

Walking the Tightrope after Knee Surgery

Optimizing Postoperative Analgesia while Minimizing Quadriceps Weakness

INTRODUCTION of ultrasound as a monitor of needle placement and disposition of the local anesthetic has had a significant impact on the clinical practice of peripheral nerve blocks. In particular, the ability to visualize the interaction between needle and anatomy in real time has led to an increase in the use and success of peripheral nerve blocks. Not surprisingly, ultrasound guidance has inspired the development of a multitude of new block techniques, previously unreliable because of the inability to position a needle tip consistently in a tissue plane or adjacent to sensory nerves. A few examples include transverse adductor canal, transversus abdominis plane, and pectoralis blocks; all enthusiastically discussed at regional anesthesia gatherings and online discussion forums.‡ However, before widespread adoption, scrutinizing the novel approaches in high-quality, randomized, controlled trials is necessary to document a favorable



“[Dr. Jæger et al. provide] new information that may have potentially significant ramifications for walking the tightrope of optimizing analgesia while retaining quadriceps strength after major knee surgery.”

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‡ <http://anesthesiology-network.com/forums/topic/143/adductorcanal-saphenous-nerve-b>. Accessed September 5, 2012.

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risk–benefit ratio. For this reason, the study involving femoral nerve blocks published in this issue of ANESTHESIOLOGY by Jæger *et al.*¹ is noteworthy.

Knee arthroplasty is associated with severe postoperative pain, despite treatment with oral and intravenous analgesics.² Single-injection and/or continuous femoral nerve blocks are common analgesic modalities with well-documented outcome benefits.^{2,3} However, current block techniques and local anesthetic pharmacodynamics invariably affect motor fibers to the quadriceps muscle.⁴ The resulting quadriceps muscle weakness is undesirable and often leads to functional disability,⁵ which limits ambulation and rehabilitation,⁶ and is associated with an increased risk of falls.^{7,8} Unfortunately, strategies proposed to decrease femoral nerve block–induced quadriceps weakness while preserving proportionate analgesia have generally failed.^{4,9,10}

More recently, the adductor canal block was proposed as an alternative analgesic modality to prevent quadriceps muscle weakness and gait instability.¹¹ Theoretically, conduction block of the predominantly sensory branches of the femoral nerve contained in the adductor canal—an aponeurotic tunnel in the middle of third of the thigh—distal to the conventional femoral nerve block technique at the inguinal crease could avoid the undesired motor blockade while preserving analgesia. This concept is based on the anatomical fact that of the major nerves innervating the quadriceps femoris muscle, *only* the branch to the vastus medialis passes through the adductor canal. In addition, multiple sensory nerves that help innervate the knee pass through the same canal.¹² Therefore, in contrast to a standard femoral nerve block proximal to the nerve’s division into multiple smaller nerves innervating the quadriceps muscle, injection of a local anesthetic into the adductor canal

◆ This Editorial View accompanies the following article: Jæger P, Nielsen ZJK, Henningsen MH, Hilsted KL, Mathiesen O, Dahl JB: Adductor-canal-blockade versus femoral nerve block and quadriceps strength: A randomized, double-blind, placebo-controlled, crossover study in healthy volunteers. ANESTHESIOLOGY 2013;118:409–15.

should hypothetically block only the branch to vastus medialis, sparing the function to the rest of the quadriceps muscle.

Indeed, in a randomized, double-masked, placebo-controlled trial, repeated boluses of ropivacaine *via* a perineural catheter inserted into the adductor canal resulted in less dynamic pain and morphine consumption compared with saline boluses in patients with knee arthroplasty.¹³ Importantly, subjects receiving boluses of ropivacaine in the adductor canal demonstrated improved ambulation after 24 h, although the factors leading to this improvement remain unknown.¹³

The study published in this issue of *ANESTHESIOLOGY* by Jæger *et al.*¹ provides new information that may have potentially significant ramifications for walking the tightrope of optimizing analgesia while retaining quadriceps strength after major knee surgery. Eleven healthy volunteers received either bilateral femoral or adductor canal single-injection nerve blocks (30 ml each), one with ropivacaine (0.1%) and the other with saline, administered in a randomized, double-masked fashion. On a subsequent day after block resolution, the subjects received the alternative/crossover peripheral nerve block (femoral or adductor canal), again with one side receiving ropivacaine and the other saline. Compared with baseline values, the adductor canal block reduced quadriceps muscle strength by 8%, *versus* 49% for the femoral nerve block. Of note, an 8% reduction with the adductor canal block is probably clinically irrelevant, given that a 10% side-to-side strength difference is common, yet functionally unnoticeable in healthy individuals.^{14,15} Equally noteworthy, the femoral nerve block resulted in decreased ambulation ability relative to the adductor canal block.

We applaud the important documentation by Jæger *et al.* of quadriceps preservation achieved with adductor canal block. However, we should avoid the temptation to overinterpret the data from healthy volunteers, and conclude that compared with a femoral nerve block, the adductor canal block is a superior technique to provide postoperative analgesia after knee arthroplasty. This study does not provide information on the relative postoperative analgesia imparted by these two approaches. Therefore, it is best viewed as producing data highlighting the reason (minimizing the motor-to-sensory block ratio) that further investigation is required.

Additional questions remain unanswered, such as the volume of local anesthetic to optimize the analgesic to motor block ratio. For example, 3 of 11 subjects in the study by Jæger *et al.* experienced more significant quadriceps muscle weakness relative to the remaining volunteers. A previous study documented that an injection of 30 ml fills the entire adductor canal; therefore, any excess volume may track proximally and reach additional nerves/muscle groups.¹¹ Furthermore, the results of a single-injection adductor canal block cannot be extrapolated to a continuous perineural infusion because pharmacodynamics of local anesthetics vary considerably among anatomic locations and modes of introduction (*e.g.*, single-injection *vs.* continuous infusion).^{9,16} The previously mentioned randomized, placebo-controlled trial of

knee arthroplasty patients receiving repeated adductor canal ropivacaine boluses provides evidence that a catheter technique is superior to no regional anesthetic at all.¹³ However, what is now required is a trial directly comparing single-injection and continuous adductor canal and femoral nerve blocks in postsurgical patients.

History is replete with instances of medical “conclusions” based on sound theory, early laboratory evidence, and/or preliminary clinical results, which later proved either misleading or simply incorrect;¹⁷ and, in the interim, patients received suboptimal care.¹⁸ It is therefore imperative that we avoid the temptation to draw conclusions based on incomplete evidence, only to consequently discover our error at the expense of suboptimal analgesia. Therefore, additional clinical research is necessary to determine whether the data reported by Jæger *et al.* signal a transformation in postknee surgery analgesic management, or, rather, represent an important addition to our understanding of functional regional anesthesia, but without a prodigious impact on clinical practice. The same scrutiny should be applied to an ever-increasing number of technique innovations made possible with ultrasound guidance, but awaiting documentation of both benefits and risks.

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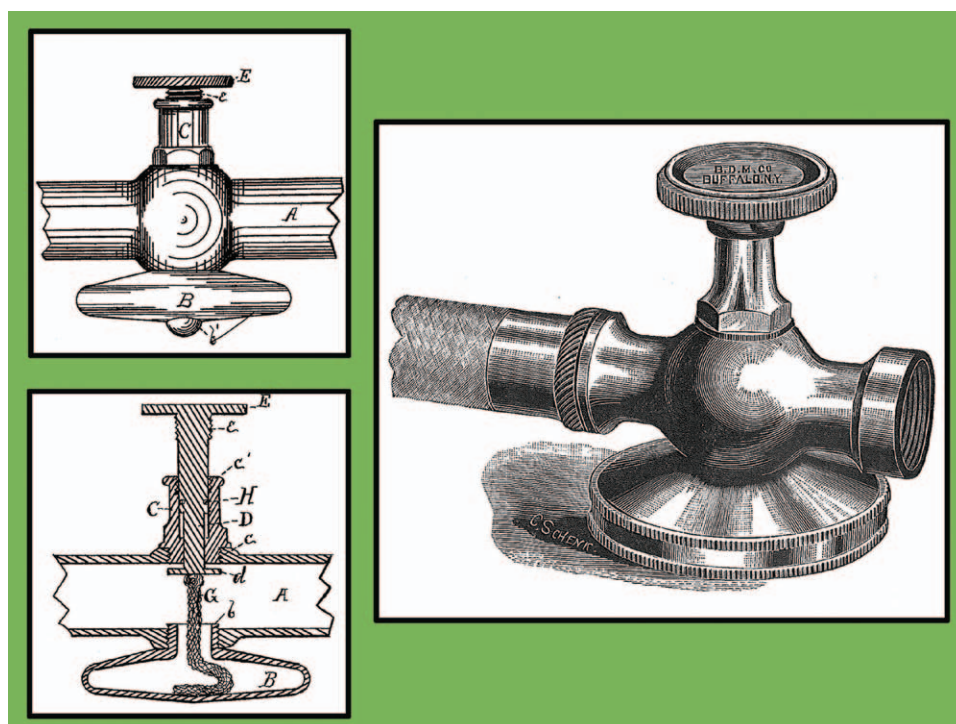
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G.B. Snow's Inhaler or Chloroform Mixer



In December of 1884, George B. Snow of Buffalo, New York, filed a patent application for his “inhaler” with its “capillary feeder leading from the [chloroform] reservoir below to the [nitrous oxide] inhaling-tube above” — from B to A in two of the filed diagrams (*left*). Snow’s filing was granted U.S. Patent No. 312771 in February of 1885, and he assigned patent rights to the Buffalo Dental Manufacturing Company. Within two months that company was advertising Snow’s innovation in the *Dental Advertiser* as a “Chloroform Mixer for Attachment to Nitrous Oxide Apparatus” (*right*). (Copyright © the American Society of Anesthesiologists, Inc.)

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