ASRA NEWS

A PUBLICATION OF THE AMERICAN SOCIETY OF REGIONAL ANESTHESIA AND PAIN MEDICINE

FEBRUARY 2018

In This Issue

ASRA PAIN MEDICINE EDUCATION RESEARCH

Advancing the science and practice of regional anesthesiology and pain medicine to improve patient outcomes through research, education, and advocacy

Table of Contents

American Society of Regional Anesthesia and Pain Medicine

Four Penn Center West, Suite 401 • Pittsburgh PA 15276
phone toll free 855-795-ASRA • fax 412-471-7503 • www.asra.com

ASRA News is published quarterly in February, May, August, and November. ISSN: 2474-2864

Working for You: Practice Management Resources Can Help You Be a Better Provider

Asokumar Buvanendran, MD
ASRA President

As professionals dedicated to improving patient outcomes, we want to spend as much time as possible helping patients. But more and more, we spend our time doing paperwork or electronic administrative work.

Medical administrative costs in the United States significantly exceed those in other developed nations. An article comparing hospital administrative costs among eight developed nations found that administrative costs in the United States exceeded all others and accounted for 25% of total spending in United States hospitals.[1] A study by Casalino et al[2] estimated that when the amount of time spent interacting with insurance companies was converted into dollars, the national time cost estimate to practices was at least $23–$31 billion each year. It also estimated that nursing staff spends an average of 13.1 hours per week on authorizations.

As administrative costs have risen, physician reimbursement has declined. In addition, physician compensation as a percentage of health care cost in the United States is 8.4%, among the lowest of major Western nations compared to Germany's 15% and France's 11%.

Physician burnout secondary to practice management challenges has also become a major health care crisis. Multiple factors have been shown to drive physician burnout,[3] many of which are associated with practice management. Linzer et al[4–5] defined the primary factor associated with physician satisfaction as the development of patient relationships—independent of compensation.

All these statistics were part of a presentation made to the ASRA Board of Directors by Board member David Provenzano, MD, during its fall strategic planning session. Dr. Provenzano was requesting funding for development of a full-service practice management resource center, which would establish a portfolio that allowed for continued and advanced learning through annual meetings, satellite meetings, website material, newsletter articles, and webcasts. The hope is that ASRA can help providers spend more time caring for patients and less time struggling with administrative burdens. In support of leaders with well-defined skills in practice management, we hope to combat the trend toward physicians being detached, with fewer resources available for the core missions of patient care, research, and education. I am pleased to report that the project was approved by the Board of Directors, and the Practice Management Committee is now charged with developing the resource center with a planned 2018 rollout.

In recent years, ASRA has increasingly been allocating resources toward practice management. We provided comments and feedback to the Centers for Medicaid and Medicare Services (CMS) regarding the Merit-Based Incentive Payment System (MIPS) and Alternative Payment Model Incentive under the Physician Fee Schedule, and Criteria for Physician-Focused Payment Models. We've also created an educational curriculum at our annual meetings focused on practice management issues. This past fall, we worked with the American Society of Anesthesiologists to develop new quality measures through the Acute and Chronic Pain Technical Expert Panel. We are proud to say that CMS has approved the Anesthesia Quality Institute (AQI) National Anesthesia Clinical Outcomes Registry (NACOR) as a Qualified Registry and Qualified Clinical Data Registry (QCDR) for 2018 MIPS reporting and has approved the 2018 menu of QCDR measures, posted here. ASRA members can participate in AQI NACOR at a discounted rate by going to https://www.aqihq.org/send-me-info.aspx

"Be sure to also take advantage of the wealth of practice management resources that we provide."

ASRA will continue this focus in 2018 with proposed resources, including fact sheets on recommended quality measures for MIPS, a checklist on how to earn 15 points to be neutral (the minimum for 2018 is 15 points), and a "How I Do It" podcast on implementing MACRA, focused on small- and medium-sized practices.

We are also very proud to report that ASRA has earned a seat on the American Medical Association's Specialty and Service Society. This allows ASRA to move one step closer to discussions about current procedural terminology and related conversations.

Although you may often attend our meetings, read our publications, or visit our website with the goal of learning the latest research and developing your practical skills, be sure to also take advantage of the wealth of practice management resources that we provide. This aspect of your practice is becoming increasingly important to ensure that you have the skills to be successful in practice and ultimately provide the best care for your patients.

ACKNOWLEDGMENT

Thank you to David Provenzano, MD, for contributing to this article.

REFERENCES

1. Himmelstein DU, Jun M, Busse R, et al. A comparison of hospital administrative costs in eight nations: US costs exceed all others by far. Health Aff (Millwood). 2014;33(9):1586–1594.
2. Casalino LP, Nicholson S, Gans DN, et al. What does it cost physician practices to interact with health insurance plans? Health Aff (Millwood). 2009;28(4):w533–543.
3. Rothenberger DA. Physician burnout and well-being: a systematic review and framework for action. Dis Colon Rectum. 2017;60(6):567–576.
4. Linzer M, Poplau S, Babbott S, et al. Worklife and wellness in academic general internal medicine: results from a national survey. J Gen Intern Med. 2016;31(9):1004–1010.
5. Linzer M, Manwell LB, Williams ES, et al. Working conditions in primary care: physician reactions and care quality. Ann Intern Med. 2009;151(1):28–36, w6–9.

Editorial – In Nabil's Corner

And That's a Wrap!

Just like that, 3 years are now over. As I write my last article as your *ASRA News* editor, I look back at the past 3 years and I am really proud of what *ASRA News* has become. I am grateful for the time and effort that the *ASRA News* family has put in over the past 3 years to get us to this point. I have witnessed *ASRA News* transition from print to digital, and I can attest to how much this allowed us to expand our content and include resources in each article that we were incapable of before. I am confident that *ASRA News* will continue to thrive under the editorship of Kristopher Schroeder, MD. I have no doubt that he will bring new energy and brilliant ideas to enrich this platform and take it to the next level.

I want to thank every ASRA member who contributed to *ASRA News* during my tenure and allowed us to offer you the materials we presented each quarter. I am also grateful to the ASRA staff who worked tirelessly behind the scenes to bring you each issue. I was fortunate to share my time with our dedicated committee members and associate editors. Last but not least, I would like to thank ASRA leadership for their support and for entrusting me with this opportunity to serve the subspecialty I cherish.

OK! Enough with the thank-yous.

This issue of your *ASRA News* is a phenomenal one. With the 2018 World Congress on Regional Anesthesia and Pain Medicine in New York City just around the corner, ASRA members and leaders share why they are going to the Big Apple. We also present two examples of fighting the opioid epidemic. The first highlights the collaboration between Pennsylvania state and government officials and pain physicians, and the second discusses the effort of the pain physician group at the University of Texas and its plans to further educate providers and regulate opioid prescription practices. I also know you will be intrigued by this issue's "How I Do It" article, where the regional anesthesia and acute pain medicine group at Penn State Hershey Medical Center shares its experience in expanding the use of a relatively new erector spinae plane block for acute pain management after thoracic trauma and rib fractures.

Nabil Elkassabany, MD, MSCE
ASRA News Editor

"I look back at the past 3 years and I am really proud of what ASRA News *has become."*

In this issue, we also present articles about myofascial pain, use of ultrasound for interventional pain procedures, and the lost art of intravenous regional anesthesia. We share Ohio State University's experience in training its nursing staff on simulation scenarios for local anesthetic systemic toxicity. There's so much more to share in this issue, but you have to read it all to learn it all.

Why I'm Going to New York

Are you coming to New York for the 2018 World Congress on Regional Anesthesia and Pain Medicine?

The 2018 World Congress will be held April 19–21, 2018, in New York City. This is the fifth time this meeting has been held—it happens only once every four years, and this is the first time it will be held in the United States. It brings together all five of the world's regional anesthesia and pain medicine societies: ASRA, the European Society of Regional Anaesthesia and Pain Therapy (ESRA), the Asian and Oceanic Society of Regional Anesthesia (AOSRA), the Latin American Society of Regional Anesthesia (LASRA), and the African Society of Regional Anesthesia (AFSRA). The three-day comprehensive meeting covers acute and chronic pain as well as regional anesthesia and includes five parallel session tracks; 47 workshops; and a preconference day of special sessions, including point-of-care ultrasound workshops, the ASRA Pain and MSK Interventional Ultrasound Certificate examination, and the European Diploma in Regional Anesthesia and Acute Pain Management (EDRA) exam.

Here, a few of the session chairs and speakers share a preview of some content being presented at this historic meeting and explain why they're going to New York. To register, go to www.asra.com/world-congress.

NEW BLOCKS—WHY AND HOW WELL DO THEY WORK?

Ki Jinn Chin, MB, BS, FANZCA, FRCPC
Anesthesiologist
Toronto Western Hospital
Toronto, Canada

I'm honored to be chairing the session on "New Blocks—Why and How Well Do They Work?" Even though ultrasound-guided regional anesthesia is more than 15 years old, we are still discovering new ways to use ultrasound to deposit local anesthetics in novel locations that have enormous potential impact on patient care. Particularly exciting for me is that many of these new block techniques also mark a shift toward making ultrasound-guided regional anesthesia safer and simpler to perform, thus putting it within reach of more of our colleagues.

For example, we will discuss new approaches to the infraclavicular brachial plexus block, which address the limitations of the classic ultrasound-guided technique. We will also feature the erector spinae plane block, a truncal block for thoracic and abdominal analgesia described just in the past year, generating a lot of interest because of its potential as an alternative to thoracic epidural or paravertebral blocks in challenging patients. I am also looking forward to discussions on the quadratus lumborum block and anesthesiologist-led, ultrasound-guided techniques of periarticular infiltration around the knee. From an intellectual point of view, I'm pleased to see that many of those new techniques have renewed our study of clinical anatomy, which was always a cornerstone of the art of regional anesthesia. I hope you will join our panel of clinical experts for what promises to be an engaging session that will inspire and educate us all.

ADVANCES IN NEUROMODULATION

Timothy Deer, MD
President and
Chief Executive Officer
The Center for Pain Relief, Inc.
Charleston, West Virginia

I am going to New York to enjoy time with friends and colleagues and to explore the best practices I can use in my patient care to help more people who suffer from chronic pain. I am particularly excited about the panel on Advances in Neuromodulation. It is a rare event to have such a collaboration of experiences brought together as experts discuss the critical points of using neuromodulation to expand and perfect electrical medicine. Those attending will hear a great presentation on the best use of new feedback loops, dorsal root ganglion stimulation, waveform advances, and new software and hardware to advance the therapy. Perhaps more important than content is the panelists' evolution of ideas. Those ideas lead to the next device innovation, which then will undergo a long and tumultuous road of critical analysis, including level-one studies and in-depth evaluation of efficacy and safety. Those are the ideas that will lead to future device approvals and be the content of future world meetings.

In addition to the panels and discussion, the Congress offers an opportunity to participate in firsthand training in the area of implantable devices. This option will be important for both fellows and practicing physicians who want to advance their skills. In addition, we will dig deep into the proper use of opioids in non-cancer pain and discuss which algorithms are the most appropriate. Finally, the discussion of best algorithms will bring this together as a cohesive set of information that will help a great number of people.

So, my friends, as you can see, the reasons to go to New York are numerous. I am sure it will be an incredible time and an experience we all remember for years to come. Please join me and bring a friend to this amazing opportunity.

ENHANCED RECOVERY FOR TOTAL KNEE ARTHROPLASTY: A 360° ROUNDTABLE DISCUSSION

The World Congress is shaping up to be the educational event of the decade for students of regional anesthesia and acute pain medicine. The hallmark of this World Congress is innovative

educational sessions. One such session is “Enhanced Recovery for Total Knee Arthroplasty: A 360° Roundtable Discussion.”

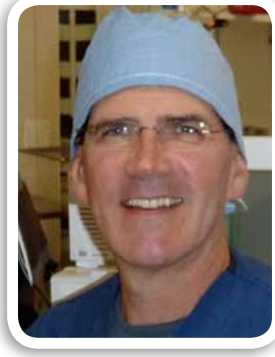
Gregory A. Liguori, MD
Director, Department of Anesthesiology
Anesthesiologist-in-Chief
Hospital for Special Surgery
Clinical Professor of Anesthesiology
Weill Cornell Medical College
New York, New York

Knee arthroplasty procedures in the United States are expected to exceed 3 million by the end of 2030. It will be one of the most-commonly performed procedures in the United States and beyond. It is also one of the most painful procedures currently being performed. A few years ago, patients could expect a long hospitalization followed by a grueling recovery period. Today, expectations for patients and their physicians are much different. Length of stay for most patients is less than 2 to 3 days, with many centers performing the procedures on an ambulatory basis. Surgical techniques, tourniquet times, and hemostasis strategies are much improved. Finally, anesthetic and analgesic options not only speed recovery and reduce pain but also contribute to improved long-term outcomes.

In “Enhanced Recovery for Total Knee Arthroplasty: A 360° Roundtable Discussion,” the perspectives of each participant in this operation will be explored. Why do patients choose to have knee replacement surgery? What are patients' expectations for the perioperative period and for the rehabilitation? Are patients adequately informed about what to expect? Do the surgeons' and anesthesiologists' perceptions of the perioperative course match the patients' actual experience? How do prehabilitation, physical therapy, and the home situation influence outcomes? What are surgeons' views of regional anesthesia and various analgesic techniques? What are the most important surgical variables for a successful knee replacement? What complications (eg, prolonged pain and stiffness) keep surgeons awake at night? Do anesthesiologists understand their patients' concerns about regional versus general anesthesia? What are the optimal regional techniques? How can anesthesiologists add value to knee arthroplasty during the perioperative period and beyond? Finally, is it safe to perform a knee arthroplasty on an ambulatory basis? If so, what is the advantage for the patients? What are the surgical concerns and considerations? How can the anesthesiologist facilitate safe discharge?

These are some of the topics that will be covered in an informal conversation among the experts during this session. We look forward to your attendance and participation in this novel educational session.

“HOW I DO IT” SESSIONS



Brian Harrington, MD
Physician
Billings Clinic Hospital
Billings, Montana

The 2018 World Congress on Regional Anesthesia and Pain Medicine will afford exceptional opportunities to learn and refine state-of-the-art regional anesthesia techniques directly from the world's experts. The two scheduled interactive video sessions on “How I Do It: Tips,” for example, are specially designed to share regional anesthesia pearls in a format that is:

- **Audience-driven:** Short videos will be shown that have been submitted by anesthesiologists in attendance at the meeting. See instructions for video submissions at https://www.asra.com/page/1532/call-for-videos
- **Loose and interactive:** Although the videos are educational and often entertaining, their primary purpose is to prompt a professional dialogue with the audience.
- **Current and authoritative:** A dynamic panel has been assembled for each session, with topics from several expert perspectives.
- **Fast-paced and engaging:** Topics will shift frequently because each video newly sets the stage for a fresh discussion.

One interactive session will be dedicated to peripheral nerve and intramuscular plane blocks and another to paravertebral and neuraxial blocks. Come to New York and be a part of this unique educational experience!

CONTENT FOR CHRONIC PAIN SPECIALISTS

David Provenzano, MD
President
Pain Diagnostics and Interventional Care
Sewickley, Pennsylvania

Why should you come to New York City in the spring if you are a chronic pain specialist? The answer is to receive current, advanced, and comprehensive education for interventional and noninterventional pain management care. Traditionally, the spring ASRA meetings focus on acute and regional anesthesia. For the World Congress on Regional Anesthesia and Pain Medicine, national and international teachers will provide significant didactic and workshop content on the management of chronic pain.

The workshop offerings will cover all aspects of interventional care, including ultrasound-guided pain blocks,

radiofrequency, neuraxial pain procedures, regenerative medicine, minimally invasive lumbar decompression, and fluoroscopic-guided pain procedures. On Wednesday, the ASRA Pain and Musculoskeletal Interventional Ultrasound certificate will be offered. The didactic sessions will have multiple special topics, including coverage of advanced neuromodulation techniques in collaboration with the International Neuromodulation Society. In this session, waveform and technology advancements will be discussed. Regenerative medicine, intrathecal, headache, and radiofrequency sessions will cover advancements in those areas. The lectures are being developed to assist practitioners in incorporating best practices into their clinical activities. We will also have sessions covering practice and medicolegal issues, including such topics as mitigating legal risk, protecting oneself from medical negligence, and understanding the USA Close Claims related to interventional pain medicine. Issues surrounding cannabis and opioid treatment will be analyzed.

Speakers will be coming from all five of the regional anesthesia and pain medicine world societies—ASRA, ESRA, LASRA, AFSRA, and AOSRA—and the Congress will include physician assistant, nurse practitioner, and nurse educational tracks. Furthermore, the research portion of the program will be strong with abstracts from all over the globe. We encourage you to submit your research to the meeting.

The World Congress will be a state-of-the-art educational activity that chronic pain specialists should not miss. We look forward to seeing you in Times Square in April!

Learn More About Regenerative Medicine

Rush University Orthopedic Surgeon Brian J. Cole, MD, is among the experts presenting the "Regenerative Medicine Symposium: Sports Medicine/Injury" session on Thursday, April 19, from 3:30–5 p.m. He will provide a "Critical Appraisal of Techniques of Regenerative Medicine." The session will also include presentations by Dmitri Souza, MD, Gregory Lutz, MD, and Aaron Calodney, MD. Listen to some of Dr. Cole's insights in "Sparing the Scalpel: A Surgeon's Perspective on the Future of Orthopedics | Brian Cole | TEDxRushU" on YouTube.

NYSORA
CONTINUING MEDICAL EDUCATION

NYSORA Mini-Boutique Workshop

The New York School of Regional Anesthesia (NYSORA) will present its "Mini-Boutique Workshop: 3D Anatomy and Lower Abdominal and Extremity Blocks" on April 21 from 8–11:45 a.m. in conjunction with the World Congress. This workshop is a short version of one of NYSORA's most popular workshops. The session will consist of brief didactic instructions, followed by 3D and attorney presentations and ultrasound scanning demonstration. The delegates then break up into small groups with instructors for practical, hands-on scanning and case management discussions. Boutique workshops have just become even better with the introduction of the most sophisticated tissue simulators to date: MiniSims(http://www.myminisim.com). NYSORA's proprietary MiniSims allow training in ultrasound tissue recognition and practice in hand-eye coordination using in-plane and out-of-plane United States guidance approaches.

Instructors are Admir Hadzic, MD, PhD, Michael Akerman, MD, Daryl Henshaw, MD, J. Doug Jaffe, MD, Ana Lopez, MD, and Catherine Vandepitte, MD.

Session objectives:

- Review the anatomy for the most clinically applicable nerve block techniques.
- Review updates on the techniques.
- Understand the mechanisms of complications and discuss strategies for their prevention.
- Review emerging technologies in nerve blocks.
- Review functional and 3D as a basis of the practice of peripheral nerve blocks.

NYSORA will not be offering its spring meeting in order to support participation in the 2018 World Congress.

Pennsylvania Initiatives to Address Opioid Use Disorder

Sarah Boateng
Executive Deputy Secretary
of Health
Commonwealth of Pennsylvania
Harrisburg, Pennsylvania

Rachel L. Levine, MD
Acting Secretary of Health,
Physician General, Commonwealth
of Pennsylvania
Departments of Pediatrics
and Psychiatry
Penn State College of Medicine
Hershey, Pennsylvania

Michael A. Ashburn, MD, MPH
Professor
Department of Anesthesiology and
Critical Care
Perelman School of Medicine at the
University of Pennsylvania
Philadelphia, Pennsylvania

Section Editor: Rany Abdallah, MD, PhD

Drug overdose death rates are in the news almost daily, and the data demonstrate that the situation continues to get worse. Although 2016 data document that deaths attributable to prescription drugs has leveled off, deaths attributed to heroin and fentanyl continue to rise. Indeed, more Americans died from drug overdose in 2016 than during the Vietnam War.

In this article, we report on ongoing efforts to address opioid overdose deaths in Pennsylvania. This Pennsylvania story has been one of partnership among state government leadership, health professionals, and patient advocacy organizations. Several states have taken action to address this public health emergency. In Pennsylvania, legislation was passed in 2015 and 2016 that created a prescription drug monitoring program, established physician education requirements, and required changes to medical school education.

Pennsylvania has been working on improving the use of opioids for the treatment of pain for several years. Convened by the Department of Health and the Department of Drug and Alcohol Programs, the Safe and Effective Prescribing Practices and Pain Management Task Force was established by the state in 2015. The task force includes representatives from state and federal government, professional societies, individual physicians, and patient advocates. It developed 10 evidence-based specialty or location-specific state-based clinical practice guidelines to provide clinicians with best practices related to the use of opioids for treatment of non-cancer pain (Figure 1). The guidelines ultimately were reviewed and endorsed by several state regulatory boards, including boards representing physicians, nurses, and pharmacists.

Figure 1: *Pennsylvania state pain guidelines.*

- Prescribing Guidelines for Pennsylvania: Use of Addiction Treatment Medications in the Treatment of Pregnant Patients With Opioid Use Disorder
- Prescribing Guidelines for Pennsylvania: Safe Prescribing of Opioids in Pediatric and Adolescent Populations
- Prescribing Guidelines for Pennsylvania: Safe Prescribing of Opioids in Orthopedics and Sports Medicine
- Prescribing Guidelines for Pennsylvania: Obstetrics and Gynecology Opioid Prescribing Guidelines
- Pennsylvania Guidelines on the Use of Opioids to Treat Chronic Noncancer Pain
- Prescribing Guidelines for Pennsylvania: Geriatric Pain. Opioid Use and Safe Prescribing
- Prescribing Guidelines for Pennsylvania: Opioid Dispensing
- Pennsylvania Guidelines: Emergency Department Pain Treatment Guidelines
- Pennsylvania Guidelines on the Use of Opioids in Dental Practice
- Prescribing Guidelines for Pennsylvania: Safe Prescribing of Benzodiazepines for Acute Treatment of Anxiety and Insomnia

Pennsylvania task force members have recognized that changes in the patient care process do not occur simply through publication of guidelines. Therefore, the task force advocated for the creation of continuing education on topics related to pain, the use of opioids, addiction screening, and referral for treatment. In partnership with the Pennsylvania Medical Society and other professional organizations, the task force made continuing medical education on the above topics free and available to all providers within the state.

Pennsylvania state leadership created a task force consisting of leadership from all Pennsylvania medical schools in 2016 to discuss possible changes to medical student education related to prescribing opioids. The task force developed core competencies for education on pain, opioids, and addiction (Figure 2). Ultimately, the Pennsylvania state legislature passed legislation that required Pennsylvania health education programs to provide instruction on pain management, addiction, prescribing, and dispensing practices for opioids as part of their training. In addition, the Pennsylvania

Figure 2: *Pennsylvania pain and addiction core competencies.*

- Understanding core aspects of addiction
- Patient screening for substance use disorder
- Proper referral for evaluation and treatment of substance use disorder
- Proper patient assessment with treating pain
- Proper use of multimodal treatment options when treating acute pain
- Proper use of opioids for treating acute pain
- The role of opioids in treatment of chronic noncancer pain
- Patient risk assessment for aberrant drug-related behavior associated with use of opioids for noncancer pain
- The process for patient education, initiation of treatment, patient monitoring, and discontinuation of therapy when using opioids to treat noncancer pain

state legislature passed legislation that required continuing medical education for all providers on these same topics.

Pennsylvania leadership recognized the need to establish a prescription drug monitoring program (PDMP) that providers could use to guide clinical decision-making related to prescribing controlled substances. The Pennsylvania PDMP went live for licensed prescribers and dispensers in 2016; those sources are now required to register with the program. Additional state legislation quickly led to adoption of a requirement that all providers query the PDMP before prescribing any opioids and benzodiazepines. As a result, more than 94,000 providers registered with the Pennsylvania PDMP in the first 12 months of operation, and an average of 52,000 queries are completed during a typical workday. In 2017, the Pennsylvania PDMP became capable of providing data from 15 other states and Washington, DC.

"This Pennsylvania story has been one of partnership among state government leadership with health professionals and patient advocacy organizations."

The system will soon integrate with electronic health records to facilitate the availability of PDMP data in guiding clinical decision-making. Initial data indicate that the availability of the PDMP is impacting provider prescribing. In fact, the number of people receiving schedule II medications from more than 10 physicians and pharmacies has essentially been eliminated, and the number of people receiving schedule II medications from more than 5 providers and pharmacies has decreased by more than 80%. PDMP data demonstrate a decrease in opioid prescribing of 12.6% since the third quarter of 2016.

Concern is growing about the impact of physicians overprescribing opioids for the treatment of acute pain. Between the duration of opioid therapy and the risk of migration from acute to chronic opioid use, the association has recognized that 80% of individuals who use heroin report having started opioid use through use of prescription opioids.

In addition, several published reports have documented that physicians routinely overprescribe opioids for acute pain, resulting in large numbers of unused opioids being left in the home, often unsecured, and thus readily available for nonmedical use. To decrease the availability of unused opioids and other medications in the home, Pennsylvania created the Pennsylvania Prescription Drug Take-Back Program. Under the leadership of the Department of Drug and Alcohol Programs, the commonwealth has collected and destroyed 301,388 pounds of drugs since 2015.

Pennsylvania has also made progress in expanding naloxone availability for the treatment of opioid overdose. This included the physician general signing a standing order to make naloxone available to first responders (as well as the general public), allocating several million dollars to provide naloxone for first responders. Since the start of the program, increased availability has led to 3,988 reversals of opioid overdoses by Pennsylvania law enforcement using naloxone.

Pennsylvania is working on the expanded availability of medication-assisted treatment for opioid use disorders through a series of grants offered to providers to explore transformative methods of providing expanded addiction treatment throughout the state. This program, the Pennsylvania Coordinated Medication Assisted Treatment, expands medication-assisted treatment through a hub-and-spoke model with an addiction-medicine physician as the hub, networking with primary care providers as the spokes.

Although considerable more work needs to be done, the experience in Pennsylvania and other states demonstrates that progress can be made when state government leadership effectively partners with health care professional leadership and others to develop and implement sound policy to address a pressing public health need.

Diaphragm Ultrasonography for Regional Anesthesiologists

Peter H. Cheng, DO
Partner Emeritus
Kaiser Permanente Medical Center
Moreno Valley, California

Andrea J. Boon, MD
Professor of Physical Medicine and Rehabilitation
Professor of Neurology
Mayo Clinic
Rochester, Minnesota

Stephen Haskins, MD
Assistant Attending Anesthesiologist
Hospital for Special Surgery
Clinical Assistant Professor of Anesthesiology
Weill Cornell Medical College
New York, New York

Section Editor: Kristopher Schroeder, MD

Regional anesthesiologists frequently perform interscalene and supraclavicular brachial plexus blocks to manage postoperative pain after shoulder surgery, with some patients developing respiratory distress from hemidiaphragm paralysis caused by simultaneous phrenic nerve blocks.

Although chest radiographic findings of an elevated hemidiaphragm suggests phrenic nerve paralysis, sonographic assessment of the diaphragm provides a more accurate and quantitative analysis (movement and contractility) that anesthesiologists can perform at the bedside before or after those nerve blocks. Preoperative diagnosis of diaphragm dysfunction on the surgical site's contralateral side may warrant suprascapular and axillary nerve blocks or other alternate techniques in patients with pre-existing respiratory dysfunction. Additionally, when dyspnea occurs after an interscalene block, chest sonography can be used to identify iatrogenic pneumothorax.

"Could a perioperative ultrasound examination be used to assess diaphragm function and reversal of phrenic nerve blockade prior to extubation?"

In this article, we will describe sonographic evaluation of the diaphragm at the zone of apposition (ZOA) pertinent to the practice of anesthesia. Unlike sonography of diaphragm *excursion*, which is influenced by the accessory muscles of respiration, diaphragm *thickening* more accurately quantifies diaphragmatic contraction.

CLINICAL SCENARIO

A 58-year-old American Society of Anesthesiologists class III male patient presented for a right rotator cuff repair. He had a history of smoking, well-controlled chronic obstructive pulmonary disease, obstructive sleep apnea, obesity, difficult airway, diabetes mellitus, and hypertension. He denied dyspnea at rest. After a right interscalene nerve block, rotator cuff repair was performed under general anesthesia. At the conclusion of surgery and after reversal of neuromuscular blockade, he was fully responsive to command. Because he had mild respiratory dysfunction, he was extubated. Following extubation, he required reintubation because of worsening dyspnea. He was admitted to the intensive care unit, where he was successfully extubated the following day.

Did the interscalene nerve block and associated phrenic nerve block cause diaphragm paralysis? Could a preoperative ultrasound examination have identified diaphragm dysfunction that would warrant phrenic nerve-sparing blocks? Could a perioperative ultrasound examination be used to assess diaphragm function and reversal of phrenic nerve blockade prior to extubation?

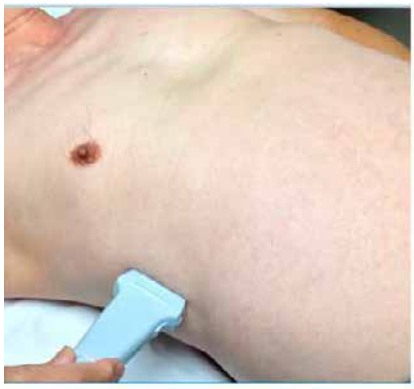
ULTRASOUND EQUIPMENT AND SETTINGS

Correct probe selection is essential when insonating the diaphragm, and it depends on the location of the diaphragmatic evaluation. When assessing the diaphragm through the liver and spleen as acoustic windows using M-mode sonography, a low-frequency curvilinear array (2–5 MHz) or narrower cardiac phased array transducer (1–5 MHz) is recommended to provide the penetration needed for abdominal sonography. When assessing the diaphragm at the zone of apposition (ZOA), a high-frequency linear array transducer (10–13 MHz) is recommended.

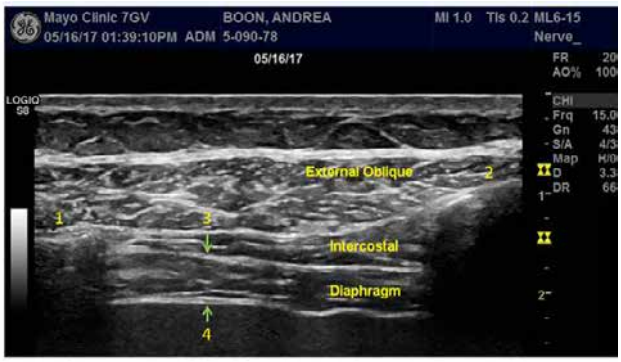
DIAPHRAGMATIC EVALUATION AT THE ZOA: ABCDE

Zone of Apposition. Sonographic assessment of diaphragm motion and contractility is performed at the ZOA, which is best seen in the coronal plane at the level of the eighth and ninth ribs in the region of the axillary or anterior axillary line (Figure 1A). The diaphragm appears as a thin hypoechoic or isoechoic structure located between two hyperechoic layers: peritoneum and diaphragmatic pleura (Figure 1B). During inspiration, the diaphragm normally thickens more than 20% (Figure 2).

Figure 1: *Diaphragm ultrasound at the Zone of Apposition.*

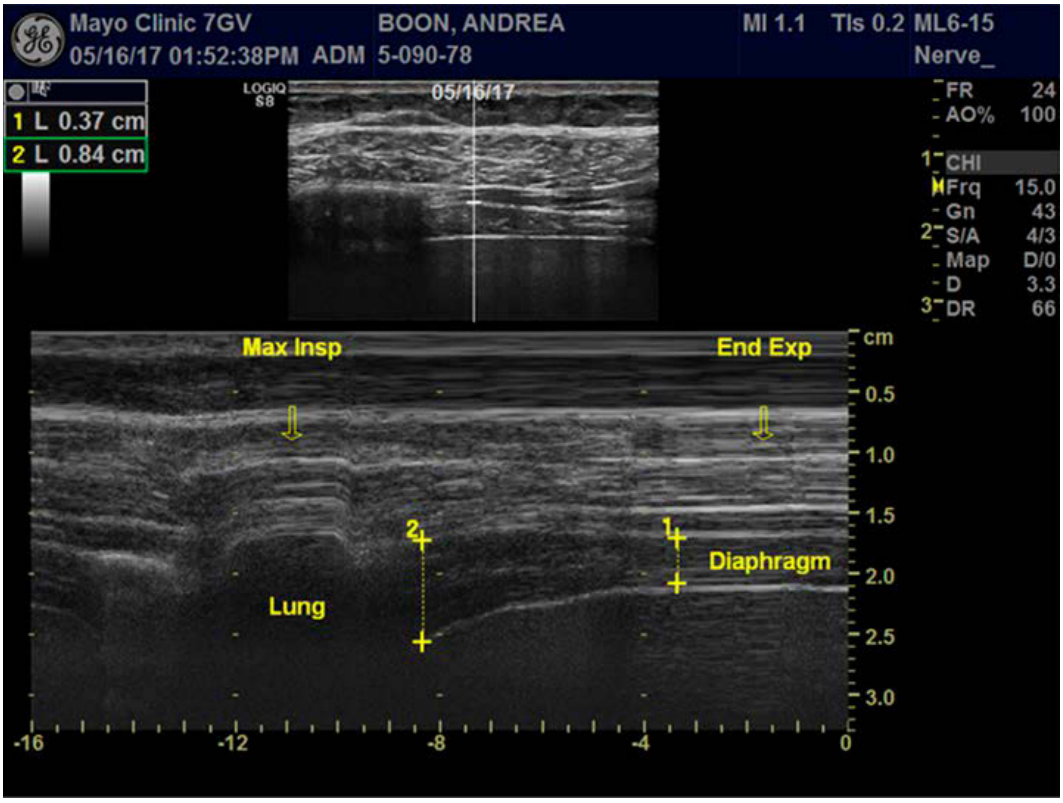


Linear array transducer placed over the anterior or mid-axillary line over the 8th and 9th ribs in the coronal plane



1. Rib 8
2. Rib 9
3. Diaphragmatic Pleura
4. Peritoneum

Figure 2: *Diaphragm thickening.*



In Figure 2, a linear array transducer (more than 10 MHz) is placed in the midaxillary or anterior axillary line in the coronal plane, along the ZOA between the eighth and ninth intercostal space. The upper image is taken in B-mode. The lower image is taken in M-mode and shows the diaphragm thickening during inspiration.

Ban et al described a simple technique (Figure 3) for evaluation of the diaphragm: ABCDE. A linear array transducer is placed parallel to the anterior **a**xillary line just caudal to the level of the nipple. Lung sliding superficial to the diaphragm during **b**reathing will be evident as a bright hyperechoic shadow entering the field of view

Figure 3: *ABCDE approach for diaphragmatic evaluation.*

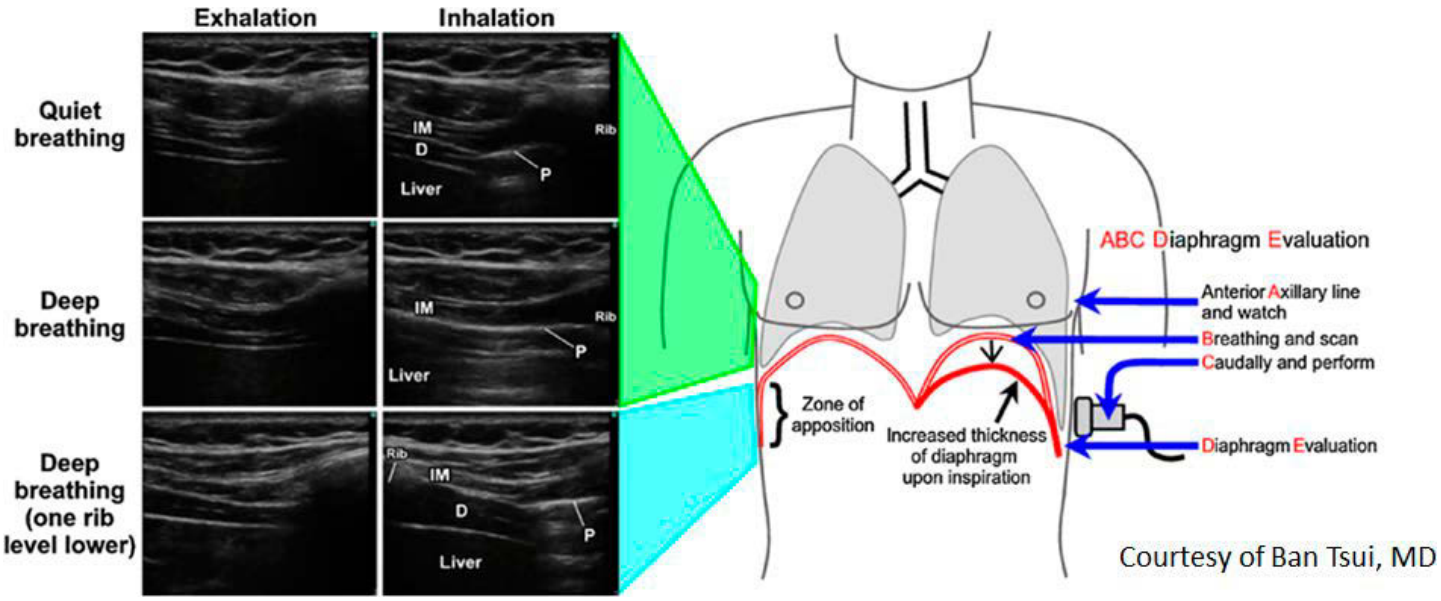
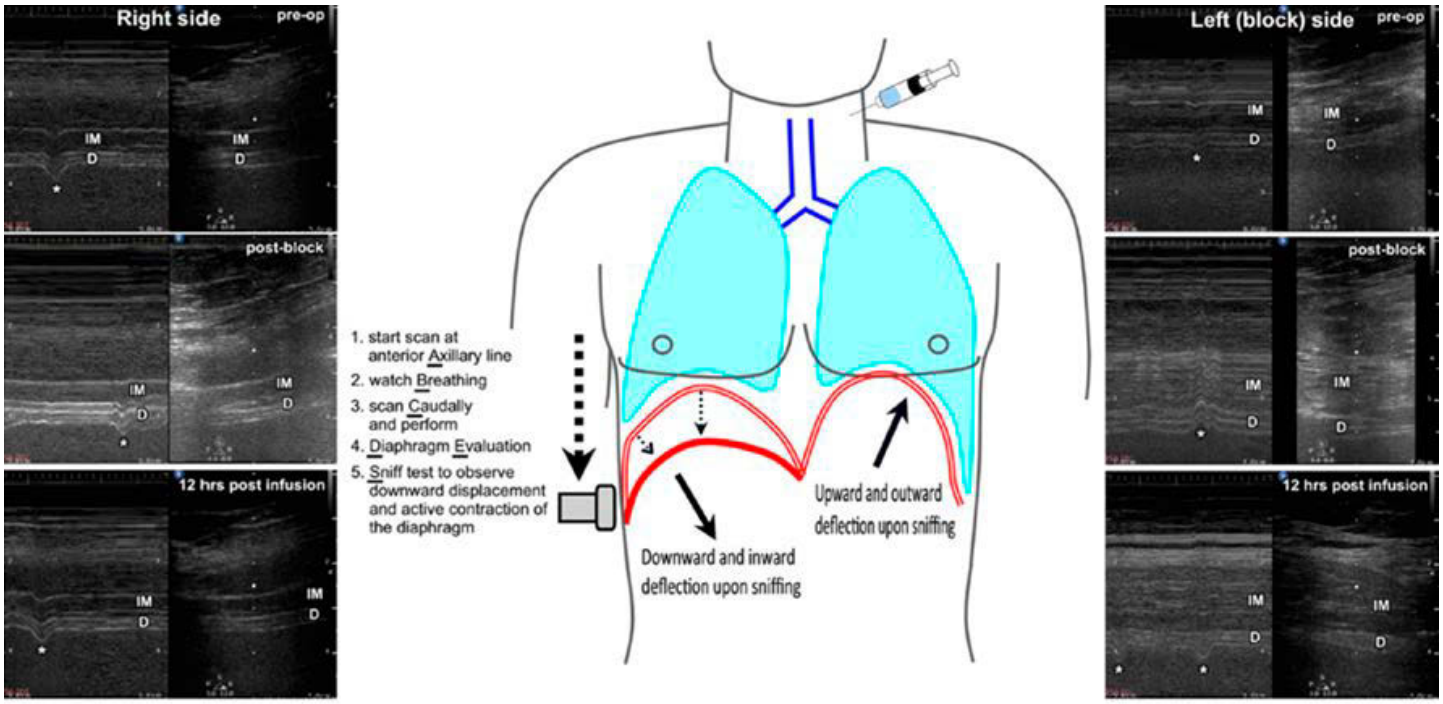
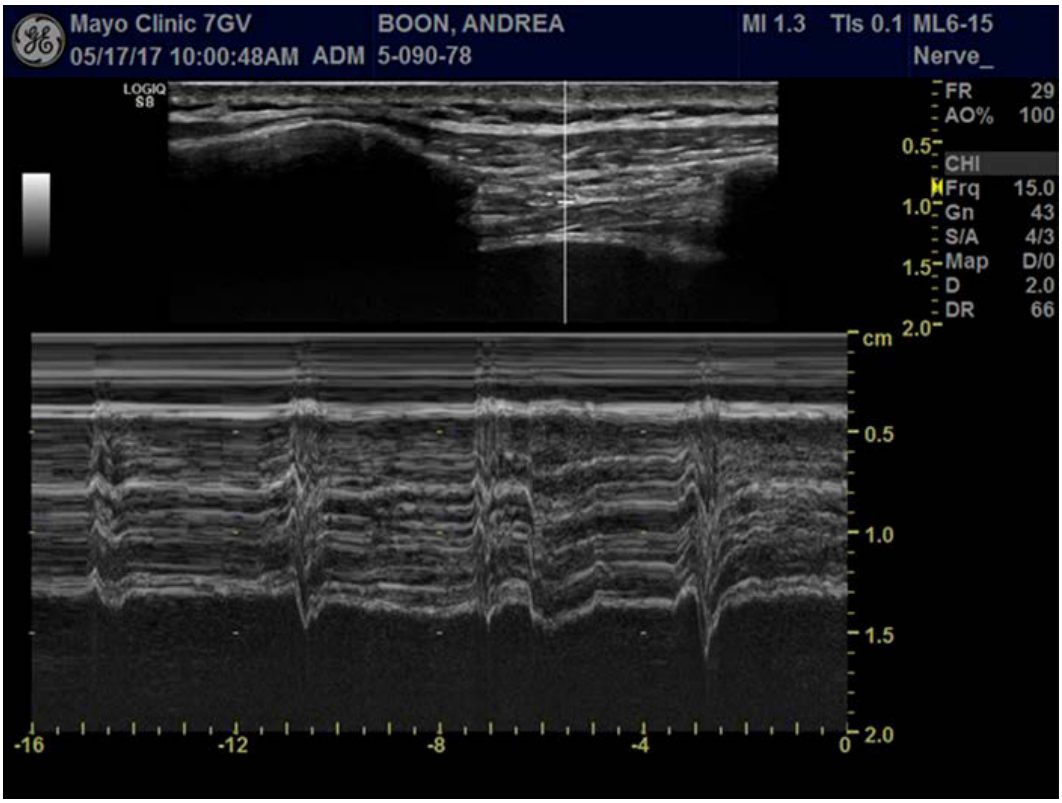


Figure 4: *Sniff test: an ultrasound-guided ABCDE approach.*



Courtesy of Ban Tsui, MD

Figure 5: *Sniff test (M-Mode).*



from the cephalad aspect. As the transducer is moved **c**audally, the **d**iaphragm thickens during inspiration and is **e**valuated caudal to the pleural line so that the diaphragm is not obscured by pleura. During unforced inspiration, the intercostal muscles remain still, and the diaphragmatic pleura descend caudally. The presence of pleural movement (sliding lung sign) does not equate to diaphragm contraction as the accessory muscles of respiration and the contralateral diaphragm can cause pleural motion, despite the presence of ipsilateral hemidiaphragm paralysis/abdominal paradox.

Both the thickening ratio (TR) and thickening fraction (TF) can be calculated to quantify the degree of thickening. TR quantifies the degree of thickening, by comparing the differences between the two measurements, and is calculated as follows:

TR = thickness at maximal inspiration/thickness at end expiration, which is normally greater than 1.2.

TF serves as a measure of the efficiency of diaphragmatic contractility and can be calculated by using the B-mode.

TF = thickness at end inspiration – thickness at end expiration/ thickness at end expiration. Lower limit of normal TF is 0.2.

Patients with acute hemidiaphragm paralysis from interscalene nerve block will have normal diaphragm thickness, but the degree of thickening (TR or TF) would be diminished.

Phrenic Nerve Block and Abdominal Paradox. Unilateral diaphragm paralysis that typically occurs after interscalene block can be diagnosed using M-mode at the ZOA. After successful phrenic nerve block, forceful inhalation or sniffing (Figures 4 and 5) will cause the contralateral hemidiaphragm to increase the intra-abdominal pressure, which then passively shifts the paralyzed/ flaccid diaphragm cephalad, resulting in an abdominal paradox. The abdomen moves inward, and the rib cage expands in response to the increased negative intrapleural pressure. Additionally, the mediastinum shifts to the contralateral side. However, observing this phenomenon can be difficult, and a false-positive finding may occur in the absence of diaphragm paralysis. False-negative results can also occur because accessory muscle activation can cause rib cage expansion, displacing the diaphragm caudally. These errors can be eliminated by diaphragm ultrasound at the ZOA, using B-mode, to evaluate for the presence of normal diaphragm thickening.

The supine position provides the most accurate measurement of diaphragm excursion because the abdominal viscera move

more freely, and an abdominal paradox is readily seen. During the sniff test, Naik et al reported an upward spike during M-mode sonography, indicating displacement of the hemidiaphragm cranially instead of caudally (abdominal paradox), whereas a normal diaphragm briefly descends during sniff testing, evident as a downward spike.[6]

Other causes of abdominal paradox include a large pleural effusion, negative pressure pneumothorax, subphrenic abscess, pulmonary fibrosis, and atelectasis. Abdominal paradox can also be seen in patients who have undergone lobectomy. These pre-existing conditions can be identified on a chest radiograph.

SUMMARY AND RECOMMENDATIONS

Many patients presenting for shoulder surgery may have asymptomatic unilateral diaphragm dysfunction. However, after interscalene nerve block resulting in hemidiaphragm paralysis, such patients may develop dyspnea severe enough to warrant rescheduling their surgery.

Insonation of the diaphragm bilaterally at the ZOA preoperatively can demonstrate evidence of diaphragm dysfunction. If the patients have normal diaphragm thickening on the contralateral side to the surgical site surgery may proceed safely. On the other hand, diaphragm dysfunction on that contralateral side may necessitate suprascapular and axillary nerve blocks that will spare the phrenic nerve. Patients with bilateral diaphragm dysfunction typically have severe dyspnea, rely heavily on their accessory muscles of respiration, and are not candidates for interscalene blocks.

In conclusion, ultrasound of the diaphragm is a practical and highly accurate diagnostic imaging modality to assess diaphragm function, to determine which patients may be candidates for interscalene brachial plexus blocks and to quantify diaphragm contractibility prior to extubation.

REFERENCES

1. Boon AJ, O'Gorman C. Ultrasound in the assessment of respiration. J Clin Neurophysiol. 2016;33(2):112–119.
2. Matamis D, Soilemezi E, Tsagourias M, et al. Sonographic evaluation of the diaphragm in critically ill patients. Technique and clinical applications. Intensive Care Med. 2013;39(5):801–810.
3. Sarwal A, Walker FO, Cartwright MS. Neuromuscular ultrasound for evaluation of the diaphragm. Muscle Nerve. 2013;47(3):319–329.
4. Tsui JJ, Tsui BC. A novel systematic ABC approach to diaphragmatic evaluation (ABCDE). Can J Anaesth. 2016;63(5):636–637.
5. Zambon M, Greco M, Bocchino S, Cabrini L, Beccaria PF, Zangrillo A. Assessment of diaphragmatic dysfunction in the critically ill patient with ultrasound: a systematic review. Intensive Care Med. 2017;43(1):29–38.
6. Naik LY, Sondekoppam RV, Jenkin Tsui J, Tsui BC. An ultrasound-guided ABCDE approach with a sniff test to evaluate diaphragmatic function without acoustic windows. Can J Anaesth. 2016;63(10):1199–1200.

How I Do It: Erector Spinae Block for Rib Fractures: The Penn State Health Experience

Hillenn Cruz Eng, MD
Assistant Professor
Department of Anesthesiology and Perioperative Medicine
Penn State Health
Hershey, Pennsylvania

Ki Jinn Chin, MBBS, MMed, FRCPC
Associate Professor
Department of Anesthesia
University of Toronto
Toronto, Canada

Sanjib Adhikary, MBBS
Associate Professor
Department of Anesthesiology and Perioperative Medicine
Penn State Health
Hershey, Pennsylvania

INTRODUCTION

Rib fractures are common in multitrauma patients and require effective analgesia to prevent respiratory complications. At the Penn State Health Milton S. Hershey Medical Center, all multitrauma patients with rib fractures are referred to the acute pain medicine service (APMS) once they have been assessed and stabilized by the trauma surgery service. APMS performs a detailed history and physical examination, focusing on location of fractures, medications, patient's current coagulation status, allergies, and other injuries, including trauma to internal abdominal organs, spine, pelvis, or limbs. APMS also evaluates history of prior surgeries or disease and mental status. An analgesic plan is formulated with the goals of optimizing respiratory function, minimizing opioid consumption, and preventing cognitive dysfunction. Therefore, the plan usually includes an interventional regional anesthesia procedure.

Until recently, APMS performed mainly thoracic epidural, thoracic paravertebral, and intercostal blocks to provide rib fracture analgesia.[1,2] In general, patients with one to two rib fractures were considered for intercostal blocks, whereas patients with three or more rib fractures were considered for thoracic epidural or paravertebral blocks. However, the latter two techniques are not always feasible because of various factors, including pre-existing anticoagulation or antiplatelet therapy, hemodynamic instability, or other associated injuries (eg, vertebral fractures).

"The erector spinae plane (ESP) block was described in 2016 as a novel regional anesthetic technique for acute and chronic thoracic pain."

The erector spinae plane (ESP) block was described in 2016 as a novel regional anesthetic technique for acute and chronic thoracic pain.[3,4] It is a paraspinal fascial plane block that involves injection of local anesthetic deep in the erector spinae muscle and superficial to the tips of the thoracic transverse processes. The site of injection is distant from the pleura, major blood vessels, and spinal cord; hence, performing the ESP block has relatively few contraindications. The ESP block is less difficult to perform relative to thoracic epidural anesthesia and thoracic paravertebral block. Also, significant cranial-caudal spread occurs from a single injection point, which is an additional advantage in the setting of multiple rib fractures. The mechanism of analgesic action is believed to result from diffusion of local anesthetic anteriorly to the ventral and dorsal rami of spinal nerves. Since its description in 2016, our practice has evolved to incorporate ESP blockade as the first-line intervention in patients with multiple rib fractures.

Single-Shot ESP Versus Continuous Catheter Block. We initially began with single-shot ESP blocks for rib fractures. However, we found that although this improved the pain and effectiveness of breathing significantly, the pain often recurred within 2 to 3 hours of the block, despite the use of long-acting local anesthetics. We postulated that systemic absorption of local anesthetic may be a contributing factor to the shorter-than-expected duration. This led to our current practice of inserting a catheter in all our patients, which has allowed us to provide prolonged analgesia.

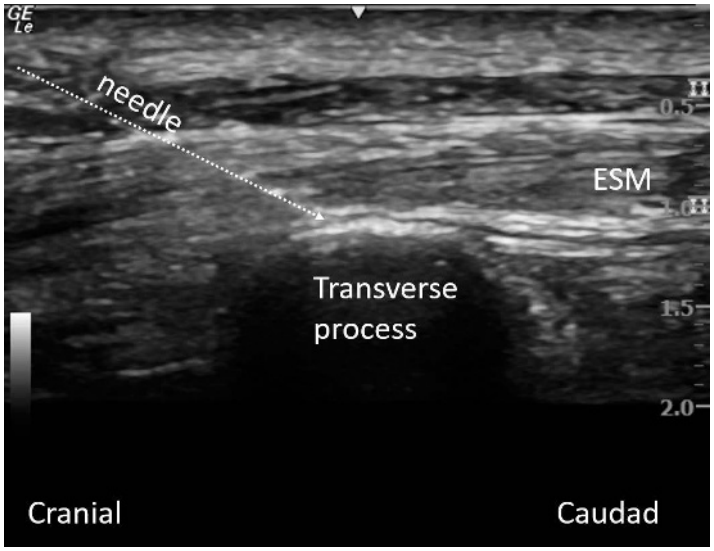
Continuous Catheter Infusion Regimens. We initially used a continuous infusion regimen of ropivacaine 0.2% at 8–10 ml/h with patient-controlled regional analgesia (PCRA) boluses of 8 ml every 60 minutes. However, we observed that patients reported significantly lower pain scores at rest and improved respiration after the bolus doses. We have therefore moved to a programmed intermittent bolus regimen of 15 ml of 0.2% ropivacaine every 3 hours with additional patient-controlled boluses of 5 ml every 60 minutes, resulting in superior analgesia and patient satisfaction.

THE ESP BLOCK TECHNIQUE

Patient Selection. Any patient with three or more rib fractures, either unilateral or bilateral, is a candidate for ESP blockade. A thorough history, physical exam, and informed consent are carried

Figure 1: *After patients are positioned optimally (sitting or lateral decubitus), the affected area is identified along with the target transverse process.*

Figure 2: *Transverse processes in an in-plane approach are recognizable as flat, squared-off acoustic shadows with a faint image of the pleura.*



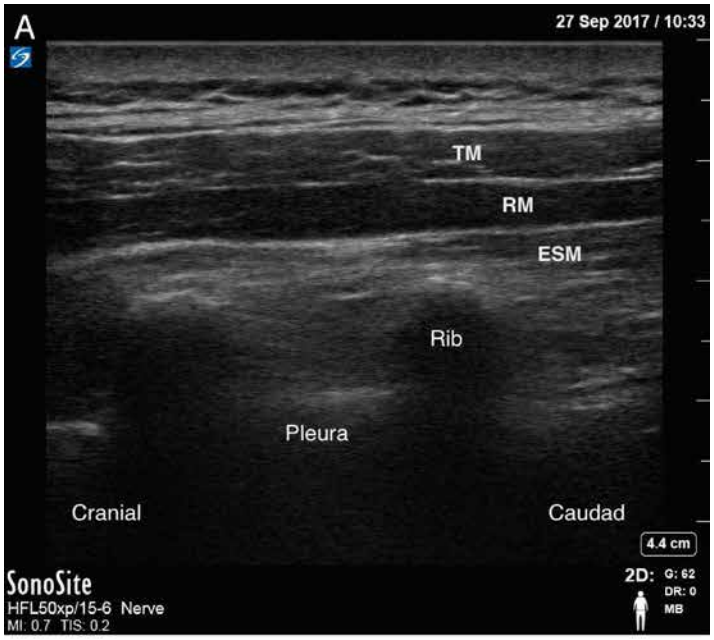
out. Altered mental status, concomitant injuries, and intubation/ventilation are considerations primarily with regard to the ability to position the patient safely and access the paraspinal area to perform the block. Unlike thoracic epidurals, the ESP block may be performed in patients with pre-existing thoracic spine disease or thoracic vertebral (ie, spinous process or lamina) fractures. Pleural puncture and pneumothorax are not significant concerns, given that the site of injection is distant from the pleura. We do not view coagulopathy or the use of anticoagulants or antiplatelet drugs as absolute contraindications to ESP block because the theoretical risk of clinically significant hemorrhage or hematoma is very low; however, an individualized risk-benefit assessment should be performed for every patient.

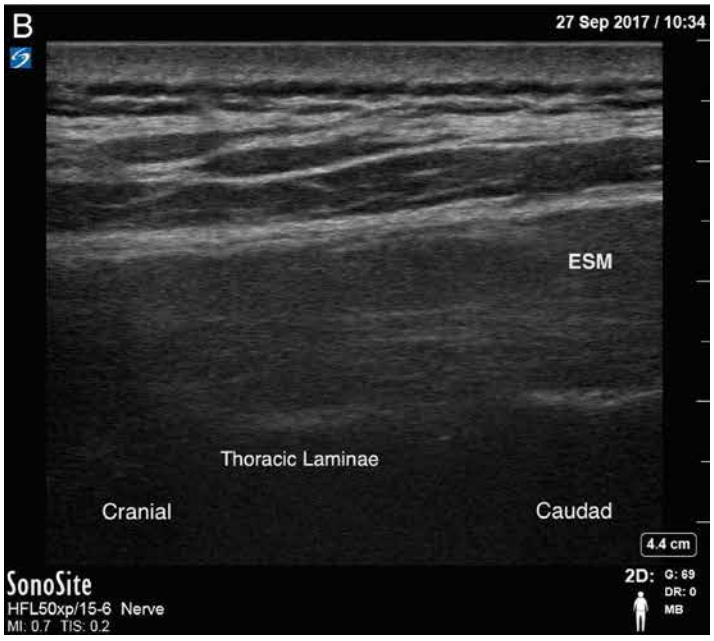
Block Equipment and Preparation. In the majority of patients, we use a high-frequency (10–15 MHz) linear-array transducer because it provides a higher-resolution image; however, a low-frequency (5–2 MHz) curvilinear probe is useful in more obese patients where the transverse processes lie at a depth greater than 4 cm. We prefer to use the catheter-over-needle kit (Pajunk E-Cath, Pajunk Medical Systems, Norcross, Georgia) because they are more kink resistant. The block is performed with full aseptic precautions, and the usual precautions for any regional anesthesia procedures should be applied.

Scanning Technique. After patients are positioned optimally (sitting or lateral decubitus), the affected area is identified along with the target transverse process (Figure 1). Given that local anesthetic spreads cranially and caudally from the point of injection, this is usually the transverse process most central to the affected rib levels. The ultrasound transducer is placed in a longitudinal parasagittal orientation, about 3 cm lateral to the spinous processes, allowing for visualization of adjacent transverse processes (TP) in an in-plane approach. These are recognizable as flat, squared-off acoustic shadows with only a very faint image of the pleura visible (Figure 2). If the transducer is too lateral, the ribs will be visualized instead; these are recognizable as rounded acoustic shadows with an intervening hyperechoic pleural line (Figure 3A). If the transducer is too medial, the thoracic laminae (flat hyperechoic lines) will be visualized (Figure 3B).

After correct TP identification, an 18-gauge echogenic needle (Pajunk E-Cath, Pajunk Medical Systems) is inserted using an in-plane, cranial-to-caudad approach to contact the bony shadow of the TP with the tip deep to the fascial plane of the erector spinae muscle (Figure 4). The correct location of the needle tip

Figure 3: *If the transducer is too lateral, the ribs will be visualized instead. (A)These are recognizable as rounded acoustic shadows with an intervening hyperechoic pleural line. If the transducer is too medial, the thoracic laminae (flat hyperechoic lines) will be visualized (B).*





is confirmed by injecting 0.5–1 cc of normal saline 0.9% and observing linear fluid spread lifting the erector spinae muscle off the tip of the TP (Figure 5). Once the fascial plane is recognized, the needle is removed and the catheter is inserted through the needle

Figure 4: *After correct transverse process (TP) identification, an 18-gauge echogenic needle is inserted using an in-plane, cranial-to-caudad approach to contact the bony shadow of the TP with the tip deep to the fascial plane of the erector spinae muscle.*

sheath. Correct catheter location is confirmed by bolusing 2–3 cc of normal saline 0.9%. Following confirmation of correct catheter tip location, 20 cc of ropivacaine 0.5% is injected and cranial and caudal spread of local anesthetic can be visualized.

ESP Catheter Management and Follow-Up. The APMS team assesses patients daily, focusing on pain scores, incentive spirometry outcomes, ambulation status, 24-hour opioid requirements, mental status, and the integrity of the catheter insertion site. The anesthesia on-call team gets a thorough sign-out and manages any issues overnight, these may include infusion pump malfunction, inadequate analgesia, and inadvertent catheter removal.

Breakthrough pain is managed with small doses of intravenous opioids. We have observed fewer instances of inadequate analgesia

Figure 5: *The correct location of the needle tip is confirmed by injecting 0.5–1 cc of normal saline 0.9% and observing linear fluid spread lifting the erector spinae muscle off the tip of the TP.*

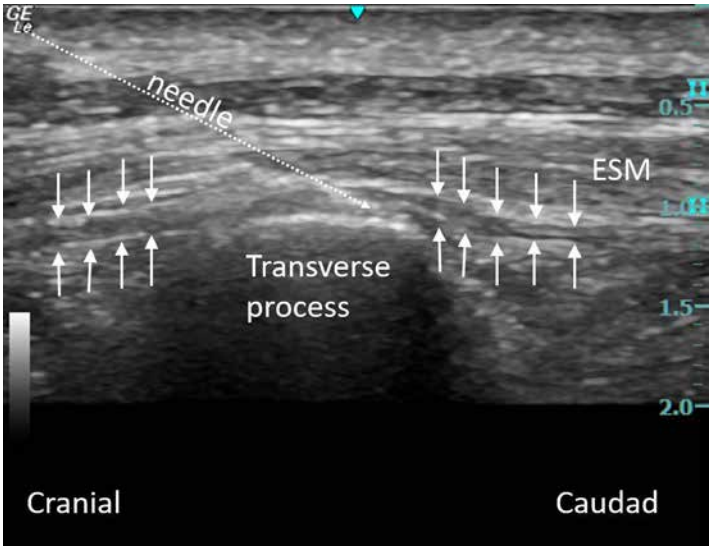
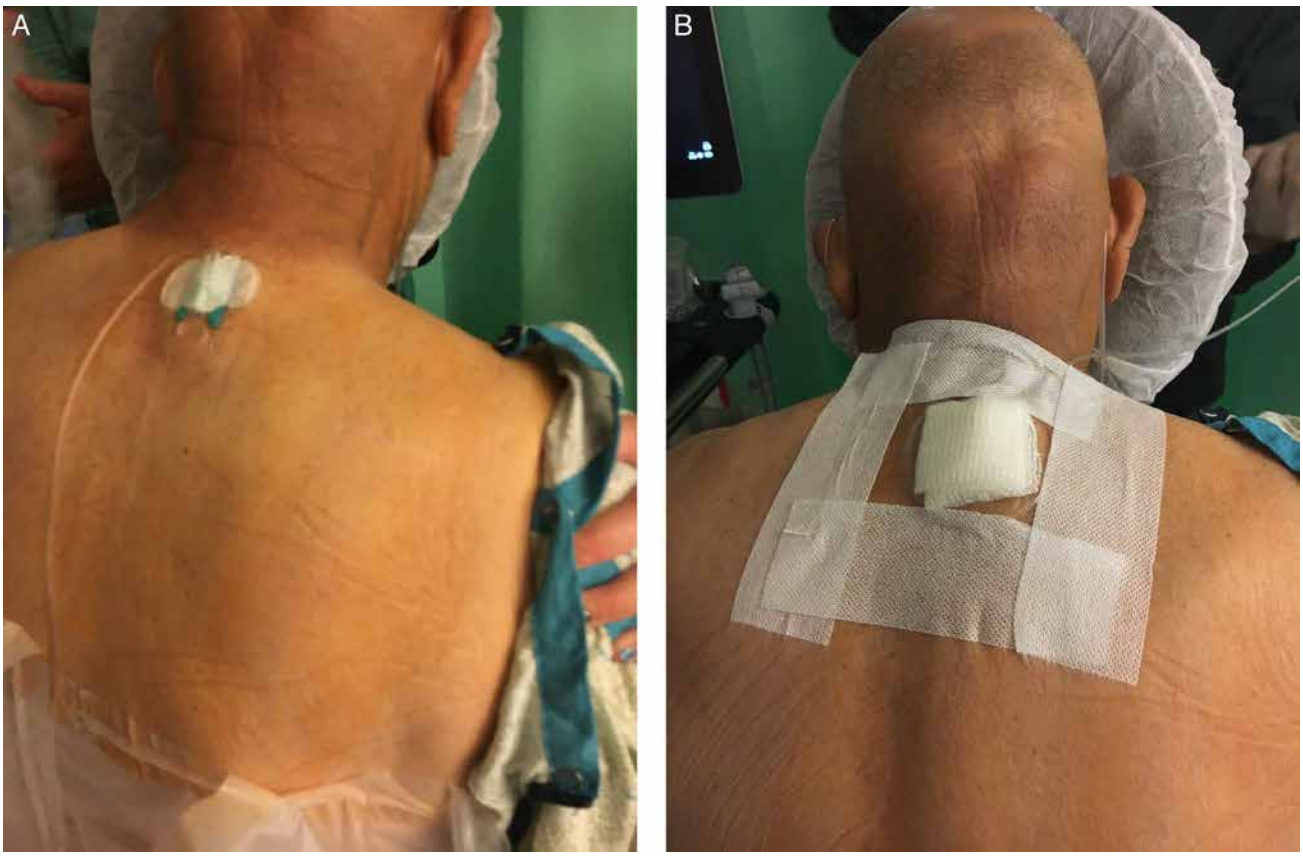


Figure 6: *Breakthrough pain is managed with small doses of IV opioid using programmed intermittent bolus. Using a catheter fixation device and meticulous dressing at the time of placement has reduced catheter dislodgement rates.*



with the programmed intermittent bolus regimen. Using a catheter fixation device and meticulous dressing at the time of placement has reduced catheter dislodgement rates (Figures 6A and B).

The APMS team communicates daily with the trauma surgery team regarding progress and discharge planning. The ESP catheter is kept in place as long as it is providing analgesic benefit. Factors such as respiratory status, ambulation, oral intake of medications, and chest tube removal are taken into account when deciding when to remove the ESP catheter. The catheter may also be removed if the site becomes infected, local anesthetic leaks, or at the patient's request. Currently, patients are not routinely discharged with ESP catheters in situ, although we have occasionally done so in selected patients who we judge are able to safely manage an ambulatory infusion of local anesthetic.

REFERENCES

1. Karmakar MK, Ho AM-H. Acute pain management of patients with multiple fractured ribs. J Trauma. 2003;54:615–625.
2. Malekpour M, Hashmi A, Dove J, et al. Analgesic choice in management of rib fractures: paravertebral block or epidural analgesia? Anesth Analg. 2017;124(6):1906–1911.
3. Forero M, Adhikary SD, Lopez H, et al. The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med. 2016;41(5):621–627.
4. Hamilton DL, Manickam B. Erector spinae plane block for pain relief in rib fractures. Br J Anaesth. 2017;118(3):474–475.

Combating the Opioid Epidemic: The UT Southwestern and Parkland Health Care System Experience

Despite several federal and state efforts to combat the opioid epidemic, opioid overdose remains one of the nation's pressing health care problems. Nearly 1,000 people present to emergency rooms daily requiring treatment from opioid overdose.[1] Approximately 90 deaths occur daily because of opioid overdose,[2] and 2 million Americans are dependent on prescription opioids. The majority of those opioids can be traced back to prescriptions, which are the main source fueling the epidemic. Several guidelines have been put in place to try to prevent these numbers from escalating.[3] However, with the new mandates and requirements, concerns surround limiting access to opioids for those who are in legitimate need along with burdening the health care system with new regulations that are time consuming and labor intensive.

Enas Kandil, MD, MSc
Assistant Professor
Anesthesiology and
Pain Management
University of Texas Southwestern
Medical Center
Dallas, Texas

Funding Statement: This work was supported in part by National Institutes of Health/National Center for Advancing Translational Sciences grants KL2TR001103 and UL1TR001105 from the UT Southwestern Center for Translational Medicine (Dr. Kandil).

Section Editor: Dalia Elmofty, MD

THE UT SOUTHWESTERN AND PARKLAND HEALTH CARE SYSTEM EXPERIENCE

Our efforts to address those concerns started in 2013 at the University of Texas Southwestern (UTSW) and Parkland Health Care Systems (PHS). Our initial goal was to assess our institutional status, opioid prescribing patterns, and risk assessment. Our project progressed to ensure our compliance with the new Centers for Disease Control and Prevention (CDC) opioid prescribing guidelines and Texas State Medical Board (TMB) opioid prescribing rules. Our focus revolved around transforming the electronic medical record (EMR) to alleviate the burden on opioid prescribers while ensuring proper assessment and monitoring. Through these efforts, we hope to maintain access to opioids for those in need while providing tools for adequate, effective, and time-efficient monitoring, leading to an overall improvement in patient outcomes and opioid safety.

PHS emergency room (ER) encounters 15–20 patients with suspected opioid overdoses monthly who require treatment with naloxone and subsequent admission. We conducted a retrospective cohort review of 385 of those patients' charts from January 2012–December 2014. Patients with chronic opioid prescriptions (OP) were more likely to have been previously diagnosed with mental health, cardiovascular, pulmonary, endocrine, or central nervous system disorders than those without OP (Figure 1). Nearly equal percentages of patients with and without OP had prior histories of substance abuse and were also equally likely to have positive urine drug screening (UDS) for cocaine during ER visit. Patients with OP were more likely to have presented to the ER for suspected overdose than those without prescriptions. It was noted that 66% of patients with OPs, of which 19% also had histories of substance abuse, had received no UDS in the 12 months prior to their ER admission (Figure 2).

"Confronting the opioid epidemic is a large undertaking that requires a multidisciplinary team approach."

This led us to conclude that we need a system-wide change that addresses opioid prescribing and patient monitoring. With support of the leadership at UTSW and PHS, two multidisciplinary teams were formed: the Opioid Workgroup at UTSW and the Opioid Stewardship Team at PHS. The teams consist of hospital executive leaders, pain management, primary care, pain pharmacists, medication safety personnel, quality improvement personnel, business analyst managers, medical informatics officers, and nurses. The objectives were to initiate and maintain a coordinated multidisciplinary effort that promotes the appropriate use of

Figure 1: *Patients with chronic opioid prescriptions were more likely to have been previously diagnosed with mental health, cardiovascular, pulmonary, endocrine, or central nervous system disorders than those without chronic opioid prescriptions on file.*

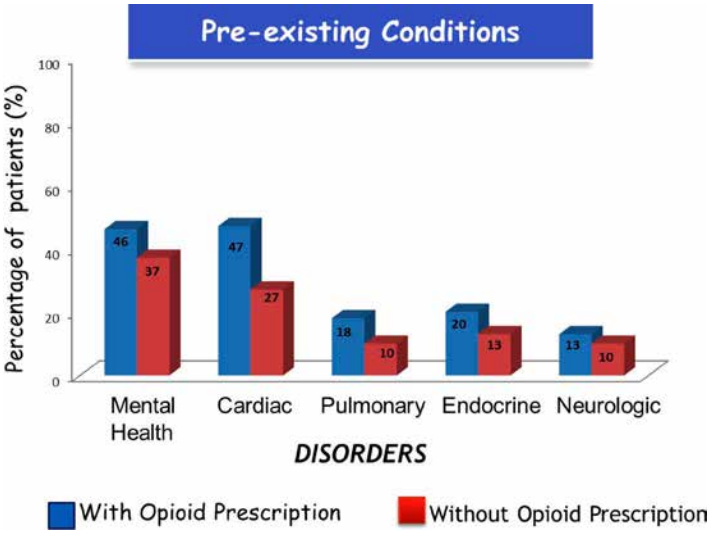
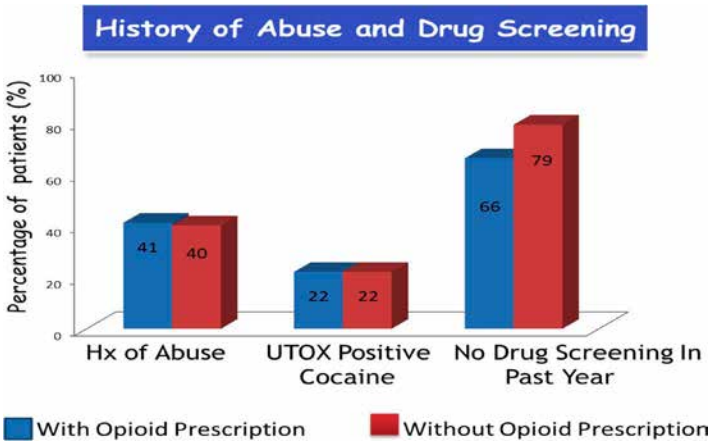


Figure 2: *Nearly the same percentage of patients with and without opioid prescriptions had charts noting prior histories of substance abuse. They were also equally likely to have positive urine toxicology screenings for cocaine during the current admission. A total of 66% of patients with opioid prescriptions, of which 19% also had histories of substance abuse, had received no urine drug screening in the 12 months prior to their ED admission.*



opioids, reduces opioid adverse effects, and improves patient outcomes.

Both institutions furnished an opioid policy detailing the requirements that ensure adherence to the CDC and TMB guidelines. Both institutions worked with EPIC system team builders to create an opioid registry and an opioid dashboard/pain navigator. The registry contains all patients with ICD-10 diagnosis for chronic pain, and it will be used to feed our opioid dashboard/pain navigator (Figure 3) for monitoring UDS, controlled substance agreements, and concomitant use of illicit substances, benzodiazepines, or alcohol.

To establish a baseline assessment, we identified all chronic pain patients in our ambulatory clinics at PHS. Patients were identified by ICD-10 code while excluding those with cancer pain. Patients with chronic pain diagnosis represented 37% of our ambulatory patient population, of which 9.4% are on chronic opioids (Table).

Prior to our education implementation, we assessed the percentage of patients with completed opioid agreement/consent signed, risk assessment tools documented on file, UDS over the past 12 months, suicide risk screen assessment, and history of drug and alcohol abuse. We found that the majority of patients had a suicide risk assessment on file (91.6%), whereas only a quarter of the ambulatory chronic pain patients on opioids had a UDS within the past 12 months, despite 16.6% having a history of illicit drug use and 25.9% having a documented history of alcohol abuse (Table). An understanding for the need and the value of opioid abuse risk assessment tools was lacking, as reflected by the low percentage (1.6%) of patients having an opioid risk assessment tool or addiction behavioral checklist completed on record. Our goal is at least 90% compliance in all fields when reassessed in 12 months.

Figure 3: *Opioid dashboard/pain navigator. ©2017 Epic Systems Corporation. Used with permission.*

Table: *Results of baseline assessment in ambulatory clinics.*

Baseline data	Numerator	Denominator	Percentage
Total ambulatory patients[a]			
Short-acting opioid only	2,151	23,786	9%
Long-acting opioid only	52	23,786	0.2%
Short- and long-acting opioid	39	23,786	0.2%
Ambulatory patients on opioids[b]			
Consent signed	379	2,242	16.9%
ORT/ABC baseline	35	2,242	1.6%
Urine drug screening	570	2,242	25%
Suicide risk screening	2,054	2,242	91.6%
Illicit drug abuse diagnosis	272	2,242	16.6%
Alcohol abuse diagnosis	581	2,242	25.9%

[a] Numerator represents all patients with chronic pain who are on chronic opioids. Denominator represents patients who have a diagnosis for chronic pain (ICD-10): 23,786, which represents 37% of our ambulatory population.
[b] Numerator represents the following categories: opioid consent/agreement completed, urine toxicology screen in past 12 months, suicide risk assessment, history of drug abuse, history of alcohol abuse. Denominator represents all patients with chronic pain who are on chronic opioids.

Several breakout workgroups targeted different areas pertaining to opioid safety. Areas with significant progress include:

1. Education to providers on the chronic opioid practice policy and CDC and TMB regulations. The educational process on campus is an ongoing effort, with our target audience starting with medical students. Quarterly lectures focus on nonopioids, coanalgesics, nonpharmacologic options, equianalgesic dosing of opioids, interpretation of UDS, and interesting case scenario presentations.
2. EPIC embedded smart phrases for the documentation of the new mandated requirements. Such phrases facilitate documentation and ease the process of prescribing in high-flow, busy primary care clinics.
3. Designing an opioid dashboard/pain navigator, which includes an informed consent and opioid agreement, UDS, and opioid risk assessment tool or addiction behavioral checklist.
4. Collaboration with other institutions nationwide through participation with Centers for Medicare and Medicaid Services, transforming clinical practice networks through collaborative projects, thus sharing our experience.
5. The toxicology workgroup is standardizing toxicology essays among all three teaching hospitals and re-evaluating toxicology order sets to unify, simplify, and ensure cost effectiveness.
6. The addiction workgroup is increasing patient access to medication-assisted treatment and increasing the number of providers who are buprenorphine licensed by providing certification classes on campus.

CONCLUSION

Confronting the opioid epidemic is a large undertaking that requires a multidisciplinary team approach and a system-wide change to ensure a meaningful impact. The new prescribing regulatory requirements place an increased burden on prescribers who are at higher risk for frustration and burnout. An integral part of the solution lies in using EMRs, thereby facilitating and standardizing documentation and simplifying opioid prescription practices while improving monitoring.

REFERENCES

1. Crane EH. Highlights of the 2011 Drug Abuse Warning Network (DAWN) findings on drug-related emergency department visits. Updated February 18, 2013. https://www.samhsa.gov/data/sites/default/files/DAWN127/DAWN127/sr127-DAWN-highlights.htm. Accessed December 16, 2017.
2. Rudd RA, Seth P, David F, Scholl L. Increases in drug and opioid-involved overdose deaths—United States, 2010–2015. MMWR Morb Mortal Wkly Rep. 2016;65(5051):1445–1452.
3. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain—United States, 2016. MMWR Recomm Rep. 2016;65(1):1–49.

Introduction to the Education in Regional Anesthesia Specialty Interest Group

Adam K. Jacob, MD
Associate Professor of Anesthesiology
Mayo Clinic
Rochester, Minnesota

Reva Ramlogan, MB, BS, FRCPC
Assistant Professor of Anesthesiology

Colin J. L. McCartney, MB, ChB, FRCA, FRCPC
Professor and Chair of the Department of Anesthesiology
University of Ottawa
Ottawa, Ontario, Canada

Section Editor: Kristopher Schroeder, MD

Helen Hayes is credited with saying, "The expert in anything was once a beginner." Nowhere is that more true than the specialty of regional anesthesia (RA). The best, fastest, and safest way to educate someone on the science and art of RA to achieve proficiency—let alone, expert status—is an often-debated subject without a clear consensus. How many blocks are necessary? What is the role of simulation or other learning aids? What strategy should be used: didactic, web-based, self-directed, or group learning? These questions and others have been investigated and considered in the ongoing discussion of how best to educate anesthesia trainees.[1–5] Compounding the complexity of these issues is the advancement and restructuring of residency training programs from a time-based model to a competency-based model through the achievement of specific milestones.

Technical proficiency is, of course, only one aspect of becoming competent in ultrasound-guided RA (UGRA). An equally important aspect of educating a trainee or current practitioner is the nontechnical nuances of RA: judgment, patient engagement, preparation, and follow-up. Furthermore, tracking outcomes and adverse events must be considered in the context of an individualized learning curve as well as ongoing practice improvement.

"Technical proficiency is, of course, only one aspect of becoming competent in ultrasound-guided RA."

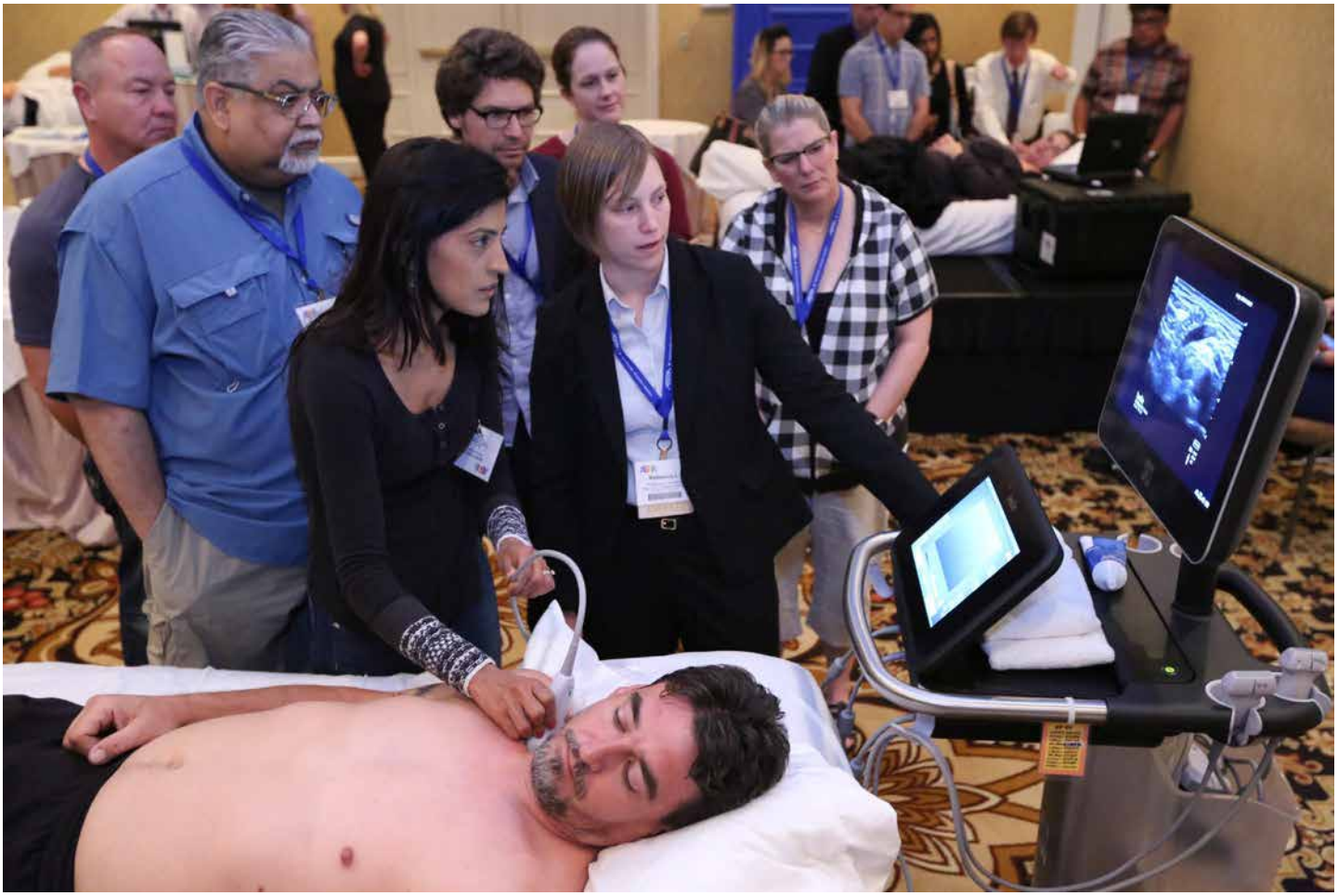
Addressing those challenges in the setting of a formal, structured anesthesia training program may be daunting. Guidelines to advise fellowship training in RA and acute pain medicine were first developed in 2005 and subsequently updated in 2010 and 2014.[6] These guidelines provide a comprehensive framework for fellowship programs to follow regarding organization, content, and evaluation. However, many learners seeking training in RA have already graduated from formal anesthesia training programs and are currently practicing.[7] Whether the same educational approach can be extrapolated to experienced, practicing clinicians interested in learning (or improving) UGRA skills has not been investigated and remains uncertain.

In 2013, Nix and colleagues[8] presented a comprehensive review of evidence for teaching UGRA. From that, they identified three gaps in knowledge: (1) teaching styles that lend themselves to improved knowledge retention and performance improvement, (2) methods to assess learners' performance that would allow comparison across institutions, and (3) trainer and trainee characteristics or attitudes to training in RA. Their efforts represented a significant step forward in understanding limitations in current educational programs. The relative ambiguity of how best to create competent and safe regional anesthesiologists who provide high-quality care creates an opportunity to identify the best-available evidence in educational strategies, identify gaps in knowledge and practice, and lead collaborative research efforts to close those gaps.

HISTORY AND STRUCTURE OF THE SPECIAL INTEREST GROUP (SIG)

Initially founded in 2016 by 26 ASRA members and led by Chair Dr Colin McCartney and Vice-Chair Dr Reva Ramlogan, the Education in RA SIG held its inaugural meeting at the 2017 ASRA meeting in San Francisco. The Education in RA SIG was established with the core mission of developing and advancing evidence-based educational best practices in RA training in the context of a competency-based educational model. Since its inception, the membership has grown to approximately 800 ASRA members. The SIG's goals and objectives are the following:

1. To promote an international collaboration for the development and advancement of assessment strategies of trainees in evidence-based education in RA
2. To develop methodology for the evaluation of assessment tools and simulation models, to determine the best instructional design and learning strategies for RA
3. To advance the education and implementation of RA techniques by anesthesiologists at all levels of training



Given the large size of the SIG and broad reach of education into other ASRA committees and interests, the SIG leadership created five liaison subcommittees: Continuing Medical Education (CME), Newsletter, Research, Podcast/Webcast, and Website. These liaison subcommittees were tasked with the following responsibilities:

- CME (led by Dr Stuart Grant, Duke University, Durham, North Carolina): Coordinate submitting panel suggestions, educational content, and meeting faculty to the scientific meeting planning committee and coordinate a monthly quiz question relevant to the SIG that would be sent to members and available on the website
- Newsletter (led by Dr Adam Jacob, Mayo Clinic, Rochester, Minnesota): Coordinate unique SIG newsletter articles for *ASRA News* and solicit a call to action for the quarterly communication to SIG members
- Research (led by Dr Alwin Chuan, University of New South Wales, Australia): Develop and maintain an online repository of ongoing research in education in RA and generate ideas for research in education in RA
- Webcast/Podcast (led by Dr Jaime Ortiz, Baylor College of Medicine, Houston, Texas): Coordinate the production of quarterly webcasts on a relevant SIG topic that is placed on the website and available to members
- Website (led by Dr Brian Allen, Vanderbilt University Medical Center, Nashville, Tennessee): Monitor the SIG webpage for updates, questions, and comments; disperse inquiries to the appropriate people; and develop and maintain a repository of key articles for the related SIG webpage

PROGRESS TO DATE

In the short time since the inception of the SIG, the liaison leaders and subcommittees have been working to achieve their own objectives as well as the broader goals of the SIG. Accomplishments to date include the following:

- Development of a series of education podcasts that will be published on the website
- Initiation of multinational studies and mentorship of investigators in trials design

- Collaboration with *ASRA News* editorial staff to broaden education-based content and highlight efforts of all ASRA SIGs
- Updates to the ASRA Education in RA SIG website that will occur over the next several months, including educational resources for those interested in teaching RA (eg, links to assessment tools, guidance on how to teach technical and nontechnical skills around RA, helpful information for those pursuing education research)

FUTURE MEETING

The next scheduled SIG meeting will be held during the 2018 World Congress on Regional Anesthesia and Pain Medicine, April 19–21, 2018, at the New York Marriott Marquis. For those unable to attend, a teleconference option will be available.

HOW CAN I JOIN?

The Education in RA SIG invites all ASRA members who share an interest in education to join for free. Members can join the SIG by contacting membership services or via the ASRA website (https://www.asra.com/page/1387/education-in-regional-anesthesia-sig).

REFERENCES

1. Neal JM, Gravel Sullivan A, Rosenquist RW, Kopacz DJ. Regional anesthesia and pain medicine: US anesthesiology resident training—the year 2015. Reg Anesth Pain Med 2017;42:437–441.
2. Allen BFS, McEvoy MD. Competency assessment in regional anesthesia: quantity today, quality tomorrow. Reg Anesth Pain Med 2017;42:429–431.
3. Niazi AU, Peng PW, Ho M, Tiwari A, Chan VW. The future of regional anesthesia education: lessons learned from the surgical specialty. Can J Anaesth 2016;63:966–972.
4. McCartney CJ, Mariano ER. Education in ultrasound-guided regional anesthesia: lots of learning left to do. Reg Anesth Pain Med 2016;41:663–664.
5. Neal JM. Education in regional anesthesia: caseloads, simulation, journals, and politics: 2011 Carl Koller Lecture. Reg Anesth Pain Med 2012;37:647–651.
6. Kopp SL, Hargett MJ, Liguori, GA, et al. Guidelines for fellowship training in regional anesthesiology and acute pain medicine: third edition, 2014. Reg Anesth Pain Med 2015;40:213–217.
7. Mariano ER, Harrison TK, Kim TE, et al. Evaluation of a standardized program for training practicing anesthesiologists in ultrasound-guided regional anesthesia skills. J Ultrasound Med 2015;34:1883–1893.
8. Nix CM, Margarido CB, Awad IT, et al. A scoping review of the evidence for teaching ultrasound-guided regional anesthesia. Reg Anesth Pain Med 2013;38:471–480.

ASRA Carl Koller Memorial Research Grant 2016: NMDA Antagonists and Steroids for the Prevention of Persisting Postsurgical Pain After Thoracoscopic Surgeries: A Randomized Controlled, Factorial Design, International, Multicenter Pilot Study

Study Acronym: *Preventing pAIn with NMDA antagonists—Steroids in Thoracoscopic lObectomy Procedures (PAIN-STOP) Pilot Trial*

Harsha Shanthanna, MBBS, MD, MSc, FIPP, EDRA
Associate Professor, Department of Anesthesia, McMaster University
Chronic Pain Physician, St. Joseph's Hospital
Associate Chair, Research, Department of Anesthesia, McMaster University
Hamilton, Ontario, Canada

Section Editor: Kristopher Schroeder, MD

The Carl Koller Memorial Research Grant supports research projects that enhance patient care by improving our understanding and delivery of regional analgesia and pain medicine interventions. This research funding goes a long way in promoting research endeavors from ASRA members within North America. As a recipient of this award for 2016, I would like to express my sincere appreciation and gratitude for the ASRA research committee and the Board of Directors. For a clinician researcher like me, it is a great encouragement and motivation to continue to engage in meaningful research work and bring value to clinical care. As it is also an acknowledgment of the importance of our research project, I would like to highlight its background, interventions, and significance, apart from a study update as of September 2017.

BACKGROUND

Persistent postsurgical pain (PPSP), which develops or increases after a surgical procedure, affects 10–50% of the surgical population[1] and has been recognized as a health priority. Thoracic surgeries have a high risk of PPSP, affecting 25–60% of patients.[2] Although video-assisted thoracic surgery eliminates the need for a rib-cutting incision, the risk of clinically significant PPSP still exists in 20–40% of patients.[3] Because no effective modality of prevention has been found, patients with PPSP continue to bear its consequences.

"The Carl Koller Memorial Research Grant supports research projects that enhance patient care by improving our understanding and delivery of regional analgesia and pain medicine interventions."

Physical and emotional suffering can lead to chronic pain and ultimately poor quality of life.[4] Surgical injury results in peripheral and central sensitization.[5] As central sensitization develops, pain signaling enhancement leads to uncoupling of pain stimulus and response (no stimulus or minimal stimulus can elicit a significant pain response). Central to those changes are the release of glutamate and its action on α-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid and N-methyl-D-aspartate (NMDA) receptors.[5,6] Many of these changes can be potentially altered by NMDA antagonists.[7]

Emerging evidence also supports the role of inflammatory-immune cascades in the development of neuropathic pain, even in the absence of a clinically observable nerve injury.[8] Thoracic surgery is major organ surgery and results in significant inflammatory and immune responses.[9] Corticosteroids can neutralize those inflammatory-immune responses and hence modify the development and perception of PPSP.[10,11]

STUDY INTERVENTIONS

Ketamine is a potent anesthetic and analgesic. It acts by blocking NMDA receptors in a noncompetitive fashion. At low doses, it has several perioperative benefits. At a dose of 1–6 µg/kg/min, it can have antihyperalgesic effects without significant cardiovascular and respiratory adverse effects.[12] The psychomimetic adverse effects are noted usually with a higher dose of ketamine (>2.5 µg/kg/min).[13,14] A recent Cochrane review observed a small but statistically important signal in its potential to decrease the chances of PPSP, both at 3 and 6 months, when used for a duration of more than 24 hours.[15] However, parenteral administration of ketamine is limited in some locations by the requirement for increased or enhanced monitoring.

Memantine is a moderate-affinity, uncompetitive NMDA receptor antagonist that blocks the sustained activation of the receptor by glutamate that may occur under pathologic conditions. Memantine rapidly leaves the NMDA receptor channel during normal physiological activation. It is 100% bioavailable after an oral dose, undergoes minimal metabolism, and exhibits a terminal elimination half-life of 60–80 hours.[16] Although it is presently approved for use in Alzheimer disease, its effects on preventing pain have been studied in both animal and human studies.[17,18] However, most existing studies are preliminary and small.

Steroids are potent anti-inflammatory agents and can affect both inflammatory and immune pathways.[11,19] Among commonly used agents, dexamethasone is nearly five times as potent as

Table 1: *Study summary including methods and outcomes.*

Title	*P*reventing p*Al*n with *N*mda antagonists-*S*teroids in *T*horacoscopic l*O*bectomy *P*rocedures (PAIN-STOP)
Project office	Population Health Research Institute, 237 Barton Street East, Hamilton, Ontario, Canada, L8L 2X2
Objective	**Feasibility:** To assess the feasibility of a larger RCT evaluating NMDA antagonists and IV steroids as compared with placebo to decrease the chances of clinically significant PPSP after VATS lobectomies **Clinical:** To determine the • Effect of study interventions on the presence and intensity of PPSP at 3 months after surgery • Rate of change in postoperative pain intensity measured over time • Use of narcotic analgesic medication more than 4 weeks after surgery • Presence of neuropathic pain • Interference with the activities of daily living and thoracic surgery–specific activity limitations • Change in global health status and quality of life • Incidence of serious adverse effects
Eligibility criteria	**Inclusion:** 18–75 years of age, undergoing elective VATS, and provided written, informed consent **Exclusion:** Current pain on the same side of the chest of moderate to severe intensity, known intracranial mass or cerebral aneurysm or raised intraocular pressure, severe renal impairment (creatinine clearance–based glomerular filtration rate of less than 30 mL/min), allergy to one or more of the study medications, history of schizophrenia or bipolar disease, history of drug addiction (prescription or nonprescription drug addiction diagnosed by a physician, excluding alcohol), steroid treatment with more than 10 mg/d of prednisolone or its equivalent for more than 3 weeks within the past 3 months, current diagnosis of Cushing syndrome, pregnancy, or previous participation in the PAIN-STOP trial
Design and sample size	Multicenter RCT with two-by-two factorial design with 48 patients
Study sites	St Joseph's Hospital at McMaster University in Hamilton, Canada, and Cleveland Clinic in Cleveland, Ohio
Study groups	(1) NMDA active + steroid placebo, (2) steroid active + NMDA placebo, (3) NMDA active + steroid active, and (4) NMDA placebo + steroid placebo
Interventions	**NMDA treatment:** Ketamine: 0.5 mg/kg IV bolus preincision and 0.1 mg/kg/hr infusion postoperatively up to 24 hours; oral memantine: 5 mg BID (first week) and 10 mg BID (following 3 weeks) **Steroids:** Two doses of dexamethasone 25 mg given prior to starting surgery and on the morning of the second postoperative day
Primary outcomes	Proportion of (1) eligible patients recruited, (2) patients adhering to the study protocol, and (3) patients completing the follow-up at 3 months
Secondary outcomes	(1) Intensity of PPSP on a scale of 0–10 at 3 months postsurgery, (2) incidence of more than 3/10 PPSP with movement at 3 months, (3) the rate of change of postoperative pain intensity measured over time (pain trajectory), (4) use for narcotic analgesic medication more than 3 d/wk beyond 4 weeks and up to 3 months, (5) presence of neuropathic pain, (6) interference with activities of daily living based on the Brief Pain Inventory at 3 months, (7) thoracic surgery–specific activity limitations assessed using a quantitative scale at 3 months, (8) change in health status using a global impression of change scale at 3 months, and (9) quality of life (European Organization for Research and Treatment of Cancer 30 scale) at 3 months
Tertiary outcomes	Incidence of (1) myocardial infarction and myocardial injury after noncardiac surgery; (2) postoperative pneumonia; (3) surgical site infection; (4) need for new, positive-pressure ventilation; and (5) prolonged air leak
Follow-up	In hospital, phone call at day 8 and month 2, and in-person follow-up visits at 1 month and 3 months postrandomization; for patients who cannot attend in person, a telephone follow-up will be done

Abbreviations: BID, twice-a-day dose; IV, intravenous; NMDA, N-methyl-D-aspartate; PPSP, persistent postsurgical pain; RCT, randomized control trial; VATS, video-assisted thoracoscopic surgeries.

methylprednisolone, with a biological half-life of 36–72 hours.[11] Its potential to improve perioperative outcomes without significant harm have been recognized in abdominal, orthopedic, and other surgeries.[20–22] As identified in the Cochrane review, despite the potential for steroids to modify PPSP, overall, their effect on PPPS has not been well studied.[15]

PROPOSAL

The PAIN-STOP pilot trial is a multicenter randomized controlled trial (RCT) of 48 patients. This RCT will use a two-by-two factorial design to evaluate NMDA antagonists versus placebo and intravenous dexamethasone versus placebo. Patients will be stratified based on site. Because the interventions work through different biologic pathways, we do not expect a negative interaction; hence, they are ideal drugs to study using a factorial design in a single trial to increase the efficiency by capitalizing on the resources required for an RCT.[23] Patients, health care providers, data collectors, outcome adjudicators, and investigators will all be blind to treatment allocation. The study methods and outcomes are highlighted in Table 1.

STRENGTHS

- The study focuses on an important and challenging question that has been identified as a health priority.[24]
- The study interventions have sound biologic rationale and have been identified as potentially promising for preventing PPSP. More importantly, the interventions potentially cover the period of transition from acute to chronic pain, as suggested by the concept of preventive analgesia.[7,25]
- The factorial design allows for better efficiency in resources and cost, allowing for assessment of two different interventions.
- The clinical outcomes satisfy the definition of PPSP by ICD-11[26] and include clinically important, patient-relevant outcomes.
- The design is a multicenter, international study that demonstrates the feasibility of a larger international trial with the potential for greater clinical translation and applicability.
- The study team includes experienced and well-recognized clinician investigators, research methodologists, and content experts.
- The study is being coordinated from the Population Health Research Institute at McMaster University in Hamilton, Canada, which is recognized as a leading research institute engaged in the conduct of large-scale, high-impact, randomized clinical trials.

LIMITATIONS

- The timing, dose, and duration of study interventions have been planned based on their biologic rationale and potential for clinical applicability, as a pragmatic study. However, the study will not be able to provide information on possible dose-dependent effects or the impact of a different duration of study interventions.

FUNDING

- 2016 Carl Koller Memorial Research Grant award, ASRA, in July 2016 with USD 50,624.20
- Michael G. DeGroote Institute of Pain Research and Care seed grant, McMaster University, 2016 for CAD 30,000

REGISTRATION

https://clinicaltrials.gov/ct2/show/NCT02950233?term=PAIn+STOP&draw=1&rank=1

STUDY CHALLENGES

- Acquisition of memantine tablets at 5-mg and 10-mg strengths from a licensed supplier
- Obtaining approval of health regulatory authorities
- Collaborating and coordinating interdepartmental involvement (anesthesiologists, surgeons, pharmacy, nursing, clinical research) for the smooth conduct of the trial.

STUDY UPDATES

As of September 2017, the following updates indicate the study progress.

- The study has obtained approval of health regulatory authorities (Health Canada and the US Food and Drug Administration) for the use of investigational drugs.
- The study's memantine and placebo medications were encapsulated, labeled, and packaged.
- After approval from the ethics board, the study has been initiated at McMaster University in Hamilton, Canada, since May 2017.
- An ethics committee application at Cleveland Clinic will be submitted in October 2017.
- Ten patients have been recruited and completed their surgery.
- The study started at Cleveland Clinic in November 2017.
- Recruitment will be completed by April 2018 and follow-up completed by July 2018.

ACKNOWLEDGMENTS

I would like to acknowledge the support from our funding agencies and the entire PAIN-STOP investigating team.

REFERENCES

1. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet 2006;367(9522):1618–1625.
2. Wildgaard K, Ravn J, Kehlet H. Chronic post-thoracotomy pain: a critical review of pathogenic mechanisms and strategies for prevention. Eur J Cardiothorac Surg 2009;36(1):170–180.
3. Gottschalk A, Cohen SP, Yang S, Ochroch EA. Preventing and treating pain after thoracic surgery. Anesthesiology 2006;104(3):594–600.
4. Gureje O, Von Korff M, Simon GE, Gater R. Persistent pain and well-being: a World Health Organization Study in Primary Care. JAMA 1998;280(2):147–151.
5. Woolf CJ. Central sensitization: implications for the diagnosis and treatment of pain. Pain 2011;152(3 suppl):S2–S15.

6. Woolf CJ, Thompson SW. The induction and maintenance of central sensitization is dependent on N-methyl-D-aspartic acid receptor activation; implications for the treatment of post-injury pain hypersensitivity states. Pain 1991;44(3):293–299.
7. Himmelseher S, Durieux ME. Ketamine for perioperative pain management. Anesthesiology 2005;102(1):211–220.
8. Ellis A, Bennett DL. Neuroinflammation and the generation of neuropathic pain. Br J Anaesth 2013;111(1):26–37.
9. Amar D, Zhang H, Park B, Heerdt PM, Fleisher M, Thaler HT. Inflammation and outcome after general thoracic surgery. Eur J Cardiothorac Surg 2007;32(3):431–434.
10. Zhang JM, An J. Cytokines, inflammation, and pain. Int Anesthesiol Clin 2007;45(2):27–37.
11. Becker DE. Basic and clinical pharmacology of glucocorticosteroids. Anesth Prog 2013;60(1):25–31.
12. Jouguelet-Lacoste J, La Colla L, Schilling D, Chelly JE. The use of intravenous infusion or single dose of low-dose ketamine for postoperative analgesia: a review of the current literature. Pain Med 2015;16(2):383–403.
13. Mathews TJ, Churchhouse AM, Housden T, Dunning J. Does adding ketamine to morphine patient-controlled analgesia safely improve post-thoracotomy pain? Interact Cardiovasc Thorac Surg 2012;14(2):194–199.
14. Wang L, Johnston B, Kaushal A, Cheng D, Zhu F, Martin J. Ketamine added to morphine or hydromorphone patient-controlled analgesia for acute postoperative pain in adults: a systematic review and meta-analysis of randomized trials. Can J Anaesth 2016;63(3):311–325.
15. Chaparro LE, Smith SA, Moore RA, Wiffen PJ, Gilron I. Pharmacotherapy for the prevention of chronic pain after surgery in adults. Cochrane Database Syst Rev 2013;7:CD008307.
16. Kumar S. Memantine: pharmacological properties and clinical uses. Neurol India 2004;52(3):307–309.
17. Fayed N, Olivan-Blazquez B, Herrera-Mercadal P, et al. Changes in metabolites after treatment with memantine in fibromyalgia: a double-blind randomized controlled trial with magnetic resonance spectroscopy with a 6-month follow-up. CNS Neurosci Ther 2014;20(11):999–1007.
18. Takeda K, Muramatsu M, Chikuma T, Kato T. Effect of memantine on the levels of neuropeptides and microglial cells in the brain regions of rats with neuropathic pain. J Mol Neurosci 2009;39(3):380–390.
19. Rhen T, Cidlowski JA. Antiinflammatory action of glucocorticoids—new mechanisms for old drugs. N Engl J Med 2005;353(16):1711–1723.
20. Lunn TH, Kehlet H. Perioperative glucocorticoids in hip and knee surgery—benefit vs. harm? A review of randomized clinical trials. Acta Anaesthesiol Scand 2013;57(7):823–834.
21. Srinivasa S, Kahokehr AA, Yu TC, Hill AG. Preoperative glucocorticoid use in major abdominal surgery: systematic review and meta-analysis of randomized trials. Ann Surg 2011;254(2):183–191.
22. Turan A, Sessler DI. Steroids to ameliorate postoperative pain. Anesthesiology 2011;115(3):457–459.
23. Whelan DB, Dainty K, Chahal J. Efficient designs: factorial randomized trials. J Bone Joint Surg Am 2012;94(suppl 1):34–38.
24. International Association for the Study of Pain. IASP sponsors global year against pain after surgery. January 19, 2017. Available at: https://www.iasp-pain.org/files/2017GlobalYear/News Release for 2017 Global Year.pdf. Accessed September 28, 2017.
25. Katz J, Seltzer Z. Transition from acute to chronic postsurgical pain: risk factors and protective factors. Expert Rev Neurother 2009;9(5):723–744.
26. Treede RD, Rief W, Barke A, et al. A classification of chronic pain for ICD-11. Pain 2015;156(6):1003–1007.

Integrating Spiritual Care in an Acute Pain Service

Adrianne Dyer, MAPS, BCC
Spiritual Care Provider

Debra B. Gordon RN, DNP, FAAN
Co-Director

Ivan Lesnik, MD
Chief and Co-Director

Harborview Integrated Pain Care Program
Harborview Medical Center
Anesthesiology and Pain Medicine
University of Washington
Seattle, Washington

Spirituality is the aspect of humanity that refers to the way individuals seek and express meaning and purpose. Spirituality frames the way "people experience their connectedness to the moment, to self, to others, to nature and to the significant or sacred."[1] Spirituality has been described as a dimension of life and what it means to be human.[2] We are more than psychological, social, and physical beings; we are also spiritual beings. Therefore, when faced with a medical illness or injury, a patient not only needs medical care to address a diagnosis and treatment but will also benefit from spiritual care to aid in overall spiritual well-being.

Spiritual well-being is a multidimensional construct that includes a sense of meaning and purpose, inner peace, strength, and comfort.[3] Spiritual well-being is recognized as an important indicator of quality of life, and the importance of spirituality in holistic patient-centered care is being increasingly recognized.[4]

INTEGRATING SPIRITUAL CARE IN AN ACUTE PAIN SERVICE (APS)

The Harborview Medical Center (HMC) is a 413-bed, level 1 trauma center located in the center of Seattle. It is part of the University of Washington. As a county-owned and safety-net hospital, HMC's mission is to provide a significant level of care to low-income, uninsured, and vulnerable populations. The HMC APS provides care to a high number of patients with complex pain conditions across multiple key clinical services, including perioperative, emergency, trauma, medical, and palliative care services.

Although many hospitals have dedicated spiritual care services with assignments to intensive care units or palliative care services, our program is unique in having a dedicated spiritual care provider as an integrated member of an anesthesiology-based APS. Our rationale is that the experience of pain is biopsychosocial, rooted not only in physical sensations but also emotional, cognitive, spiritual, and social elements.

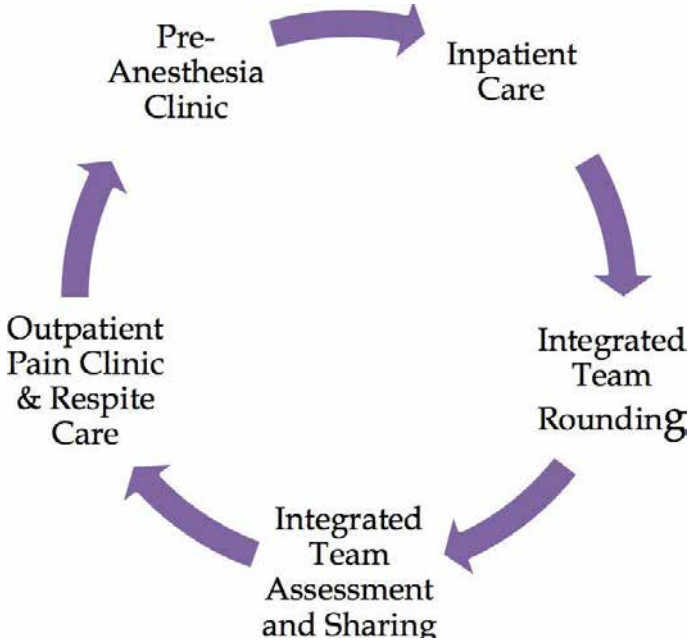
Traditionally, an APS focuses on pharmacologic management and regional analgesia offered by physicians with limited interdisciplinary and integrated services. Acute pain, experienced while hospitalized, often short-circuits the reflective process and can lead to a desire to pursue an unrealistic immediate quick fix or resolution with pain medications. When patients experience pain, they may feel a sense of loss of control, become concerned about the source of the pain, experience isolation, or become overwhelmed when the pain becomes dire or chronic.[5] The treatment of pain from a purely pharmacologic standpoint is rarely, if ever, transformative. In the words of Richard Rohr, "If we do not transform our pain, we will most assuredly transmit it."[6] This phenomena points to the vital need to practice more holistic care. Pain and suffering are multifaceted; leaning into pain and suffering is the key to moving through it. Understanding the broader context of pain and suffering that patients experience is necessary to help in the transformation of pain.[7]

"Spiritual care aims to empower patients to discover, claim, and rely on their inner religious or spiritual resources as integral and valid treatment interventions as part of a multimodal plan of care."

When people encounter a medical condition, sometimes the impact of their experience can lead to a spiritual struggle. Like approaching a fork in the road, patients may engage with their medical reality that leads them to a place of renewal, growth, or change. On the other hand, a medical situation can lead patients to despair, hopelessness, and meaninglessness.[2]

In response to spiritual struggles, patients may need to confront what they have held as significant or sacred and perhaps need to let go, reframe, or reengage their spiritual resources in a new way.[2] In that movement of change or transformation, patients may feel afraid and

Figure 1: *Pain service continuum of care.*



unsure. Spiritual care providers have distinct skills and training to explore spiritual history, identify and respond to spiritual concerns, identify and navigate spiritual struggle, empower patients to draw on their own spiritual resources, and assess how those aspects hinder or help patients journey toward health and well-being.

When patients who are suffering with acute or chronic pain are supported in their human essence to be reflective about their life and assess their personal story, they can better evaluate aspects or decisions they are making in their life.[8] That support comes not in the form of a diagnosis but rather through the practice of compassionate care. Christina M. Puchalski, MD, MS, writes that compassionate care occurs when care providers walk with patients in the midst of their pain. The means of effective medical care is to pay attention to the patient as a whole, not just the specific illness or symptoms.[9]

Spirituality plays an important factor in how patients face illness, suffering, loss, and recovery. Spiritual care providers help patients draw on, search for, and/or assist in reframing meaning and acceptance in the midst of their suffering and illness.[9] The Association of American Medical Colleges endorses the concept of spirituality as an expression of an individual's search for ultimate meaning through participation in religion or belief in God, family, naturalism, rationalism, humanism, or the arts. Understanding and attending to all these factors can influence how patients and health care professionals perceive health and illness and how they interact.[10] The integration of a spiritual care provider on the APS team has enhanced efforts to better understand and answer the question of what are we treating (eg, physical pain, emotional distress, spiritual distress, all in one)?

We developed an APS model that includes availability of a spiritual care provider throughout the pain service continuum of care (Figure 1). Spiritual care provides a variety of interventions (Figure 2) to support patients, their families, and staff that is culturally sensitive and compassionate, respecting diversity, demographics, faiths, and beliefs. Spiritual care providers listen intently to patients stories in order to capture aspects of their internal soul and how that soul is integrated or detached from their health concerns.[11] By using spiritual care assessment (Figure 3), the APS team is able to understand the patient's needs, hopes,

Figure 2: *Spiritual care interventions.*

Spiritual care providers listen to try to "capture the soul" of a patient and how that inner soul is integrated or detached from the patient's health concerns.[11] • Listen with empathy • Engage in narrative dialogue • Facilitate and give witness to grief or loss testimony • Provide a calm and supportive presence • Address meaning, purpose in life, and sense of wholeness through life review • Attend emotionally to sadness, anxiety, hope, fear, anger, and crisis intervention

Figure 3: *Spiritual assessment.*

Questions to Ask:
How does spirituality or religious beliefs aid in coping and healing?
How does this individual's spirituality contribute to his or her sense of spiritual well-being, hope, healing, coping, or adversity?
How does this person uniquely maintain his or her own human spirit?[11]
What has this person lost, historically or anticipatory?[11]
What does this person need from me emotionally?[11]
What sustains this person as he or she deals with this chronic condition?
Where does he or she find strength?
Care Approaches:
• Attempt to identify and unearth spiritual or religious resources to promote healing, help with pain and suffering, and increase peace of mind. • Provide prayer and scripture, administer rituals, and secure outside clergy for specific ritual needs. • Explore and acknowledge grief and distress, including loss of connection to the divine, self, social dynamics,or others. • Notice and invite reflection on the gap between spiritual resources and current experience, and facilitate greater intervention and integration. • Attend to uncertainty about future and hope. • Assist in reframing meaning and purpose; finding meaning may not be about *doing* things different but rather *seeing* familiar things in new ways.[12]

distress, and religious or spiritual resources. Finding meaning and purpose many not be about doing things differently but rather seeing familiar things in new ways.[12]

Spiritual care services provides the APS team, including resident anesthesiologists, and pain clinic staff with information and didactics to help broaden their understanding of spiritual care. Spiritual care providers round together with the entire APS team (and independently), providing oral and written communication to increase the team's awareness of patients' spiritual distress, connection to pain, and inner resources.

Spiritual care aims to empower patients to discover, claim, and rely on their inner religious or spiritual resources as integral and valid treatment interventions as part of a multimodal plan of care. For example, a patient was admitted for a complex infection; the patient was alone, in distress, and had high pain management needs. As spiritual care engaged in the patient's story, it became apparent that the patient was suffering from unresolved grief (the loss of a loved one a year prior). The patient's unresolved grief was interwoven with his discomfort and limited his ability to cope with acute pain. As the patient's grief was addressed and supported, the patient's physical discomfort decreased, and the patient was better able to cope through the duration of his hospital stay.

In another example, a patient came to the pain clinic for a presurgical consultation for back surgery. The patient was feeling apprehensive about having another surgery because of her history of chronic back pain and previous back surgeries. Spiritual care was able to meet with the patient in the pain clinic and listen to the patient's anxiety, concerns, and hopes for her upcoming surgery and long-term health. Spiritual care was able to assess the patient's spiritual resources and draw on them during her subsequent hospital stay to help her cope through discomfort and anxiety while being hospitalized. Upon hospital discharge and pain clinic follow-up, the patient was appreciative of the holistic support she received from the APS team throughout her medical care and procedure.

SUMMARY

It has been our experience that integration of spiritual care in an APS has demonstrated an increase in building of essential trust, rapport, and patient engagement in plans of care. The focus of pain service treatment has deepened and broadened to include reinforcement of spiritual resources and greater empathy for how grief and spiritual distress affect patients. When patients feel heard and understood and believe that their spiritual needs have been addressed, providers report decreased need for opioid pain medications. Affirming and assisting patients in reframing their connection to meaning, purpose, and spiritual resources establishes hope for transformation. It has also created opportunity to draw on nonpharmacologic resources as tools to assist with effective pain management.

REFERENCES

1. Puchalski C, Ferrell B, Virani R, et al. Improving the quality of spiritual care as a dimension of palliative care: the report of the Consensus Conference. J Palliat Med 2009;12(10):885–904.
2. Pargament K. Spiritually Integrated Psychotherapy. New York, New York: The Guilford Press; 2007.
3. Bai M, Dixon JK. Exploratory factor analysis of the 12-item functional assessment of chronic illness therapy-spiritual well-being scale in people newly diagnosed with advanced cancer. J Nurs Meas 2014;22(3):404–420.
4. Mundle R. A narrative analysis of spiritual distress in geriatric physical rehabilitation. J Health Psychol 2015;20(3):273–285.
5. Cassel EJ. The nature of suffering and the goals of medicine. N Engl J Med 1982;306(11):639–645.
6. Rohr R. Things Hidden: Scripture as Spirituality. Cincinnati, Ohio: Franciscan Media; 2008.
7. Groves RF, Klauser HA. The American Book of Living and Dying: Lessons in Healing Spiritual Pain. Berkeley, California: Celestial Arts; 2009.
8. Nouwen H. Can You Drink This Cup? Notre Dame, Indiana: Ave Maria Press; 1985.
9. Puchalski C. The role of spirituality in health care. Proc (Bayl Univ Med Cent) 2001;14(4):352–357.
10. Association of American Medical Colleges. Report III: Contemporary issues in Medicine: Communication in Medicine. Medical School Objectives Project. 1999:25–26. https://members.aamc.org/eweb/upload/Contemporary%20Issues%20In%20Med%20Commun%20in%20Medicine%20Report%20III%20.pdf. Accessed December 12, 2017.
11. Hilsman GJ. Spiritual Care in Common Terms: How Chaplains Can Effectively Describe the Spiritual Needs of Patients in Medical Records. London, United Kingdom: Jessica Kingsley Publishers; 2017.
12. Remen RN. My Grandfather's Blessing: Stories of Strength, Refuge, and Belonging. New York, New York: Riverhead Books; 2000.

Intravenous Regional Anesthesia: A New Look at an Old Technique

Cody Rowan, MD
Assistant Professor
Department of Anesthesiology
University of North Carolina
Chapel Hill, North Carolina

Elizabeth Wilson, MD
Assistant Professor
Department of Anesthesiology
University of Wisconsin
Madison, Wisconsin

Section Editor: Kristopher Schroeder, MD

BACKGROUND

More than a century has passed since Dr August Bier first described vein anesthesia as a rapid-onset anesthetic technique for extremity surgery. The process required exsanguination of the extremity, application of a tourniquet, vascular cutdown for access, and administration of local anesthetic. The technique was considered cumbersome, and with the introduction of brachial plexus blockade, it was largely forgotten. However, in 1963, C. Holmes published a case series in *Lancet* using dilute lidocaine for intravenous anesthesia, thus reviving interest in the anesthetic technique.[1]

Today, the technique is commonly referred to as a Bier block or intravenous regional anesthesia (IVRA). It has been refined over the years and remains a core skill for anesthesiologists worldwide. Although IVRA has been used for lower-extremity surgery, it is most commonly performed on upper extremities for planned surgical procedures 60 minutes or shorter in duration. Indications, contraindications, advantages, and disadvantages as well as potential adverse outcomes must be considered when selecting IVRA as an anesthetic plan (see Table 1).

TECHNIQUE

IVRA is a simple, effective anesthetic technique with a reported success rate of 96–100%.[2] Preparation for the block should ensure standard American Society of Anesthesiologists monitors application, adequate nil per os status, and immediate access to resuscitation equipment, including lipid emulsion. The technique requires reliable intravenous access in the operative extremity near the surgical site. Following Esmarch bandage exsanguination, the tourniquet is inflated. Tourniquet use has several accepted approaches, including single or double tourniquet and proximal (upper arm) or distal (forearm) tourniquet. Recently, use of a forearm tourniquet has increased because of diminished tourniquet pain and potentially improved safety with the use of decreased local anesthetic volumes.[3–5]

Although optimal inflation pressure has not been determined, the tourniquet is typically inflated to 100 mm Hg over systolic blood pressure or to a minimum of 250 mm Hg.[6,7] After the bandage is removed, local anesthetic is injected into the cannulated vein distal to the tourniquet. Dilute lidocaine (0.5%) is the most commonly used local anesthetic, and the total dose should not

Table 1: *Considerations for IVRA.*

Indications	Contraindications	Advantages	Disadvantages	Potential adverse events
Extremity surgery shorter than 60 min in duration Examples: Carpal tunnel release Dupuytren release Neuroma excision Fracture reduction	Absolute: Sickle cell disease Raynaud disease Berger disease A/V shunt Local anesthetic allergy Patient refusal Relative: Local Infection Paget disease PVD Uncontrolled HTN Crush injury	Simple, reliable Cost-effective Rapid recovery of function Bloodless field Avoidance of general anesthesia	Limited to short surgical procedures Minimal postoperative analgesic benefits	LAST Compartment syndrome Nerve injury Skin discoloration Thrombophlebitis

Abbreviations: A/V, arteriovenous; LAST, local anesthetic systemic toxicity; HTN, hypertension; IVRA, intravenous regional anesthesia; PVD, peripheral vascular disease.

Table 2: *Additives used for intravenous regional anesthesia.*

Additive	Common dose	Potential benefits
Alpha-agonists		
Dexmedetomidine	0.5–1 µg/kg	Faster onset, improved analgesia
Clonidine	1–2 µg/kg	Improved tourniquet tolerance
Opioids		
Sufentanil	25 µg	Faster onset
Fentanyl	50–200 µg	Reduced local anesthetic dose
Tramadol	50–100 mg	Faster onset, better tourniquet tolerance
Meperidine	100 mg	Improved tourniquet tolerance
Ketorolac	20 mg	Improved analgesia
Dexamethasone	8 mg	Faster onset, improved analgesia

exceed 3 mg/kg. Following injection, the intravenous catheter is removed, pressure is held on the site, and within 5–10 minutes, reliable surgical anesthesia is achieved with adequate muscle relaxation. Once the surgical procedure is complete, the tourniquet is deflated. Following 25–30 minutes of tourniquet time, most of the lidocaine is bound to local tissue, and the risk of local anesthetic systemic toxicity (LAST) should be significantly diminished. However, a recent retrospective cohort study saw no increase in major complications for tourniquet times less than 20 minutes.[8]

Multiple mechanisms are responsible for surgical anesthesia during IVRA. Local anesthetic is carried through the veins to the intraneural capillary plexus, where it reaches the terminal nerve endings and secondarily diffuses out of the vascular space to affect local nerves. In addition, tourniquet inflation leads to ischemia as well as nerve compression; however, this is often delayed and not the primary mechanism for anesthesia.[9]

SAFETY

IVRA is safe but not entirely without the risk of complications. Bupivacaine was once used for IVRA in an attempt to improve postoperative analgesia. Its use was abandoned after reports of LAST upon tourniquet release; this was especially true in cases of premature release of the tourniquet.[10] LAST during IVRA may still occur despite the use of less cardiotoxic lidocaine, with seizures reported at doses as low as 1.4 mg/kg and cardiac arrest with doses as low as 2.5 mg/kg. Importantly, seizures have been reported after tourniquet deflation, despite tourniquet times up to 60 minutes, and may also occur up to 10 minutes after the tourniquet is completely deflated. This indicates the need for continued vigilance during tourniquet deflation and during transport from the operating room, as this may fall within the window of time that seizures may occur.[11]

The most common local anesthetics for IVRA are lidocaine (United States) and prilocaine (Europe).[12] Given that ropivacaine is less cardiotoxic than bupivacaine, several studies have investigated the use of ropivacaine for IVRA. Ropivacaine use results in similar onset times and tourniquet tolerance as with lidocaine but increased time to recovery of sensory and motor function and improved postoperative analgesia. Cardiotoxicity is still possible with ropivacaine, and its widespread use for IVRA is limited by this potential. However, a recent review of studies evaluating ropivacaine IVRA described tinnitus and dizziness as reported complications but no cases of cardiotoxicity.[12]

Complications unrelated to local anesthetic administration may also occur. The most serious of these is compartment syndrome, either as a result of the tourniquet itself (unrelated to the use of local anesthetics) or the inadvertent use of hypertonic saline as the diluent for the local anesthetic. Nerve injury may occur and is associated with longer tourniquet times, higher tourniquet inflation pressures, and younger patient age. Petechiae or other skin discoloration and hypertension with tourniquet inflation have been reported. Thrombophlebitis has been reported with chloroprocaine and lidocaine and is more common with preservative-containing local anesthetic solutions.[11]

ADDITIVES

The primary disadvantage of IVRA compared with nerve or plexus blocks is the provision of limited postoperative pain relief. As the procedure is now more than 100 years old, many modifications to the original Bier block, particularly additives, have been evaluated (see Table 2).

The study of additives in IVRA is difficult in that systemic absorption of the additive must always occur after tourniquet deflation; hence, careful protocol design must attempt to exclude the systemic effect

of the medication and isolate its block-related effect. Additives may improve the block's quality, onset time, duration, or performance (ie, motor block). Opioids added to IVRA may improve tourniquet pain and onset time modestly; these benefits are generally not outweighed by the significant occurrence of nausea, vomiting, and sedation at tourniquet deflation.[13] Recent interest in the use of tramadol and sufentanil as adjuncts in IVRA is inspired by the local anesthetic-like properties of both drugs; indeed, both agents seem to shorten the onset of sensory block. However, neither appears to confer significant postoperative analgesic benefits. The addition of nondepolarizing muscle relaxants may improve motor block and in combination with fentanyl may result in acceptable blockade at a reduced dose of local anesthetic. This benefit, however, is offset by the potential for increased sensory block onset time. Furthermore, the theoretical analgesic benefit of muscle relaxants added to IVRA solutions (through reduction in muscle spasm) has not been convincingly shown.[12]

"Intravenous regional anesthesia is one of the oldest anesthetic techniques still in use today. More than 100 years of experience attest to its safety and utility in a wide variety of procedures."

The use of nonsteroidal anti-inflammatory drugs (NSAIDs) as adjuncts for IVRA has been widely studied. A review by Choyce and Peng in 2002 summarized the state of the literature at that time, with ketorolac shown to reduce postoperative pain after IVRA.[13] However, the subsequent retraction of several articles published regarding NSAIDs and acute pain have clouded the picture.[14] Recent studies have indirectly addressed that question by investigating the use of additional adjuvants. Two of those studies have associated ketorolac with postoperative pain and analgesic requirements when added to the IVRA solution compared with lidocaine alone but did not include a systemic administration control group.[15,16]

Clonidine and dexmedetomidine have also been added to IVRA solutions with mixed results. Clonidine may increase tourniquet tolerance time and modestly reduce postoperative pain scores, but sedation and hypotension after tourniquet release are significant adverse effects.[13] Dexmedetomidine is more selective for alpha-2 receptors than clonidine, which accounts for its preferential sedative over hemodynamic effects. At doses of 0.5–1 µg/kg added to lidocaine, dexmedetomidine improves postoperative analgesia and may shorten sensory block onset time.[17,18] Importantly, hemodynamic changes (bradycardia, hypotension) may still occur with dexmedetomidine but seem less severe than with clonidine.

A wide variety of other additives have been studied to improve IVRA, although most studies are small and often limited by the lack of a systemic control group. Dexamethasone in a dose of 8 mg added to plain lidocaine 3 mg/kg shortens block onset and improves postoperative analgesia in some small studies,[19] and this effect may be magnified by the addition of other additives such as ketorolac.[16] The addition of ketamine to the block solution improves postoperative and intraoperative analgesic requirements[20]; however, this effect seems to be no different than with systemic administration.[21] The addition of potassium[22] confers no advantages, and changing the temperature of the injectate does not affect the quality of the block, although warmer solutions are less painful on injection.[23]

SUMMARY

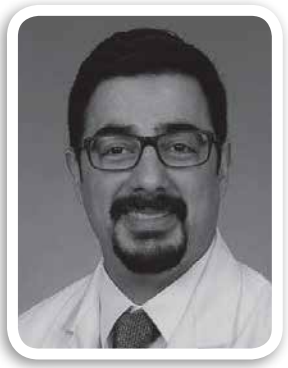
Intravenous regional anesthesia is one of the oldest anesthetic techniques still in use today. More than 100 years of experience attest to its safety and utility in a wide variety of procedures. Recent investigations have sought to improve the technique via lower doses of local anesthetic with more distal tourniquets, the use of longer-acting local anesthetics (ropivacaine), and the addition of other medications (eg, dexmedetomidine) to the block solution. As always, vigilance, careful patient selection, consideration of comorbidities, and case-by-case individual assessment by a skilled anesthesiologist are necessary to ensure optimal outcomes.

REFERENCES

1. Holmes C. Intravenous regional analgesia: a useful method of producing analgesia of the limbs. Lancet 1963;1:245–247.
2. Brill S, Middleton W, Brill G, Fisher A. Bier's block: 100 years old and still going strong! Acta Anaesthesiol Scand 2004;48(1):117–122.
3. Arslanian B, Mehrzad R, Kramer T, Kim DC. Forearm Bier block: a new regional anesthetic technique for upper extremity surgery. Ann Plast Surg 2014;73(2):156–157.
4. Chiao FB, Chen J, Lesser JB, et al. Single-cuff forearm tourniquet in intravenous regional anaesthesia results in less pain and fewer sedation requirements than upper arm tourniquet. Br J Anaesth 2013;111(2):271–275.
5. Perlas A, Peng PW, Plaza MB, et al. Forearm rescue cuff improves tourniquet tolerance during intravenous regional anesthesia. Reg Anesth Pain Med 2003;28(2):98–102.
6. Wilson JK, Lyon GD. Bier block tourniquet pressure. Anes Analg 1989;68(6):823–824.
7. Kumar K, Railton C, Tawfic Q. Tourniquet application during anesthesia: what we need to know? J Anaesthesiol Clin Pharmacol 2016;32(4):424.
8. Gurich RW Jr, Langan JW, Teasdall RJ, et al. Tourniquet deflation prior to 20 minutes in upper extremity intravenous regional anesthesia [published online January 4, 2017]. Hand. doi:10.1177/1558944716686214
9. Rosenberg PH. Intravenous regional anesthesia: nerve block by multiple mechanisms. Reg Anesth Pain Med 1993;18(1):1–5.
10. Heath ML. Deaths after intravenous regional anaesthesia. BMJ 1982;(285)6346:13–14.

11. Guay J. Adverse events associated with intravenous regional anesthesia (Bier block): a systematic review of complications. J Clin Anesth 2009;21(8):585–594.
12. Flamer D, Peng PWH. Intravenous regional anesthesia: a review of common local anesthetic options and the use of opioids and muscle relaxants as adjuncts. Local Reg Anesth 2011;4(1):57–76.
13. Choyce A, Peng P. A systematic review of adjuncts for intravenous regional anesthesia for surgical procedures. Can J Anes 2002;49(1):32–45.
14. Shafer SL. Notice of retraction. Anes Analg 2009;108(4):1350.
15. Ko MJ, Lee JH, Cheong SH, et al. Comparison of the effects of acetaminophen to ketorolac when added to lidocaine for intravenous regional anesthesia. Korean J Anesthesiol 2010;58(4):357–361.
16. Akram M, Farooqi FM, Irshad M, et al. Role of addition of dexamethasone and ketorolac to lignocaine intravenous regional anesthesia (Bier's block) to improve tourniquet tolerance and post-operative analgesia in hand and forearm surgery. J Pak Med Assoc 2015;65(11 suppl 3):S128–S131.
17. Ramadhyani U, Park JL, Carollo DS, et al. Dexmedetomidine: clinical application as an adjunct for intravenous regional anesthesia. Anesthesiol Clin 2010;28(4):709–722.
18. Sardesai SP, Patil KN, Sarkar A. Comparison of clonidine and dexmedetomidine as adjuncts to intravenous regional anaesthesia. Indian J Anaesth 2015;59(11): 733–738.
19. Hassani E, Mahoori A, Aghdashi MM, Pirnejad H. Evaluating the quality of intravenous regional anesthesia following adding dexamethasone to lidocaine. Saudi J Anaesth 2015;9(4):418–421.
20. Abdel-Ghaffar HS, Kalefa MA., Imbaby AS. Efficacy of ketamine as an adjunct to lidocaine in intravenous regional anesthesia. Reg Anesth Pain Med 2014;39(5):418–422.
21. Viscomi CM, Friend A, Parker C, Murphy T, Yarnell M. Ketamine as an adjuvant in lidocaine intravenous regional anesthesia. Reg Anesth Pain Med 2009;34(2):130–133.
22. McKeown DW, Scott DB. Influence of the addition of potassium to 0.5% prilocaine solution during I.V. regional anaesthesia. Br J Anaesth 1984;56(10):1167–1170.
23. Paul DL, Logan MR, Wildsmith JA. The effects of injected solution temperature on intravenous regional anaesthesia. Anaesthesia 1988;43(5):362–364.

Local Anesthetic Systemic Toxicity (LAST): Certainly Not the Least of Our Concerns



Mark D. Mudarth, MD
CA2–Resident

Michael Kushelev, MD
Assistant Professor

Department of Anesthesiology
The Ohio State University Wexner
Medical Center
Columbus, Ohio

Section Editor: Kristopher Schroeder, MD

Consider the following scenario: At the conclusion of a busy day at your free-standing ambulatory surgery center, you are transporting your last patient to the recovery room following repair of their anterior cruciate ligament. Thirty minutes into his recovery, the patient continues to complain of 10/10 anterior knee pain, despite intravenous opioids. As the recovery room is starting to empty out and your colleagues head for home, you decide to proceed with an adductor canal block with ropivacaine for analgesic purposes. Five minutes after completing the block, you notice tachycardia, hypertension, and frequent premature ventricular contractions. Your mind immediately jumps to the possibility of local anesthetic systemic toxicity (LAST). As the patient begins to seize, you instantly take action by notifying the nurse, requesting help, and asking for midazolam, lipid emulsion, and airway equipment. The nursing staff is able to recognize the concern in your voice, but they report that you are the only anesthesia provider left in the building and give you a puzzled look at the request for lipids. As you are able to gather the resources to successfully manage the situation, you ponder how prepared your ambulatory surgery center (ASC) is to manage a case of LAST.

LAST is a rare and potentially devastating complication of regional anesthesia. Clinicians must be vigilant because, despite its rarity, the incidence of LAST in peripheral nerve blocks ranges from 0.4–21 per 10,000.[1,2] Awareness of some independent risk factors for LAST, such as local anesthetic dose, site of injection, and extremes of age, is useful, but providers cannot fully predict which patients may develop this life-threatening complication. In the face of this reality, it is important that all clinicians and support staff are appropriately trained in early recognition and proper management of the signs and symptoms of toxicity. It follows that work environments in which local anesthetics are administered should be adequately supplied with necessary medications and safety features.

"As the number of regional anesthetics continues to rise, we must strive for excellence in our preparedness to treat LAST."

LAST presents with signs, symptoms, and timing that vary but may feature tinnitus, altered mental state, circumoral numbness, seizures, cardiac arrhythmias, and, in its most devastating form, complete cardiovascular collapse.[3,4] As noted in ASRA's Checklist for Treatment of LAST, the initial focus of treatment includes managing the airway, suppressing seizures, and alerting nearby facilities with cardiopulmonary bypass capabilities.[5] The subsequent steps on the checklist are management of cardiac arrhythmias and lipid emulsion therapy. These steps would be difficult, if not impossible, for an individual practitioner in an isolated location without additional assistance of properly trained support staff.

Unfortunately, given the infrequent number of LAST cases, allied health providers may be unfamiliar with the management and medications used during LAST resuscitation, leading to delays in caring for this anesthetic emergency. In fact, most nonanesthesiologists lack knowledge of toxic doses of local anesthetics or the treatments for LAST, with one survey finding that only 7% of nonanesthesiologists are aware of the role of lipid therapy.[6] Reliance on support staff becomes even more significant with the frequency of surgical procedures employing regional anesthetics performed in ASCs with limited staffing. For instance, in the past 10 years, the number of rotator cuff repairs performed at ambulatory surgery centers nationally has increased 272%.[7]

At our institution, a large number of orthopedic procedures requiring regional anesthesia occur at stand-alone outpatient surgical centers. In the past year, we have performed more than 2,000 nerve blocks in ASCs. In an attempt to assess and educate perioperative nurses and technicians on the management of LAST, we initiated a survey followed by a low-fidelity simulation on the topic. Of 40 respondents, only two individuals (5%) reported having been involved in the care of a patient with LAST. When asked about managing a patient with suspected LAST, only six individuals (15%) felt confident that they will have easy access to medications and supplies necessary to treat LAST. Furthermore, only 16 individuals (40%) reported knowing that lipid emulsion was a mainstay of

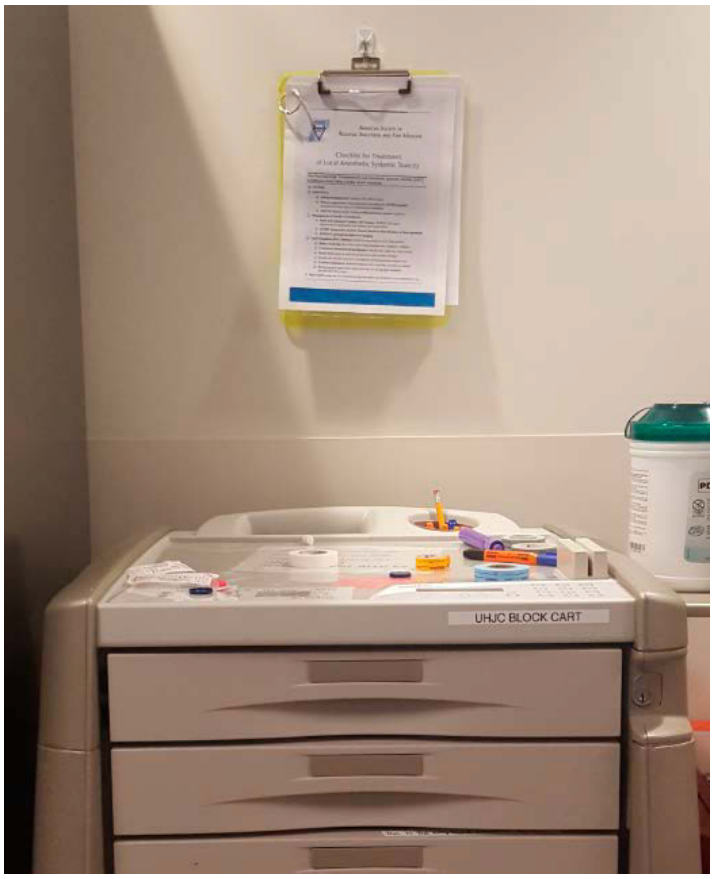
treatment for LAST, and 20 individuals (50%) acknowledged knowing how and where to find it in the perioperative environment. All of these deficiencies highlighted the potential challenges in managing LAST in ASCs.

Considering the benefit of using simulation to improve response to rare events,[8] perioperative staff members were taken through a low-fidelity, low-intensity simulation of diagnosing and caring for a suspected case of LAST. Special focus was given to the significance of lipid emulsion as the mainstay of treatment as well as standardization of the process for securing the lipid emulsion at the bedside and the process for initiating patient transfer with the potential need for cardiopulmonary bypass. During the event, we highlighted the now-standard placement of the ASRA checklist, located with our local anesthetic supplies (Figure 1). After the simulation, participants were surveyed again about the treatment of a patient with presumed LAST, and all individuals (100%) responded with confidence.

In response to the simulation session, an important question was raised: How much lipid emulsion should we have available to be adequately prepared to appropriately treat a patient while awaiting transfer? Following the ASRA checklist recommendations, patients experiencing LAST should receive a 1.5-mL/kg lean body mass bolus of lipid emulsion equating to approximately 100 mL of lipid emulsion for a 70-kg patient. Subsequently, the patient should receive a 0.25-mL/kg/min infusion dose, which equates to an approximate rate of 18 mL/min. In addition, the LAST checklist suggests repeating bolus doses or doubling the infusion rate for persistent cardiovascular instability. With these recommendations, it is easy to anticipate the need of more than 1,000 mL of lipid emulsion while awaiting transfer to a tertiary care center. Even with two 250-mL bags available, our previous standard, the lipid emulsion infusion would be sufficient to treat a patient for only approximately 25 minutes. At the recommended doses, combined with the frequency with which we care for obese patients (who have an increase in lean body mass in addition to excess fat[9]), a relatively large amount of lipid emulsion must be available at free-standing ASCs, because a patient may be delayed more than 1 hour before reaching a more equipped medical facility with expanded pharmaceutical service. We believe that this is true for many ASCs and could potentially limit the safety of patient care.

LAST is a rare complication of which regional anesthesia providers are keenly aware, but in today's ever-changing workplace, successful management of any complication, especially one as potentially devastating as LAST, requires that support staff are educated on early recognition and initial management and that work environments are designed with safety in mind and adequately supplied to ensure optimal outcomes. As the number of regional anesthetics continues to rise, particularly in ASCs, we must strive for excellence in our preparedness, otherwise our practice and patients face the ultimate adverse consequence.

Figure 1: *ASRA checklist located with local anesthetic supplies.*



REFERENCES

1. Liu SS, Ortolan S, Sandoval MV, et al. Cardiac arrest and seizures due to local anesthetic systemic toxicity after peripheral nerve blocks: should we still fear the reaper? Reg Anesth Pain Med 2016;41:5–21.
2. Barrington MJ, Kluger R. Ultrasound guidance reduces the risk of local anesthetic systemic toxicity following peripheral nerve blockade. Reg Anesth Pain Med 2013;38:289–297.
3. Di Gregorio G, Neal JM, Rosenquist RW, Weinberg GL. Clinical presentation of local anesthetic systemic toxicity: a review of published cases, 1979 to 2009. Reg Anesth Pain Med 2010;35:181–187.
4. Vasques F, Behr AU, Weinberg GL, Ori C, Di Gregorio G. A review of local anesthetic systemic toxicity cases since publication of the ASRA recommendations: to whom it may concern. Reg Anesth Pain Med 2015;40:698–705.
5. Neal JM, Weinberg GL, Bernards CM, et al. ASRA practice advisory on local anesthetic systemic toxicity. Reg Anesth Pain Med 2010;35:152–161.
6. Collins J. Awareness of local anaesthetic toxicity issues among hospital staff. Anaesthesia 2010;65:960–961.
7. Goldfarb CA, Bansal A, Brophy, RH. Ambulatory surgical centers: a review of complications and adverse events. J Am Acad Orthop Surg 2017;25:12–22.
8. Neal JM, Hsiung RL, Mulroy MF, Halpern BB, Dragnich AD, Slee AE. ASRA checklist improves trainee performance during a simulated episode of local anesthetic systemic toxicity. Reg Anesth Pain Med 2012;37:8–15.
9. Forbes GB, Welle SL. Lean body mass in obesity. Int J Obes 1983;7(2):99–107.

Ultrasound Guidance for Interventional Pain Procedures: Recent Evidence From Around the World

Ashutosh Joshi, MBBS, MD
Fellow

Anuj Bhatia, MD, FRCPC
Associate Professor

Department of Anesthesia and Pain Management
Toronto Western Hospital and University of Toronto
Toronto, Ontario, Canada

Section Editor: Lynn Kohan, MD

Ultrasonography (US) has unique benefits over anatomic landmarks (ALs) and fluoroscopy (FL), including lack of ionizing radiation, visualization of soft tissues and vascular structures, and portability. International publications on US-guided neuraxial, peripheral nerve, and joint-related procedures to relieve pain indicate an expanding role for this imaging modality. The objective of this review is to discuss important publications in the past 5 years on the use of US in interventional pain medicine.

NEURAXIAL PROCEDURES

Cervical Spine. Two studies by a group of Canadian and Thai researchers reported that US-guided C5 and C6 medial branch block (MBB) needle placement was accurate in 100% and 97.5% of procedures, respectively (as verified by FL), and vascular penetration was avoided in 30% of procedures.[1] The authors also reported that US-guided C7 MBB required less time to perform, used fewer needle passes than the FL-guided technique, and avoided vascular penetration in 40% of patients without compromising success rates, postblock analgesia, or complication rates.[2] Reduced procedural discomfort, fewer attempts, and faster procedure times for CMBB with US as compared to fluoroscopy were also reported by Korean investigators, with similar success and complication rates in the two groups.[3] Finally, use of US allowed identification of critical vessels around the cervical nerve roots while providing similar analgesic benefit as FL-guided injections, as evident in two recent studies from Korea.[4,5]

Lumbar Spine. In a trial by Korean investigators, US-guided lumbar intra-articular injections had similar analgesic and functional outcomes as compared to FL-guided injections,[6] but the mean body mass index (BMI) of the participants was under 25 kg/m^2. Cadaveric studies on US-guided lumbar facet joint and lumbar transforaminal epidural injections from the United States have reported 88% and 91.3% accuracy, respectively, as verified by FL.[7,8] However, targets could not be visualized with US at the foramen between the fifth lumbar and sacral vertebrae in 8% of the procedures because of prominent iliac crests.[8] In another trial from Taiwan, shorter performance time for US-guided lumbar nerve root block and similar analgesic efficacy in comparison to FL-guided injections were reported, but participants' mean BMI was less than 25 kg/m^2.[9]

"Current evidence is stronger for using ultrasonography to guide injections into joints and around peripheral nerves as compared to neuraxial procedures."

A Korean retrospective study on 146 patients who received US- or FL-guided lumbar MBB reported shorter procedure time with US while conferring similar analgesic benefits.[10] A limitation of US-guided MBB is that access to the fifth lumbar dorsal ramus is often challenging because of prominent iliac crests. A group of researchers from Austria, Canada, Switzerland, and Italy performed a cadaveric study to develop a US-guided, out-of-plane technique for this procedure with a success rate of 80%.[11]

Sacroiliac Joint (SIJ). US-and FL-guided SIJ intra-articular injections were associated with similar analgesic benefits, functional improvement, and patient satisfaction in two studies from Korea and Canada.[12,13] The authors also reported enhanced safety with US because blood vessels around the SIJ could be avoided. However, the US-guided approach had slightly lower accuracy[12,13] and required more time[13] for performing SIJ injections when compared to FL. US-guided lateral sacral branch blocks were associated with a shorter performance time, fewer needle passes, and a lower incidence of vascular breach than FL-guided technique with similar analgesic outcomes in both groups in a Canadian study. Interestingly, the interventionists' level of experience significantly affected performance time with US but not with FL.[14]

PERIPHERAL JOINT PROCEDURES

Lower-Limb Joints. A recent Spanish study reported similar accuracy for US- and FL-guided injections into the hip joint.[15] Furthermore, investigators from United States found that US-guided injections of the hip were less painful than FL-guided injections and patients who had undergone procedures with those modalities preferred US over FL.[16] We identified one systematic review and two studies from China, Iran, and Korea, respectively, that reported

higher accuracy rates (validation with FL) and more analgesic benefit with US-guided knee injections.[17,18,19] A study by French investigators reported greater efficacy and patient satisfaction with imaging guidance (US or FL) for ankle (tibiotalar) joint injections than with ALs (84% and 66%, respectively). However, no differences were observed between US or FL groups in terms of efficacy or satisfaction.[20]

Upper-Limb Joints. US-guided glenohumeral (GH) joint injections were found to be more accurate and to yield better analgesic and functional benefits than AL-guided approach in two studies from Iran and the United States.[21,22] A study from Hong Kong and a meta-analysis reported similar accuracy for US- and FL-guided injections in the GH joint.[23,24] Use of US significantly improved the accuracy of intra-articular acromioclavicular joint, elbow joint, and distal radioulnar joint injections when compared to AL technique in studies from Switzerland and Korea.[25–27]

PERIPHERAL NERVE PROCEDURES

A team of investigators from Austria, Germany, and Switzerland reported that US can be used to identify and block the greater occipital nerve in cadavers either at the level of the C2 transverse process or the occiput with a higher success rate at the C2 level (100% vs 86%).[28] Two studies from the United States and Canada also showed that vascular and esophageal penetration are potential risks that can be prevented by using US to guide cervical sympathetic blocks.[29,30]

US-guided ilioinguinal and iliohypogastric nerve blocks were shown to be as effective as AL-guided blocks for the treatment of chronic postherniorrhaphy pain by a team from the United States.[31] However, inaccurate placement of injectate has been reported in AL-guided nerve blocks.[32] A team from Austria suggested an alternative technique to block the suprascapular nerve near its origin from the upper trunk of the brachial plexus with 81% visualization as compared to 36% in traditional suprascapular site.[33] In another study, use of US conferred higher accuracy and lower injectate volumes than ALs as a guidance method for intercostal nerve injections in cadaveric study from Canada and the United States.[34] A Canadian study on cadavers and volunteers that compared AL- and US-guided needle placement and identification of the lateral femoral cutaneous nerve, respectively, showed a huge improvement in accuracy with US (5.3% and 84.2%, respectively).[35] However, another Canadian study found that US- and FL-guided pudendal nerve blocks were similar in accuracy and visualization of surrounding structures like vessels and nerves, but the procedural time was longer with US (428 vs 219 seconds).[36]

CONCLUSIONS

Despite its potential to enhance accuracy, efficacy, and safety, a paucity of high-quality trials to confirm advantages of US over traditional modalities and a perception that experience of the interventionalist impacts procedural performance with US guidance are significant barriers to widespread use of US for interventional pain. Furthermore, cadaveric studies that demonstrate the potential of US in increasing accuracy of interventional procedures need to be replicated in patients. Current evidence is stronger for using ultrasonography to guide injections into joints and around peripheral nerves as compared to neuraxial procedures. Studies that combine use of ultrasonography (for identifying and avoiding vessels and other structures) and fluoroscopy (for simultaneous visualization of multiple spinal levels) may improve outcomes of neuraxial procedures.

REFERENCES

1. Finlayson RJ, Etheridge JP, Tiyaprasertkul W, Nelems B, Tran DQ. A prospective validation of biplanar ultrasound imaging for C5-C6 cervical medial branch blocks. *Reg Anesth Pain Med*. 2014;39:160–163. doi: 10.1097/AAP.0000000000000043.
2. Finlayson RJ, Etheridge JP, Tiyaprasertkul W, Nelems B, Tran DQ. A randomized comparison between ultrasound- and fluoroscopy-guided C7 medial branch block. *Reg Anesth Pain Med*. 2015;40:52–57. doi: 10.1097/AAP.0000000000000186.
3. Park KD, Lim DJ, Lee WY, Ahn J, Park Y. Ultrasound versus fluoroscopy-guided cervical medial branch block for the treatment of chronic cervical facet joint pain: a retrospective comparative study. *Skeletal Radiol*. 2017;46:81–91. doi: 10.1007/s00256-016-2516-2.
4. Park Y, Ahn JK, Sohn Y, et al. Treatment effects of ultrasound guide selective nerve root block for lower cervical radicular pain: a retrospective study of 1-year follow-up. *Ann Rehabil Med*. 2013;37:658–667. doi: 10.5535/arm.2013.37.5.658.
5. Jee H, Lee JH, Kim J, Park KD, Lee WY, Park Y. Ultrasound-guided selective nerve root block versus fluoroscopy-guided transforaminal block for the treatment of radicular pain in the lower cervical spine: a randomized, blinded, controlled study. *Skeletal Radiol*. 2013;42:69–78. doi: 10.1007/s00256-012-1434-1.
6. Yun DH, Kim HS, Yoo SD, et al. Efficacy of ultrasonography-guided injections in patients with facet syndrome of the low lumbar spine. *Ann Rehabil Med*. 2012;36:66–71. doi: 10.5535/arm.2012.36.1.66.
7. Gofeld M, Bristow SJ, Chiu S. Ultrasound-guided injection of lumbar zygapophyseal joints: an anatomic study with fluoroscopy validation. *Reg Anesth Pain Med*. 2012;37:228–231. doi: 10.1097/AAP.0b013e3182461144.
8. Gofeld M, Bristow SJ, Chiu SC, McQueen CK, Bollag L. Ultrasound-guided lumbar transforaminal injections: feasibility and validation study. *Spine (Phila Pa 1976)*. 2012;37:808–812. doi: 10.1097/BRS.0b013e3182340096.
9. Yang SH, Park KD, Cho KR, Park Y. Ultrasound-guided versus fluoroscopy-controlled lumbar transforaminal epidural injections: a prospective randomized clinical trial. *Clin J Pain*. 2016;32:103–108.
10. Han SH, Park KD, Cho KR, Park Y. Ultrasound versus fluoroscopy-guided medial branch block for the treatment of lower lumbar facet joint pain: a retrospective comparative study. *Medicine (Baltimore)*. 2017;96:e6655. doi: 10.1097/MD.0000000000006655.
11. Greher M, Moriggl B, Peng PW, Minella CE, Zacchino M, Eichenberger U. Ultrasound-guided approach for L5 dorsal ramus block and fluoroscopic evaluation in unpreselected cadavers. *Reg Anesth Pain Med*. 2015;40:713–717. doi: 10.1097/AAP.0000000000000314.
12. Jee H, Lee JH, Park KD, Ahn J, Park Y. Ultrasound-guided versus fluoroscopy-guided sacroiliac joint intra-articular injections in the noninflammatory sacroiliac joint dysfunction: a prospective, randomized, single-blinded study. *Arch Phys Med Rehabil*. 2014;95:330–337. doi: 10.1016/j.apmr.2013.09.021.

13. Soneji N, Bhatia A, Seib R, Tumber P, Dissanayake M, Peng PW. Comparison of fluoroscopy and ultrasound guidance for sacroiliac joint injection in patients with chronic low back pain. *Pain Pract*. 2016;16:537–544. doi: 10.1111/papr.12304.
14. Finlayson J, Etheridge JB, Elgueta MF, et al. A randomized comparison between ultrasound- and fluoroscopy-guided sacral lateral branch blocks. *Reg Anesth Pain Med*. 2017;42:400–406. doi: 10.1097/AAP.0000000000000569.
15. Martínez-Martínez A, García-Espinosa J, Ruiz-Santiago F, Guzmán-Álvarez L, Castellano-García MM. Comparison of ultrasound and fluoroscopic guidance for injection in CT arthrography and MR arthrography of the hip. *Radiologia*. 2016;58:454–459. doi: 10.1016/j.rx.2016.07.006.
16. Byrd JW, Potts EA, Allison RK, Jones KS. Ultrasound-guided hip injections: a comparative study with fluoroscopy-guided injections. *Arthroscopy*. 2014;30:42–46. doi: 10.1016/j.arthro.2013.09.083.
17. Wu T, Dong Y, Song Hx, Fu Y, Li JH. Ultrasound-guided versus landmark in knee arthrocentesis: a systematic review. *Semin Arthritis Rheum*. 2016;45:627–632. doi: 10.1016/j.semarthrit.2015.10.011.
18. Hashemi SM, Hosseini B, Zhand M, Pourrosta R. Accuracy of ultrasound guided versus blind knee intra-articular injection for knee osteoarthritis prolotherapy. *J Anesth Crit Care Open Access*. 2016;5:00181.
19. Bum Y, Ah Choi W, Kim YK, Chul Lee S, Hae Lee J. Accuracy of blind versus ultrasound-guided suprapatellar bursal injection. *J Clin Ultrasound*. 2012;40:20–25. doi: 10.1002/jcu.20890.
20. Bossert M, Boublil D, Parisaux J-M, Bozgan A-M, Richelme E, Conrozier T. Imaging guidance improves the results of viscosupplementation with HANOX-M-XL in patients with ankle osteoarthritis: results of a clinical survey in 50 patients treated in daily practice. *Clin Med Insights Arthritis Musculoskelet Disord*. 2016;9:195–199. doi: 10.4137/CMAMD.S40401.
21. Raeissadat SA, Rayegani SM, Langroudi TF, Khoiniha M. Comparing the accuracy and efficacy of ultrasound-guided versus blind injections of steroid in the glenohumeral joint in patients with shoulder adhesive capsulitis. *Clin Rheumatol*. 2017;36:933–940. doi: 10.1007/s10067-016-3393-8.
22. Patel DN, Nayyar S, Hasan S, Khatib O, Sidash S, Jazrawi LM. Comparison of ultrasound-guided versus blind glenohumeral injections: a cadaveric study. *J Shoulder Elbow Surg*. 2012;21:1664–1668. doi: 10.1016/j.jse.2011.11.026.
23. Ng W, Hung EH, Griffith JF, Tong CS, Cho CC. Comparison of ultrasound versus fluoroscopic guided rotator cuff interval approach for MR arthrography. *Clin Imaging*. 2013;37:548–553. doi: 10.1016/j.clinimag.2012.08.002.
24. Amber KT, Landy DC, Amber I, Knopf D, Guerra J. Comparing the accuracy of ultrasound versus fluoroscopy in glenohumeral injections: a systematic review and meta-analysis. *J Clin Ultrasound*. 2014;42:411–416. doi: 10.1002/jcu.22154.
25. Borbas P, Kraus T, Clement H, Grechenig S, Weinberg AM, Heidari N. The influence of ultrasound guidance in the rate of success of acromioclavicular joint injection: an experimental study on human cadavers. *J Shoulder Elbow Surg*. 2012;21:1694–1697. doi: 10.1016/j.jse.2011.11.036.
26. Kim K, Lee JH, Park KD, Lee SC, Ahn J, Park Y. Ultrasound versus palpation guidance for intra-articular injections in patients with degenerative osteoarthritis of the elbow. *J Clin Ultrasound*. 2013;41:479–485. doi: 10.1002/jcu.22071.
27. Nam SH, Kim J, Lee JH, Ahn J, Kim YJ, Park Y. Palpation versus ultrasound-guided corticosteroid injections and short-term effect in the distal radioulnar joint disorder: a randomized, prospective single-blinded study. *Clin Rheumatol*. 2014;33:1807–1814. doi: 10.1007/s10067-013-2355-7.
28. Greher M, Moriggl B, Curatolo M, Kirchmair L, Eichenberger U. Sonographic visualization and ultrasound-guided blockade of the greater occipital nerve: a comparison of two selective techniques confirmed by anatomical dissection. *Br J Anaesth*. 2010;104: 637–642. doi: 10.1093/bja/aeq052.
29. Narouze S, Vydyanathan A, Patel N. Ultrasound-guided stellate ganglion block successfully prevented esophageal puncture. *Pain Physician*. 2007;10:747–752.
30. Bhatia A, Flamer D, Peng PW. Evaluation of sonoanatomy relevant to performing stellate ganglion blocks using anterior and lateral simulated approaches: an observational study. *Can J Anesth*. 2012;59:1040–1047. doi: 10.1007/s12630-012-9779-4.
31. Trainor D, Moeschler S, Pingree M, et al. Landmark-based versus ultrasound-guided ilioinguinal/iliohypogastric nerve blocks in the treatment of chronic postherniorrhaphy groin pain: a retrospective study. *J Pain Res*. 2015;8:767–770. doi: 10.2147/JPR.S86777.
32. Weintraud M, Marhofer P, Bösenberg A, et al. Ilioinguinal/iliohypogastric blocks in children: where do we administer the local anesthetic without direct visualization? *Anesth Analg*. 2008;106:89–93. doi: 10.1213/01.ane.0000287679.48530.5f.
33. Siegenthaler A, Moriggl B, Mlekusch S, et al. Ultrasound-guided suprascapular nerve block, description of a novel supraclavicular approach. *Reg Anesth Pain Med*. 2012;37:325–328. doi: 10.1097/AAP.0b013e3182409168.
34. Bhatia A, Gofeld M, Ganapathy S, Hanlon J, Johnson M. Comparison of anatomic landmarks and ultrasound guidance for intercostal nerve injections in cadavers. *Reg Anesth Pain Med*. 2013;38:503–507. doi: 10.1097/AAP.0000000000000006.
35. Ng I, Vaghadia H, Choi PT, Helmy N. Ultrasound imaging accurately identifies the lateral femoral cutaneous nerve. *Anesth Analg*. 2008;107:1070–1074. doi: 10.1213/ane.0b013e31817ef1e5.
36. Bellingham GA, Bhatia A, Chan CW, Peng PW. Randomized controlled trial comparing pudendal nerve block under ultrasound and fluoroscopic guidance. *Reg Anesth Pain Med*. 2012;37:262–236. doi: 10.1097/AAP.0b013e318248c51d.

What Is Myofascial Pain?

Floria E. Chae, MD
Fellow in Critical Care Medicine
The Ohio State University,
Wexner Medical Center
Columbus, Ohio

Section Editor: Dalia Elmofty, MD

Guillaume de Baillou, a French clinician and epidemiologist during the 16th century, prepared one of the first manuscripts on arthritis[1] and muscle pain disorders.[2] Kellgren, a British rheumatologist, studied patterns of referred pain in different muscle groups and ligaments of the spine by injecting intramuscular hypertonic saline.[3] Balfour described painful inflamed nodules in 1816. Since then, many terms have been used to describe trigger points (TrPs): fibrosis myofasciitis, muscular rheumatism, rheumatic myositis, myogelosis, myalgia, myofascial pain, and fibromyalgia.[4] Travell and Rinzler published the first summary of specific referral patterns and tenderness from referred trigger points in 1952.[5] Travell and Simons furthered the knowledge regarding myofascial pain in the two-volume work titled *Myofascial Pain and Dysfunction,* published in 1983. Travell introduced the term *myofascial pain syndrome* (MPS) to describe pain generated from TrPs in muscles, tendons, skin, fascia, and ligaments.

The term *myofascial pain syndrome* today indicates a specific condition that is different from other soft-tissue pain disorders such as fibromyalgia, tendonitis, or bursitis. MPS can be regional or widespread, where pain often crosses multiple dermatomes, and is frequently accompanied by increased tension and decreased flexibility. It can coexist with other pain conditions such as fibromyalgia, radiculopathies, joint dysfunction, migraines, pelvic pain and other urologic syndromes, postherpetic neuralgia, and complex regional pain syndromes.[6]

"It is important to understand the pathophysiology of myofascial pain because it is common and distinct entity from other musculoskeletal disorders."

MPS affects every age group and is characterized by myofascial TrP (MTrP) and pain. An MTrP is classically defined as "a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band."[7] Palpation of MTrP produces local pain as well as referred pain in a known pattern. MTrP can be classified as active or latent: active MTrP causes spontaneous pain and pain on palpation, whereas latent MTrP causes pain only on palpation.[8]

CINDERELLA HYPOTHESIS

Several hypotheses imply that muscle overload and overuse are required for developing MTrP. The Cinderella hypothesis describes how muscle recruitment patterns during low-level, static exertions may lead to musculoskeletal disorder symptoms. Because smaller, type I muscle fibers are continuously activated and metabolically overloaded, whereas larger motor fibers spend more time inactivated, type I or Cinderella fibers are more susceptible to muscle damage and calcium dysregulation, which are key factors in the formation of TrPs.[9] Research has demonstrated that upper trapezius MTrPs developed after continued typing for as little as 30 minutes, which supports the theory that even low-level static exertions can cause MTrPs.[10]

ELECTROPHYSIOLOGY

Electromyographic studies show spontaneous electrical activity (SEA) generated at MTrP loci, which are not seen in surrounding tissue. SEA results from increases in miniature endplate potentials and excessive acetylcholine release.[11] These dysfunctional motor endplates may explain the taut band phenomenon. Others have hypothesized that excessive acetylcholine release sustains a contracture of the muscle fibers and thus increases metabolic demands.[8]

INTEGRATED TRIGGER POINT HYPOTHESIS

Simons introduced the integrated trigger point hypothesis, which ties together several findings to describe a possible sequence of events in the development of MTrPs. An energy crisis perpetuates sustained contracture of the muscle fibers near an abnormal endplate. The excessive acetylcholine release and the sustained sarcomere contracture lead to increased local metabolic demands and compressed capillary circulation. With the decreased blood flow and sources of adenosine triphosphate, muscle fibers remain in a contracted state and are unable to return calcium to the sarcoplasmic reticulum for muscle relaxation.[7] The local hypoxic condition leads to release of ischemic mediators that can sensitize peripheral nociceptors and generate pain.[12]

NOCICEPTORS

Muscle nociceptors can comprise up to 50% of muscle nerves. This may explain the severity of pain and tenderness in muscles on palpation. Nociceptors also innervate the connective tissue of muscle fibers. They can be activated by several stimuli, depending on whether they contain chemoreceptors, mechanoreceptors, or thermoreceptors.[13] Active and latent MTrPs have biochemical differences, as well as healthy muscle tissue by microdialysis.

In one study, subjects were classified into active (neck pain with MTrP), latent (no neck pain, MTrP present), and normal (no neck pain, no MTrP) groups. Results showed that active MTrPs had acidic pH levels, elevated catecholamines (norepinephrine and serotonin), elevated neuropeptides (substance P [SP] and calcitonin gene-regulated peptide [CRGP]), and elevated cytokines (TNF-a, IL-6, and IL-8) as compared to the latent MTrP and normal groups. After dry needling in the active group, SP and CGRP concentrations were significantly lower than before dry needling. This may be because of increased local blood flow, leading to a washout of pain and inflammatory mediators.[14] Continuous activation of muscle nociceptors by local release of pain mediators from muscle injury and inflammation can induce neuroplastic changes and central sensitization by causing transcriptional changes on the cellular level, leading to hypersensitivity and hyperexcitability.[15]

SUMMARY

It is important to understand the pathophysiology of myofascial pain because it is common and distinct entity from other musculoskeletal disorders and is treated differently than other disorders. Studies have confirmed the presence of elevated levels of inflammatory and pain mediators in MTrPs that are not found in normal muscles, supporting the integrated trigger point hypothesis in which an energy crisis and local hypoxic conditions contribute to release of inflammatory and pain mediators that sensitize peripheral nociceptors, leading to central sensitization and pain.

REFERENCES

1. Guillaume de Baillou (1538–1616) clinician and epidemiologist. *JAMA*. 1966;195(11):957.
2. Shah JP, Thaker N, Heimur J, et al. Myofascial trigger points then and now: a historical and scientific perspective. *PM R*. 2015;7:746–761. doi: 10.1016/j.pmrj. 2015.01.024.
3. Bubnov, V. Evidence-based pain management: is the concept of integrative medicine applicable? *EPMA J*. 2012;3(1):13. doi: 10.1186/1878-5085-3-13.
4. Simons DG. Muscle pain syndromes—part 1. *Am J Phys Med*. 1975;54:289–311.
5. Osterwies M, Kleinman A, Mechanic D, eds. *Pain and Disability: Clinical, Behavioral, and Public Policy Perspectives*. Washington, DC: The National Academies Press; 1987. Available at: https://doi.org/10.17226/991. Accessed October 22, 2017.
6. Borg-Stein J, Simons DG. Focused review: myofascial pain. *Arch Phys Med Rehabil*. 2002;83(3 suppl 1):S40–S47, S48–S49.
7. Simons DG, Travell JG, Simons L. *Myofascial Pain and Dysfunction: The Trigger Point Manual*. Philadelphia, PA: Lippincott Williams & Wilkins; 1999.
8. Mense S, Simons DG. *Muscle Pain: Understanding Its Nature, Diagnosis, and Treatment*. Philadelphia, PA: Lippincott Williams & Wilkins; 2001.
9. Hagg G. Ny forklaringsmodell for muskelskador vid statisk belastnin i skuldra och nacke [in Swedish; New explanation for muscle damage as a result of static loads in the neck and shoulder]. *Arbete Manniska Miljo*. 1988;4: 260–262.
10. Treaster D, Marras WS, Burr D, Sheedy JE, Hart D. Myofascial trigger point development from visual and postural stressors during computer work. *J Electromyogr Kinesiol*. 2006;16:115–124. doi: 10.1016/j.jelekin.2005.06.016.
11. Hubbard DR, Berkoff GM. Myofascial trigger points show spontaneous needle EMG activity. *Spine*. 1993;18:1803–1807.
12. Huguenin LK. Myofascial trigger points: the current evidence. *Phys Ther Sport*. 2004;5:2–12. doi: 10.1016/j.ptsp.2003.11.002.
13. Willard F. Basic mechanisms of pain. In: Audette JF, Bailey A, eds. *Integrative Pain Medicine: The Science and Practice of Complementary and Alternative Medicine in Pain Management*. New York, NY: Humana Press; 2008:19–61.
14. Shah JP, Gilliams, EA. Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome. *J Bodyw Mov Ther*. 2008;12:371–384. doi: 10.1016/j.jbmt.2008.06.006.
15. Wall PD, Woolf CJ. Muscle but not cutaneous C-afferent input produces prolonged increases in the excitability of the flexion reflex in the rat. *J Physiol*. 1984;356:443–458.

Developing an Online and Print Patient Education Tool for Pain Relief Options in Labor

Lauren Faber, BA
Kylee Greider, BS
University of New Mexico School of Medicine
Albuquerque, New Mexico

Nicole Nesiba, BS
University of New Mexico
School of Medicine
Albuquerque, New Mexico

Katherine M. Seligman, MD
Department of Anesthesiology and
Critical Care Medicine
University of New Mexico
Albuquerque, New Mexico

In today's technologic climate, patients and their families are routinely seeking out medical information on the internet. A study of 96 websites with anesthesia-related patient education materials (PEMs) showed they were all written above the recommended 6th-grade reading level.[1] Online PEMs for pain relief options in labor have also been shown to be above the recommended reading level and lack critical information on risks, benefits, and alternatives.[2] The Program for the International Assessment of Adult Competencies (PIACC) evaluates literacy in the adult population on a five-level scale, with literacy defined as "understanding, evaluating, using, and engaging with written texts to participate in society, to achieve one's goals, and to develop one's knowledge and potential."[3]

In New Mexico, 46% of the population is considered functionally illiterate, which is designated as a level-two proficiency or lower on the PIACC scale.[4] Many of those individuals fail to identify a total on a sales receipt or identify information in a news article. This low literacy proficiency in the state makes providing accessible PEM while retaining scientific accuracy and integrity a challenge.

With this in mind, we aimed to develop a comprehensive patient-education tool covering pain relief options for labor and delivery, including online, print, and audio information aimed at patients with all literacy levels. This culminated in the development of a free online resource (http://thepainlesspush.com), currently available in English and Spanish, with simplified print and audio material also available online for download. Appropriately designed PEMs should be available to all patients prior to hospitalization as well as during their time in labor and delivery to improve the informed component of the informed consent process.

"Low literacy proficiency in the state makes providing accessible patient education material while retaining scientific accuracy and integrity a challenge."

Assessing a patient population's educational level is at best an indirect means to determine typical patient reading ability. No available correlation exists between PIACC literacy level and completed United States school grade level. Numerous preexisting validated analytic methods are available to check the readability of PEMs, and all reference a corresponding grade level for ease of interpretation. Three validated tools to assess readability and give an estimated score are the Flesch-Kincaid Grade Level (FKGL), the Simple Measure of Gobbledygook (SMOG), and the Gunning Frequency of Gobbledygook (Gunning FOG). The FKGL score focuses on word length (in syllables) and sentence length (in number of words used). Longer sentences and more syllables lead to higher scores. The SMOG focuses on polysyllabic words and sentence count. The Gunning FOG relates word count per sentence to the proportion of polysyllabic words. Thus, the main predictors for readability levels include polysyllabic words and sentence length and structure. The Readability Test Tool, available for free online (https://www.webpagefx.com/tools/read-able), uses the FKGL, SMOG, Gunning FOG, and other indices to score websites and text items for readability.

The characteristics that increase texts' reading difficulty are particularly relevant for scientific literature and PEMs, where

medication names, procedure names, and other medical terminology can dramatically inflate the readability level of the text. Although the scales are not intended to yield precise scores with isolated words, checking them can confirm suspected problematic terms and phrases. For example, "anesthesiologist" rates at a grade level of 49 when input into the Readability Test Tool online. "Doctor," however, rates at a grade level of 7. "Epidural anesthesia" comes out at 28, but even the simplified phrase of "pain medicine" still rates at 13. By substituting words and phrases to reduce the reading level, authors risk sacrificing the scientific integrity of the education materials.

The Centers for Medicare and Medicaid Services (CMS) and the National Institutes of Health (NIH) provide recommendations for authors to assist in writing PEMs at a reasonable grade level. These include directions to limit paragraph size, use bullet points and lists, use underlining, include images, and use meaningful headings. Thepainlesspush.com website uses these design principles to make the scientifically accurate information more engaging and accessible.

Analyzing the text of thepainlesspush.com results in a SMOG score of 9, FKGL of 9.5, and Gunning FOG of 12. The simplified print resource and audio voice-over, by design, have lower reading levels: SMOG 6.2, FKGL 5, and Gunning FOG 7.6. The diversity in reading levels allows readers and patients with varying backgrounds to access information in a format that is right for them. Having it all available online for download or reference means that patients can choose the education material that they find most helpful.

By designing PEMs with limited-literacy and non-English-speaking patients in mind, as well as following the recommendations from CMS and NIH, we feel that we have created a unique combination of scientifically sound materials that are easily accessible to our patients. We believe that this tool can help patients be better informed of their options to moderate pain relief during labor and delivery, including the relevant risks and benefits of each.

REFERENCES

1. De Oliveira GS Jr, Jung M, McCaffery KJ, McCarthy RJ, Wolf MS. Readability evaluation of internet-based patient education materials related to the anesthesiology field. *J Clin Anesth*. 2015;27:401–405. doi: 10.1016/j.jclinane.2015.02.005.
2. Patel SK, Gordon EJ, Wong CA, Grobman WA, Goucher H, Toledo P. Readability, content, and quality assessment of web-based patient education materials addressing neuraxial labor analgesia. *Anesth Analg*. 2015;121:1295–1300. doi: 10.1213/ANE.0000000000000888.
3. Goodman MF, Mohadjer L, Krenske T, Jacquie H. *Literacy, Numeracy, and Problem Solving in Technology-Rich Environments: Framework for the OECD Survey of Adult Skills*. Paris, France: OECD Publishing; 2012. doi: 10.1787/9789264128859-en.
4. New Mexico Coalition for Literacy. NM literacy overview. Available at: https://newmexicoliteracy.org/literacy-facts. Accessed August 21, 2017.

ASRA

ASRA PAIN MEDICINE EDUCATION RESEARCH

2018 World Congress on REGIONAL ANESTHESIA & PAIN MEDICINE

ASRA's 43rd Annual Regional Anesthesiology & Acute Pain Medicine Meeting

April 19-21, 2018
New York Marriott Marquis, New York City, USA

www.asra.com