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ORIGINAL ARTICLE

Clonidine administration during intraoperative monitoring for pediatric scoliosis surgery: Effects on central and peripheral motor responses

Administration de clonidine durant le monitorage per-opératoire de chirurgie de la scoliose en pédiatrie: effets sur les réponses motrices centrales et périphériques

Pedro Calderón[a], Paul Deltenre[a,b,*], Ida Stany[c], Jean-Paul Kaleeta Maalu[d], Magali Stevens[a], Jean Lamoureux[d], Michel Bellemans[d], Sylvie Dujardin[a,1], Philippe Van der Linden[c], Bernard Dachy[a]

[a] *Department of neurology, université libre de Bruxelles, CHU Brugmann, 4, place Van-Gehuchten, 1020 Brussels, Belgium*
[b] *Laboratory of sensory and cognitive neurophysiology, université libre de Bruxelles, CHU Brugmann, place Van-Gehuchten, 4, 1020 Brussels, Belgium*
[c] *Department of anesthesiology, CHU Brugmann, Queen-Fabiola Children's university hospital, université libre de Bruxelles, 15, avenue JJ Crocq, 1020 Brussels, Belgium*
[d] *Department of orthopaedic surgery, Queen-Fabiola Children's university hospital, université libre de Bruxelles, 15, avenue J-J-Crocq, 1020 Brussels, Belgium*

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KEYWORDS
Alpha-2 adrenergic agonists;

Summary
Objective. — To study the effect of clonidine administrated as a co-analgesic during scoliosis surgery, on the neuromonitoring of spinal motor pathways.

* Corresponding author.
E-mail address: paul.deltenre@chu-brugmann.be (P. Deltenre).
[1] Current address: Sleep Medicine Center Kempenhaeghe Postbus 65, 5591 VE Heeze, The Netherlands

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Clonidine;
Cortico-spinal motor pathways;
Neuromonitoring;
Postoperative pain;
Scoliosis surgery;
Somatosensory evoked potentials;
Total intravenous anesthesia;
Transcranial electrical motor evoked potentials

Methods. — Using standardized intraoperative monitoring, we compared the time course of peripherally and transcranially electrically evoked motor potentials (TcEMEPs) before and after injection of a single bolus of clonidine in children under total intravenous anesthesia (TIVA). MEP data were obtained from 9 patients and somatosensory evoked potentials (SSEPs) were obtained from 2 patients. The potential effect of clonidine on mean blood pressure (BP) was controlled.

Results. — TcEMEPs from upper and lower limbs rapidly showed significant drops in amplitude after the injection of clonidine. Amplitudes reached minimal values within five minutes and remained very weak for at least 10—20 minutes during which monitoring of the central motor pathways was severely compromised. SSEPs were not altered during maximal amplitude depression of the TcEMEPS.

Conclusions. — This is the first report showing that clonidine severely interferes with neuromonitoring of the spinal cord motor pathways. The results are discussed in light of the literature describing the effects of dexmedetomidine, another α-2 adrenergic agonist. The experimental and literature data point to central mechanisms taking place at both the spinal and cerebral levels. Therefore, clonidine as well as other α-2 adrenergic agonists should be used with extreme caution in patients for whom neuromonitoring of the motor pathways is required during surgery.

Introduction

Since Merton and Morton demonstrated that it was possible to stimulate the human motor cortex through the intact scalp using a high-voltage electrical stimulus [26,27], transcranial electrical motor evoked potentials (TcEMEPs) recorded from limb muscles have become an irreplaceable method for non-invasive assessment of the functional integrity of the corticospinal pathways during various potentially high-risk surgical procedures. See [21] and [22] for comprehensive reviews on the subject.

According to the American Academy of Neurology evidenced-based guidelines [32], Intraoperative monitoring (IOM) of neural function can be used to issue warnings about the risk of impending neurological deficits induced by the ongoing surgical procedure. When prompted by such IOM warnings, anesthesiologists and surgeons are able to intervene in a variety of ways in order to avoid or limit neurological sequelae. Anesthesiologists can raise blood pressure, increase tissue oxygenation, or administer corticosteroids. Surgeons can adapt their surgical strategy by reducing the degree of spinal distraction, adjusting retractors, removing or adjusting grafts or hardware, reimplanting or unclamping arteries, placing vascular bypass grafts, minimizing the remaining portion of surgery, or other appropriate actions. During the whole time period across which TcEMEPs monitoring is used, it is crucial to ascertain reliable recording conditions allowing the monitoring team to detect significant events heralding genuine surgery-related neurological dysfunctions.

The success of IOM procedures is partly governed by the level of coordination between the surgical, anesthetic and neurophysiological teams and by reciprocal understanding of the respective constraints applying to each of them. In particular, the details of the anesthetic regimen play a major role in the reliability of IOM with TcEMEPs. The inhibitory effect of inhalation-based anesthetics on the firing rates of anterior horn cells is well known [4] and results in a reduction/abolition of motor responses recorded from peripheral muscles [8]. Propofol, an intravenous anesthetic, causes less suppression of motor neurons excitability than inhalational agents [39,40]. Total intravenous anesthesia (TIVA), based on a combination of propofol and an opioid agent, has been identified as the optimal scheme for IOM procedures resorting to TcEMEPs [9,17,19].

During scoliosis surgery, the most dreaded surgical complication is spinal cord injury. In this context, neurological deficits can be observed to occur at any time during the surgical procedure, sometimes well outside the surgical time frame considered as bearing the highest neurological risk [31], so that spinal cord monitoring must be performed until the very end of the surgical procedure. Therefore, it is of importance to gain full knowledge about every modification of the basic TIVA regimen that could alter TcEMEPs recordings and induce false alarms or jeopardize the monitoring procedure.

The present study was prompted by the serendipitous observation that an intravenous bolus of 1—2 μg/kg of the α-2 adrenergic agonist clonidine administrated during the dissection phase of scoliosis surgery, as the loading dose of an adjunct to the basic anesthetic regimen in order to contribute to postoperative analgesia, was associated with a drastic reduction of TcEMEPs amplitudes in all recorded muscles, without noticeable effect on cortical somatosensory evoked potentials (SSEPs). Whereas we are not aware of published studies on the effect of clonidine on per-operative TcEMEPs, several papers have dealt with their susceptibility to dexmedetomidine, another α-2 adrenergic agonist [1,2,6,16,24]. However these studies yield conflicting conclusions, some showing a significant deleterious effect of dexmedetomidine used as an adjunct to propofol-opioid TIVA on TcEMEPs [2,24] whereas others do not [1,6,16].

In the last 30 years, in addition to its role in blood pressure reduction in hypertensive patients, clonidine has been used for many purposes, including reduction in stress response, and recently as an anti-ischemic agent to reduce the risk of perioperative myocardial ischemia and

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