale for use in severe postoperative pain. Br J Anaesth 1991; 66:703–12.
8. Aldrete JA, Kroulik D. A postanesthetic recovery score. Anesth Analg 1970;49:924–34.
9. Huskisson EC. Measurement of pain. Lancet 1974;ii:1127–31.
10. Gift AG. Visual analogue scales: measurement of subjective phenomena. Nurs Res 1989;38:286–8.
11. Chung F. Are discharge criteria changing? J Clin Anesth 1993; 5:64S–68S.
12. Nathanson I.K, Shimi S, Cuschieri A. Laparoscopic cholecystectomy: the Dundee technique. Br J Surg 1991;78:155–9.

13. Salky BA, Bauer JJ, Kreel I, et al. Laparoscopic cholecystectomy: an initial report. Gastrointest Endosc 1991;37:1–4.
14. Liu J, Ding Y, White PF, et al. Laparoscopic cholecystectomy: effect of ketorolac on postoperative pain and ventilatory function. Anesth Analg 1993;76:1061–6.
15. Narchi P, Lecoq G, Fernandez H, Benhamou D. Intraperitoneal local anesthetics and scapular pain following daycase laparoscopy. Lancet 1991;338:1569–70.
16. Riedel HH, Semm K. The post-laparoscopic syndrome. Geburtshilfe Frauenheilkd 1980;40:635–43.
17. Wall PD. The prevention of postoperative pain. Pain 1988;33: 289–90.
18. Kehlet H. Surgical stress: the role of pain and analgesia. Br J Anaesth 1989;63:189–95.
19. Andersen R, Krohg K. Pain as a major cause of postoperative nausea. Can J Anaesth 1976;23:366–9.
20. Covino BG. Clinical pharmacology of local anesthetic agents. In: Cousins MI, Bridenbaugh PO, eds. Neural blockade. 2nd ed. Philadelphia: Lippincott, 1988:112.
21. Krimmer H, Bullingham RES, Lloyd J, Bruch HP. Effect on biliary tract pressure in humans of intravenous ketorolac tromethamine compared with morphine and placebo. Anesth Analg 1992;75:204–7.
22. Butterworth JF, Strichartz GR. Molecular mechanisms of local anesthesia: a review. Anesthesiology 1990;72:711–34.
23. Tverskoy M, Cozacov C, Ayache M, et al. Postoperative pain after inguinal herniorrhaphy with different types of anesthesia. Anesth Analg 1990;70:29–35.
24. Patel JM, Lanzafame RJ, Williams JS, et al. The effect of incisional infiltration of bupivacaine hydrochloride upon pulmonary functions, atelectasis and narcotic need following elective cholecystectomy. Surg Gynecol Obstet 1983;157:338–40.
25. Wood M. Opioid agonists and antagonists. In: Drugs and anesthesia pharmacology for anesthesiologists, 2nd ed. Baltimore: Williams & Wilkins, 1990:146.
26. Bartholdy J, Sperling K, Ibsan M, et al. Preoperative infiltration of the surgical area enhances postoperative analgesia of a combined low-dose epidural bupivacaine and morphine regimen after upper abdominal surgery. Acta Anesthesiol Scand 1994;38: 262–5.
27. Kavanagh B, Katz J, Sandler A, et al. Multi-modal analgesia before thoracic surgery does not reduce postoperative pain. Br J Anaesth 1994;73:184–9.
28. Rose DK, Cohen MM, Soutter DJ. Laparoscopic cholecystectomy: the anaesthetist's point of view. Can J Anaesth 1992; 39:809–15.
29. Joris J, Cigarini I, Legrand M, et al. Metabolic and respiratory changes after cholecystectomy performed via laparotomy or laparoscopy. Br J Anaesth 1992;69:341–5.