Title

Effects of programmed intermittent thoracic paravertebral bolus of levobupivacaine on the spread of sensory block: a randomized, controlled, double-blind study

Journal

Regional Anesthesia & Pain Medicine, 44(3)

ISSN

1098-7339

Authors

Hida, Kumiko
Murata, Hiroaki
Ichinomiya, Taiga
et al.

Publication Date

2019-03-01

DOI

10.1136/rapm-2018-100021

Peer reviewed

Basal infusion versus intermittent boluses for perineural catheters: should we take the 'continuous' out of 'continuous peripheral nerve blocks'?

Brian M Ilfeld,[1,2] Rodney A Gabriel[1,2]

[1]Department of Anesthesiology, University of California at San Diego, San Diego, California, USA
[2]Outcomes Research Consortium, Cleveland, Ohio, USA

Correspondence to
Dr Brian M Ilfeld, Department of Anesthesiology, University of California at San Diego, San Diego, CA 92093, USA; bilfeld@ucsd.edu

Received 27 November 2018
Accepted 5 December 2018
Published Online First 13 January 2019

In providing postoperative analgesia, a perineural catheter may be percutaneously inserted adjacent to a peripheral nerve, which then provides a conduit for subsequent local anesthetic administration.[1] Although frequently described as a '*continuous* peripheral nerve block' or 'perineural *infusion*', the local anesthetic method of administration is not limited to a *continuous* basal infusion, but may be supplemented—or even completely replaced—with *bolus* doses.[2] Until very recently, boluses were generally self-administered by patients by actively triggering the infusion pump. However, more-recent advances in pump technology have enabled automated intermittent boluses without the need for active patient involvement—the pumps may be programmed to repeatedly deliver a bolus volume.[3] Within the epidural space, automated repeated boluses improve analgesia compared with a basal infusion of an equivalent local anesthetic volume/dose,[3–5] possibly due to a more uniform local anesthetic spread.[6]

These promising results in favor of programmed intermittent boluses within the epidural space led to investigations involving similar scenarios for catheters within the perineural space of a peripheral nerve. Initial results were promising with two different randomized controlled trials (RCTs) demonstrating that, compared with a continuous infusion, intermittent boluses either decreased pain scores or opioid requirements for patients undergoing painful orthopedic foot surgery with sciatic perineural catheters inserted using an insulated needle and nerve stimulator.[7 8] Unfortunately, these results were not reproduced in subsequent investigations involving ultrasound-guided interscalene,[9] femoral,[10] and adductor canal catheters.[11] A fourth RCT involving femoral catheters reported a minimal decrease in cumulative opioid use over the first 2 days following knee arthroplasty for subjects receiving intermittent boluses, but no difference between treatments at each time point.[12] Unfortunately, this investigation lacked a designated primary outcome measure, a sample size estimation, or correction for multiple end points. Therefore, with nearly as many statistical comparisons as study subjects, the risk of a Type I error makes confidence in any positive findings unacceptably low.

Following these multiple failures to reproduce the clear benefits of intermittent bolus doses found in the previous reports,[7 8] investigators theorized that much larger bolus volumes provided every 3 hours—as opposed to smaller hourly doses—might result in positive findings. Unfortunately, this strategy also failed to demonstrate any benefits compared with equivalent-dose basal infusions for both transversus abdominis plane (24 mL boluses) and adductor canal (21 mL boluses) catheters.[13 14] One contrasting RCT reported decreased pain scores and opioid requirements in subjects with intermittent boluses undergoing anterior cruciate ligament reconstruction with adductor canal catheters: subjects received 0.5% ropivacaine either as a 2.5 mL/hour basal infusion or 15 mL bolus doses every 6 hours.[15] However, these findings may not demonstrate the superiority of intermittent boluses so much as the inferiority of a suboptimal basal infusion: continuous adductor canal blocks appear to require a higher basal rate of local anesthetic than their femoral counterparts[16]—even with a relatively high rate of 8 mL/hour, local anesthetic spread remains somewhat limited.[17] Therefore, a basal rate of 2.5 mL/hour—far lower than reported in nearly every other clinical trial involving adductor canal catheters—was probably inadequate to optimize the perineural infusion effects.[2]

With such a dearth of reliable positive data, it would be understandable to discount the concept of programmed intermittent boluses, except that a new RCT published in the current issue of this journal provides evidence to the contrary.[18] Dr Hida and colleagues included patients (n=32) undergoing video-assisted, unilateral pulmonary lobectomy or segmentectomy with an ultrasound-guided, ipsilateral, percutaneous thoracic paravertebral catheter.[18] After administering lidocaine 2% (3 mL) and mepivacaine 1% (20 mL) preoperatively and then levobupivacaine 0.25% (20 mL) postoperatively, subjects were randomized to receive perineural levobupivacaine 0.2% as either a 10 mL bolus every 2 hours or 5 mL/hour basal infusion. Subjects receiving repeated boluses experienced a higher number of affected dermatomes from 6 to 48 hours following surgery, with more than twice as many, on average, at the primary end point of 24 hours (6.8 vs 3.1; $p<0.001$). Importantly, no differences were detected between the treatment groups for pain levels and opioid requirements at any time point. However, this is probably due to the horizontal surgical incision made at approximately the same dermatome level as the paravertebral catheter, and the minimal invasiveness of the 1–3 thoracoscopic ports placed between the fourth to eighth intercostal nerves.

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► https://dx.doi.org/10.1136/rapm-2018-100021

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To cite: Ilfeld BM, Gabriel RA. *Reg Anesth Pain Med* 2019;**44**:285–286.

Regardless, the findings on the number of affected dermatomes suggest that, at least under some circumstances, a difference in elicited effects may be produced using automated intermittent boluses compared with a constant basal infusion.[19] The conflicting results among the myriad publications are most likely due to differences in local anatomy of the various catheter locations (eg, popliteal-sciatic vs adductor canal), catheter designs (nonstimulating vs stimulating), local anesthetic types (eg, ropivacaine vs levobupivacaine), catheter insertion techniques (eg, ultrasound vs stimulation), chosen outcome measures (eg, dermatomal levels vs opioid consumption), surgical procedures, basal rates, bolus volumes, delay between boluses, as well as a multitude of other factors. While the article by Dr Hida and colleagues in this issue of the journal does not provide actionable information for clinicians since no outcomes other than the number of dermatomes was influenced by the use of intermittent boluses, it does serve as an important reminder of the *potential* for analgesic and other benefits by adjusting the local anesthetic delivery regimen. For this, we applaud their superbly designed and reported clinical trial and hope that it serves as the inspiration for prospective studies that will further optimize patients' postoperative experience. Although the available evidence does not currently support it, perhaps someday we will take the 'continuous' out of 'continuous peripheral nerve blocks'.

Contributors BMI first authored the manuscript with RAG's input and RAG revised the manuscript significantly.

Funding Funding for this project provided by the Department of Anesthesiology, University of California San Diego, San Diego, California, USA. The contents of this editorial are solely the responsibility of the authors and do not necessarily represent the official views of this entity.

Competing interests BMIs institution has received funding and/or product for his research from Myoscience, Epimed, Ferrosan Medical, Infutronics, Teleflex Medical, SPR Therapeutics, and Heron Therapeutics. RAG's institution has received funding and/or product for his research from Myoscience, Epimed, Ferrosan Medical, Infutronics, and SPR Therapeutics.

Patient consent for publication Not required.

Provenance and peer review Commissioned; externally peer reviewed.

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