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Ultrasound guided vs nerve stimulation : Is there an influence on the anesthetic block occurrence during sciatic nerve regional anesthesia using clinical and electrophysiological measurements.

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Introduction

The introduction of ultrasound in regional anesthesia seems to be a real progress mainly about the direct view of the anatomical structures and their possible variability. Nevertheless, this statement needs to be verified against the actual subjective tendency. On the same way, the possible shortening in the time of occurrence of an efficient block for surgery must be proved (Marhofer, *et al.*, ANESTHESIA, **59**, 642-6, 2004. Gray, ANESTHESIOLOGY, **104**, 368-73, 2006).

We wanted to investigate those points using the somatosensory evoked potentials mentioned as potential tools and objective measures in comparison to classical clinical assessments.

This study is the first step in the understanding of the possible interaction between the electrical nerve stimulation and the ability of local anesthetics to block the nerve fibers at the channel receptors on the cytoplasmic membrane.

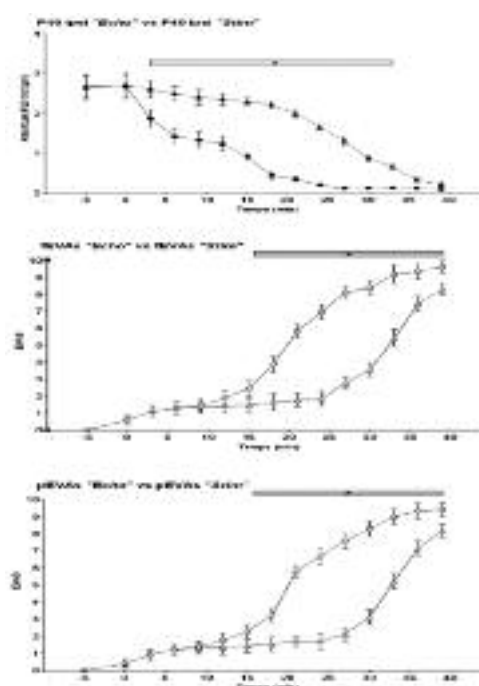
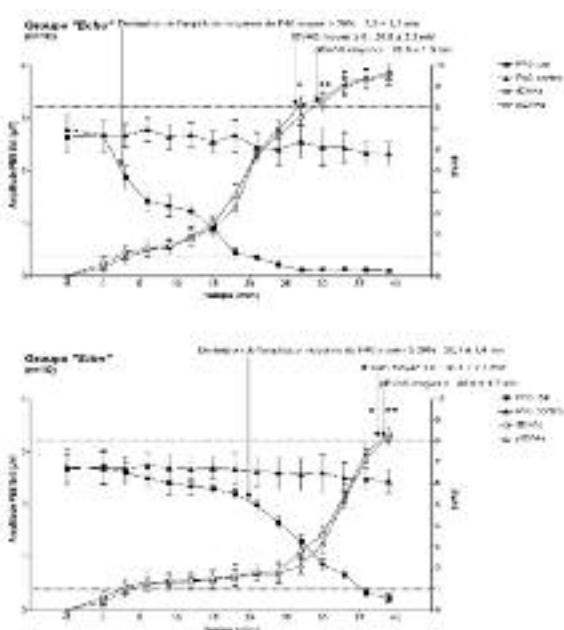
Methods

For this study agreed by the ethics committee of the Erasmus academic hospital, we obtained the written consent of 20 ASA I-III patients, admitted for elective distal leg, ankle or foot surgery. The exclusion criteria are the

infection of the ponction site, coagulopathy, allergy of local anesthetic, diabete mellitus, neuropathy, pregnant patient, the incapacity of collaboration. The patients were prospectively included in two groups. In the ultrasound group (Us - n = 10), the somatosensory evoked potentials (SEP) were directly recorded after the local anesthetic mixture injection. In the stimulation group (Stim - n = 10), we have stimulated for the sciatic nerve (1.5 mA, 2 Hz during 60 sec) after the location of the nerve with sonography and before injection and then the SEP recording was started. Finally the SEP were recorded over a period of 40 minutes in each patient. In addition, we carry out a clinical assessment (cold and pinprick every 3 min until the end of the study procedure) using a based visual analogical score method (fEVAS for cold, and the pEVAS for pinprick test, respectively). The two investigators have proven experience in regional anesthesia.

Data analysis corresponds to clinical tests and the SEP (latencies and amplitudes) analysis and mainly P40 (first cortical SEP) over time. The statistical analysis of data based on the principle of repeated measurements of a test variance to 2 channels (two way ANOVA, Instat 3.05 and 3.03 Prism software).

Results



P40 IPHSILATERAL

TIME (min)	ECHO Mean ± SD	STIMULATION Mean ± SD	p-value (Single degree of freedom polynomial contrast)
-3	2.9 ± 0.5	2.7 ± 0.4	0.55
0	2.7 ± 0.4	2.8 ± 0.4	0.74
3	1.8 ± 0.3**	2.8 ± 0.4	0.000006
6	1.4 ± 0.3**	2.6 ± 0.3	0.000001
9	1.3 ± 0.2	2.3 ± 0.3*	0.000001
12	1.2 ± 0.2	2.3 ± 0.3	0.000001
15	0.9 ± 0.1**	2.3 ± 0.3	0.000001
18	0.4 ± 0.09**	2.2 ± 0.3	0.000001
21	0.3 ± 0.09	2.0 ± 0.4*	0.000001
24	0.2 ± 0.05	1.7 ± 0.3**	0.000001
27	0.02 ± 0.1	1.5 ± 0.3**	0.000001
30	0.01 ± 0.1	0.8 ± 0.1**	0.000001
33	0.02 ± 0.1	0.6 ± 0.2**	0.000001
36	0.01 ± 0.1	0.5 ± 0.2**	0.000001
39	0.01 ± 0.09	0.7 ± 0.09	0.003

Two-way analysis of variance for repeated measures: Between groups difference: $F=95.3$ $p<0.000001$
 Effect of time: $F=303.2$ $p<0.000001$
 Interaction: $F=66.9$ $p<0.000001$
 * = $p<0.05$ vs previous measure
 ** = $p<0.01$ vs previous measure

pEVAS IPHSILATERAL

TIME (min)	ECHO Mean ± SD	STIMULATION Mean ± SD	p-value
-3	0.00 ± 0.00	0.00 ± 0.00	N/S
0	0.11 ± 0.25*	0.41 ± 0.13**	N/S
3	0.00 ± 0.19**	0.94 ± 0.12**	N/S
6	1.20 ± 0.15**	1.21 ± 0.13**	N/S
9	1.43 ± 0.12	1.33 ± 0.16	N/S
12	1.74 ± 0.19	1.30 ± 0.16	<0.05
15	2.18 ± 0.40**	1.21 ± 0.09	<0.01
18	3.23 ± 0.46**	1.88 ± 0.07	<0.01
21	5.55 ± 0.33**	1.66 ± 0.15	<0.01
24	6.67 ± 0.30**	1.69 ± 0.13	<0.01
27	7.11 ± 0.30**	1.01 ± 0.14*	<0.01
30	6.14 ± 0.23**	3.04 ± 0.007**	<0.01
33	6.94 ± 0.25**	2.82 ± 0.61**	<0.01
36	6.30 ± 0.28**	7.63 ± 0.49**	<0.01
39	5.23 ± 0.31	5.26 ± 0.22**	<0.01

Two-way analysis of variance for repeated measures: Between groups difference: $F=1260.9$ $p<0.0001$
 Effect of time: $F=2434.4$ $p<0.0001$
 Interaction: $F=317.7$ $p<0.0001$
 * = $p<0.05$ vs previous measure
 ** = $p<0.01$ vs previous measure

P40 CONTRALATERAL

TIME (min)	ECHO Mean ± SD	STIMULATION Mean ± SD	p-value
-3	2.9 ± 0.4	2.6 ± 0.1	
0	2.7 ± 0.4	2.8 ± 0.4	
3	2.7 ± 0.4	2.8 ± 0.3	
6	2.7 ± 0.4	2.8 ± 0.3	
9	2.7 ± 0.4	2.8 ± 0.3	
12	2.7 ± 0.4	2.8 ± 0.3	
15	2.6 ± 0.4	2.8 ± 0.3	
18	2.6 ± 0.4	2.8 ± 0.3	
21	2.6 ± 0.4	2.8 ± 0.3	
24	2.6 ± 0.3	2.8 ± 0.2	
27	2.6 ± 0.3	2.7 ± 0.2	
30	2.6 ± 0.3	2.7 ± 0.2	
33	2.5 ± 0.3	2.6 ± 0.3	
36	2.5 ± 0.2	2.6 ± 0.2	
39	2.4 ± 0.2	2.5 ± 0.2	

Two-way analysis of variance for repeated measures: Between groups difference: $F=0.16$ $p=0.5$
 Effect of time: $F=9.5$ $p<0.000001$

pEVAS CONTRALATERAL

TIME (min)	ECHO Mean ± SD	STIMULATION Mean ± SD	p-value
-3	0.00 ± 0.00	0.00 ± 0.00	N/S
0	0.60 ± 0.23**	0.84 ± 0.18**	N/S
3	1.13 ± 0.26**	0.99 ± 0.27**	N/S
6	1.56 ± 0.23	1.41 ± 0.14*	N/S
9	1.81 ± 0.15	1.43 ± 0.13	N/S
12	1.97 ± 0.40	1.28 ± 0.15	N/S
15	2.34 ± 0.30**	1.31 ± 0.07	<0.01
18	3.76 ± 0.43**	1.69 ± 0.12	<0.01
21	5.64 ± 0.33**	1.74 ± 0.16	<0.01
24	7.04 ± 0.37**	1.78 ± 0.17	<0.01
27	8.10 ± 0.40**	2.02 ± 0.01**	<0.01
30	8.41 ± 0.43*	3.47 ± 0.40**	<0.01
33	9.70 ± 0.27**	2.26 ± 0.75**	<0.01
36	9.43 ± 0.30*	7.42 ± 0.73**	<0.01
39	9.73 ± 0.36*	8.64 ± 0.61**	<0.01

Two-way analysis of variance for repeated measures: Between groups difference: $F=1450.1$ $p<0.0001$
 Effect of time: $F=1847.1$ $p<0.0001$
 Interaction: $F=167.9$ $p<0.0001$
 * = $p<0.05$ vs previous measure
 ** = $p<0.01$ vs previous measure

No significant statistical induced modifications of the latencies were noted, as previously described (Benzon, *et al.*, ANESTH ANALG., **65**, 843-848, 1986). The first graph depicts the evolution of averaged values of the amplitude of the P40, the fEVAS, and the pEVAS over the 40 minutes after the local anesthetic injection in each group. In Stim group, the threshold of 20% of decrease of the P40 amplitude is encountered at $20.7 \pm 1, 4$ min, whereas in the Echo group it is achieved at $2.9 \pm 1 9$ min. The profiles of the respective curves of the clinical assessments (fEVAS and pEVAS) are substantially similar (without significant difference). Consequently, based on clinical arguments, the sensory block is efficient (> 80% of the adapted visual analogical scales) at 38.6 ± 1.8 min and 28.8 ± 1.9 min in the Stim and Echo groups, respectively. Despite this significant difference, this reflects that the threshold of an effective sensory block (efficient and compatible with the completion of surgery), was achieved in all patients but with different kinetics. The second graph, depicts the highly significant difference, at each moment of the investigation between the respective values of the P40 amplitude and the fEVAS and pEVAS either for Echo or Stim group. The baseline is similar in each group for the three measurements. The changes of P40 are earlier than the clinical tests. This confirms previous results about distinct nervous structures as brachial plexus (PANDIN, *et al.*, 2006), about early electrophysiological induced changes and more delayed clinical modifications.

Discussion

This study has to be considered as a first and even a preliminary step in the understanding of the possible

influence or lack of influence when the ultrasounds are used to guide a sciatic nerve performance in comparison to the actual gold standard method ; the nerve stimulation. Because, they are an objective measurement, the SEP can be interesting and why not attractive to qualify and even to quantify the early electrophysiological changes induced by the local anesthetics at the neural level, when these changes are always infraclinical. The results show clearly that when we use the neurostimulation, the onset of the block is later than we use only the ultrasound. The ultrasounds not modifying the local biochemical and electrolytical balance of the tissues of the patient, probably help the local anesthetics molecules to directly block the sodium and potassium channel receptors. On the contrary, the nerve stimulation could bother the occurrence of the conduction block because instilling locally a variable amount of electrical charges it causes a sort of “electro-biochemical” interference. This could delay the anesthetic block occurrence just because the channel receptors conformation is slightly reversibly modified. In conclusion, it is too early to definitively argue that the ultrasounds have to drastically and definitively replace the nerve stimulation, but the presented results remain a questionable argument about the strength of the efficacy of this new method of nerve location : the ultrasounds.

References

1. Benzon *et al.*, ANESTH ANALG., **65**, 843-848, 1986.
2. Gray, ANESTHESIOLOGY, **104**, 368-73, 2006.
3. Marhofer *et al.*, ANESTHESIA, **59**, 642-6, 2004.

Effects of neostigmine and clonidine epidurally in patients with an episiotomy on postpartum pain : a randomized, double-blind, placebo-controlled trial. Joke CAENEN, Marina KUYPERS, Frederik De Buck, Eugène Vandermeersch, Marc Van De Velde. Department of Anaesthesiology, UZ Leuven, Belgium.

Introduction

Both neostigmine and clonidine have been shown to prolong and improve labour epidural analgesia (1, 2). The goal of the present trial was to evaluate whether the postpartum epidural injection of clonidine and neostigmine, in patients having received an episiotomy, would improve postpartum analgesia as compared to the epidural injection of placebo.

Methods

Following ethics committee approval and written patient informed consent, 35 patients with a functioning labour epidural catheter and who had undergone an episiotomy during delivery, were randomized to receive epidurally either 10 mL of saline (P-group) or 10 mL of the study solution (NC-group). The study solution consisted of 500 mcg neostigmine and 75 mcg clonidine. Placebo or the study solution were administered in a double blind design and 30 minutes after delivery of the foetus. Demographic data were recorded as well as visual analogue scores for pain (VAS) at 1, 2, 3, 6, 9, 12 and 24 hours following delivery. At the same time points maternal hemodynamics were recorded. Overall satisfaction with analgesia was assessed 24 hours after delivery. Data were analyzed using Chi square analysis and

repeated measures ANOVA with appropriate post hoc testing.

Results

No differences between the two groups were noted with respect to demographic data. Neostigmine and clonidine conferred no benefit in terms of quality of analgesia following episiotomy when compared with saline : VAS scores for pain were similar both at rest and following mobilisation (Table 1). Overall satisfaction was similar between the groups. Parenteral and oral consumption of analgesic drugs was similar between the two groups. Maternal blood pressure and heart rate were lower in the NC-group at 2 and 3 hours postpartum.

Discussion and conclusion

The epidural administration of neostigmine and clonidine in patients with an episiotomy did not result in better analgesia as compared to epidural saline. In the patients treated with neostigmine and clonidine, blood pressure and heart rate were reduced for several hours after delivery. Based on the results of the present trial we cannot recommend the epidural administration of neostigmine and clonidine to treat post-episiotomy pain.

Table 1

	VAS rest 0	VAS rest 1	VAS rest 2	VAS rest 3	VAS rest 6	VAS rest 9	VAS rest 12	VAS rest 24
NC (n = 18)	2 ± 7	2 ± 7	2 ± 7	4 ± 10	13 ± 21	12 ± 17	13 ± 15	16 ± 21
P (n = 17)	0 ± 0	6 ± 24	4 ± 13	2 ± 7	19 ± 31	22 ± 27	22 ± 29	16 ± 19
	VAS active 0	VAS active 1	VAS active 2	VAS active 3	VAS active 6	VAS active 9	VAS active 12	VAS active 24
NC (n = 18)	2 ± 7	3 ± 10	4 ± 11	6 ± 12	22 ± 31	24 ± 29	25 ± 28	30 ± 29
P (n = 17)	1 ± 5	7 ± 24	6 ± 19	8 ± 16	25 ± 31	24 ± 27	26 ± 30	38 ± 24

References

1. Van Dam, *et al.*, EUR. J. ANAESTHESIOL., **23**, S37, A711, 184, 2006.
2. Geelen, *et al.*, EUR. J. ANAESTHESIOL., **25**, S44, 159-160, 2008.
3. Roelants, *et al.*, ANESTHESIOLOGY, **102** (6), 1205-1210, 2005.

Unexpected Entropy Response to saline spraying during posterior fossa surgery : report of a few cases. M. CLANET¹, V. BONHOMME¹, J. D. BORN², P. Hans¹. University Department of Anaesthesia and ICM¹, Department of Neurosurgery², CHR de la Citadelle, Liege University Hospital, 4000 Liege, Belgium.

Background

The Spectral Entropy of the electroencephalogram (EEG) (M. Entropy™, Datex-Ohmeda™, Helsinki, Finland) proposed to monitor the depth of anaesthesia includes two components : the State Entropy (SE), computed from the EEG, and the Response Entropy (RE), computed from EEG and facial muscles activity (1). This study reports unexpected Entropy responses to haemostatic saline spraying at the end of posterior fossa surgery.

Methods

Haemodynamic and Entropy parameters of six consenting adults undergoing a scheduled functional surgery of the posterior fossa for trigeminal neuralgia or facial nerve hemispasm were recorded every 5 seconds throughout the procedure. Patients were anaesthetized with propofol and remifentanyl using target-controlled infusions and were given rocuronium for tracheal intubation.

Observations

Under stable anaesthetic infusion rates, a sustained increase in RE, SE, and RE-SE gradient was observed in four patients during haemostatic saline spraying at the end of the procedure, without any haemodynamic modification. In the responders, the response was attenuated after 0.1 mg kg⁻¹ rocuronium in one patient. In the two non responders, repetition of spraying or rocuronium administration did not change Entropy values.

Discussion

In non-paralyzed patients, a sustained increase in Spectral Entropy and in the RE-SE may be observed in response to haemostatic spraying during posterior fossa surgery. This increase is probably not related to a change in depth of anaesthesia. It is rather likely caused by an increase in EMG activity (2), resulting from either a direct mechanical stimulation of the facial nerve or a trigemino-facial reflex, as far as it can be attenuated by a small dose of rocuronium. Haemostatic spraying may therefore confound interpretation of entropy monitoring in functional posterior fossa surgery. Further studies are needed to explore the exact mechanism involved.

References

1. Bein, BEST PRACT. RES. CLIN. ANAESTH., **20**, 101-9, 2006.
2. Bonhomme, BR. J. ANAESTH., **99**, 456-60, 2007.

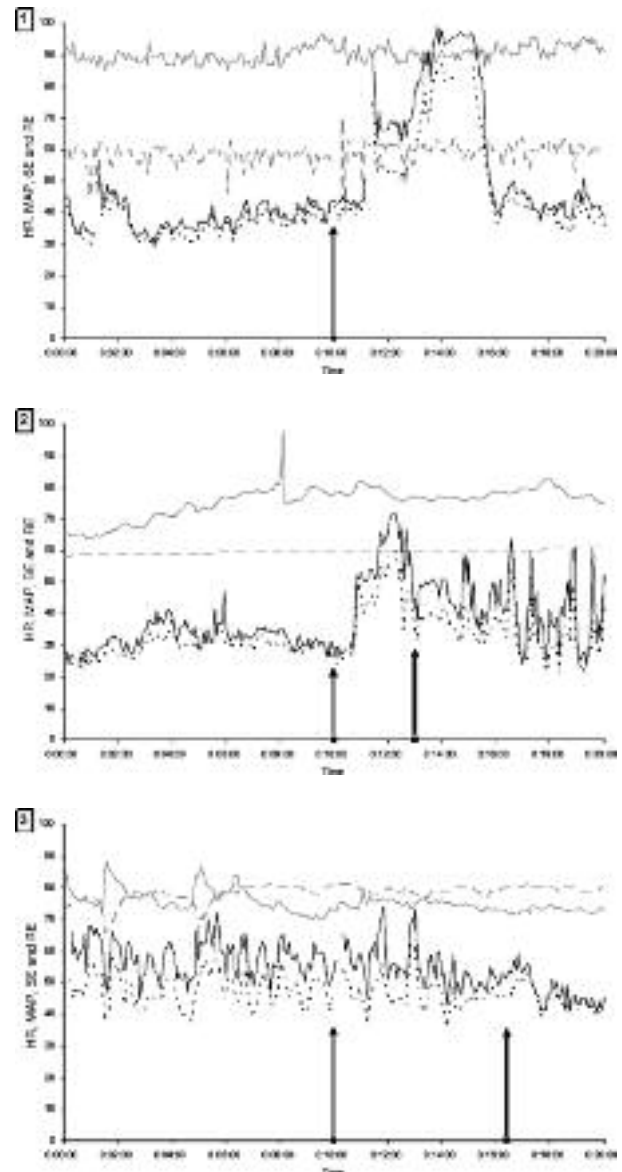


Fig. 1. — Heart rate (dashed grey), mean arterial pressure (plain grey), RE (plain black), and SE (dashed black) observed in 3 patients at the time of haemostatic spraying. Arrows correspond to the beginning of sprayings. 1 : Sustained RE-SE response to spraying. 2 : Attenuation of response after muscle relaxation. 3 : Non-responding patient. Muscle relaxation occurred between the 2 arrows in patient 2 and 3.

Comparison of the delivery rate accuracy and reliability of portable infusion pumps. P. DEBAENST, E. VANDERMEERSCH, VAN DE VELDE, J. DE COSTER. UZ Leuven, dienst anesthesiologie-reanimatie.

Introduction

Portable infusion pumps with pre-fixed flow rates have been used with increased frequency to provide perineural infusion, long-term antibiotic therapy, chemotherapy, antiviral therapy and chronic pain therapy (1).

Therefore, we thought it is important to evaluate the infusion rate accuracy and performance of various portable infusion devices (2).

Methods

Four brands of infusion devices (four samples each) were tested using a computer/mass balance combination to record infusion rates : Baxter Infusor 200, Baxter Folf, Leventon Dosi-Fuser, Coopdech Balloonjector 200.

The used pre-fixed flow rate was 5 ml/hr, which was measured during 36 hours.

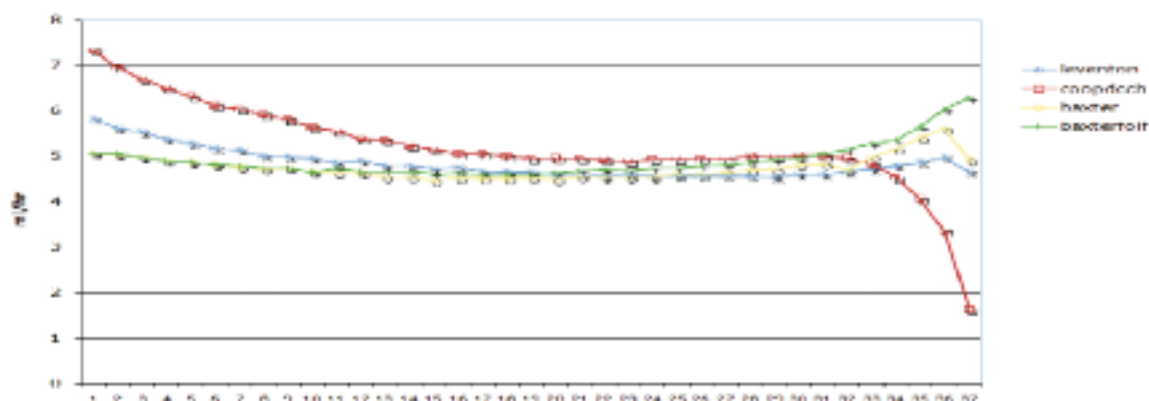
All external factors influencing the flow rate were controlled and monitored : temperature of the regulator (skin temperature : 32 degrees C), height of the reservoir

(5 cm under measuring point) and the volume/nature of the fluid (200 ml of saline). Scheffe's post hoc test was used for the statistical measurements.

Results

Infusion rate accuracy differed significantly among the elastomeric pumps. Statistics exhibit flow rates within 15% of their expected rate for 70% to 100% of their infusion duration. However the first 8-9 hours show distinctive accuracy differences between the infusion devices, after which a steady state is reached - without any major deviations from the fixed flow rate for all infusion pumps.

Both Baxter infusion pumps as well as the Leventon elastomeric devices, have the most accurate flow rate and the smallest variation. The Coopdech infusion pumps deviated considerably from the claimed flow rate of 5 mL/hr, both at the beginning and at the end of the infusion - with as much as 47%.



Discussion

These results suggest that the flow-rate accuracy and stability should be taken into consideration when choosing a portable infusion pump for local anesthetic or chemotherapy administration. Some of the elastomeric pumps are imprecise with drug delivery and are therefore less well suited for epidural infusions or chemotherapy. Although most of the devices have little variation from the claimed infusion rate we believe that the reliability of some devices for peripheral nerve blocks should be further evaluated.

Some infusion devices show distinctive differences with the claimed properties. However, further product improvement and development resulting in an acceptable infusion rate for the greatest percentage of the infusion period could make elastomeric devices suitable for most purposes.

Conclusion

Some elastomeric devices are less well suited for epidural infusions or chemotherapy due to distinctive infusion rate deviation from the claimed fixed flow rate.

References

1. Skryabina E. A., Dunn T. S., *Disposable infusion pumps*, AM. J. HEALTH-SYST. PHARM., **63** (13), 1260-1268, 2006.
2. Thiveaud D., Demazières V., Lafont J., *Comparison of the performance of four elastomeric devices*, EJHP, **2**, 54-56, 2005.
3. Ilfeld B. M., Morey T. E., Enneking F. K., *Delivery rate accuracy of portable, bolus-capable infusion pumps used for patient-controlled continuous regional analgesia*, REG. ANESTH. PAIN MED., **28** (1), 17-23, 2003.

Lowest O₂ fresh gas flow to maintain a constant end-expired sevoflurane % with constant vaporizer setting during colonoscopy. Part I: model derivation. Steven DEWAELE^{1,2}, J. F. A. HENDRICKX¹, M. VERCAUTEREN², T. DE LOOF¹, G. VANDENBROUCKE¹, L. FOUBERT¹, D. VANDEPUT¹, J. VANDERVOORT³, P. VAN DER SPEK³, L. LEPOUTRE³, A. M. DE WOLF⁴. Depts. Anesthesiology (1) OLV Hospital, Aalst ; (2) U.Z.A., Antwerpen ; (4) NWU, Chicago, IL, USA ; and (3) Dept. Gastroenterology, OLV Hospital, Aalst.

Introduction

The number of vaporizer setting (F_D , %) and fresh gas flow (FGF) combinations to maintain a desired end-expired concentration of (F_A) an inhaled anesthetic is infinite (= concept of the general anesthetic equation (1)). We sought to empirically derive the F_D -O₂ FGF sequence that at all times uses the lowest FGF to maintain F_A sevoflurane at 1.3% with a constant F_D . A better understanding of this sequence could help to develop clinically easy to apply administration schedules that lower agent consumption. In this first part, we describe how the model for the F_D -FGF sequence was derived.

Materials and methods

After IRB approval and patient consent, 37 ASA PS I or II patients undergoing colonoscopy were enrolled. After IV administration of propofol (3 mg/kg) and placement of a laryngeal mask airway (LMA), ventilation was initially mechanically controlled by an ADU anesthesia machine (Anesthesia Delivery Unit, GE, Helsinki, Finland). The gas sampled by the gas analyzer (± 200 mL.min⁻¹) was redirected to the anesthesia circuit. Sevoflurane F_D was set at 3, 3.5, 4, 4.5, 5, 5.5, 6.5, or 7% in 3, 5, 17, 4, 4, 1, 1, or 2 patients, respectively. The initial O₂ FGF was left at the discretion of the anesthesiologist, but had to be at least 4 L.min⁻¹ to ensure rapid wash-in ; after wash-in, the anesthesiologist had to find the lowest FGF that maintained F_A sevoflurane at 1.3% with the previously defined constant F_D . If clinically obvious leaks around the LMA were present, the patient was excluded. Data collection lasted for the duration of the procedure, up to 15 min.

The F_D -FGF data were entered in an Excel spreadsheet. An empirical, mathematical model was built guided

by a MOF (minimum objective function - sum of least squares weighted by predicted FGF) ; Excel's solver function was used to decide whether or not the addition or omission of a parameter improved the MOF. Because visual inspection indicated the FGF decreased exponentially, 1-, 2-, and 3-exponential decay curves were used in the nominator of the model. Because the FGF is expected to be lower with a higher F_D , polynomials (function of F_D) were used in the denominator of the model. The effect of covariates (age, height, and weight, presented as mean (standard deviation) was also examined, guided by improvement of the MOF.

Results

The patient's age, height, and weight were 64.5(14) years, 168 (76) cm, and 73 (14) kg. The following formula best described the FGF required to maintain F_A at 1.3% :

$$\text{FGF (L.min}^{-1}\text{)} = [\text{Height} \times 0.01 \times (100^{-e^{\text{Time}/1.67}} + 10^{-e^{\text{Time}/2.00}} + 8.60^{-e^{\text{Time}/2148.67}})] / (0.12 \times \text{Age} + F_D^{1.38} + 1.45 \times F_D^2).$$

Weight could not be withheld as a covariate.

Discussion

We derived an empirical mathematical formula that at anytime describes the lowest O₂ FGF that can be used to maintain sevoflurane F_A at 1.3% during colonoscopy. The F_D -FGF sequence will be tested prospectively. The use of this formula may be restricted to the particular anesthesia machine used in this study.

Reference

1. Lowe H., Ernst E., The quantitative practice of anesthesia : Use of closed circuit. Baltimore : Williams and Wilkins, 1981.

Lowest O₂ fresh gas flow to maintain a constant end-expired sevoflurane % with constant vaporizer setting during colonoscopy. Part II : prospective testing. Steven DEWAELE^{1,2}, J. F. A. HENDRICKX¹, M. VERCAUTEREN², T. DE LOOF¹, G. VANDENBROUCKE¹, L. FOUBERT¹, D. VANDEPUT¹, J. VANDERVOORT³, P. VAN DER SPEK³, L. LEPOUTRE³, A. M. DE WOLF⁴. Depts. Anesthesiology (1) OLV Hospital, Aalst ; (2) U.Z.A., Antwerpen ; (4) NWU, Chicago, IL,USA ; and (3) Dept. Gastroenterology, OLV Hospital, Aalst.

Introduction

A clinically easy to apply vaporizer-fresh gas flow (F_D-FGF) sequence may encourage the use of lower FGF, especially early on during the anesthetic (1). A previously derived formula that describes the lowest O₂ FGF that can be used to maintain the sevoflurane end-expired % (F_A) at 1.3% at anytime during colonoscopy is now tested prospectively.

Materials and methods

After IRB approval and patient consent, 53 patients presenting for colonoscopy were enrolled. After IV administration of propofol (3 mg/kg) and placement of a laryngeal mask airway (LMA), ventilation was mechanically controlled by an ADU anesthesia machine (Anesthesia Delivery Unit, GE, Helsinki, Finland). If obvious leaks were present, the patient was excluded. Gases sampled by the gas analyzer (± 200 mL.min⁻¹) were redirected to the anesthesia circuit. Sevoflurane F_D was set at 3, 4, 5, 6, 7, or 8% in 8, 10, 9, 10, 9, and 7 patients respectively, and the O₂ FGF was adjusted

according to the following formula : $FGF (L.min^{-1}) = [height \times 0.01 \times (100 \cdot e^{-t/1.67} + 10 \cdot e^{-t/2.00} + 8.60 \cdot e^{-t/2148.67})] / (0.12 \times age + F_D^{1.38} + 1.45 \times F_D^2)$, with age (years) and height (cm) as covariates. F_A was recorded every minute for the duration of the procedure (maximum of 15 min). The performance of the model was analyzed using Varvel's criteria (presented as (average, P25, P75)) using the F_A target of 1.3% (2).

Results

Age, height, and weight (mean (SD)) were 62 (15) years, 167 (11) cm, and 72 (16) kg. Because the vaporizer ceases to administer agent at FGF below 0.2 L.min⁻¹, the model could not be further tested in the 8% group when the predicted FGF became lower than 0.2 L.min⁻¹ (after 6 - 11 min). Fig. 1 presents sevoflurane F_A (median, 25th and 75th percentile), fig. 2 performance error (median, 25th and 75th percentile). Average median performance error (PE) was 15 (0, 30) %, average median absolute PE 19 (8, 31) %, divergence -164 (-308, -111) %/h, and wobble 12 (8,15) %. The current model overestimates initial FGF settings.

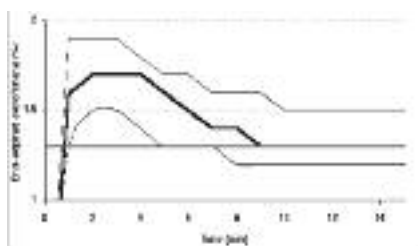


Fig. 1. — Sevoflurane F_A (% , median with 25th and 75th percentiles ; red line = target).

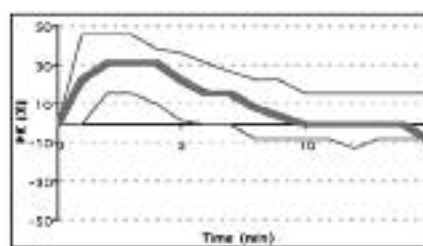


Fig. 2. — Performance error (% , median with 25th and 75th percentiles).

Discussion

Our model overestimates initial FGF settings, but overall remains within the limits deemed acceptable for target controlled infusion systems (MDPE < 10-20% and MDAPE 20-40% (3)). The overshoot may be attenuated in a future model after better characterization of initial circuit wash-in. Further fine-tuning of these non-compartmental empirical mathematical models may help

develop F_D-FGF combinations that minimize waste of inhaled agents.

References

1. BR. J. ANAESTH., **88**, 175-83, 2002.
2. J. PHARMACOKINET. BIOPHARM., **20**, 63-94, 1992.
3. ANAESTHESIA, **53**, 61-7, 1998.

Surgical Day Care Centre : A quality evaluation of the perioperative aspects. S. DOOM, A. TEUNKENS, E. VANDERMEERSCH. Department of Anesthesiology, UZ Leuven, Belgium.

Introduction

Since major mortality and morbidity in ambulatory surgery are low, the patient’s quality of life should be considered one of the principal end-points (1,3). In this study we evaluated postoperative pain, nausea and vomiting (PONV) in the recovery and at home, and also their management ; patient satisfaction with received information, the intake, the contact with nurses/doctors, and the discharge ; and other factors like unanticipated hospital admission.

Methods

The study was performed on 642 ambulatory patients operated on in our Surgical Day Care Centre. We interviewed the patients (or the parent when the patient is younger than 12y) based on a questionnaire of 79 questions. The data were collected by a telephone interview on day 2 postoperative. A numerical rating scale (NRS) 1 to 10 was used to evaluate postoperative pain. Main surgical specialties involved were Abdominal Surgery (laparoscopic N = 139, other N = 44), Gynaecology (laparoscopic N = 48, other N = 22), Orthopaedics (knee arthroscopy N = 154, other N = 31) and Dental Surgery (tooth extractions N = 88, other N = 18). There was no standardization of the anesthesia. Statistical analysis was based on the Chi Square test and t-test.

Table 1

	PO pain : N	Average NRS
Total population (N = 642)	271 (42.21%)	4.82
Laparoscopies (N = 187) vs others (N = 455)	95 (50.8%) vs 176 (38.68%) *	5.01 vs 4.72

* : P < 0.05 (= significant).

Discussion and conclusion

It is difficult to compare this evaluation of quality with other studies due to the diversity of questionnaires (2). The general patient satisfaction is high and seems not affected by factors like pain and PONV. The incidence and severity of pain after discharge until day 2 is quite high. Better informing of the patient about the pain management at home is needed, since less than 60% of the patients with pain took analgesics like prescribed. The incidence of PONV and rate of unexpected admissions in this study are acceptable. In the literature they vary resp. between 10-70% and 0.3-9.5% (1, 3). In our study, children had a much higher incidence of PONV than adults, possibly due to the difference in use of anti-emetic drugs at induction. There are a few questionable

Main results

About 42.2% of the patients (N = 271) complained of pain in the recovery room with an average NRS of 4.8. Of these 36.5% (99/271) had a NRS of 6 or more. Postoperatively, analgesia was given in 46.3% (N = 297). We see significant more pain following laparoscopies (table 1) (p = .028). The incidence of postoperative nausea was 12.6% and postoperative vomiting was 5.1%. We found significant more nausea (p = .003) and vomiting (p = .000) in children (table 2). However, we found that 72.4% of the children didn’t get any anti-emetic drug at induction in comparison with only 10.6% of the adults. At discharge, 8.9% (N = 56) felt not well enough to leave the hospital. The unanticipated hospital admission rate was 3.6% (N = 23) of which 16 laparoscopies. Most patients (N = 15) were admitted due to surgical causes, three due to pain or nausea. At home patients still complained of pain on day 0 in 47.2% (N = 303) with an average NRS of 4.7, on day 1 in 52.5% (N = 337) with an average NRS of 4.7 and on day 2 in 43% (N = 277) with an average NRS of 4.2. Those patients took analgesics as prescribed in 59.4% (day 0), 46.6% (day 1) and 41.2% (day 2). The general practitioner was contacted in 21% (N = 135), with the complaint of pain/nausea in 21 cases. 40.8% of the patients (N = 262) were able to resume their daily activity at home on day 1. The general satisfaction was 98.3%.

Table 2

	PO Nausea : N	PO Vomiting : N
Total population (N = 642)	81 (12.6%)	33 (5.1%)
Children (< 12 y ; N = 87) vs Adults (N = 555)	28 (32.18%) vs 53 (9.55%)*	18 (20.69%) vs 15 (2.7%)*

* : P < 0.05 (= significant).

issues in the study. The incidence of pain and PONV, and also the NRS are based on what the patient remembers in the telephone interview on day 2. Also the fact that parents speak for their children may lead to distorted results.

References

1. Shnaider I., Chung F., *Outcomes in day surgery*, CURR. OPIN. ANAESTHESIOL., **19**, 622-629, 2006.
2. Garratt A., et al., *Quality of life measurement : bibliographic study of patient assessed health outcome measures*, BMJ, **324**, 1417, 2002.
3. Troy A. M., Cunningham A. J., *Ambulatory surgery : an overview*, CURR. OPIN. ANAESTHESIOL., **15**, 647-657, 2002.

Epinephrine for in-hospital LUCAS-CPR : a predictor of outcome ? P. J. GERMONPRÉ, P. J. DURNEZ, R. WYNENDAELE, D. DE KEGEL, W. STOCKMAN. Heilig Hartziekenhuis Roeselare-Menen, Wilgenstraat 2, 8800 Roeselare, Belgium.

Introduction

The role of epinephrine in cardiac arrest remains controversial. We compare the doses of epinephrine administered in patients with good versus bad outcome after cardiopulmonary resuscitation with the Lund University Cardiopulmonary Assist System (LUCAS) device.

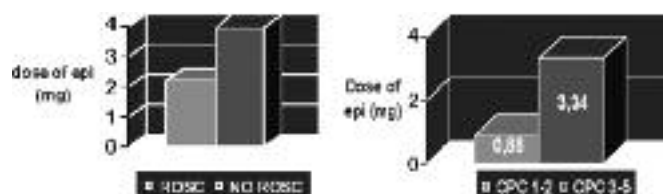
Methods

From February 2006 until June 2007, LUCAS-CPR was used for all cases of adult in-hospital arrest, after arrival of the in-hospital emergency team. Return of spontaneous circulation (ROSC), Cerebral Performance Categories (CPC) at 6 months and administered doses of epinephrine were recorded. CPC 1 or 2 at 6 months are considered good outcome. Epinephrine was administered per milligram to all patients during CPR every 3 to 5 minutes according to the guidelines 2005 and at the discretion of the attending physician. Results are presented

as means and inter quartile ranges (IQR). The Mann-Whitney test was used for statistical analysis.

Results

72 patients received in-hospital LUCAS-CPR. The mean age was 71.46 (SD +/- 11.9). In 2 patients (one with and one without ROSC), the dose of epinephrine remains unknown. The 45 patients with ROSC received 2.19 mg (IQR 0-3) of epinephrine. In the 25 patients with no ROSC, the dose was 3.96 mg (IQR 2-5) ($p = 0.01$). In the patients with CPC 1 (6 patients) and 2 (11 patients), the dose of epinephrine was 0.33 mg (IQR 0-0.75) and 1.18 mg (IQR 0.5-1.5). Only one of these patients, who was resuscitated for an extended period as a bridge to cardiopulmonary bypass, received more than 2 mg of epinephrine (4 mg). In the 55 patients with CPC 3, 4 or 5, the dose of epinephrine was 3.44 mg (IQR 1-5). The difference in epinephrine in patients with $CPC \leq 2$ versus ≥ 3 is highly significant at $p < 0.01$.



Conclusion

In our study the total dose of epinephrine administered during LUCAS-CPR is inversely related to outcome. Except for one patient, no good outcome was achieved in patients who needed more than 2 mg of epinephrine during in-hospital LUCAS-CPR. This result adds up to the mounting body of evidence for the detrimental features of epinephrine in the treatment for cardiac arrest.

References

1. A randomized clinical trial of calcium entry blocker administration to comatose survivors of cardiac arrest : Design, methods and patient characteristics. The Brain Resuscitation Clinical Trial II Study Group, CONTROL CLIN. TRIALS, **12** (4), 525-45, 1991 Aug.
2. European Resuscitation Council Guidelines for Resuscitation 2005, RESUSCITATION, **67S**, S47, 2005.
3. Vasopressors for cardiopulmonary resuscitation (CPR). Does pharmacological evidence support clinical practice ? Penson *et al.*, PHARMACOLOGY & THERAPEUTICS, **115**, 37-55, 2007.

Addition of ketamine to morphine Patient-Controlled Analgesia (PCA) in patients suffering severe postoperative pain: Effect of a preoperative opioids intake. P. GEUKENS, S. GENONCEAUX, M. N. FRANCE, P. LAVAND'HOMME. Anesthesiology Department, St Luc Hospital, Université Catholique de Louvain, Brussels.

Introduction

Efficient postoperative pain management can be difficult for some patients, specifically for those who are chronically taking opioids (1). Today, the benefit of a regular use of morphine-ketamine (K) combination in Patient-Controlled Analgesia (PCA) is still debated particularly because of the side effects of K (2). However, that combination might be helpful to control severe postoperative pain and opioids needs in patients who are under chronic opioid treatment. The study assessed the effect of adding K to morphine PCA in patients suffering severe postoperative pain, taking into account a preoperative intake of opioids (OP) or not.

Material and methods

All the patients presenting with severe postoperative pain (VAS score > 6/10 at rest and/or with movement) which was not relieved by PCA morphine and analgesic adjuvants like NSAIDs and paracetamol within the first 24h after surgery were included. In these patients, K was added to morphine (ratio morphine : K = 1 :2.5) in PCA

device, keeping the same setting (bolus 1mg morphine, interval 5 min, maximal dose allowed for morphine use = 30 mg/4h). Pain scores at rest and with movement (VAS score 0 – 10), morphine consumption, adverse effects (hallucinations, nightmares, nausea, sedation, pruritus, diplopia, respiratory depression) were recorded at 24h, 48h and 72h after addition of K. For data analysis, the patients were separated in two groups, according to a preoperative intake of opioid analgesics (group OP) or not (Controls, group C). Statistical analysis used ANOVA one way repeated measures and unpaired t-test. P value < 0.05 was significant.

Results

Age was 78 ± 22 and 72 ± 17 yrs, respectively in C and OP group. Sex ratio males/females (12/11 and 7/7) was similar between the two groups. In group C (n = 23), 43% of the patients presented with preoperative pain, average VAS score of 4.3 ± 0.9 ; in group OP (n = 14), 100% of the patients presented with preoperative pain, average VAS score of 6.8 ± 1.4 .

	groups	Before K	0-24 h postK	24-48 h postK	48-72 h postK
VAS score (0-10) at rest	C	6.1 ± 1.7	3.7 ± 1.9	2.7 ± 2.2	2.2 ± 2.3
	OP	6.4 ± 1.9	3.8 ± 2.0	3.3 ± 1.5	2.1 ± 2.2
VAS score (0-10) with movement	C	8.9 ± 1.0	6.3 ± 1.6	5.7 ± 1.9	4.3 ± 1.7
	OP	8.9 ± 1.0	6.5 ± 1.6	5.7 ± 2.2	5.7 ± 1.8
Morphine PCA use (mg/kg)	C	0.8 ± 0.4	$0.5 \pm 0.2^\dagger$	$0.3 \pm 0.2^\dagger$	$0.2 \pm 0.1^\dagger$
	OP	0.9 ± 0.4	$0.6 \pm 0.3^\dagger$	$0.4 \pm 0.3^\dagger$	$0.5 \pm 0.2^*$
Ketamine PCA use (mg/kg)	C	-----	1.3 ± 0.5	0.8 ± 0.6	0.5 ± 0.3
	OP	-----	$0.6 \pm 0.3^*$	1.0 ± 0.8	$1.2 \pm 0.6^*$
Ketamine adverse effects (%)	C	-----	36	28	30
	OP	-----	28.5	20	33

(*) P < 0.05 between controls (group C) et preoperative opioids intake (group OP).

(†) P < 0.05 between before K and postK data in the same group. Data are expressed as mean \pm SD.

Discussion

These preliminary data show that addition of Ketamine to morphine PCA has improved postoperative pain management, with similar VAS scores at rest and with movement, in both groups. Ketamine however afforded a greater and more constant (up to 72 h) morphine sparing effect in patients who were not taking opioids preoperatively. The incidence of adverse effects related to Ketamine did not differ between the groups of patients and was similar to previous published reports

(mostly nausea, sedation and hallucinations ; no respiratory depression was noted) (3).

References

1. Carroll, *et al.*, RAPM, **29**, 576-91, 2004.
2. Subramaniam, *et al.*, ANESTH. ANALG., **99**, 482-95, 2004.
3. Svetcic, *et al.*, ACTA ANAESTHESIOL. SCAND., **49**, 870-5, 2005.

Cerebral subarachnoid blood migration consecutive to a lumbar haematoma after spinal anaesthesia. J. GOUJON DUBOIS, G. A. HANS, M. SENARD, L. ROEDIGER, B. M. HUBERT, D. LEDOUX, M. L. LAMY. Department of Anaesthesia and Intensive Care Medicine, CHU de Liège, University of Liège, Belgium.

Introduction

Spinal haematomas are severe complications of neuraxial anaesthetic procedures more frequent in patients treated with anti-coagulant or anti-platelets agents (1). We describe the case of a patient who presented a spinal subarachnoid haematoma with likely progressive caudo-rostral blood migration which mimics delayed cerebral subarachnoid haemorrhage after a spinal anaesthesia for vascular surgery.

Case report

A 73 years-old woman was scheduled for arterial femoro popliteal bypass or balloon angioplasty. Her medical history consisted in CABG, hypertension, COPD and type II diabetes mellitus. Ticlopidine and ASA were withdrawn respectively 10 and 3 days before surgery. Spinal anaesthesia was performed at the L3-L4 level. At the third attempt, hyperbaric bupivacaine and sufentanil were injected. Because of a successful balloon angioplasty, no systemic heparin was injected intra-operatively. The resolution of the motor block was complete within 4 hours. Two hundred and fifty milligrams IV lyfyn acetyl salicylate and 40 milligrams of SC enoxaparin were respectively given 6 and 10 hours after surgery. Next morning, the patient received po100 mg ASA and ticlopidine 250 mg. During the first night she complained of unusual low back pain with irradiation to the lower limbs. No sensitive or motor deficit and no sphincter dysfunction were observed. A lumbar spine MRI was performed the next morning. It permits the diagnosis of spinal subarachnoid haematoma from L1 to S1. Anti-platelet agents and anticoagulant were withdrawn and the patient was transferred to the ICU where platelets transfusion was performed. No neurological deficit of the lower limbs developed subsequently. The neurosurgeon remained conservative. Three days later, the patient complained of headache, vomited and became stuporous. Physical examination showed no focal neurological sign. A brain CT-scan revealed diffuse blood sedimentation into the posterior horns of the ventricular system. Angiographic sequences excluded the presence of vascular malformation. Stupor progressively resolved in two weeks. One month after spinal puncture the patient was

free of neurological symptoms and a control CT-scan of the brain was unremarkable.

Discussion

Possible complications of neuraxial anaesthetic procedures range from transient paraesthesia to exceptional and potentially devastating spinal haematoma. Their incidence is low and estimated to be around 1:3.600 epidural anaesthesia and 1:20000 spinal anaesthesia (2). Compared to epidural (75%), subarachnoid haematomas are fewer (15%) (3). Spinal anaesthesia can produce exceptionally cerebral complications such as acute subdural haematoma or vascular intracerebral rupture (4). They are both favoured by a cerebrospinal fluid (CSF) hypotension. Our report suggests causal relationship between a subarachnoid lumbar haematoma and delayed cerebral subarachnoid bleeding symptoms after spinal anaesthesia. Indeed, both the diffuse distribution of blood into the cerebral subarachnoid spaces and the normal aspect of angiographic sequences reasonably excluded the delayed rupture of a vascular malformation. We therefore hypothesized that the blood migrated rostrally from the lumbar toward the cerebral subarachnoid spaces. At the arachnoid villi level, blood increases the resistance to CSF resorption. The resultant change in CSF hydrodynamics can induce a transient bloody CSF reflux into the ventricles. The use of ASA and enoxaparin required after vascular surgery can have facilitated the occurrence of the patent spinal haematoma. The apparition of an unusual back pain should prompt the realization of a lumbar MRI to exclude the diagnosis of spinal haematoma even in the absence of neurological deficit. Treatment can remain conservative in the absence of neurological sign. Closed clinical monitoring is required to diagnose subsequent spinal or cerebral complications.

References

1. Vandermeulen E., CURRENT OPINION IN ANAESTHESIOLOGY, **12**, 539-43, 1999.
2. Kreppel D., *et al.*, NEUROSURG. REV., **26**, 1-49, 2003.
3. Moen V., *et al.*, ANESTHESIOLOGY, **101**, 950-9, 2004.
4. Bjarnhall M., *et al.*, ACTA ANAESTHESIOL. SCAND., **40**, 1249-1251, 1996.

Perioperative blood glucose management in patients undergoing tumor hepatectomy.

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Background and goal of study

Hypoglycaemia can be expected in cases that require extensive liver resection. Recently, it was found that intraoperative hyperglycaemia during liver transplantation was associated with an increased risk of post-operative infection and mortality (1). The aim of this study was to investigate whether our institutional insulin management (modified Atlanta) protocol for cardiac surgery (2), a dynamic algorithm that adjusts insulin dosage to changing insulin needs, is efficient and safe in controlling blood glucose level (BGL) in the perioperative period in surgical patients undergoing tumor hepatectomy.

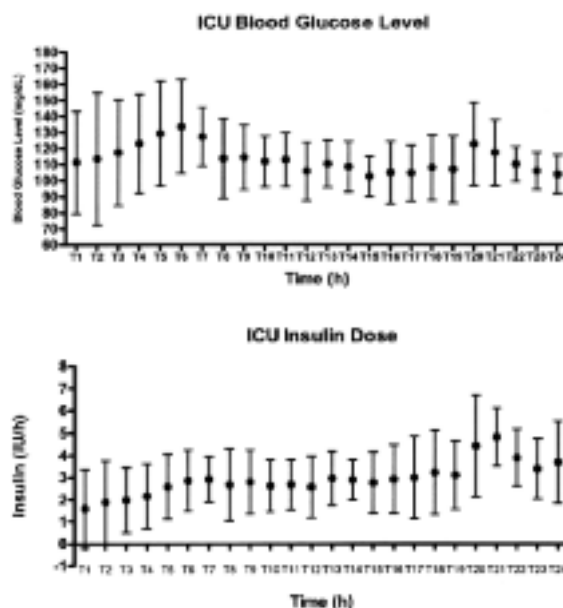
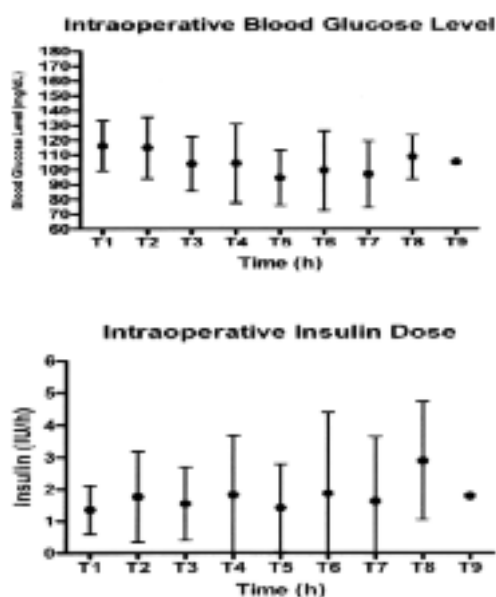
Materials and methods

Retrospective study of 20 consecutive patients undergoing liver resection for hepatocellular carcinoma, liver metastasis, or other hepatobiliary tumors. On admission to the operating theatre, all patients continuously received intravenous glucose (5% dextrose in

water, 1 mL/kg/h); insulin was administered according to a strict algorithm (2), and dose adjustments were based on measurements of whole-blood glucose intraoperatively at 1-hour intervals, as well as in the ICU. The lower and upper blood glucose limits were set at 85 and 110 mg/dL, respectively, in the operating theatre. In the ICU, the lower and upper limits were 90 and 140 mg/dL, respectively.

Results

Intraoperatively, 51.3% of measurements were within the target range; i.e., a BGL of 85-110 mg/dL. In the ICU, 75.2% of measurements showed a BGL of 90-140 mg/dL. There were 2/78 (2.6%) and 2/363 (0.5%) measurements with a BGL < 70 mg/dL in the operating theatre and in the ICU, respectively. The lowest BGLs were 65 mg/dL (operating room) and 66 mg/dL (ICU). Figure below shows blood glucose levels and insulin infusion rates in the operating room and the ICU, respectively. Symbols and bars are mean \pm SD.



Discussion and conclusion

The modified Atlanta protocol is efficient and safe in controlling BGLs in the perioperative period of hepatic tumor resection, and can be used by the routine staff in the operating theatre as well as in the ICU. Because of decreased insulin needs in the ICU, where surgical stress

is absent, the use of a more liberal algorithm successfully reduced the risk of hypoglycaemia.

References

1. Ammori J.B., *et al.*, J. SURG. RES., **140**, 227-33, 2007.
2. Lecomte P., *et al.*, ANESTH. ANALG., **107**, 51-8, 2008.

Monitoring enteral nutrition efficacy in ICU patients : is there a place for the Brix value derived fraction of enteral formula in gastric residual volume ? J. HELDERWEIRT, M.P. CASAER, D. LEROUGE, N. NIJS, G. VAN DEN BERGHE, I. VANHOREBEEK. Department of Intensive Care Medicine, University Hospital Gasthuisberg, Leuven, Belgium.

Introduction

Achieving nutritional targets by means of enteral nutrition in critically ill (ICU) patients has been shown to be difficult and unpredictable [1]. In this regard, the amount of enteral formula lost in gastric residual volume (GRV) remains unknown. In previous studies performed in a non-ICU population, bedside monitoring of the specific gravity (or relative density) of GRV with a refractometer (expressed as Brix value) has been shown to be an accurate, non-invasive tool to measure the concentration of enteral nutrition (%EF) in GRV (2, 3). The objective of this study was to evaluate the use of the Brix value in monitoring of %EF in GRV of patients in the ICU.

Methods

This prospective, observational trial was performed in a predominantly surgical ICU in a tertiary teaching hospital and was designed in 3 phases :

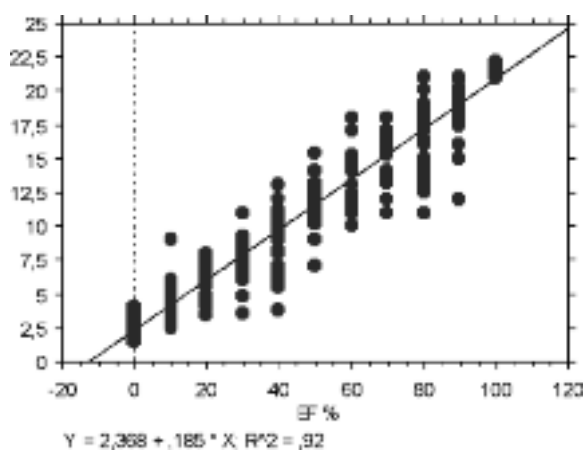
- In phase 1, the specific gravity, pH and clinical aspect of GRV in fasting ICU patients was examined.
- In phase 2, enteral nutrition was diluted in GRV *in vitro* to establish the relation between measured Brix value and %EF by linear regression analysis.
- In phase 3, this equation was used to determine nutri-

tional losses in GRV in ICU patients receiving enteral nutrition.

Normally and not-normally distributed data were reported as mean \pm SD and median (interquartile range) respectively.

Main results

- Phase 1 : The mean \pm SD Brix value for GRV of 51 fasting ICU patients was 2.9 ± 1.1 (ranging from 0.0 to 6.0). The inter- and intra-observer variability were 8.4 and 3.2%.
- Phase 2 : Five representative GRV samples were diluted using enteral nutrition *in vitro*. The relation between Brix value and %EF was significantly affected by gastric fluid pH before mixing with nutrition. Analyzing all measurements with simple linear regression revealed the following linear relation ($p < 0.0001$) : $\%EF = (\text{Brix value} - 2.368) / 0.185$, ($R^2 0,92$) (Fig. 1).
- Phase 3 : GRV of 193 patients was evaluated. 123 patients were excluded because of no GRV and 7 because of a post-bulbar feeding tube. In the remaining 63 patients, median GRV was 20 ml (IQR 10 – 93 ml). Median %EF, calculated using the Brix value, was 37% (IQR 17 to 51%).



Conclusions

The hand-held refractometer is a good tool for monitoring the overall nutritional efficacy in an enteral nutrition strategy measuring and discarding GRV. The linear relation between %EF in GRV and measured Brix value described in earlier non-ICU studies, was confirmed in ICU patients. However, the large baseline Brix variation in ICU patients and unpredictable impact of GRV pH makes the Brix value less suitable for the management of nutrition in individual patients.

References

1. De Jonghe B., *et al.*, A prospective survey of nutritional support practices in intensive care unit patients : what is prescribed ? What is delivered ?, *CRIT. CARE MED.*, **29**, 8-12, 2001.
2. Chang W. K., *et al.*, Validation the use of refractometer and mathematic equations to measure dietary formula contents for clinical application, *CLIN. NUTR.*, **24**, 760-767, 2005.
3. Chang W. K., *et al.*, Continuous nasogastric tube feeding : monitoring by combined use of refractometry and traditional gastric residual volumes, *CLIN. NUTR.*, **23**, 105-112, 2004.

The effect of adenosine continuous infusion on R3 nociceptive flexion reflex and temporal summation in healthy volunteers. E. MARIAULE, B. DACHY, A. MABROUK, Ph. VAN DER LINDEN. CHU Brugmann, place Van Gehuchten, 1020 Bruxelles.

Introduction

Adenosine is a purinergic derivative implied in a lot of biological process. Both in humans and animals, experimental studies show adenosine analgesic effects on acute and chronic pain. The R3 nociceptive reflex is a performant neurophysiological tool for the study of the analgesic effect. The temporal summation is a way to study the wind up phenomenon in humans. The wind up is an underlying phenomenon in hyperalgesia and allodynia.

In the attempt to better understand adenosine analgesic action in humans, we study the effect of a clinically effective dosis of adenosine at 50 mcg kg⁻¹ min⁻¹ on R3 nociceptive reflex and temporal summation.

Materials and method

After ethical approval, six ASA 1 volunteers having given informed consent have been included in this randomized, double-blind, cross-over study. The R3 reflex is recorded from biceps femoralis and elicited by an electrical stimulation of the sural nerve. First, we record the recruitment curve of the R3 nociceptive reflex between 0 and 30 mA to determine the threshold of the nociceptive reflex. A series of 15 high frequency stimulations (1 hertz) at the intensity of 120% of the threshold reflex is applied to study temporal summation. Pain is evaluated by visual analogical scale (V.A.S.) during the R3 reflex recruitment and temporal summation. Each volunteer is participating to 2 experimental sessions at 1 week interval. Each session is divided in 2 parts : during the first one, volunteers undergo control protocol ; during second one, they undergo placebo or adenosine protocol.

The drug's infusion is begun 20 minutes before the second part. Statistical analyses include one way ANOVA and Wilcoxon's rank tests. Data obtained during placebo or adenosine protocols are compared to those obtained during control on the same session.

Results

Placebo or adenosine did not modify the recruitment curve, the threshold and the pain evaluated with V.A.S. In contrast, the increase of response reflex during temporal summation is significantly decreased with adenosine infusion ($P < 0.01$) but not with placebo. Pain during temporal summation is not modified with adenosine or placebo. Pain score are respectively 65 ± 7 mm and 64 ± 8 mm. One patient exhibited transient flush during adenosine infusion.

Discussion

Adenosine infusion at 50 mcg kg⁻¹ min⁻¹ does not show any effect on acute pain evaluated by R3 reflex

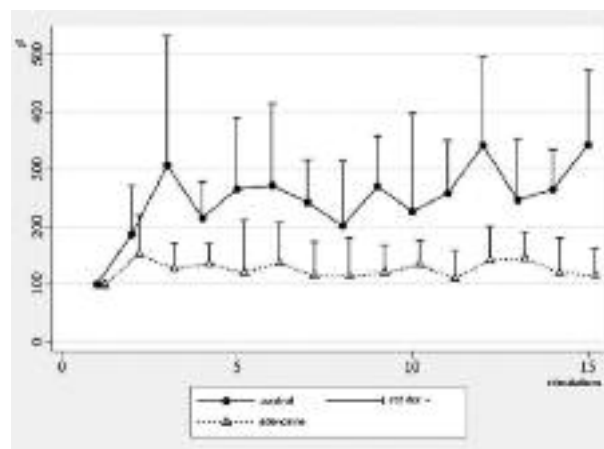


Fig. 1. — Cumulative results showing the effects of adenosine on the temporal summation of the R3 reflex. Each reflex response was expressed as a percentage of the first response in the series.

recruitment and V.A.S. These results can be due to the method or the used dose. During adenosine infusion, the R3 reflex temporal summation is remarkably decreased. Temporal summation plays a key role in hyperalgesia and central sensitization.

Conclusion

The adenosine infusion at 50 mcg kg⁻¹ min⁻¹ decreased the temporal summation of R3 nociceptive reflex. This result reinforces the interest of adenosine in prevention and treatment of chronic pain.

References

1. Chizh, *et al.*, *The effect of intravenous infusion of adenosine on electrically evoked hyperalgesia in a healthy volunteer model of central sensitization*, ANESTH. ANALG., **99**, 816-22, 2004.
2. Bossard A. E., Guirimand F., Fletcher D., Gaude-Joindreau V., Chauvin M., Bouhassira D., *Interaction of a combination of morphine and ketamine on the nociceptive flexion reflex in human volunteers*, PAIN, **98** (1-2), 47-57, 2002 Jul.
3. Lynch M. E., Clark A. J., Sawynok J., *Intravenous adenosine alleviates neuropathic pain: a double blind placebo controlled crossover trial using an enriched enrolment design*, PAIN, **103** (1-2), 111-7, 2003 May.

Patient-Controlled Intravenous Analgesia (PCIA) as an alternative to Epidural Analgesia during labor. Survey of the current use in the French part of Belgium (Wallonia and Brussels). T. POSPIECH, F. ROELANTS, P. LAVAND'HOMME. Anesthesiology Department, St Luc Hospital, Université Catholique de Louvain, Brussels.

Introduction

Epidural analgesia (EA) is the most effective way to relieve childbirth pain but it is contraindicated or impossible to perform for some parturients. In these patients, opioid PCIA represents an acceptable alternative (1). We designed a survey of the current use of PCIA as analgesic alternative to EA for labor pain in the French part of Belgium (Wallonia and Brussels).

Materials and methods

After approval of the board of the Belgian Society of Anesthesiologists, a questionnaire was mailed to the head anesthesiologists of the hospitals with an obstetric unit (University Hospitals (UH) and non-University Hospitals centers, N = 53). The questionnaire evaluated the availability of EA, the use of different analgesic alternatives to EA and specifically the use of PCIA with opioid preference, and finally the reasons for not using PCIA.

Results

The response rate was 67.5% (N = 36). Median EA rate for vaginal delivery was 68% (range 25-85%) in non-UH and 83.5% (range 75-92%) in UH centers. PCIA was available in 100% of the UH and in 36% of the non-UH, and for an additional 11% of them only in case of intrauterine death. In 28% of the centers however, no analgesic alternative was proposed (Fig. 1). For PCIA, remifentanyl was the first choice (76.5%), followed by sufentanil (23.5%), piritramide (18%), fentanyl (6%), ketamine (6%) and morphine (12%).

Reasons for not using PCIA were : lack of knowledge (7%), fear of side effects (48%) in both the mother and the fetus, inability to provide a correct supervision of the parturient (48%), opposition from the pediatricians or the obstetricians (17%), technique considered as ineffective (17%).

Discussion

The survey demonstrated that, when EA is contraindicated, 47% of non-UH centers propose opioid PCIA as an alternative to EA. PCIA use is close to that of a recent UK survey (57%) (2) and greater than recent-

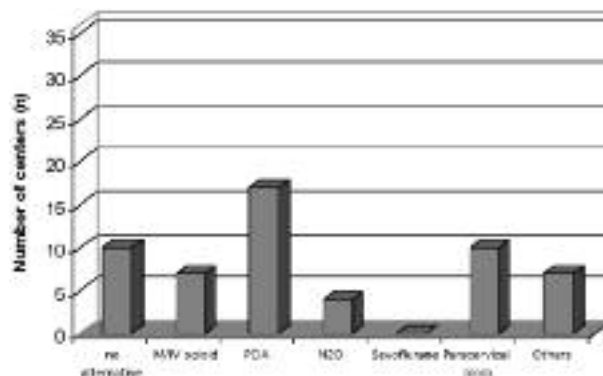


Fig. 1. — Analgesic alternatives to EA in both UH and non-UH centers (N = 36).

Others : non pharmacologic alternatives such as baths, massages, hypnosis, sophrology...

ly found in France (25%) (3). In agreement with the current literature, remifentanyl is the first choice among the opioids, particularly when a live birth is expected. Morphine PCIA is still used in case of intra uterine death (12% in our survey and 35.5% in UK survey (2)) despite a pharmacologic profile less adapted to labor pain. Although no clinical study has evaluated sufentanil in that indication, 23.5% of PCIAs were set to deliver sufentanil in the present survey and it was the preferred opioid (70% of PCIAs) in France (3).

References

1. Bruyere M., Mercier F. J., *Alternative techniques to labour epidural analgesia*, ANN. FR. ANESTH. REANIM., **24**, 1375-1382, 2005.
2. Saravanakumar K., Garstang J. S., Hasan K., *Intravenous patient-controlled analgesia for labour : a survey of UK practice*, INT. J. OBSTET. ANESTH., **16**, 221-225, 2007.
3. Bergeret S., Loffredo P., Bosson J. L., Palot M., Seebacher J., Benhamou D., Payen J. F., *Prospective national survey on alternatives to obstetrical peridural analgesia*, ANN. FR. ANESTH. REANIM., **19**, 530-539, 2000.

Effect of Clonidine on Propofol and Remifentanyl requirements using BIS score and the A-line ARX (AAI) index during laparoscopic gastric bypass in obese patients. S. ROSANT¹, G. NIKO¹, S. LAUWICK¹, A. KABA¹, A. DEROOVER², J. JORIS¹. Department of Anaesthesiology & ICM¹ and the Service of Digestive Surgery². CHU Liège, University of Liège, B-4000 Liège, Belgium.

Introduction

Intravenous clonidine reduces intraoperative requirements of anaesthetic agents. Mechanism(s) of this sparing effect remain controversial : control of haemodynamic response versus actual anaesthetic properties (1). To elucidate this controversy we investigated the sparing effect of clonidine on propofol and remifentanyl requirements using PRST (Pressure, Rate, Sweating, Tears), BIS scores and the A-line ARX index (AAI : an index of the depth of analgesia [2]) during laparoscopic gastric bypass in obese patients.

Materials and methods

After IEC approval, 34 morbidly obese patients scheduled for laparoscopic gastric bypass gave their consent to be included in this randomized double-blind study. Anaesthesia combined target-controlled infusions of propofol (Schnider's model) and remifentanyl (Minto's model). Before the induction of anaesthesia

patients were randomly allocated in two groups : Clonidine 4 µg/kg of IBW (Ideal Body Weight) in 10 min followed by 2 µg/kg/h during 1 h or the same volume of saline. Propofol was adjusted to keep BIS score around 50. Remifentanyl was titrated to maintain PRST score < 3 and AAI < 30. BIS scores, AAI, effect-site concentrations of propofol and remifentanyl were recorded using RUGLOOP software. PRST and BIS scores, AAI, effect-site concentrations of propofol and remifentanyl were measured (values = average of 5 min periods) at skin incision (T1), during jejuno-jejunal anastomosis (T2), gastric stapling (T3), and gastro-intestinal anastomosis (T4). Data (mean ± SD) were analyzed using ANOVA. P ≤ 0.05 = statistically significance.

Results

Demographic data, PRST scores, BIS values, AAI, and haemodynamics were similar in the two groups. Effect-site concentrations of propofol and remifentanyl were significantly less in the Clonidine group (Tables).

Table 1

Effect of Clonidine on effect-site concentrations of Propofol (µg/ml) (* = P < 0.05)

	Incision	Jejuno-jejunal anastom.	Gastric stapling	GI anastomosis
Clonidine	2.15 ± 0.47*	1.85 ± 0.52*	1.79 ± 0.43*	1.65 ± 0.56*
Saline	3.45 ± 0.55	2.85 ± 0.29	2.85 ± 0.37	2.62 ± 0.27

Table 2

Effect of Clonidine on effect-site concentrations of Remifentanyl (ng/ml) (* = P < 0.05)

	Incision	Jejuno-jejunal anastom.	Gastric stapling	GI anastomosis
Clonidine	3.11 ± 0.44*	1.79 ± 0.39*	1.68 ± 0.40*	1.43 ± 0.45*
Saline	3.74 ± 0.33	3.06 ± 0.25	2.76 ± 0.22	2.74 ± 0.28

Discussion

This study suggests that the sparing effect of Clonidine (6 µg/kg IBW in 1 h) on Propofol and Remifentanyl requirements are mediated by hypnotic and analgesic effects. These sparing effects are independent on haemodynamic effects of Clonidine.

References

- Wallace A., CURR. OPINION ANAESTHESIOL., **19**, 411-17, 2006.
- Bonhomme V., *et al.*, BJA, **96**, 353-60, 2006.

Increased analgesic requirements associated with induced labour are related to dystocia. C. SOUGNÉ¹, P. Y. DEWANDRE¹, P. HANS¹, V. BONHOMME¹, J. M. FOIDART², J. F. BRICHANT¹. University Dpts of Anaesthesia¹ & ICM and Obstetric & Gynaecology², Liege University Hospital, CHR de la Citadelle, 4000 Liege, Belgium.

Background

Induced labour would be more painful than spontaneous labour¹. In addition, elective induction of labour is associated with an increased risk of caesarean delivery for dystocia, especially in nulliparous women with an unfavourable cervix^{2,3}. Because, in early labour, parturients who will develop dystocia later experience more severe pain than those who will deliver vaginally⁴, it could be that the increased analgesia requirement observed in prostaglandin induced labour is related to subsequent dystocia and not to labour induction itself.

Methods

Following the Ethics Committee approval, 154 consenting nulliparous parturients at more than 37 weeks normal gestation and requesting labour epidural analgesia were included in this prospective double blind sequential allocation study.

They were allocated to one of four study groups : vaginal delivery after spontaneous labour (VS), vaginal delivery after induced labour (VI), caesarean section for dystocia after spontaneous labour (CS) and caesarean section for dystocia after induced labour (CI). The epidural technique was performed in a standard manner. A modified up down sequential allocation method for determining the median effective ropivacaine concentration was used⁵. The modification consisted in adding a criteria for rejection : a given patient that did not deliver by the assigned mode was "rejected" from the study. The median effective concentration with the 95% CI's was estimated using a probit analysis.

Results

Parturients characteristics were similar in the four groups. Among the 154 recruited parturients, 63 were excluded. Patients who delivered vaginally had 29-33% lower MLAC than those who needed a C-section after a spontaneous or induced labour, respectively (Fig. 1).

Discussion

Increased analgesia requirements associated with prostaglandin induced labour is related to an increased incidence of dystocia and not to the induction of labour itself.

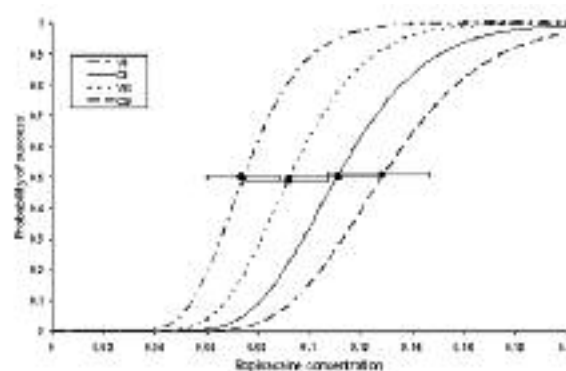


Fig. 1. — Probit regression : probability of success as a function of ropivacaine concentration in each group of parturients. VI = vaginal delivery, induced labour, CI = C-section delivery, induced labour, VS = vaginal delivery, spontaneous labour, CS = C-section delivery, spontaneous labour. Black dots correspond to MLAC of ropivacaine in each case, bars represent the 95% CI's. A shift of the curve to the right denotes a higher MLAC.

References

1. Capogna G., ANESTHESIOLOGY, **94**, 740-4, 2001.
2. Wuitchik M., OBSTET. GYNECOL., **73**, 35-42, 1989.
3. Alexander J. M., ANESTH. ANALG., **92**, 1524-8, 2001.
4. Panni M. K., ANESTHESIOLOGY, **98**, 957-63, 2003.
5. Dixon W. J., In : *Statistical Analysis*. NY-Mc Graw-Hill, pp. 428-39, 1983.

Ketamine intravenous in the treatment of neuropathic pain : an observational study. Dr. STUER, Dr. KUMAR, Dr. MORLION, Dr. VANDERMEERSCH, UZ Leuven.

Introduction

Neuropathic pain represents an enormous burden for patients and a challenge for the medical community because of its severity, chronicity and resistance to simple analgesics.

Ketamine, a non-competitive antagonist of N-methyl-D-Aspartaat (NMDA) receptors has been used in the treatment of chronic neuropathic pain for almost 15 years.

Its continu use in pain management can be accompanied with some side and adverse effects mainly sedation, drowsiness, dizziness and dry mouth. (1)

Objective

To review and assess the effectiveness of the unit's intravenous low-dose ketamine scheme in reducing pain intensity and interference with quality of life among patients with neuropathic pain one week and one month after treatment. Prospective descriptive study.

Methods

Twenty patients, diagnosed with neuropathic pain of mixed aetiologies were reviewed. Four patients were excluded because they did not attend follow-up out patients appointments. Requested inclusions criteria were a diagnoses of neuropathic pain, a score of 4 or more on the neuropathic pain scale DN-4 and resistance to multi pharmacological therapies.

Pain intensity was assessed by means of the Visual Analogue Scale (VAS) and quality of life using the Pain Disability Index (PDI). All patients were assessed at baseline and one month after treatment. VAS en PGIC (Patient Global Impression of Change) was obtained one week post-treatment via telephone contact.

Patients were fully monitored with ECG, SpO2 and non-invasive blood pressure cuffs.

The IV (intravenous) ketamine infusion was started at 0.1 mg/kg/h during 30 minutes followed by 0.2 mg/kg/h for the next 30 minutes, and finally 0.3 mg/kg/h for 3 hours. Rescue midazolam 1mg/ml was titrated in patients suffering from hallucinations.

Patients left the department 1 hour after terminating the infusion.

Statistical analysis was performed by Friedman test for comparison of the VAS scores and the Wilcoxon Signed Ranks Test for comparison of the PDI and PGIC scores.

Results

Four patients were excluded because they did not attend follow-up out patient appointments. There were no statistical significant changes in VAS, PGIC or PDI at 1 week of 1 month after treatment with IV ketamine.

One patient required midazolam 1 mg/ml with a dose of 0.3 mg/kg/h. No adverse haemodynamic effects were recorded.

	baseline	1 week after treatment	1 month after treatment
VAS	64.8(30,90)	60(20,90)	63,25(20,90)
PDI	41.9(6,65)	/	42.8(8,64)
PGIC	/	3.625(3,6)	3.875(2,5)

Data shown are mean scores and between brackets the lowest and the highest score.

Discussion

No statistical differences in the variables assessed were found after one week and one month. Added to this, there is no justification in blocking a bed for 4 hours as well as valuable professional time.

However sample size was small and a large difference in pain variation was observed. There is a need for studies with larger sample size for the examination on background pain after ketamine.

For non-specific neuropathic pain, the double-blind, placebo-controlled studies showed a significant reduction in hyperalgesia and allodynia although the effect on continuous background pain was less marked (2). Subanesthetic infusions of ketamine have been shown to offer extended pain relief in patients with Complex Regional Pain Syndrome and this group may be more suited to burst ketamine rather than general neuropathic complaints (3).

Conclusion

No prolonged pain relief after intravenous ketamine was observed during this study.

References

1. Cvrcek P., *Side effects of Ketamine*, PAIN MEDICINE, Volume 9 (2), pp 253-257, 2008.
2. Hocking G., *Ketamine in chronic pain management : an evidence-based review*, ANAESTHESIA AND ANALGESIA, Volume 97 (6), pp 1730-1739, December 2003.
3. Correll G. E., Maleki J., Gracely E. J., Muir J. J., Harbut R. E., *Subanesthetic Ketamine Infusion Therapy : A Retrospective Analysis of a Novel Therapeutic Approach to Complex Regional Pain Syndrome*, PAIN MEDICINE, 5 (3), 263-275, 2004.

Endothelial alpha-2 adrenoreceptors are necessary to induce clonidine-induced posthypoxic vasomotricity protection. Th. VAN ENGLAND¹, M GOURDIN², O PONCHAU¹, J JAMART³, M, DE KOCK¹.
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Background and goal of study

Clonidine (CL), an α_2 -adrenoreceptor agonist, reduces perioperative myocardial ischemia in-patients undergoing surgery¹. In previous studies, we have showed that CL improves post-hypoxic vasoconstriction and endothelium-dependent vasodilatation (PVD) in young rats. Our experimental study intends to understand the mechanisms underlying this phenomenon.

Materials and methods

After animal ethic committee approval, 120 rings aorta (4×30) from 30 rats were studied according to a validated methodology². For every aorta, CL (10-4M) was added in two randomized baths and two used as the control group (CTL). We have assessed the effect of CL on aorta without endothelium and on aorta having beforehand received Rauwolscine (RW), an α_2 -adrenoreceptor antagonist, 15 minutes before randomization. In another group, with intact endothelium, CL

was substituted by UK 14.304 (UK, 10-4M), a specific α_2 -adrenoreceptor agonist. After fifteen minutes, all baths were washed and 25 minutes of hypoxia (PpO₂ < 10 mmHg) was applied. After 40 minutes re-oxygenation (PpO₂ > 400 mmHg), post-hypoxic vasoconstriction was evaluated by cumulative phenylephrine concentrations (10-10-10-4M) and PVD by cumulative acetylcholine concentrations on pre-contracted aorta. The statistical analysis used GEE regression, $p < 0.05$ significant.

Results and discussions

In aorta without endothelium, no significant difference was found between CL and CTL groups. In intact aorta, RW abolished the difference between CL and CTL groups concerning PVD and post-hypoxic vasoconstriction. In UK group, post-hypoxic vasoconstriction was significantly different from the CTL ($p = 0,005$) but concerning PVD no difference was found.

Table 1

Post-hypoxic Vasomotricity						
	VasoDil Endo-Dpdt			VasoConstriction		
	Clo group	Ctrl group	p	Clo group	Ctrl group	p
Without endoth	111.59 + 27	112.37 + 24,24	0,687	111.59 ± 27%	112.37 ± 24.24%	0,687
Rw	-41.92 ± 8.47%	-41.72 ± 9.70%	0,803	73.84 ± 17.52%	70.26 ± 21.54%	0,917
UK	-33.41 ± 9.12%	33.37 ± 8.41%	0,954	73.73 ± 18.2%	67.06 ± 17.95%	0,005

Conclusion(s)

RW and endothelial removal abolish the CL effect on post-hypoxic vasomotricity. Specific α_2 -adrenoreceptor stimulation improves post-hypoxic vasoconstriction but no PVD. These results show the implication of endothelial α_2 -adrenoreceptors in clonidine-induced vascular protection against ischemia-reperfusion.

References

- Wallace A., CUR OPINION ANAESTH., **19** (4), 411-17, 2006.
- Besse S., EUR J PHARMACOL., **531** (1-3), 187-93, 2006.
- Molin J. C., VASCUL PHARMACOL., **20** (4), 339-49, 2004.

Statistical models to detect factors associated with second day discharge from the intensive care unit in patients undergoing non-emergency cardiac surgery. T. P. VU, L. VANFLETEREN, P. VAN DEN EYNDE, G. VAN DEN BERGHE, G. MEYFROIDT. Intensive Care Medicine, University Hospitals, Leuven, Belgium.

Introduction

Most predictive models in the intensive care unit (ICU) focus on mortality as outcome (1). Planned cardiac surgery patients have a very low mortality, but their ICU length of stay (LOS) might vary considerably (2). Logistic regression models have shown to be discriminative for prolonged LOS, although different papers mention different LOS thresholds (2, 3). In this study we attempted to develop statistical models that are discriminative for discharge the day after surgery, in patients after non-emergency cardiac surgery.

Methods

Between June 1st 2006 and May 31st 2007 electronic medical records were evaluated from all patients older than 17 years admitted to the ICU after non-emergency cardiac surgery. Data were collected from the Patient Data Management System (PDMS), Lab Information System (LIS) and the hospital's data warehouse. The outcome was a dichotomized parameter, defined as "Second Day Discharge" (SDD or not SDD).

As input parameters we used patient information available until the 2nd day at 12.00 AM, the time when the decision of SDD or not SDD was taken by the medical staff. The relationship between explanatory variables and outcome was assessed by univariate and multiple logistic regression analyses. A total of 48 variables were considered as discriminative candidates.

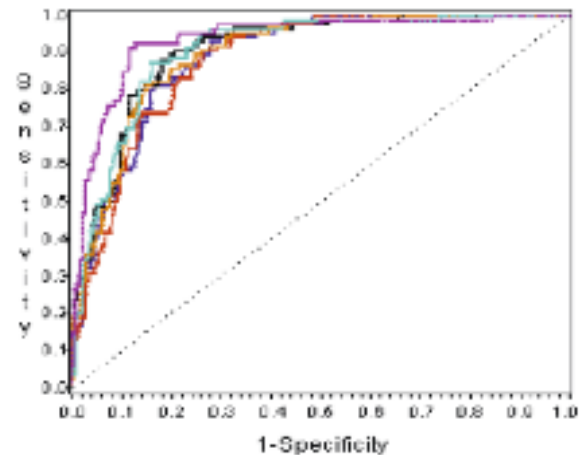
Before fitting the logistic regression model, we studied the influence of each parameter on the response (SDD or not) by assessing the significance in an univariate logit model. Variables associated with outcome with a P value < 0.05 in the univariate analyses were entered into separate multivariate logistic regression models to identify an optimal subset of independent factors. This was performed using a forward, backward, stepwise and Collett's logistic regression approach.

When all statistically non-significant variables had been eliminated from the model, the discriminative power of each statistical model was tested with the area under the receiver operating characteristic (ROC) curves. Model calibration (precision) was evaluated by the Hosmer-Lemeshow goodness-of-fit statistical method.

Results

A total of 453 patients were admitted within the described period. Most patients (149 or 32.89%) were discharged on the third day; 99 patients (21.85%) were discharged on the second day.

We developed 6 different models. The Hosmer-Lemeshow goodness-of-fit statistics showed good calibration for all models and the area under the ROC-curve was also indicative of good to excellent fit for each model.



- (1) Forward
- (2)(4) Forward/Stepwise (without Pain Score)
- (3) Stepwise
- (5) Collett's Approach
- (6) Backward
- (7) Combination Model

The 6 multivariate models identified the following determinants associated with SDD: Gender, Age, Weekday of discharge, Hemodynamic medication, the last minus first measurement of the systolic Arterial blood pressure, the last measurement of the Heart rate, the last and last minus first measurement for the verbal Glasgow coma scale, the average of Urine output and Mechanical ventilation.

Conclusion

In our retrospective study of 453 patients undergoing non-emergency cardiac surgery multivariate logistic regression models were developed to identify factors associated with Second Day Discharge. We derived 10 significant parameters, 2 preoperative and 8 post-operative variables.

There was no "best fitting model" since all models performed well in prediction of the outcome. Future studies are needed to validate the models in a prospective setting.

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References

1. Geissler H. J., *et al.*, EUR. J. CARDIOTHORAC SURG., **17**, 400-6, 2000.
2. Pitkänen O., *et al.*, EUR. J. CARDIOTHORAC. SURG., **18**, 703-10, 2000.
3. Tu J. V., *et al.*, CIRCULATION, **91**, 677-681, 1995.