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Effects of Perioperative Analgesic Technique on the Surgical Outcome and Duration of Rehabilitation after Major Knee Surgery

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Background: **Continuous passive motion after major knee surgery optimizes the functional prognosis but causes severe pain. The authors tested the hypothesis that postoperative analgesic techniques influence surgical outcome and the duration of convalescence.**

Methods: **Before standardized general anesthesia, 56 adult scheduled for major knee surgery were randomly assigned to one of three groups, each to receive a different postoperative analgesic technique for 72 h: continuous epidural infusion, continuous femoral block, or intravenous patient-controlled morphine (dose, 1 mg; lockout interval, 7 min; maximum dose, 30 mg/4 h). The first two techniques were performed using a solution of 1% lidocaine, 0.03 mg/ml morphine, and 2 μg/ml clonidine administered at 0.1 ml · kg^{-1} · h^{-1}. Pain was assessed at rest and during continuous passive motion using a visual analog scale. The early postoperative maximal amplitude of knee flexion was measured during continuous passive motion at 24 h and 48 h and compared with the target levels prescribed by the surgeon. To evaluate functional outcome, the maximal amplitudes were measured again on postoperative day 5, at hospital discharge (day 7), and at 1- and 3-month follow-up examinations. When the patients left the surgical ward, they were admitted to a rehabilitation center, where their length of stay depended on prospectively determined discharge criteria.**

Results: **The continuous epidural infusion and continuous femoral block groups showed significantly lower visual analog scale scores at rest and during continuous passive motion compared with the patient-controlled morphine group. The early postoperative knee mobilization levels in both continuous epidural infusion and continuous femoral block groups were significantly closer to the target levels prescribed by the surgeon than in the patient-controlled morphine group. On postoperative day 7, these values were 90° (60–100°) (median and 25th–75th percentiles) in the continuous epidural infusion group, 90° (60–100°) in the continuous femoral block group, and 80° (60–100°) in the patient-controlled morphine group ($P < 0.05$). The durations of stay in the rehabilitation center were significantly shorter: 37 days (range, 30–45 days) in the continuous epidural infusion group, 40 days (range, 31–60 days) in the continuous femoral block group, and 50 days (range, 30–80 days) in the patient-controlled morphine group ($P < 0.05$). Side effects were encountered more frequently in the continuous epidural infusion group.**

Conclusion: **Regional analgesic techniques improve early rehabilitation after major knee surgery by effectively controlling pain during continuous passive motion, thereby hastening convalescence. (Key words: Local anesthetics; morphine; pain relief; physiotherapy.)**

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ALTHOUGH pain control occupies an unargued position in postoperative management, many questions concerning the role of analgesia on the postoperative outcome, beyond the fundamental humane aspect, remain to be resolved.

Several authors have reported the importance of pain management in controlling postoperative complications in high-risk patient populations.[1-3] The beneficial effects of analgesia on functional rehabilitation and the duration of convalescence have been suggested repeatedly but demonstrated in only few publications.[4,5] Liu *et al.*[6] showed that epidural analgesia, associated with early ambulation and feeding, improved postoperative outcome after elective colon surgery. Kehlet[7] and Kehlet and Dahl[8] highlighted the importance of analgesia in optimizing postoperative rehabilitation. The authors insist on the need to develop techniques that allow early functional recuperation and emphasize the importance

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of integrating analgesia into multimodal rehabilitation programs.

Many teams have included early mobilization using continuous passive motion (CPM) into their rehabilitation regimens after knee surgery. Although CPM improves the functional outcome, and as such may decrease the length of hospital stay,[9] it causes severe pain during mobilization. Few studies have explored the effects of postoperative analgesia on the functional prognosis of major knee surgery.[5,10,11] None of them have evaluated the benefits of postoperative continuous plexus or femoral blocks, and they could not show a decreased length of stay in patients who received epidural infusions. The aim of this study was to evaluate prospectively the influence of three postoperative analgesic techniques on the functional outcome and subsequent duration of hospitalization (hospital and rehabilitation center) after major knee surgery and use of CPM; *i.e.*, continuous epidural infusion (CEI), continuous femoral block (CFB), and intravenous patient-controlled analgesia with morphine (PCA).

Methods

After our institutional review board give its approval and patients provided written informed consent, we enrolled 56 patients into this prospective study. All patients were classified as either American Society of Anesthesiologists physical status I or II, ranged in age from 18 to 75 yr, and were scheduled for total knee replacement or arthrolysis.

Protocol

One of three surgeons belonging to the same team and using the same techniques performed all of the operations. Before surgery, each patient was randomized to one of three postoperative analgesia groups: CEI, CFB, or PCA.

All patients were premedicated with 0.5 mg oral alprazolam. The patients of the CEI and CFB groups were prepared for regional analgesia using 20-gauge catheters (Vygon, Les Ullis, France) placed under surgical aseptic conditions. For the CEA patients, the catheter was threaded 3 cm into the epidural space after medial puncture of the L2-L3 or L3-L4 vertebral interspaces with an 18-gauge Tuohy needle (Braun, Melsungen, Germany). For the CFB patients, the puncture was performed using Winnie's landmarks with a 16-gauge, 80-mm nontraumatic needle (Krebbs; Pajunk, Ulm, Germany) linked to a neurostimulator (Stimuplex, Braun) by a sterile cable. The femoral nerve was localized by a required motor response, ascension of the patella, obtained at less than 0.5 mA. The catheter insertion length was 12-15 cm. Local anesthetics were not administered *via* the catheters in either group before the postoperative period.

Intraoperative general anesthesia, standardized for the three study groups, was induced with 5 mg/kg intravenous thiopental, 1 μg/kg sufentanil, and 0.5 mg/kg atracurium. All patients were intubated, and controlled ventilation was applied for the duration of surgery. Anesthesia was maintained using 60% nitrous oxide in oxygen, 0.75%-1.5% isoflurane end-tidal concentration, and 0.3 μg/kg sufentanil given over 60 min, followed by a 0.15 $\mu g \cdot kg^{-1} \cdot h^{-1}$ continuous infusion, which was stopped 30 min before the end of surgery.

Postoperative Analgesic Management and Discharge Criteria

Pain was evaluated during the study period using a visual analog scale (VAS) ranging from 0 mm (no pain) to 100 mm (worst imaginable pain). The postoperative analgesia protocol was initiated in the post-anesthesia care unit and continued in the surgical ward.

The CFB patients received a 25-ml bolus of 2% lidocaine with 1/200,000 epinephrine and 2 mg morphine without preservatives *via* the femoral catheter. The resulting blockade was tested using the pinprick technique, assuring at least a femoral if not 3-in-1 blockade. The block was maintained by the continuous infusion of an analgesic solution, containing 1% lidocaine, 2 μg/ml clonidine, and 0.03 mg/ml morphine administered at 0.1 $ml \cdot kg^{-1} \cdot h^{-1}$. If after 30 min pain control was considered insufficient (*i.e.*, a VAS of 40 mm), a subcutaneous injection of morphine (0.1 mg/kg) was administered as rescue analgesia and repeated at 6-h intervals as required.

The CEI patients received 2 mg morphine without preservatives and 5-ml doses of 2% lidocaine with 1/200,000 epinephrine, *via* the epidural catheter, until a T10 level was determined using the pinprick method. The epidural blockade was maintained by the continuous infusion of the same solution used to maintain the femoral blockade in the CFB group, administered at the same rate. If after 30 min pain control was considered insufficient (*i.e.*, a VAS of 40), a subcutaneous injection of 0.1 mg/kg morphine was administered as rescue analgesia and repeated at 6-h intervals as required.

The PCA patients received an initial intravenous infusion of morphine (2-mg doses at 5-min intervals) titrated

manually until VAS scores of 30 mm were obtained. At this time, a PCA pump (Ivac, San Diego, CA) was connected, delivering 1-mg doses with a 7-min lockout period and a maximum dose of 30 mg in 4 h. The first pain evaluation under the influence of PCA morphine was performed 30 min later. If after 1 h pain control was considered insufficient (*i.e.*, a VAS of 40 mm), the intermittent doses were increased to 1.5 mg and the patients were encouraged to use the PCA as often as possible.

The patients stayed 12 h in the post-anesthesia care unit.

During the 48 h after surgery, all patients received 2 g propacetamol and 100 mg ketoprofen, infused intravenously during 15 min at 8-h and 12-h intervals, respectively.

All supplementary subcutaneous injections of morphine administered in the CFB and CEI groups were noted.

On the morning of postoperative day 3, PCA, CFB, and CEI were discontinued and the catheters were removed.

Pain was evaluated at rest and during early mobilization. The resting pain levels were determined and recorded 1 (H_1), 6 (H_6), 12 (H_{12}), 24 (H_{24}), and 48 (H_{48}) h after the onset of analgesia. Early rehabilitation was initiated on the day after surgery (day 1) using a motorized variable amplitude splint (Kinetec, Tournes, France) and maintained during 10–12 h per day. In accordance with the surgical team, knee flexions of 40° and 50° were progressively attempted during 30 min on days 1 and 2, respectively. Pain during mobilization was evaluated by a physiotherapist during this 30-min onset period of CPM, at 24 h, and at 48 h. Excessive pain (*i.e.*, a VAS of 60) was treated by decreasing the amplitude of flexion as necessary. If severe pain (*i.e.*, a VAS of 80) was encountered despite the protocol's maximal analgesic levels and decreases in the amplitude of flexion, mobilization was deferred. All deferments required within the hour after the onset of mobilization were noted. The median maximal amplitude of flexion obtained at 24 h and 48 h were noted, allowing comparison with the target levels prescribed by the surgeon.

All pain evaluations were associated with the surveillance and recording of possible side effects arising from the analgesic protocol. General effects included arterial hypotension (> 20% decrease in the preoperative mean blood pressure value), respiratory depression (respiratory rate, ≤8 breaths/min), sedation (0 = awake, 1 = sleepy but awakened by oral order, 2 = sleepy but awakened by nociceptive stimulation, 3 = not awakened), urinary retention (impossibility to urinate, requiring a urinary catheter to empty the bladder), nausea, vomiting, pruritus, and dysesthesia (paresthesia, numbness). Local complications included hematomas, catheter occlusions, kinks, or displacements.

A member of the surgical team, blinded to the postoperative analgesic technique, determined the maximal amplitude of knee flexion achieved on postoperative day 5 and on discharge from the surgical ward on day 7. All patients were admitted to a rehabilitation center when they were discharged from the surgical ward on day 7. A daily postoperative rehabilitation and assessment program was established for each patient based on four targets: joint mobility (including 2 h of CPM twice daily and manual mobilizations conducted by a physiotherapist), muscle force (quadriceps muscle force was evaluated daily using an isometric force dynamometer and trained using a weighted pulley system), motor function (rehabilitation was performed by having the patient walk an inclined plane, crouch, and climb steps), and absence of local complications (thrombophlebitis, inflammation). The length of stay in the rehabilitation center was determined by a blinded physiatrist. The objective criteria used for discharge from the rehabilitation center included knee flexion of 110°, knee extension of 0°, lower limb flexion of 90° with 0° of knee extension, and the ability to walk an inclined plane without aid and to climb and descend 10 stairs.

Statistical Analysis

Data were analyzed using SAS version 6.11 software (SAS Institute, Cary, NC). The quantitative anthropometric, hemodynamic, and morphine consumption values were expressed as the mean ± SD. Pain scores and knee mobilization values were expressed as medians (25th–75th percentiles), and the length of stay in the rehabilitation center was expressed as the median (and range). The repeated-measures aspect of this study was evaluated using analysis of variance. A Kruskall–Wallis test was used to compare the quantitative parameters of the three analgesic techniques at each evaluation. When a significant difference was encountered, the groups were compared two at a time, and Bonferroni correction was applied. Categorical data were compared using the chi-square or Fischer exact tests, as appropriate. A significance threshold of $P < 0.05$ was retained.

Table 1. Arthropometric Characteristics, Types, and Duration of Surgery

	PCA	CFB	CEI
Patients (n)	19	20	17
Sex (M/F)	10/9	8/12	10/7
Age (yr)	58 ± 16	54 ± 17	51 ± 15
Weight (kg)	78 ± 13	73 ± 12	70 ± 11
Height (cm)	166 ± 9	167 ± 13	167 ± 10
Type of surgery (TKR/arthrolysis)	13/6	15/5	10/7
Duration of surgery (h)	3.3 ± 0.8	2.9 ± 1.2	3.1 ± 1.5

TKR = total knee replacement.

Values are mean ± SD.

Results

Patient demographics, type of surgery, and duration of surgery (table 1) were similar in all three patient groups: PCA (n = 19), CFB (n = 20), CEI (n = 17).

The resting VAS scores of the CEI group were significantly less than those of the PCA group at all test times and significantly less than those of the CFB group from H_6 to H_{12}, but they were similar at H_1. The CFB group's VAS scores were significantly less than those of the PCA group at H_1 and from H_{24} onward. During mobilization (fig. 1), the VAS of the CEI and CFB groups showed no significant differences during the study period. Both were significantly less than those of the PCA group.

One subcutaneous morphine injection was required on day 1 by two CEI and six CFB patients. No significant differences were noted between the two groups' supplemental morphine consumption. Neither group required morphine supplements on day 2. The PCA group's mean morphine consumption was 36 ± 13 mg and 31 ± 15 mg on days 1 and 2, respectively.

Side effects (table 2) were most often noted in the CEI group, with a significantly elevated incidence of urinary retention, dysesthesia, and arterial hypotension (table 3). A high incidence of sedation, defined as the need to call the patient by name to incite awakening, was noted in all groups in the post-anesthesia care unit.

At 24 and 48 h, the CEI and CFB groups achieved the prescribed mobilization levels significantly more frequently and required deferred mobilization less frequently than did the PCA group (table 4). Similarly, the maximal amplitude of knee flexion reached on day 5 and at discharge from the hospital was significantly greater in the CEI and CFB groups (table 5). No significant differences were noted for the knee flexion values among the three groups at the 1- and 3-month follow-up examinations. The duration of stay in the rehabilitation center, needed to reach the target levels prescribed by the physiatrist, was significantly different between the regional analgesia and the PCA groups: CEI, 37 days (range, 30-45 days); CFB, 40 days (range, 31-60 days); PCA, 50 days (range, 30-80 days; $P < 0.05$).

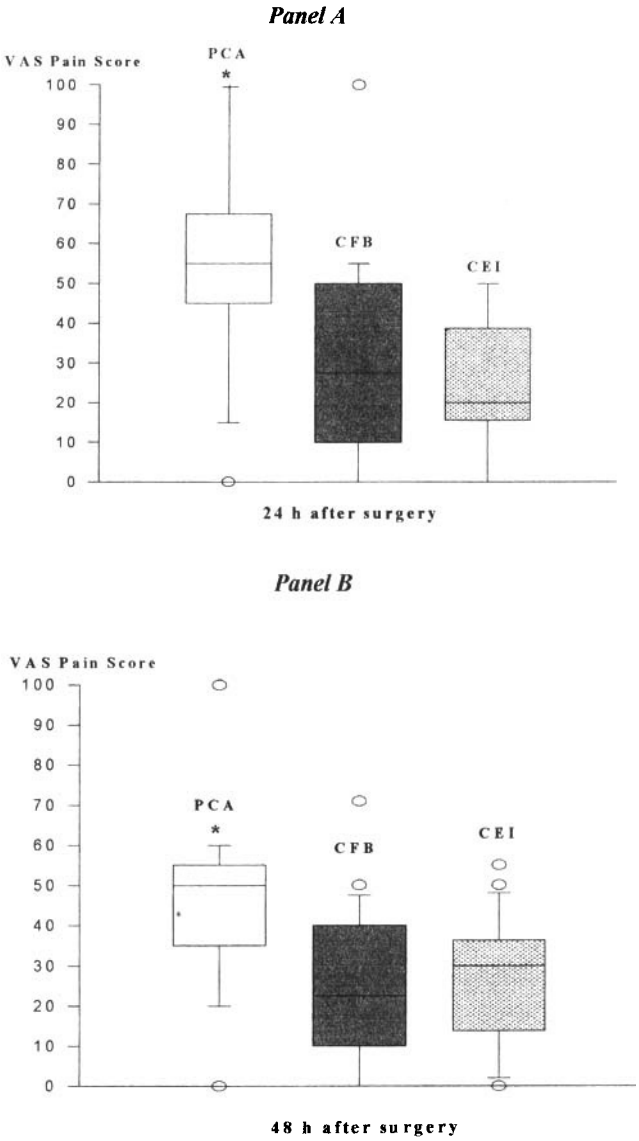

Fig. 1. Comparison of the visual analog scale values during continuous passive motion (CPM) of the three groups at (*A*) 24 h and (*B*) 48 h. The box represents the 25th–75th percentiles; the dark line is the median; the extended bars represent the 10th–90th percentiles, and the circles represent values outside this range. *$P < 0.01$ *versus* continuous femoral block (CFB) and continuous epidural infusion (CEI).

Table 2. Principal Side Effects in the Three Analgesic Techniques

	PCA (n = 19)				CFB (n = 20)				CEI (n = 17)			
Postoperative Hours	PACU	24 h	48 h	72 h	PACU	24 h	48 h	72 h	PACU	24 h	48 h	72 h
Urinary retention (%)	21*	0	0	0	0	0	0	0	53†	0	0	0
Nausea (%)	79	21*	5	5	60	5	0	0	70	12	6	6
Vomiting (%)	32	10	0	0	25	0	0	0	35	6	0	0
Pruritis (%)	5	10	5	5	5	0	0	0	17	6	0	0
Sedation (%)	94	16	5	0	85	10	5	0	70	6	6	6
Dysesthesia (%)	—	—	—	—	20	5	5	0	41†	30†	12	0
Local complications (%)	—	—	—	—	—	20	10	0	—	17	6	0

PACU = post anesthetic care unit (H12) ; Sedation = patient sleepy but awakened by oral order; Dysesthesia = paresthesia, numbness.

* $P < 0.05$ *versus* continuous femoral block (CFB) group.

† $P < 0.05$ *versus* patient-controlled analgesia (PCA) and continuous femoral block (CFB) groups.

Discussion

After major knee surgery, analgesia provided by CEI or CFB is more effective during early motorized mobilization than by intravenous PCA. These regional analgesia techniques allow for more intense early rehabilitation and accelerate functional recuperation and shorten the total (hospital and rehabilitation center) duration of institutional stay.

One aspect of the study design deserves comment. The pain evaluations during the postoperative days were not performed under blinded conditions because of the clinical setting of this study. Rigorous scientific methods would have required placing a femoral and epidural catheter and joining a PCA pump to the peripheral venous catheter in all patients. Because only the analgesic technique tested in each group would be used, evident ethical reasons restrained our application of this method. In contrast, blinded conditions were applied to the evaluations of functional outcome and the length of stay in the rehabilitation center.

Analgesia

Our results confirm the efficacy of the three tested analgesic techniques in controlling resting pain after knee surgery.[12-17] Of the three, PCA remains slightly less efficient. This difference could be caused, in part, by autoadministration with the classically maintained pain level tolerated by the patients.[18] In contrast, our findings concerning early rehabilitation using continuous motorized mobilization highlight the differences among the three techniques. Both continuous epidural and femoral blockades, optimized by their association with nonopioids in a multimodal analgesic protocol, provided more effective pain control during early mobilization, as evident by lower VAS scores. The efficacy of CFB during rehabilitation, although certainly of interest, has rarely been addressed in the literature. We found only a few contradictory studies that evaluated the postoperative analgesic effect of CFB during punctual mobilization.[12-14,17]‡ In accordance with the findings of Hirst *et al.*,[17] most of our patients reported pain in the region

‡ Hord AH, Roberson JR, Thompson WF, Cohen DE: Evaluation of continuous femoral nerve analgesia after primary total knee arthroplasty (abstract). Anesth Analg 1990; 70:S164.

Table 3. Arterial Hypotension and Mean Arterial Blood Pressure Values in the Three Analgesic Groups

	PCA (n = 19)				CFB (n = 20)				CEI (n = 17)			
Postoperative Hours	PACU	24 h	48 h	72 h	PACU	24 h	48 h	72 h	PACU	24 h	48 h	72 h
Arterial hypotension (%)	24	26	13	5	52*	50*	17	5	78†	76†	23.5†	9
Mean arterial blood pressure (mmHg)	79 ± 7	88 ± 11	83 ± 7	84 ± 8	78 ± 10	77 ± 11	78 ± 9	79 ± 7	67 ± 7†	69 ± 9†	76 ± 9†	77 ± 10

Arterial hypotension = defined by a fall of more than 20% of the preoperative mean blood pressure values; PACU = post anesthetic care unit (H12).

Values of mean arterial blood pressure are mean ± SD.

* $P < 0.05$ *versus* patient-controlled analgesia (PCA) group.

† $P < 0.05$ *versus* patient-controlled analgesia (PCA) and continuous femoral block (CFB) groups.

Table 4. Quality of Early Rehabilitation (°)

	PCA		CFB		CEI	
Postoperative Hours	24 h	48 h	24 h	48 h	24 h	48 h
Surgeon's mobilization target	40	50	40	50	40	50
Achieved mobilization	30* (10–40)	40* (32–40)	40 (34–40)	50 (48–50)	40 (40–40)	50 (45–50)
Deferred mobilization (number of patients)	5	3	2	0	1	0

Values of achieved mobilization are median (25th–75th percentiles).

* $P < 0.05$ *versus* continuous femoral block (CFB) and continuous epidural infusion (CEI).

behind the knee. The sciatic nerve, not affected by CFB because of its sacral plexus origin, participates in the knee's innervation and certainly played a role in this pain. In contrast with the findings of Hirst *et al.*,[17] our patients' pain was well controlled during mobilization. Our choice of analgesic regimen and the mobilization technique that we used may explain this difference. Although Hirst *et al.*[17] used bupivacaine alone to obtain blockade, we used a combination of lidocaine, clonidine, and morphine in the current study to obtain femoral blockade, which provided an additive if not synergistic effect to the resulting analgesia. Although the superior efficacy of CEI has been demonstrated in controlling dynamic pain when local anesthetics are associated with adjuvants,[18,19] their effects in plexus blocks are still being studied.[20–24] When standard doses are used, 1% lidocaine provides better motor blockade than bupivacaine 0.25% or 0.125%, more effectively avoiding quadriceps muscle spasm, which is cited as the cause and consequence of postoperative pain that hinders rehabilitation.[25] In addition, although as yet unconfirmed, regional analgesia would block the massive afferent nociceptive input thought to trigger increased excitability of the peripheral nociceptors and the dorsal horn neurons. Consequently, the increased reflex excitability leading to quadriceps muscle spasm, in response to even nonnociceptive input, would be controlled.[26] Furthermore, muscle relaxation was enhanced by replacing the punctual manipulations performed by physiotherapists with motorized CPM, a more gentle and progressive mobilization.[9,27] As such, the anticipated increase in pain often incriminated in the failure of rehabilitation using punctual mobilization was avoided.[15,28]‡ In accordance with the literature[15,28,29]‡ and despite the use of CPM, the pain scores of the PCA group were significantly greater than those of the groups treated by regional analgesia. The greater analgesic efficacy noted in the regional analgesia groups was associated with greater knee flexion values (*i.e.*, better quality rehabilitation).

Although not statistically significant, lower VAS scores were expressed by patients in the CEI group than by those treated with CFB, suggesting a greater analgesic effect provided by CEI. Although epidural analgesia remains the reference technique, CFB has been shown to be safe and to cause only few minor adverse effects,[12,13] thus providing the best balance of analgesia and side effects. In contrast to CEI, femoral blocks cause fewer episodes of low blood pressure and urinary retention; the latter, difficult to accept in the context of functional surgery, also increases the risk of infection arising from the use of urinary catheters.

Table 5. Functional Outcome: Knee Flexion (°) at Day 5, upon Discharge from the Surgical Ward (Day 7), and at 1- and 3-month Follow-ups

	PCA	CFB	CEI
Day 5	60 (50–70)*	80 (65–85)	85 (75–100)
Discharge	80 (65–90)*	90 (70–95)	90 (77.5–100)
1 month	90 (85–100)	95 (95–100)	105 (100–120)
3 month	125 (100–125)	125 (105–125)	130 (115–130)

Values are median (25th–75th percentiles).

* $P < 0.05$ *versus* continuous femoral block (CFB) and continuous epidural infusion (CEI).

Rehabilitation

The novelty of this study lies in the 48-h postoperative analysis of the quality of rehabilitation, functional outcome, and length of stay in the rehabilitation center. In contrast to PCA, the analgesic quality of the regional blocks allowed patients to consistently achieve the mobilization levels targeted by the surgeons. The optimized rehabilitation led to earlier functional recuperation reflected in the knee flexion values noted on day 5 and at discharge from the hospital, which were greater than those of the PCA group.

Similar findings have been reported in the literature.

Syngelyn and Gouverneur[12] noted significantly better knee flexion from days 1 to 10 after total knee replacement surgery using CFB and CEI rather than PCA. As in the current study, a 10° advantage was noted in the regional analgesia groups on day 10. Comparing intramuscular morphine and CEI with local anesthetics during CPM after the same surgery, Pettine and Wedel[10] noted mean knee flexion values of 86° and 93°, respectively, at discharge from the hospital 10–12 days after surgery. Moiniche *et al.*[11] performed the same comparison after total hip or knee replacement. When comparing the postoperative outcomes following unilateral primary total knee replacement under either epidural or general anesthesia, Williams-Russo *et al.*[4] reported that epidural anesthesia was associated with more rapid achievement of postoperative goals. All rehabilitative milestones were reached earlier, with patients climbing stairs significantly earlier. However, none of the authors could show that accelerated functional recuperation resulted in decreased hospital stays. Pettine and Wedel[10] programmed a minimal hospital stay of 10 days, masking the prolonged rehabilitation caused by persistent pain in the intramuscular morphine group. Moiniche *et al.*[11] did not include early intensive rehabilitation in the study protocol, leaving the analgesic advantage of epidural analgesia unexploited. Because the hospital stay in our study was limited to 7 days, analysis was centered on the duration of stay in the rehabilitation center. The knee flexion values noted in the regional analgesia groups at discharge from the hospital, increased by 10° compared with the PCA group, significantly shortened the rehabilitation period required to reach the objective functional discharge criteria used by the physiatrist. In accordance with Pettine and Wedel,[10] follow-up examinations at 1 and 3 months showed no functional differences among the groups, as reflected by knee flexion values. Although resolution of pain during the follow-up period allowed the three group's functional results to be homogenized, early intensive rehabilitation, facilitated by regional analgesia, accelerated functional recuperation.

A multimodal recovery program including regional analgesic techniques and CPM should be privileged after major knee surgery. The augmented analgesic effect of the regional techniques on pain during early mobilization permitted the rehabilitative advantages of CPM to be maximized. When compared with the use of PCA, functional recuperation was accelerated, and the overall hospital stay was shortened. Similar findings were reported after colon surgery,[6] leading to Kehlet's[7] recommendation of regional analgesia techniques in 1994. The choice of regional techniques should be based on a careful evaluation of the benefits and risks. The routine use of CEI after knee surgery should be limited because shortening the global hospital stay justifies neither the discomfort of side effects nor the danger of potentially serious complications. In contrast, CFB seems to have all the qualities necessary to become the primary choice for regional analgesia after major knee surgery.

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