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Patient-Controlled Analgesia After Major Abdominal Surgery in the Elderly Patient

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1. Introduction

Effective pain management of acute postoperative pain is mainly a humanitarian action that influences directly the length of recovery and hospitalization, therefore having important medical, economic, and social consequences.

As the complexity of analgesic therapies increases, priorities of care must be established to balance aggressive pain management with measures to prevent or minimize adverse events and to ensure high quality and safe care.

Analgesia remains the primary pharmacologic intervention for managing hospitalized surgical patients. Unintended advancing sedation and respiratory depression are two of the most serious analgesic-related adverse events. Multiple factors, including analgesic dose, route of administration, duration of therapy, patient-specific factors, and desired goals of therapy, can influence the occurrence of these adverse events. Furthermore, there is an urgent need to educate all members of the health care team about the dangers and potential attributes of administration of sedating medications concomitant with analgesia and the importance of initiating rational multimodal analgesic plans to help avoid adverse events.

Elderly patients frequently pose many challenges perioperatively that are not often seen in younger patients. Dementia, frailty, impaired ability to care for oneself, and malnourishment may be present at baseline and are likely to worsen postoperatively. The elderly are at increased risk of acute delirium and cognitive impairment postoperatively, which often complicates recovery and discharge placement.

Patient-controlled analgesia is a modern and effective method of postoperative pain management, mostly after major abdominal surgeries.

Using a special analgesia pump, the patient can self-administer the analgesic as needed, in pre-established bolus doses to which an analgesic basal infusion may not be associated.

Patient-controlled analgesia (PCA) with intravenous morphine and patient-controlled epidural analgesia with a local anaesthetic (sufentanyl-bupivacaine) in combination with an opioid (PCEA) are two new techniques, theoretically beneficial. However, these techniques have been inadequately evaluated in elderly people.

A relatively limited number of studies performed a comparative evaluation of the effects of various perioperative analgesic techniques on the overall recovery of elderly patients and therefore we undertook a prospective, randomized study to compare the effectiveness and possible adverse effects on postoperative pain and recovery of two analgesia and anesthesia techniques: general anesthesia in combination with epidural analgesia, followed postoperatively by PCEA (sufentanyl-bupivacaine), and general anesthesia followed postoperatively by PCA with morphine administered intravenously.

Secondly, we evaluated the mental status of patients after developing respiratory, hemodynamic, and gastrointestinal complications.

2. Background

One of the most common methods for providing postoperative analgesia is via patient-controlled analgesia (PCA). Although the typical approach is to administer opioids via a programmable infusion pump, other drugs and other modes of administration are available.

Patient-controlled analgesia (PCA) is commonly assumed to imply on-demand, intermittent, intravenous (IV) administration of opioids under patient control (with or without a continuous background infusion).

This technique is based on the use of a sophisticated microprocessor-controlled infusion pump that delivers a preprogrammed dose of opioid when the patient pushes a demand button. PCA is a conceptual framework for administration of analgesics . The broader concept of PCA is not restricted to a single class of analgesics or a single route or mode of administration. Nor should PCA imply the mandatory presence of a sophisticated and expensive infusion device. Any analgesic given by any route of delivery (i.e., oral, subcutaneous, epidural, peripheral nerve catheter, or transdermal) can be considered PCA if administered on immediate patient demand in sufficient quantities.

2.1 Historical perspective

Gross undertreatment of acute pain has been well chronicled over the last quarter century and likely continues today. The traditional approach of IM opioids given *pro re nata* (prn) results in at least 50% of patients experiencing inadequate pain relief after surgery.

Marks and Sachar's landmark 1973 publication ignited a philosophical revolution in practitioners' perception of the adequacy of conventional analgesic practices. Not only did this study document that a large proportion of hospitalized patients were undertreated, it also exposed that physicians and nurses are misinformed and lack sophistication regarding the effective use of opioid analgesics. This began the shift in intellectual milieu from the quest for the "perfect" analgesic (with an ever-expanding opioid pharmacopoeia) towards optimizing the mode of administration and delivery system for the (perfectly adequate) analgesic drugs that already existed.

Roe was the first to demonstrate, in 1963, that small IV doses of opioids provide more effective pain relief than conventional IM injections. Subsequently, Sechzer —the true pioneer of PCA—evaluated the analgesic response to small IV doses of opioid given on patient demand by a nurse in 1968 and then by machine in 1971 . Obviously, frequent

administration of IV doses of opioid by nurses to large numbers of patients is impractical and cost prohibitive. Thus, the late 1960s witnessed development of PCA technologies.

In 1976, the first commercially available PCA pump, the "Cardiff Palliator," was developed at the Welsh National School of Medicine . Since then, PCA devices have evolved enormously in technological sophistication, ease of use, flexibility, and portability.

The smallest concentration at which pain was relieved was termed the "minimum effective analgesic concentration" (MEAC). Minimal analgesia is achieved with titration of opioid until the MEAC is achieved, which marks the difference between severe pain and analgesia. Furthermore, these investigators found a discrete concentration of opioid within an individual to consistently provide effective analgesia, whereas the discrete concentration that provided analgesia varied considerably among individuals, thus establishing that pharmacodynamic variability in response to opioids accounts for individual differences in dose requirements.

Pharmacokinetic variables (volume of distribution, rates of distribution and elimination) consistently failed to correlate with dose requirement; in contrast, an individual's hourly opioid dose and their plasma opioid concentration did correlate.

Two prerequisites for effective opioid analgesia were thus established:

1. individualize dosage and titrate to pain relief response to achieve the MEAC and establish analgesia,
2. maintain constant plasma opioid concentrations and avoid peaks and troughs .

These requirements cannot be achieved with prn or around-the-clock IM injections.

After titration to achieve the MEAC and establish analgesia, patients use PCA to maintain plasma opioid concentrations at or just above their individual MEAC ("optimal plasma concentration"). In contrast, patients receiving IM bolus injections experience significant periods of severe pain with their plasma opioid concentrations less than their individual MEAC, followed by periods of "overshoot" more than the optimal plasma concentration resulting in excessive sedation, possible respiratory depression, and no better pain relief.

2.2 PCA modes and dosing variables

PCA has several modes of administration. The two most common are demand dosing (a fixed-size dose is self-administered intermittently) and continuous infusion plus demand dosing (a constant-rate fixed background infusion is supplemented by patient demand dosing). Nearly all modern PCA devices offer both modes.

Less commonly available and less studied modes of administration include infusion demand (in which successful demands are administered as an infusion), preprogrammed variable-rate infusion plus demand dosing (in which the infusion rate is preprogrammed on an internal clock to vary or turn off altogether by time of day), and variable-rate feedback infusion plus demand dosing (in which a microprocessor monitors demands and controls the infusion rate accordingly).

For all modes of PCA, there are the following basic variables: initial loading dose, demand dose, lockout interval, background infusion rate, and 1-h and 4-h limits. The initial loading dose allows for titration of medication when activated by the programmer (not the patient).

The initial loading dose can be used by nurses in the postanesthesia care unit (PACU) to titrate opioid to the MEAC or by postsurgical nurses to give "breakthrough" doses.

The demand dose (sometimes called incremental or PCA dose) is the quantity of analgesic given to the patient on activation of the demand button. To prevent overdosage by continual demand, all PCA devices use a lockout interval (or delay), which is the length of time after a successful patient demand during which the device will not administer another demand dose (even if the patient pushes the demand button).

The background or continuous infusion is a constant rate infusion that is administered regardless of whether the patient activates demand doses. Some devices allow entry of 1-h and/or 4-h limits, with the intent of programming the device to limit the patient over either 1-h or 4-h intervals to less total cumulative dose than were they to successfully activate the demand button at the end of each lockout interval. Use of these 1-h and 4-h limits is controversial.

Proponents argue that these limits provide additional safety, whereas detractors argue that no data demonstrate enhanced safety. Moreover, if a patient uses enough demand doses to reach the 1-h or 4-h limit, they probably require more analgesic instead of being locked out from further access for the balance of the interval.

The alarm on most devices is nonspecific and nurses typically do not recognize if this condition has triggered the alarm. Most modern microprocessor-driven PCA devices allow for programming in the "PCA mode" (in which a continuous infusion is not offered) or the "PCA + continuous mode." Whereas earlier PCA devices allowed for entry of parameters in units of "mL" or "mg," many newer devices also allow for entry in "μg" units, thereby reducing the potential for programming error when using fentanyl or sufentanil.

The demand dose and lockout interval (as well as the background infusion—see the hazards of continuous background infusions with IV-PCA under the safety section below) deserve further discussion. In practice, most patients have an inherent maximum frequency of demands. Thus, if the demand dose is too small, they refrain from making demands and may become frustrated with PCA, resulting in poor pain relief .

For PCA to be successful, the demand dose should produce appreciable analgesia with a single demand . However, if the demand dose is too large, plasma drug concentration may eventually reach toxic levels. There is an optimal range of doses for each opioid, albeit a wide enough dose range to accommodate the pharmacodynamic variability in response to opioids among individuals.

It is possible to coach patients to increase the demand rate. If the demand dose is changed during PCA treatment, patients will alter their demand rate to accommodate the change, thus maintaining a consistent plasma opioid concentration.

The lockout interval is designed to prevent overdose. Ideally, it should be long enough for the patient to experience the maximal effect of one dose before another is permitted, thus preventing "stacking" of doses. Therefore, speed of onset of analgesia is paramount in setting the lockout interval. Based on this rationale, one might consider using a slightly shorter lockout interval when using the "fentanyl family of opioids" compared to morphine or hydromorphone.

However, once titration to MEAC has been achieved, there appears to be no clinically appreciable major differences in time of onset of analgesia among the opioids commonly used for PCA . The rate of drug distribution (flux) between plasma and brain is a useful concept in determining the lockout interval. While drug flux is positive, there is net movement of drug from plasma to brain and drug effect increases. The next dose should be administered when net flux becomes negative, i.e., when drug is leaving the brain and effect has peaked.

The change from positive to negative flux occurs over a similar length of time for diverse opioids. Many studies examined the relative brain and spinal cord central nervous system (CNS) concentration profiles of opioids. CNS concentration was expressed as a percentage of its maximum value. Relative onset was defined as the time that the relative CNS concentration first reached 80% of maximum and relative duration was defined as the period during which the concentration remained more than 80%. For an IV bolus dose of all the common opioids, relative onset varies from approximately 1 min for alfentanil to 6 min for morphine, and relative durations are 2 min and 96 min, respectively.

They concluded that, although all of the common opioids (except alfentanil) have kinetic and dynamic properties suitable for IV-PCA, the relatively long duration of morphine makes it particularly suited for a gradual titration approach.

Furthermore, titration is improved by frequent administration of small doses after the initial "loading" period. Thus, there appears to be pharmacokinetic rationale for the empirically derived use of 5–12 min lockout intervals for the opioids commonly used for IV-PCA.

2.3 Choice of analgesic

All of the common opioids have been used successfully for IV-PCA, with morphine having been studied the most. Whichever opioid is chosen for IV-PCA, knowledge of its pharmacology is prerequisite for setting the dosing variables of the PCA device. A review of the practical clinical pharmacology of opioids, as it pertains to management of IV-PCA, is essential.

Parenteral opioids have three profiles of μ opiate-receptor binding capacity: pure agonists, agonist-antagonists, and partial agonists. Pure agonists are mainstays of acute pain management because they provide full μ-receptor binding, i.e., there is no analgesic ceiling (e.g., titration of more opioid results in better pain relief).

There is a "clinical ceiling" in that side effects such as sedation, specifically respiratory depression, often prevent further dosing before achieving adequate pain relief. The μ agonists are equally effective at equianalgesic doses (e.g., 10 mg of morphine = 2 mg of hydromorphone = 100 mg of meperidine). Similarly, there are no differences in side-effect profile, although individual patients may experience reproducible nausea and vomiting or pruritus with one drug but not another.

All μ-agonists reduce propulsive gut activity and coordination, contributing to postoperative ileus. Contrary to surgical myth, no individual μ-agonist has less effect on gut motility: in conventional IV-PCA doses, morphine, meperidine, and fentanyl have similar effects on the bile ducts and sphincter of Oddi.

There is evidence that agonist-antagonists share this activity to a lesser degree. Metabolites and routes of elimination differ markedly between µ-agonists, providing one rationale for choosing an opioid for IV-PCA.

The agonist-antagonist opioids provide κ-receptor activation and µ-receptor antagonism. Although they are marketed as having a ceiling effect on respiratory depression, thereby providing a greater margin of safety, this effect appears only at very large doses relative to µ-agonists. Most importantly, the agonist-antagonists possess an analgesic ceiling, rendering them unable to reliably provide a level of pain relief comparable to the µ-agonists. Thus, although the successful use of an agonist-antagonist for IV-PCA has been described for gynecologic surgery , they are not commonly used in clinical practice and would not reliably provide adequate analgesia for moderate-to-severe pain conditions.

Furthermore, agonist-antagonists can provoke an acute withdrawal response in patients who have already received a µ-agonist or are maintained on one chronically. As a result of ç-receptor activation, they also have a frequent incidence of disturbing psychotomimetic side effects.

Interestingly, there appears to be a major gender difference in response to agonist-antagonists. Although women consistently experience dose-dependent analgesia, an antianalgesic response with increased pain compared with placebo was observed in men receiving nalbuphine . Partial agonists produce only a partial response in binding to µ receptors, thereby limiting the analgesia that can be achieved. They are not used commonly for IV-PCA.

Morphine remains the "gold standard" for IV-PCA, as the most studied and most commonly used IV-PCA drug. It is important to note that morphine has an active metabolite—morphine-6-glucuronide (M6G)—that also produces analgesia, sedation, and respiratory depression. Whereas morphine is eliminated mainly by glucuronidation, its active metabolite relies predominantly on renal excretion for elimination. Prolonged and profound delayed onset respiratory depression has been reported in patients with renal failure receiving parenteral morphine.

Hydromorphone is a good alternative for morphine-intolerant patients or those with altered renal function because it is metabolized primarily in the liver and excreted primarily as an inactive glucuronide metabolite .A demand dose of 0.2 mg of Hydromorphine is considered equi-analgesic to 1.0 mg of morphine since it is approximately six times as potent as morphine.Following this analgesic advantage over morphine, it is commonly used PCApumps at a concentration of 0.5 mg/ml or 1 mg/ml. Hydromorphine is ideally suited for opioid-tolerant patients, increasing the interval between refilling the drug reservoir.

Fentanyl is considered 80–100 times as potent as morphine with single doses or brief periods of administration. However, because of its short duration of action, particularly in the early phase of administration (owing to redistribution pharmacokinetics), double-blind IV-PCA comparator trials have suggested 25–30 µg fentanyl to be equianalgesic to 1 mg morphine as an IV-PCA demand dose, i.e., 33–40 times as potent as morphine. Fentanyl has a quicker onset than morphine and better suited for iv-PCA probably due its lipophilicity. Fentanyl has been used successfully for IV-PCA . It is an excellent alternative for morphine-intolerant

patients and is suitable for patients with renal failure because it does not rely on renal excretion for elimination.

Although meperidine has traditionally been the second most common μ-agonist opioid prescribed for IV-PCA, its routine use for IV-PCA is strongly discouraged . Meperidine has a neurotoxic metabolite, normeperidine, that possesses no analgesic property and relies mostly on renal excretion for elimination. Normeperidine accumulation causes CNS excitation, resulting in a range of toxic reactions from anxiety and tremors to grand mal seizures. Unwitnessed seizures with loss of airway reflexes can result in severe permanent anoxic brain injury or death.

Use of sufentanil, alfentanil, and remifentanil for IV-PCA has been reported, with sufentanil studied the most . With sufentanil, an initial demand dose of 4–6 μg appears to be most appropriate. In contrast to the longer-acting opioids discussed above, a small background infusion may be necessary to sustain analgesia with sufentanil. Owen et al. could not identify an optimal dose and administration rate for alfentanil, concluding that it is not a useful drug for IV-PCA. Because of its ultra-short duration, remifentanil is probably only appropriate for IV-PCA use in short duration, severe episodic pain conditions such as labor pain.

3. Materials and method

This prospective, randomized study was approved by the Ethics Committee of the Emergency Clinical Hospital Constanta and included 70 patients undergoing major elective abdominal surgery.

The patient inclusion criteria in the study were: over 70 years old; status ASA I –III; scheduled major abdominal surgery; normal preoperative mental status, defined by score≥ 8 in the adapted Abbreviated Mental Test (AMT–Table 1); absence of contraindications for epidural anesthesia (clinical or laboratory); absence of extreme malnutrition or of cerebral vascular insufficiency.

Age
Time
Hospital address
Year
Hospital name
Recognizes two persons (for example, physician, assistant)
Date of birth
Year First World War began
Name of the President of the country
Counts backwards from 20 to 1

*The patients were asked to answer these 10 questions.Each correct answer received one point.

Table 1. Abbreviated Mental Test (AMT)*

On the day preceding surgery, during the pre-anesthesia interview, the patients signed the informed consent and received written and verbal instruction regarding the use of PCA or PCEA.

The patients were randomly assigned to two groups, using the random numbers list method: the PCA group – 35 patients with intravenous postoperative analgesia (morphine), the PCEA group – 35 patients with postoperative analgesia by epidural catheter (sufentanyl-bupivacaine).

In the PCEA group, before surgery, a thoracic (T7 – T11) epidural catheter was inserted in each patient, depending on the location of the surgery.

All surgeries were performed under balanced general anesthesia (induction with propofol, sufentanyl and atracurium, maintenance with sevoflurane, sufentanyl and atracurium) with standard intraoperative monitoring. After surgery, the patients were transferred to the Postoperative Care Unit.

In the PCA group, analgesia was initiated with a loading dose of 5 mg morphine intravenously, and subsequently the PCA analgesic pump (B.Braun Melsungen) was programmed to provide 1.5 mg morphine boluses intravenously with a blocking interval of 8 minutes.

For the postoperative analgesia in the PCEA group, we used a combination of bupivacaine 0.125% and sufentanyl 5 µg/ml administered by the patient-controlled analgesia pump (B.Braun Melsungen). The settings of the pump parametrs were: 2-3 ml bolus, safety interval of 12 minutes, and a basal infusion rate of 3 – 5 ml/hour.

In order to quantify the severity of postoperative pain, the patients were asked to use the 10 cm Visual Analogue Scale (VAS) graded from 0 cm (no pain) to 10 cm (unbearable pain). The VAS score was recorded daily at rest after coughing at 8 am, 12 pm, 8 pm, during the first 5 days after surgery. To optimize analgesia and minimize sedation and haemodynamic instability, the patient control setting was checked throughout the day for individual adjuatments.

When inadequate analgesia was noted (VAS>3), additiona injectable acetaminophen (1 g i.v.) or ketoprofen (100 mg i.v.) was administered.

Overall, the patient satisfaction score regarding postoperative analgesia was recorded on the 5th day after surgery (insufficient analgesia = 0, relatively good analgesia =1, good analgesia=2, excellent =3).

The patients' sedation was evaluated using a 4-point sedation scale (0=awake, opens eyes spontaneously, 1 = slightly sleepy, openes eyes on verbal stimuli, 2=moderately sleepy, opens eyes on tactile stimuli, nociceptive, 3=exremely sleepy, unresponsive).

The incidence of adverse effects caused by the opioid was evaluated: pruritus (present or absent), nausea or vomiting (present or absent).

These parametrs were recorded daily at 8 am, 12 pm, 8 pm, during the first 5 days after surgery.

The sensitive block was tested daily using the blunt pin prick technique as well as the motor block using the Bromage scale (0= free movement of the lower limb,1= cannot lift the extended lower limb; 2= cannot flex the knee, 3= lower limb completely motionless).

The blood pressure, heart rate, respiration rate, SpO2, were monitored every two hours during the first 5 days after surgery.

Gastrointestinal function was evaluated by systematically questioning the patients regarding the recovery of the digestive tolerance and transit of gases.

The statistical data proccessing was performed using the Student's t-tests and chi-square test. Values of <0.05 were considered statistically significant.

4. Results

A total number of 108 patients were scheduled for major abdominal surgical interventions at the Emergency Country Clinical Hospital in Constanta during this study.

Out of these, 38 (35%) were not included in the study for various reasons: patient (4%), severe cardiopulmonary conditions or MT score <8 (24%), neurological dysfunction (2%), patient death (6%).

The remaining 70 patients were randomly assigned to two groups: the PCA group, PCEA group.

Six patients did not complete the postoperative study or were excluded from the postoperative data analysis due to the absence of surgical resection (2 patients in each group) or to their non-compliance to the patient-controlled analgesia devices; these patients requested conventional analgesia (2 patients in the PCEA group).

Demographic and intraoperative data were comparable in both groups, and there were no statistically significant differences regarding the duration or type of surgery (Table 2).

No significant differences were noticed between the two groups regarding the intraoperative need for infusion solutions.

The patients in the PCEA group received less sevoflurane (p=0.0001) and sufentanyl intravenously (p=0.0001) during surgery, however they required significantly more ephedrine (p=0.0001) than the patients in the PCA group.

At the end of surgery, the duration of mechanical ventilation was similar in both groups, however extubation was performed significantly earlier in the PCEA group than in the PCA group.

The duration of patient-controlled analgesia was similar in both groups (PCA GROUP -70 ± 22 hours), avalid situation concerning the daily number of analgesic boluses used by the patients. The postoperative patient-controlled analgesic consumption is presented in Table 3.

The VAS score analysis shows that PCEA ensured significantly better (p=0.0001) postoperative pain management than PCA at rest (PCEA 22.93 ± 10, PCA 38.74 ± 8) and after coughing (PCEA 32.45 ± 13.05, PCA 45.40 ± 11.6) during the first 5 days after surgery .

During the first day after surgery, a significantly smaller number of patients in the PCEA group requested additional analgesia (VAS ≥4) compared with the patients in the PCA group (Table 4).

Parameter	PCA group (n=35)	PCEA group (n=35)
Age (years)	76.8 ± 4.7	± 5.6
Weight (kg)	69.3 ± 15.5	66.5 ±14.2
Gender	17 F/18M	15 F/20M
Surgery		
Colectomy	26 (74%)	20 (57%)
Gastrectomy	2 (6%)	6 (17%)
Cephalic pancreatectomy	5 (14%)	7 (20%)
Absence of resection	2 (6%)	2 (6 %)
Mean duration of surgery (minutes) (range)	242 (172 -295)	230 (180-305)
Average sevoflurane (%)	0.8 (0.6 – 1)	0.5 (0.4-0.6)*
Sufentanyl intravenously (µg/kg)	1.7 (1.3-2.2)	0.3 (0.3-0.4)
Crystalloids (l)	5 (4-6)	5 (4-6)
Colloids (l)	0.5 (0-1)	1.0 (0.5-1.5)
Incidence of systolic hypotension intraoperatively (<90 mmHg)	21 (60%)	26 (74%)
Duration of systolic hypotension intraoperatively (minutes)	5 (0 -209	15 ((5-30)
Ephedrine intravenously (mg)	0 (0-0)	12 (6 -36%)*
Postoperative extubation (minutes)	60 (32-90)	30 (17 -57)*
Duration of postoperative mechanical ventilation (minutes)	27 (10-65)	27 (12-45)

Data presented as median ± DS, median or numeric
*$p < 0.05$ between the two treatment groups

Table 2. Demographic and perioperative data of study groups

Postoperative day	Morphine sulphate i.v. (mg/day) PCA group	Bupivacaine epidural (mg/day) PCEA group	Epidural sufentanyl (µg/day) PCEA group
1	25 (24 - 44)	169 (150-236)	68 (57-94.5)
2	19 (8 -32)	158 (120-216)	63 (48-87)
3	10 (0 -21)	127 (94-153)	51 (37-61)
4	0 (0-0)	50 (0 -120)	20 (0 -48)
5	0 (0-0)	0 (0-0)	0 (-0)

Data presented as median;
PCA group = intravenous patient-controlled analgesia
PCEA group = epidural patient-controlled analgesia

Table 3. Postoperative consumption of patient –controlled analgesic

Postoperative day	Number of patient who required acetaminophen intravenously		Number of patient who required ketoprofen intravenously	
	PCAgroup no.(%)	PCEA group no.(%)	PCAgroup no.(%)	PCEA group no.(%)
1	18 (54)	11(35)	15 (45)	5 (16)*
2	18 (54)	15 (48)	6 (18)	3 (10)
3	19 (58)	17 (55)	3 (9)	3 (10)
4	15 (45)	17 (55)	2 (6)	3 (10)
5	12 (36)	10 (32)	1 (3)	0 (0)

Data presented as n.(%) *p<0.05 between the two study groups; The PCA group = intravenous patient-controlled analgesia; The PCEA group = epidural patient-controlled analgesia

Table 4. Postoperative consumption of additionally requested analgesic in the two study groups

The patient satisfaction score was significantly higher (p=0.012) in the PCEA group compared to the PCA group (Table 5).

Parameter	PCA group (n=33)	PCEA group (n= 33)
Recovery of intestinal transit (hours)	115 (90-144)	80 (60 -120)*
Digestive tolerance (hours)	182 (140-240)	142 (120 -164)*
Nausea and vomiting	10 (30%)	10 (32%)
Systolic arterial hypotension (<90 mmHg)	0 (0%)	5 (16%)
SpO2 <95%	5 (15%)	3 (10%)
Moderate pulmonary complications	2 (6%)	3 (10%)
Major pulmonary complications	1 (3%)	1 (3%)
Urinary tract infections	5 (15%)	1 (3%)
Pruritus	1 (3%)	1 (3%)
Postoperative delirium	8 (24%)	8 (26%)
Duration of hospitalization (days)	11.5 (8 -16)	10.5 (8-15)
Patients satisfaction score (no. of patients with score 0/1/2/3)	0/3/19/11	0/1/9/21*
AMT score (no. of patients with score < 8/9/10)	5/13/15	1/7/23

Data presented as n.(%);
*p<0.05 between the two study groups;
The PCA group = intravenous patient-controlled analgesia;
The PCEA group = epidural patient-controlled analgesia;
Patient satisfaction score is: insufficient =0, relatively good= 1, good= 2, excellent =3

Table 5. Postoperative status, adverse events, and patient satisfaction score in the two study groups

The daily recorder AMT scores had, before surgery, similar values in both groups, while after surgery the PCA group had lower values during the 4th and 5th day after surgery.

There were no significant differences between the two groups regarding the daily values of oxygenation during the first 5 days after surgery and the number of minor occurrences of asymptomatic hypoxia detected by pulse oximetry. Three patients in the PCA group and 2 patients in the PCEA group had at least one episode of a fall in the SpO2 to between 90 and 95%. One patient had a much lower SpO2 value between 85 and 90%.

Five patients in the PCEA group had postoperative hypotension corrected by volume repletion. This event was not noted in the PCA group.

The frequency of postoperative delirium was similar in the PCA group (8 patients, 24%) and the PCEA group (8 patients, 26%). The patients with delirium did not have an analgesic consumption or pain score different from those without delirium.

Postoperatively, the AMT score was lower in the PCA group compared to the PCEA group.

Recovery of digestive tolerance (p=0.019) and bowel movement (p= 0.005) occured significantly sooner in the PCA group compared to the PCEA group.

The incidence of pruritus, nausea and vomiting was almost equal in the two study groups.

The duration of hospitalization was similar for the patients in the two groups (Table 5).

5. Discussion

Effective analgesia reduces perioperative stress and the rate of complications, extremely important issues in abdominal surgery. The particularities of the elderly patient require ongoing efforts to adapt current analgesic techniques in order to improve the prognosis of surgeries in this category of patients.

The main conclusion of our study is that in elderly patients , patient-controlled analgesia techniques, intravenously or epidurally, ensure an efficient management of postoperative pain.

Epidural analgesia provides better control of postoperative pain at rest as well as after coughing, without increasing the incidence of complications, a compared to intravenous analgesia. Improved mental status of the patients and faster recovery of the digestive function were noted in the PCEA group.

In elderly patients, the difficulties associated with the use of patient-controlled analgesia techniques were mainly caused by the inability to lean the correct use of analgesic pumps.

Previous studies revealed the need for a closer supervision of elderly patients and the compulsory frequent adjustment of the administered doses, however, in our study the adjustment of the initial settings of patient-controlled analgesia was seldom necessary. In the PCA group, the initial setting was not changed because no signs of overdose were recorded, and in the PCEA group only 5 patients (16%) required alterations of the bolus dosages, to adapt it to the patient requirements.

Learning and acquiring the concept of patient control obviously involves an adequate preoperative mental status. The preoperative patient selection using the AMT scores enabled us to identify those with pre-existing cognitive impairments and consequently these patients were not enrolled in the study .This aspect might explain why only 3 % of the selected patients refused the patient-controlled devices and requested conventional analgesia. The high level of acceptance by the selected patients encourages us to recommend the routine pre-operative use of the AMT to ensure effective management of postoperative care in elderly patients .

The analysis of the patient satisfaction scores reveals the superiority of the PCEA techniques, explained by the better analgesic efficiency associated to the low incidence of adverse events. An important issue to consider is that in the PCEA mode patient control is partial, since it is possible to establish a basal analgesic perfusion rate. This aspect is extremely important for confused or sleepy patients who cannot control effectively the analgesic device. The intravenous continuous analgesic infusion is not recommended since it involves a higher risk of respiratory depression even at low doses .

Abdominal epidural analgesia improves the postoperative recovery of the intestinal transit compared to parenteral analgesia. In our study, recovery of bowel movement and digestive tolerance in the PCA group were delayed, compared to the PCEA group. Clinical studies in which the epidural catheter was located at T12 or lower did not show any benefits regarding the recovery of the intestinal function , that is why we took care to always place the cather at the thoracic level.

The incidence of pulmonary complications in this study was similar to that noted in other studies with younger patients undergoing the same type of surgeries. The choice of analgesic techniques does not seem to have any influence on the incidence of moderate or major pulmonary complications.

The cardiovascular changes were clinically insignificant. As expected, in the PCEA group the hemodynamic instability was higher intraoperatively, requiring a higher consumption of ephedrine, or postoperatively, when 5 patients experienced episodes of moderate hypotension.

In the patients of the PCEA group, the risk of orthostatic hypotension and motor blockage of the lower limbs during postoperative mobilization may neutralize the benefit of faster postoperative recovery. In our study, the adjustment of pre-established analgesic doses may explain the lack of the significant hemodynamic instability or motor blockage.

6. Conclusion

This study shows that patient-controlled analgesic techniques, regardless of the epidural or parental route used, are effective in elderly patients.

An epidural analgesia is better than parenteral analgesia and ensures better pain management with improved mental status and faster recovery of intestinal activity, without influencing cardiorespiratory morbidity.

This postoperative analgesia method is a new, promising technique for elderly patients undergoing major surgery.

7. References

Agnelli, G. (2004). Prevention of venous thromboembolism in surgical patients. *Circulation*, Vol. 110, No. 24, Suppl. IV, (December 2004), pp. 4-12, ISSN: 1524-4539

Bartha, E.; Carlsson, P. & Kalman, S. (2006). Evaluation of costs and effects of epidural analgesia and patient-controlled intravenous analgesia after major abdominal surgery. *British Journal of Anaesthesia*, Vol. 96, No. 1, (January 2006), pp. 111-117, ISSN 1471-6771

Bauer, A. & Boeckxstaens, G. (2004). Mechanisms of postoperative ileus. *Neurogastroenterology & Motility*, Vol. 16, Issue Supplement s2, (October 2004), pp. 54-60

Beilin, B.; Shavit, Y. & Trabekin, E. (2003). The effects of postoperative pain management on immune response to surgery. *Anesthesia & Analgesia*, Vol. 97, No. 3, (September 2003), pp. 822-827, ISSN 1526-7598

Bombeli, T. & Spahn, D. (2004). Updates in perioperative coagulation: Physiology and management of thromboembolism and haemorrhage. *British Journal of Anaesthesia*, Vol. 93, No. 2, (August 2004), pp. 275-287, ISSN 1471-6771

Devereaux, P.; Goldman, L. & Cook, D. (2005). Perioperative cardiac events in patients undergoing noncardiac surgery: A review of the magnitude of the problem, the pathophysiology of the events and methods to estimate and communicate risk. *Canadian Medical Association Journal*, Vol. 173, No. 6, (September 2005), pp. 627-634, ISSN 1488-2329

Fong, H.; Sands, L. & Leung, J. (2006). The role of postoperative analgesia in delirium and cognitive decline in elderly patients: A systematic review. *Anesthesia & Analgesia*, Vol. 102, No. 4, (April 2006), pp. 1255-1266, ISSN 1526-7598

Groeben, H.; Schäfer, B. & Pavlakovic, G. (2002). Lung function under high thoracic segmental epidural anesthesia with ropivacaine or bupivacaine in patients with severe obstructive pulmonary disease undergoing breast surgery. *Anesthesiology*, Vol. 96, No. 3, (March 2002), pp. 536-541, ISSN 0003-3022

Holte, K. & Kehlet, H. (2002). Epidural anaesthesia and analgesia – effects on surgical stress responses and implications for postoperative nutrition. *Clinical Nutrition*, Vol. 21, No. 3, (June 2002), pp. 199-206, ISSN 0261-5614

Jørgensen, H.; Wetterslev, J. & Møiniche, S. (2000). Epidural local anaesthetics versus opioid-based analgesic regimens on postoperative gastrointestinal paralysis, PONV and pain after abdominal surgery. In: *Cochrane Database of Systematic Reviews 2001*, 23.10.2000, Available from
http://www2.cochrane.org/reviews/en/ab001893.html

Kehlet, H. (1994). Postoperative pain relief—what is the issue? *British Journal of Anaesthesia*, Vol. 72, No. 4, (April 1994), pp. 375-378, ISSN 1471-6771

Kehlet, H. (1997). Multimodal approach to control postoperative pathophysiology and rehabilitation. *British Journal of Anaesthesia*, Vol. 78, No. 5, (May 1997), pp. 606-617, ISSN 1471-6771

Kehlet, H. & Holte, K. (2001). Effect of postoperative analgesia on surgical outcome. *British Journal of Anaesthesia*, Vol. 87, No. 1, (June 2001), pp. 62-72, ISSN 1471-6771

Kehlet, H. & Dahl, J. (2003). Anaesthesia, surgery and challenges in postoperative recovery. *The Lancet*, Vol. 362, No. 9399, (December 2003), pp. 1921-1928

Kehlet, H. (2008). Fast-track colorectal surgery. *The Lancet*, Vol. 371, No. 9615, (March 2008), pp. 791-793

Kehlet, H. & Wilmore, D. (2008). Evidence-based surgical care and the evolution of fast-track surgery. *Annals of Surgery*, Vol. 248, No. 2, (August 2008), pp. 189-198, ISSN 1528-1140

McLeod, G.; Davies, H. & Munnoch N. (2001). Postoperative pain relief using thoracic epidural analgesia: Outstanding success and disappointing failures. *Anaesthesia*, Vol. 56, No. 1, (January 2001), pp. 75-81

Moraca, R.; Sheldon, D. & Thirlby, R. (2003). The role of epidural anesthesia and analgesia in surgical practice. *Annals of Surgery*, Vol. 238, No. 5, (November 2003), pp. 663-673, ISSN 1528-1140

Mythen, M. (2005). Postoperative gastrointestinal tract dysfunction. *Anesthesia & Analgesia*, Vol. 100, No. 1, (January 2005), pp. 196-204, ISSN 1526-7598

Park, W.; Thompson, J. & Lee, K. (2001). Effect of epidural anesthesia and analgesia on perioperative outcome: A randomized, controlled veterans affairs cooperative study. *Annals of Surgery*, Vol. 234, No. 4, (October 2001), pp. 560-571, ISSN 1528-1140

Paulsen, E.; Porter, M. & Helmer, S. (2001). Thoracic epidural versus patient-controlled analgesia in elective bowel resections. *The American Journal of Surgery*, Vol. 182, No. 6, (December 2001), pp. 570-577, ISSN 0002-9610

Peyton, P.; Myles, P. & Silbert, B. (2003). Perioperative epidural analgesia and outcome after major abdominal surgery in high-risk patients. *Anesthesia & Analgesia*, Vol. 96, No. 2, (February 2003), pp. 548-554, ISSN 1526-7598

Pöpping, D.; Elia, N. & Marret, E. (2008). Protective effects of epidural analgesia on pulmonary complications after abdominal and thoracic surgery. *Archives of Surgery*, Vol. 143, No. 10, (October 2008), pp. 990-999

Rigg, J.; Jamrozik, K. & Myles, P. (2000). Design of the multicenter Australian study of epidural anesthesia and analgesia in major surgery: The MASTER trial. *Controlled Clinical Trials*, Vol. 21, No. 3, (June 2000), pp. 244-256

Rigg, J.; Jamrozik, K. & Myles, P. (2002). Epidural anaesthesia and analgesia an outcome of major surgery: A randomized trial. *The Lancet*, Vol. 359, No. 9314, (April 2002), pp. 1276-1282

Waurick, R. & Van Aken, H. (2005). Update in thoracic epidural anaesthesia. *Best Practice & Research: Clinical Anaesthesiology*, Vol. 19, No. 2, (June 2005), pp.201-213, ISSN 1521-6896

Werawatganon, T. & Charuluxananan, S. (2005). Patient controlled intravenous opioid analgesia versus continuous epidural analgesia for pain after intra-abdominal surgery. *Anesthesia & Analgesia*, Vol. 100, No. 5, (May 2005), pp. 1536, ISSN 1526-7598

Wheatley, R.; Shug, S. & Watson, D. (2001). Safety and efficacy of postoperative epidural analgesia. *British Journal of Anaesthesia*, Vol. 87, No. 1, (June 2001), pp. 47-61, ISSN 1471-6771
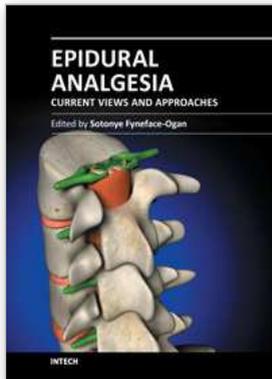
Epidural Analgesia - Current Views and Approaches

Edited by Dr. Sotonye Fyneface-Ogan

Epidural analgesia is a form of pain relief administered through the space surrounding the dural sheath either by direct injection or via catheter. The agent, when administered, can cause both a loss of sensation (anesthesia) and a loss of pain (analgesia), by reversibly interrupting the transmission of signals through nerves in or near the spinal cord. This form of pain relief has been found useful in many clinical situations. This book intends to provide an in-depth review of the current knowledge on epidural analgesia. The use of this form of analgesia is explored by contributors from different perspectives, including labor and delivery, postoperative analgesia in both pediatric and geriatric patients, and its role during anesthesia and surgery. In order to provide a balanced medical view this book was edited by an obstetric anesthesiologist.

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