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Reflex pupillary dilatation in response to skin incision and alfentanil in children anaesthetized with sevoflurane: a more sensitive measure of noxious stimulation than the commonly used variables.

Constant I, Nghe MC, Boudet L, Berniere J, Schrayer S, Seeman R, Murat I.

Abstract

BACKGROUND:
Estimation of analgesia in anaesthetized children is often imprecise, and consequently, anaesthesiologists commonly evaluate children's response to surgical stimulation by movement or haemodynamic changes. In adults reflex pupillary dilatation has been demonstrated to be a very sensitive measure of noxious stimulation, correlated with opioid concentrations. The autonomic nervous control changes with age, raising the hypothesis that mechanisms involved in pupillary autonomic functions regarding both sympathetic and parasympathetic components may also differ between adults and children. In this pilot study, we tested the hypothesis that the pupillary reflex dilatation might allow assessment of noxious stimulation and analgesic effect of alfentanil in children under sevoflurane anaesthesia, as an alternative to haemodynamic and bispectral measures.

METHODS:
After sevoflurane induction, 24 children were maintained in steady-state conditions at 1.5 MAC of sevoflurane in O(2)-N(2)O (50-50). An intense noxious stimulation was provided by standardized skin incision on the lower limb. A bolus of alfentanil (10 microg kg(-1)) was administered either 1 min (n=16) or 2 min (n=8) after skin incision. Haemodynamic values, bispectral index (BIS) and pupillary diameter (PD) were recorded just before stimulation and at 30-60 s intervals during 4 subsequent minutes.

RESULTS:
In all children PD increased significantly after noxious stimulation [+200 (40)%, at 60 s]. In contrast, mean heart rate and blood pressure increased only 11 (7)% and 10 (8)% respectively, 60 s after stimulation. BIS did not change significantly. In all children, alfentanil injection induced a rapid decrease of PD and restored pre-incision values in 2 min.

CONCLUSION:
PD is a more sensitive measure of noxious stimulation than the commonly used variables of heart rate, arterial blood pressure and BIS in children anaesthetized with sevoflurane.

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Prediction of movement to surgical stimulation by the pupillary dilatation reflex amplitude evoked by a standardized noxious test.

Guglielminotti J, Grillot N, Paule M, Mentré F, Servin F, Montravers P, Longrois D.

Abstract

BACKGROUND:
Individual assessment of the amplitude of a physiologic reflex evoked by a standardized noxious test (SNT) before surgical stimulation has been suggested to predict movement upon the forthcoming surgical stimulation. This study aimed to compare the ability of pupillary dilatation reflex amplitude (PDRA) evoked by an SNT and estimated remifentanil effect-site concentration (Ce) to predict movement upon surgical stimulation.

METHODS:
Eighty female patients were anesthetized for vacuum aspiration with propofol (Ce 4 μg/ml) and remifentanil. Remifentanil Ce was randomized to 0, 1, 3, or 5 ng/ml. SNT was a 60-mA, 5-s, 100-Hz tetanus applied on median nerve before cervix dilatation. PDRA was calculated as the difference in pupillary diameter after and before SNT. Movement upon cervix dilatation was recorded by an independent observer. Ability of PDRA and estimated remifentanil Ce to discriminate movers from non-movers during cervix dilatation was measured as the area under the receiver operating characteristics curve.

RESULTS:
Twenty-one of the 76 patients analyzed moved during cervix dilatation. Mean PDRA (±1 SD) evoked by SNT was 2.0 ± 1.2 mm in movers and 0.6 ± 0.7 in non-movers ($P < 0.0001$). Remifentanil Ce was 0.2 ± 0.4 ng/ml in movers and 3.0 ± 1.7 in non-movers ($P < 0.0001$). Area under the receiver operating characteristics curve for PDRA was 0.90 (95% CI, 0.83 to 0.96) and for remifentanil Ce 0.94 (0.89 to 0.98), without any significant difference between the two areas.

CONCLUSIONS:
PDRA evoked by an SNT is as accurate as the estimated remifentanil Ce to predict movement upon cervix dilatation. PDRA could be valuable when estimated opioid Ce is not available or reliable.

Comment in
Pupillary Reflex Dilation to Predict Movement: A Step Forward Toward Real-time Individualized Intravenous Anesthetics. [Anesthesiology. 2015]
Limitations of the Pupillary Reflex: Do the Eyes Have It? [Anesthesiology. 2015]
In Reply. [Anesthesiology. 2015]

https://www.ncbi.nlm.nih.gov/pubmed/25730338

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3

The use of pupillometry as monitoring of intraoperative analgesia in the consumption of analgesics during the first 12 hours after surgery.

Abad Torrent A, Rodríguez Bustamante V, Carrasco Fons N, Roca Tutusaus FJ, Blanco Vargas D, González García C.

Abstract

INTRODUCTION:
Intraoperative evaluation of analgesia remains today often based on heart rate and arterial pressure fluctuations. None of these parameters is specific. Incorrect handling during this process may increase surgical morbi-mortality of the patients and their acute postoperative pain. The aim of this study was to evaluate the impact of intraoperative analgesia controlled by pupillometry on postoperative analgesic consumption and the pain intensity in the first 12h in the hospital room, after major gynecological surgery.

PATIENTS AND METHODS:
A prospective, cohort study with allocation of groups of sequentially according to programming of operating room was designed. ASA I-III patients scheduled for elective surgery of abdominal hysterectomy by laparotomy or laparoscopy through intravenous general anesthesia were included. Patients were divided into 2 groups: pupillometry group (P-1), in which intraoperative analgesia was guided by pupillometry, and hemodynamic group (H-2) according to values of blood pressure and heart rate. In the hospitalization room the values of visual analogue scale (VAS) were routinely registered with 3 courts for the study: 3, 8 and 12h of the postoperative period. Postoperative analgesia was standardized as follows: NSAIDs was administered if VAS was ≥ 3 or if the patient expressly requested an analgesic. After this, the efficacy of treatment was assessed. If the patient had pain, the next scheduled drug was given up to an VAS<3. Data for total analgesic consumption administered in the hospital room, VAS and adverse effects were collected within 12h postoperatively.

RESULTS:
A total of 59 patients, 30 group P-1 and 29 group H-2, were included. Group P-1 experienced less pain than group H-2, with statistical significance in each phase (VAS 3h, VAS 8h and VAS 12h). These data are consistent with the consumption of analgesics for patients. There was a statistically significant reduction (p<0.001) in the group P-1 (1.80 [DE 0.99]; medium 2, 95% confidence interval 1.43-2.17) compared with group H-2 (5.66 [1.58]; medium 6, 95% confidence interval 5.05-6.26).

CONCLUSIONS:
Monitoring of the intraoperative analgesia by pupillometry was able to reduce the intensity of the acute postoperative pain and analgesic consumption in the first 12h in the hospital room after major gynecological surgery.

KEYWORDS:
Analgesia postoperatoria; Anestesia total intravenosa; Hemodynamic parameters; Parámetros hemodinámicos; Postoperative analgesia; Pupillometry; Pupilometría; Remifentanil; Remifentanilo; Total intravenous anesthesia

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PMID: 26431744 DOI: 10.1016/j.redar.2015.07.006

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Pupillometry-guided Intraoperative Remifentanil Administration versus Standard Practice Influences Opioid Use: A Randomized Study.

Sabourdin N, Barrois J, Louvet N, Rigouzzo A, Guye ML, Dadure C, Constant I.

Abstract

BACKGROUND:
Pupillometry has shown promising results for assessing nociception in anesthetized patients. However, its benefits in clinical practice are not demonstrated. The aim of this prospective randomized study was to evaluate the impact of intraoperative pupillometry monitoring on perioperative opioid consumption in major gynecologic surgery.

METHODS:
After receiving ethics committee approval and written consent of patients, American Society of Anesthesiologists status I to II women undergoing gynecologic surgery were included in this single-blinded, prospective, parallel-arm randomized study. General anesthesia was standardized with propofol-remifentanil target-controlled infusion. Patients were randomly assigned into two groups. In the pupillometry group, remifentanil administration was guided by pupillary diameter changes. In the standard group, remifentanil administration was left to the discretion of the anesthesiologist. The primary outcome was intraoperative remifentanil consumption.

RESULTS:
Fifty-five patients were analyzed. Remifentanil consumption was markedly decreased in the pupillometry group (3.8 [3.4 to 4.8 μg · kg · h] vs. 7.9 μg · kg · h [6.5 to 9.0 μg · kg · h] in the standard group; difference = 4.2 μg · kg · h [95% CI, 3.0 to 5.3 μg · kg · h]; P < 0.001). Cumulative 0- to 12-h morphine consumption was reduced in the pupillometry group (two-way repeated measures ANOVA 0.3 ± 0.1 vs. 0.4 ± 0.2 mg/kg; P = 0.048). A telephone survey 3 months after surgery revealed that 15 of 29 patients in the standard group still experienced procedure-related pain versus 3 of 23 in the pupillometry group (chi-square P = 0.037). No adverse events associated with pupillometry were observed during the study.

CONCLUSIONS:
The use of pupillometry to guide intraoperative analgesia reduced intraoperative remifentanil consumption and postoperative morphine requirements. The possible consequences of decreasing intraoperative remifentanil in terms of chronic pain require further investigation.

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Pupillary Reflex for Evaluation of Thoracic Paravertebral Block: A Prospective Observational Feasibility Study

Duceau, Baptiste MD; Baubillier, Mélanie MD; Bouroche, Gaëlle MD; Albi-Feldzer, Aline MD; Jayr, Christian MD, PhD

Abstract

BACKGROUND:
Although thoracic paravertebral block (TPVB) is recommended in major breast surgery, there is no gold standard to assess the success of TPVB. Pupillary dilation reflex (PDR) is the variation of the pupillary diameter after a noxious stimulus. The objective was to evaluate the feasibility of recording the PDR to assess analgesia in an anesthetized thoracic dermatome after TPVB.

METHODS:
This prospective, observational, single-center study included 32 patients requiring breast surgery under general anesthesia and TPVB. TPVB was performed before surgery under ultrasound guidance with 20 mL of 0.75% ropivacaine. At the end of the surgery, remifentanil was stopped and the PDR was recorded after a 5-second tetanic stimulation (60 mA, 100 Hz) applied to the anterior chest wall. The PDR was defined as the maximal increase in pupil diameter after a standardized noxious stimulus, expressed as a percentage of the initial pupil diameter. The PDR was recorded twice in the same eye for each patient after a stimulus on both the TPVB and the control sides. Postoperative pain scores were recorded in a postanesthesia care unit. The primary outcome was the difference between the PDR on the TPVB and the control sides.

RESULTS:
The median (interquartile range) PDR was 9% (4%–13%) on the TPVB side and 41% (27%–66%) on the control side. There was a significant difference in the PDR between the TPVB and the control sides with a Hodges-Lehmann estimate of absolute difference of 37% points (95% confidence interval, 25–52, $P < .001$). Median postoperative pain scores (interquartile range) in the postanesthesia care unit were 1 (0–3) at rest and 1 (0–3) during mobilization, respectively. There was a linear correlation between maximal postoperative pain scores and the PDR on the TPVB side with a Pearson's correlation coefficient $r = 0.40$ (95% confidence interval, 0.06–0.66, $P = .02$). No correlation was found between the number of blocked dermatomes and maximal postoperative pain scores ($P = .06$) or between the number of blocked dermatomes and the PDR on the TPVB side ($P = .15$).

CONCLUSIONS:
This proof-of-concept trial suggests that the effect of TPVB could be monitored by measuring the PDR after anterior chest wall stimulation in the dermatome of interest.

https://journals.lww.com/anesthesia-analgesia/Abstract/2017/10000/Pupillary_Reflex_for_Evaluation_of_Thoracic.41.aspx

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Regional Anesthesia and Acute Pain Medicine: Original Clinical Research Report

6

Pain assessment by pupil dilation reflex in response to noxious stimulation in anaesthetized adults.

Wildemeersch D, Peeters N, Saldien V, Vercauteren M, Hans G.

Abstract

BACKGROUND:
In response to noxious stimulation, pupillary dilation reflex (PDR) occurs even in anaesthetized patients. The aim of the study was to evaluate the ability of pupillometry with an automated increasing stimulus intensity to monitor intraoperative opioid administration.

METHODS:
Thirty-four patients undergoing elective surgery were enrolled. Induction by propofol anaesthesia was increased progressively until the sedation depth criteria (SeD) were attained. Subsequently, a first dynamic pupil measurement was performed by applying standardized nociceptive stimulation (SNS). A second PDR evaluation was performed when remifentanil reached a target effect-site concentration. Automated infrared pupillometry was used to determine PDR during nociceptive stimulations generating a unique pupillary pain index (PPI). Vital signs were measured.

RESULTS:
After opioid administration, anaesthetized patients required a higher stimulation intensity (57.43 mA vs 32.29 mA, P < .0005). Pupil variation in response to the nociceptive stimulations was significantly reduced after opioid administration (8 mm vs 28 mm, P < .0005). The PPI score decreased after analgesic treatment (8 vs 2, P < .0005), corresponding to a 30% decrease. The elicitation of PDR by nociceptive stimulation was performed without changes in vital signs before (HR 76 vs 74/min, P = .09; SBP 123 vs 113 mm Hg, P = .001) and after opioid administration (HR 63 vs 62/min, P = .4; SBP 98.66 vs 93.77 mm Hg, P = .032).

CONCLUSIONS:
During propofol anaesthesia, pupillometry with the possibility of low-intensity standardized noxious stimulation via PPI protocol can be used for PDR assessment in response to remifentanil administration.

KEYWORDS:
analgesia; assessment; monitoring; reflex

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7

Pupillary reflex measurement predicts insufficient analgesia before endotracheal suctioning in critically ill patients.

Paulus J, Roquilly A, Beloeil H, Théraud J, Asehnoune K, Lejus C.

Abstract

INTRODUCTION:
This study aimed to evaluate the pupillary dilatation reflex (PDR) during a tetanic stimulation to predict insufficient analgesia before nociceptive stimulation in the intensive care unit (ICU).

METHODS:
In this prospective non-interventional study in a surgical ICU of a university hospital, PDR was assessed during tetanic stimulation (of 10, 20 or 40 mA) immediately before 40 endotracheal suctionings in 34 deeply sedated patients. An insufficient analgesia during endotracheal suction was defined by an increase of ≥1 point on the Behavioral Pain Scale (BPS).

RESULTS:
A total of 27 (68%) patients had insufficient analgesia. PDR with 10 mA, 20 mA and 40 mA stimulation was higher in patients with insufficient analgesia ($P < 0.01$). The threshold values of the pupil diameter variation during a 10, 20 and 40 mA tetanic stimulation to predict insufficient analgesia during an endotracheal suctioning were 1, 5 and 13% respectively. The areas (95% confidence interval) under the receiver operating curve were 0.70 (0.54 to 0.85), 0.78 (0.61 to 0.91) and 0.85 (0.721 to 0.954) with 10, 20 and 40 mA tetanic stimulations respectively. A sensitivity analysis using the Richmond Agitation Sedation Scale (RASS) confirmed the results. The 40 mA stimulation was poorly tolerated.

CONCLUSIONS:
In deeply sedated mechanically ventilated patients, a pupil diameter variation ≥5% during a 20 mA tetanic stimulation was highly predictable of insufficient analgesia during endotracheal suction. A 40 mA tetanic stimulation is painful and should not be used.

Comment in
The value of pupillary dilation in pre-emptive analgesia: is there more to this than meets the eye? [Crit Care. 2013]

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