

A Checklist for Performing Regional Nerve Blocks

Michael F. Mulroy, MD,* Robert S. Weller, MD,† and Gregory A. Liguori, MD‡

Abstract: Regional blocks are frequently invasive procedures that create the risk of infection, local anesthetic toxicity, and wrong-site performance. National guidelines have been developed by the Joint Commission and the American Society of Regional Anesthesia and Pain Medicine (ASRA) to reduce the potential for each of these risks. Checklists have been shown to reduce errors and complications in medicine: it seems prudent to incorporate the recommended safety steps into a formalized checklist to be reviewed before performance of a regional block. A task force appointed by the ASRA President reviewed available resources and recommendations and performed a survey of RAPM members at the ASRA annual meeting in May 2013 and proposed a 9-point checklist to fulfill this role. Although it is apparent that local modification will be needed, the basic points and principles should be adopted for the performance of regional blocks.

(*Reg Anesth Pain Med* 2014;39: 195–199)

Accidents and errors are inevitable in complex, tightly interconnected systems such as air travel and medical care.¹ The 1999 Institute of Medicine report *To Err is Human*² highlighted an alarming incidence of medical errors leading to morbidity and mortality in the US medical system and called for strategies for change. Major sources of error in surgery are wrong-site and wrong-patient procedures, which drew the attention of the Joint Commission as early as 1998. In 2003, the Joint Commission proposed a Universal Protocol that surgical teams could use before any elective surgical intervention to reduce the risk of wrong-site procedures.³ The revised Universal Protocol, published in 2010, must be performed before any elective invasive procedure, but its application to regional block was not specifically described. Regional blocks also have the potential for wrong-site performance,^{4–6} with wrong-side blockade accounting for an increasing percentage of reported wrong-side procedures in recent years ([http://patient.safetyauthority.org/ADVISORIES/AdvisoryLibrary/2010/Mar7\(1\)/pages/26.aspx](http://patient.safetyauthority.org/ADVISORIES/AdvisoryLibrary/2010/Mar7(1)/pages/26.aspx)).

Regional block procedures may also be complicated by infection,⁷ life-threatening immediate adverse events (local anesthetic systemic toxicity [LAST]⁸), respiratory depression from overzealous sedation, and, in the anticoagulated patient, hematoma formation causing paraplegia after neuraxial blocks. The potential for these complications has led several national organizations to develop guidelines and recommendations for safety steps in

the performance of regional blocks, including the American Society of Regional Anesthesia and Pain Medicine (ASRA) Guidelines to reduce the risk of infection⁷ and sequelae of LAST,⁸ the American Society of Anesthesiologists (ASA) Guidelines on appropriate monitoring for sedation,⁹ and a recent US Food and Drug Administration (FDA) advisory on determining anticoagulation status before performing a block.¹⁰

The regional anesthesiologist, then, has a number of safety steps and guidelines to consider before a block, in addition to the Universal Protocol mandated by the Joint Commission for any invasive procedure. Recalling and ensuring compliance with these protocols is challenging for physicians in general, but potentially more so in the setting of “production pressure” to have blocks performed so as not to delay surgery. One tool that has proven indispensable in reducing variability and error in other complex, interconnected systems is a checklist.¹¹ It has been suggested that adherence to multiple guidelines and advisories can be enhanced by incorporating multiple guidelines into a single checklist.¹² In medicine, the application of checklists has already been demonstrated to reduce the frequency of central line infections,¹³ wrong-site surgery,^{14,15} and surgical mortality and morbidity.¹⁶ In surgery, the World Health Organization preoperative Surgical Safety Checklist¹⁷ has been proven to reduce surgical complications, but, like the Universal Protocol, it does not address regional anesthesia.

It seems appropriate to attempt to consolidate the recommended safety protocols with the Universal Protocol into a single preblock safety checklist incorporating a “time-out,” typically defined as a standardized procedure for final assessment. In March 2013, ASRA President Joseph M. Neal appointed a task force of 3 senior ASRA members experienced in preblock checklist creation and use, asking them to propose a preblock checklist template incorporating existing guidelines in addition to the time-out element and to seek feedback from experts in the area and from the general membership, starting at the ASRA 2013 Spring Meeting.

METHODS

The group pooled experience from their own and other institutions and reviewed published statements and guidelines. The requirements of the Universal Protocol published by the Joint Commission³ formed the basis of the proposal, incorporating the 3 core principles of the Universal Protocol, namely, preprocedure verification, site marking, and a time out. Similar recommendations from the Safe Anaesthesia Liaison Group of the Association of Anaesthetists of Great Britain and Ireland were also reviewed.¹⁸ Recommendations from the ASRA practice advisory on infectious complications were included (proceduralist uses hand washing, sterile gloves, mask, and removal of jewelry),¹⁹ as well as ASRA recommendations for managing the potential for LAST (appropriate monitoring, ready availability of resuscitation medications including lipid emulsion).⁸ The FDA recommendation for preblock review of anticoagulation status was included, as well as basic ASA monitoring and the Joint Commission requirements for drug labeling.

Starting from these basic elements and with checklists already in place at 3 institutions, a Delphic process was used to

From the *Department of Anesthesiology, Virginia Mason Medical Center, Seattle, WA; †Department of Anesthesiology, Wake Forest School of Medicine, Winston, Salem, NC; and ‡Department of Anesthesiology, Hospital for Special Surgery, New York, NY.

Accepted for publication February 11, 2014.

Address correspondence to: Michael F. Mulroy, MD, Department of Anesthesiology, Virginia Mason Medical Center, B2-AN, 1100 Ninth Ave, Seattle, WA 98101 (e-mail: Michael.Mulroy@vmmc.org).

The authors declare no conflict of interest.

Presented in part at the ASRA Annual Spring Meeting, Boston, MA, May 2013.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.rapm.org).

Copyright © 2014 by American Society of Regional Anesthesia and Pain Medicine

ISSN: 1098-7339

DOI: 10.1097/AAP.0000000000000075

develop a 9-point checklist. It became apparent that any such tool would require modification to satisfy local institutional requirements and customs, such as those for the type and timing of surgical site marking. Accordingly, a set of “recommendations for implementation” was also drafted to suggest modifications for individual practices (see Appendix, Supplemental Digital Content 1, <http://links.lww.com/AAP/A112>).

These materials were presented at the ASRA 2013 Spring Meeting (held May 2–5 in Boston) in both didactic sessions and as a poster in the exhibit area with an attached survey using a 5-point Likert scale to solicit audience responses (Table 1). To obtain further expert input, 2 subsequent surveys of the membership of Regional Anesthesia Fellowship training programs were conducted. The first survey was performed by contacting the directors of all fellowship programs who were active at the time of the survey (November 2013) identified on the ASRA Web site. The second survey used a contact list of all regional anesthesia fellowship graduates of the aforementioned programs. This list was compiled by voluntary contributions of information by the fellowship directors, and included graduates of these programs over the previous 3 decades. The survey was conducted using an Internet survey service (Survey Monkey). Participants were advised of the survey in advance by e-mail, and asked to respond within 2 weeks. A reminder e-mail was sent to all contacts 1 week after the original notice.

RESULTS

At the ASRA meeting, 20 survey forms were returned, with a high frequency of “Agree” or “Strongly Agree” to virtually all of the items. Of the 20 respondents, 5 disagreed or were

neutral about the “jewelry removed, mask applied, hand cleansing” step (taken directly from the ASRA Advisory¹⁹) and 2 made specific negative comments, but there were no suggestions for removal of an item or inclusion of any additional items. There were no specific suggestions for modification of the “Recommendations.”

In the formal didactic presentation at ASRA, the Audience Response System identified that 65% of the 66 respondents had performed or had a colleague perform a wrong-sided block. Thirty percent currently did not perform a block site marking even if the surgeon’s site mark was not visible, and 32% did not use a regional block checklist, although 92% indicated they used a formal checklist before a surgical procedure.

For the Internet survey, 63 regional anesthesia fellowship Program Directors were contacted and 44 (70%) responded. More than 80% of respondents agreed or strongly agreed that checklists were valuable, that they would use such a checklist, that the proposed model was a useful start, and that they would be able to modify it for use with the attached Recommendations (Table 1). For specific elements of the checklist, again more than 75% agreed or strongly agreed on all items except the issues of aseptic technique, review of do-not-resuscitate (DNR) status, and resuscitation equipment.

Of 44 Program Directors, 19 disagreed or were neutral about the aseptic technique step, with 5 comments specifically questioning the need for jewelry removal. Of the 44, 33 disagreed or disagreed strongly that this was necessary. Seven directors commented that DNR status was not appropriate on the checklist, confirming the 20% rate of disagreement with this step. Nineteen disagreed or disagreed strongly about the need to include availability of resuscitation equipment as a checklist item. Of

TABLE 1. Questionnaire Used for All 3 Surveys of Expert Opinion and Membership Responses, Including in the Table the Original Proposed Steps of the Checklist (Items Listed Under Question 8)

Proposed ASRA Preblock Checklist Survey	SD	D	N	A	SA
1. Checklists are valuable tools.	0.6	1.2	7.9	42.4	47.9
2. I would use a preblock checklist.	1.8	3.6	5.4	34.3	54.8
3. I could modify this checklist with the “Recommendations” to be a useful document in my practice.	1.2	2.4	7.2	53.6	35.5
4. The “Recommendations for Use” are clear.	0.6	1.8	8.5	61.8	27.3
5. The “Recommendations for Use” are useful.	0.6	4.3	17.1	51.8	26.2
6. This proposed form is too long.					
7. This proposed form does not include enough.					
8. For each of the proposed steps, indicate whether you consider this step necessary as part of a checklist:					
1) Patient is identified, 2 criteria	1.2	0.6	1.8	21.2	75.2
2) Surgical procedure/consent is confirmed.	3.0	1.8	1.2	26.1	67.9
3) Medical issues, allergies, anticoagulation, and DNR status are reviewed.	6.1	13.9	9.7	26.1	44.2
4) Resuscitation equipment is immediately available: airway devices, suction, vasoactive drugs, and lipid emulsion.	4.8	10.2	17.5	25.3	42.2
5) Necessary equipment is present, drugs/solutions are labeled.	6.1	10.9	13.3	30.3	39.4
6) Block plan is confirmed, site(s) is(are) marked.	1.2	0	3.6	14.5	80.6
7) Jewelry is removed, mask is applied, and hand cleansing is performed.	5.4	19.3	21.7	29.5	24.1
8) Appropriate monitors are applied; intravenous access, sedation, and supplemental oxygen are provided, if indicated.	3.6	8.5	8.5	32.7	46.7
9) “Time out” is performed before needle insertion for each new block site.	1.2	6.1	7.3	21.8	63.6
The completed checklist should be part of the record.	4.8	11.4	24.1	34.9	24.7

For each question, please mark scale on the right: SD, strongly disagree; D, disagree; N, neutral; A, agree; SA, strongly agree.

The combined responses (as percentages of total) of Regional Anesthesia Fellowship Program Directors (n = 44) and the graduates of these programs (n = 122) are included in the table.

44 respondents, 6 noted that their routine was to have resuscitation drugs available at each block performance location, and to only check them once daily.

A significant range of opinions was offered on whether the checklist itself or documentation of its completion should be included as part of the patient's permanent medical record. On this question, 13 respondents were "neutral"; 21, positive; and 10, negative.

The need to repeat the time-out and the checklist if a second block was performed was also controversial. Four comments suggested it was appropriate if there were a change in position or a separation in time, but that there was no need to repeat the entire checklist.

In the second survey, the e-mail addresses for 408 fellowship graduates were identified. Forty of these addresses were no longer active. Of the 368 active addresses, 122 (33%) fellowship graduates responded to the survey. The distribution of responses from the survey of fellowship graduates mirrored the responses of the Program Directors. Again, greater than 75% agreed on the utility of a checklist, the need for patient identification, site verification and marking, and the need for a time-out. The combined distribution of the 166 responses from both directors and fellows is included in Table 1. Responses from the Fellowship graduates added another 17 negative comments on the necessity of removing jewelry and 8 comments suggesting that review of DNR status was not appropriate here. Other comments likewise echoed the opinions of the Program Directors.

DISCUSSION

This proposed preblock safety checklist is the product of a task force assigned by ASRA President Joseph M. Neal to evaluate whether such a tool was appropriate for performance of regional blocks, and which items are essential. The task force used a combination of their own experience, a survey of relevant medical literature, and the feedback from 2 panels of experts (Program Directors of Regional Anesthesia fellowships and a sample of the graduates of those programs) as well as a sampling of general membership at the ASRA annual meeting.

Regarding the question of whether a checklist would be useful or appropriate, there was agreement in the responses of the experts and the membership, and positive support in the literature. Given the multitude of guidelines and advisories published surrounding the safe performance of regional blocks and the natural potential for human error, the utility of a checklist was evident and well supported. Pronovost¹² has noted that "adherence to guidelines often remains low," but that "an unambiguous checklist with interventions linked in time and space" is an appropriate tool to enhance adherence.

As for the content, the task force identified published guidelines and practice advisories that resulted in a proposed 9-step checklist. The content and order of the original proposal were revised after responses from the survey of experts and feedback from the membership (Table 2). The sequence of steps was changed to reflect the expected flow of patient care. It was recognized from the responses that many institutions already have such a checklist, and that any proposed checklist will have to be modified to fit local customs and practices. Nevertheless, the task force suggests that a form of this revised checklist be incorporated in institutions where regional blocks are performed, with appropriate modifications as suggested in the attached Recommendations.

About specific content items, the first priority of the project centered on the Universal Protocol of the Joint Commission, using the steps of this Protocol as first items reviewed: correct patient,

correct site, appropriate marking (steps 1, 3, and 4), all of which are designed to reduce the potential for wrong-sited procedures.²⁰ Wrong-site blocks have been documented in anesthesia pain practices at a rate of 0.02%.²¹ This may be an underestimate due to underreporting if no adverse consequences occur ([http://patient.safetyauthority.org/ADVISORIES/AdvisoryLibrary/2010/Mar7\(1\)/pages/26.aspx](http://patient.safetyauthority.org/ADVISORIES/AdvisoryLibrary/2010/Mar7(1)/pages/26.aspx)). Surveys in Great Britain and reports to the Joint Commission in the United States suggest that 25% of anesthesiologists have experienced a wrong-sided block, and that the frequency in the United States may be increasing with the growing use of peripheral blocks for postoperative analgesia. Further study is needed to confirm the true incidence in clinical practice. In a wrong-site regional block survey performed in the United Kingdom in 2011, contributing factors to wrong-side block included position change before block, obscured surgical site marking at the time of block, change in teams performing block, delay or distraction between surgical checklist and block, and language barrier (www.rcoa.ac.uk/sites/default/files/CSQ-PS-WSB-Brits-Simmons2011.pdf). Surprisingly, in this same series, 40% of patients were responsive at the time of wrong-sided block but did not protest to the anesthesiologist committing the error. Although most wrong-sided blocks are not associated with any permanent harm, any block may cause serious complications with lasting injury or legal action.

Other steps are included based on standard practice and other guidelines. Step 2 addresses the recent FDA requirement¹⁰ that "health care professionals and institutions involved in performing spinal/epidural anesthesia or spinal punctures should determine, as part of a preprocedure checklist, whether a patient is receiving anticoagulants..." This FDA recommendation notes that epidural hematoma with significant nerve injury remains a problem despite previous ASRA Guidelines for anticoagulation management.²²⁻²⁴ This step also includes a suggestion to review drug allergies (based on common practice). The original proposal included a review of medical history and DNR status, which were removed based on feedback from the surveys.

Step 5 (solutions labeled) reflects the Joint Commission requirements for drug labeling. Step 6 is designed to include standard resuscitation drugs for known cardiovascular adverse effects of blocks (especially neuraxial techniques), but also the ASRA recommendation to have lipid emulsion and a treatment strategy in place in the event of LAST.⁸ Although safety steps have reduced the frequency of LAST, it is reported to occur at a rate of approximately 1:2000 and continues to lead to mortality.²⁵ There was considerable discussion among the experts on this item because many institutions stock resuscitation drugs (including Intralipid [Fresenius Kabi, Bad Homburg, Germany]) on their block carts or in the block area, so that this step may not be necessary in that situation. Still, the task force feels it is a critical step that needs to be addressed for each institution.

Step 7 is a reminder of ASA standards for monitoring of patients receiving anesthesia or sedation.⁹

Step 8 includes the basic ASRA Grade-A-level recommendations for aseptic technique to reduce the chance of infection. Infection is rare but the incidence is not zero, even with single-shot blocks.²⁶ The Practice Advisory also contained Grade-B-level recommendations for removal of jewelry, stating "it may be prudent to remove all jewelry items (eg, rings and watches) before hand washing to reduce the risk of contamination." Because the evidence is not sufficient to support that this step actually reduces infections with regional blocks, and because of considerable comment on this topic from the experts, this suggestion was removed from the checklist itself but discussed in the Recommendations, and could be added if local custom chooses to follow these recommendations.

TABLE 2. Final Form of the Proposed Checklist, With Changes in Numerical Sequence and Wording Based on Expert Feedback Enumerated in Table 1**Regional Block Preprocedural Checklist**

- 1) Patient is identified, 2 criteria
- 2) Allergies and anticoagulation status are reviewed.
- 3) Surgical procedure/consent is confirmed.
- 4) Block plan is confirmed, site is marked.
- 5) Necessary equipment is present, drugs/solutions are labeled.
- 6) Resuscitation equipment is immediately available: airway devices, suction, vasoactive drugs, lipid emulsion.
- 7) Appropriate ASRA monitors are applied; intravenous access, sedation, and supplemental oxygen are provided, if indicated.
- 8) Aseptic technique is used: hand cleansing is performed, mask and sterile gloves are used.
- 9) "Time out" is performed before needle insertion for each new block site if the position is changed or separated in time or performed by another team.

Step 9, the requirement for a repeated "pause" if a second block is performed, was also the subject of commentary by the experts. The authors agree that this does not require a complete repetition of the checklist, but they suggest a pause or time-out should be enforced before a second needle placement. This step is particularly important if the patient is repositioned between blocks, if the 2 blocks are separated in time, or if the blocks are performed by different staff (such as a femoral nerve block performed by a "block team" followed by a spinal performed by the primary team). In this latter case of an entirely different team, it would be appropriate to repeat the complete checklist for verification of patient, procedure, and site.

Another significant element of controversy was the format and requirement for documentation of the checklist and time-out. Various checklist formats include wall posters in regional block areas, true paper checklists, and electronic versions. There was no consensus among the experts or the members regarding whether the finished form should be part of the medical record, or if the record should contain an entry ascertaining that the checklist was performed. The Joint Commission Universal Protocol requires documentation of completion of the time-out, but "the organization determines the amount and type of documentation." There is insufficient guidance currently to make specific recommendations on these issues, but postevent review of a wrong-site block would be difficult without documentation of the process.

There are potential limitations in adopting a new checklist. Like all checklists, the addition of new steps and documentation requirements has the potential to be distracting; it could also breed complacency should the safety check be approached with mechanical rather than thoughtful attention to the safety procedure at hand. The complexity of a checklist must be balanced against this "nuisance factor," but, in the end, any checklist is only as good as the commitment of the provider to focus on the checklist procedure, and to believe that its implementation will decrease the provider's potential for error. The evidence to date strongly supports the positive advantages of using a checklist in complex medical situations.

Another potential objection to the introduction of a new checklist is the implication that it creates additional constraints on practice or liability for the practitioner, a concern that was expressed by several Program Directors in the first survey. In reviewing the evidence base for the proposed steps in the final draft of this checklist, the authors note that every step is already supported by a published national guideline or practice advisory, or part of good medical practice for which each practitioner is responsible. The use of a checklist to ensure compliance with

these existing standards can only be presumed to reduce the chance for error or omission.

Enforcing completion of a checklist is a challenge. Until these items become as routine as placing a pulse oximeter on a patient during an anesthetic, anesthesiologists will forget to perform a time-out from time to time because of delays, distractions, or other elements previously discussed. Several reports confirm that even the presurgical pause and marking process is not universally completed despite broad acceptance of their utility.^{27,28} In the case of regional blocks, the University of Pittsburgh Medical Center reviewed nearly 100,000 procedures and found a rate of wrong-side block of approximately 1:10,000 during a 10-year period. This rate did not change with the implementation of a formal preblock checklist procedure, but in the cases of wrong-site block after such implementation, it was found in review that the checklist procedure had not been followed.²⁹ Adding a mandatory implementation step is helpful. In some institutions, a nurse is empowered to "stop the line" during central line insertion if the checklist has not been followed. One regional block center developed a process by which a nurse provides the regional block needles only after the checklist is performed.⁵

Although not a guarantee of outcome or safety, checklists have proven their worth in and outside of medicine and should be incorporated into the practice of regional anesthesia. A "pause" or "time-out" before each new block procedure starts should become an automatic and thoughtful step in every regional anesthetic. Further data are needed to confirm that use of this checklist, or a modified version based on local customs, reduces the frequency of wrong-side blocks or other complications. The experience of the use of a surgical checklist in large published surgical series suggests that it will be efficacious.

ACKNOWLEDGMENTS

The authors thank the indispensable administrative support of Mary Hargett in formatting, conducting, and collating the surveys of both the Regional Anesthesia Fellowship Program Directors and their graduates. The cooperation of the Program Directors of Regional Anesthesia Fellowships is also appreciated, both in responding to the survey and in supplying the names and contact information for their fellow graduates.

REFERENCES

1. Perrow C. *Normal Accidents: Living With High-Risk Technologies*. Princeton, NJ: Princeton University Press; 1999.

2. Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 2000.
3. Universal Protocol. Available at: http://www.jointcommission.org/standards_information/up.aspx, Accessed June 6, 2013.
4. Edmonds CR, Liguori GA, Stanton MA. Two cases of a wrong-site peripheral nerve block and a process to prevent this complication. *Reg Anesth Pain Med*. 2005;30:99–103.
5. Stanton MA, Tong-Ngork S, Liguori GA, Edmonds CR. A new approach to preanesthetic site verification after 2 cases of wrong site peripheral nerve blocks. *Reg Anesth Pain Med*. 2008;33:174–177.
6. O'Neill T, Cherreau P, Bouaziz H. Patient safety in regional anesthesia: preventing wrong-site peripheral nerve block. *J Clin Anesth*. 2010;22:74–77.
7. Hebl JR, Neal JM. Infectious complications: a new practice advisory. *Reg Anesth Pain Med*. 2006;31:289–290.
8. Neal JM, Mulroy MF, Weinberg GL, American Society of Regional Anesthesia and Pain Medicine. American Society of Regional Anesthesia and Pain Medicine checklist for managing local anesthetic systemic toxicity: 2012 version. *Reg Anesth Pain Med*. 2012;37:16–18.
9. ASA Standards for Basic Anesthetic Monitoring, (Effective July 1, 2011). Available at: <http://www.asahq.org/For-Members/Standards-Guidelines-and-Statements.aspx>. Accessed June 6, 2013.
10. <http://www.fda.gov/Drugs/DrugSafety/ucm373595.htm>, Accessed December 9, 2013.
11. Gawande A. *The Checklist Manifesto*. New York, NY: Henry Holt & Co.; 2009.
12. Pronovost PJ. Enhancing physicians' use of clinical guidelines. *JAMA*. 2013;308:2501–2502.
13. Pronovost P, Needham D, Berenholtz S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med*. 2006;355:2725–2732.
14. Michaels RK, Makary MA, Dahab Y, et al. Achieving the National Quality Forum's "Never Events": prevention of wrong site, wrong procedure, and wrong patient operations. *Ann Surg*. 2007;245:526–532.
15. Makary MA, Mukherjee A, Sexton JB, et al. Operating room briefings and wrong-site surgery. *J Am Coll Surg*. 2007;204:236–243.
16. Haynes AB, Weiser TG, Berry WR, et al. Safe Surgery Saves Lives Study Group. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med*. 2009;360:491–499.
17. WHO Surgical Safety Checklist and Implementation Manual. http://www.who.int/patientsafety/safesurgery/ss_checklist/en/.
18. RA-UK Stop Before You Block Campaign. Available at: <http://www.rcoa.ac.uk/sites/default/files/CSQ-PS-sbyb-supporting.pdf>. Accessed June 6, 2013.
19. Hebl JR. The importance and implications of aseptic techniques during regional anesthesia. *Reg Anesth Pain Med*. 2006;31:311–323.
20. Bierstein K. Preventing wrong site surgery. *ASA Newsl*. 2007;71:21–23.
21. Cohen SP, Hayek SM, Datta S, et al. Incidence and root cause analysis of wrong-site pain management procedures: a multicenter study. *Anesthesiology*. 2010;112:711–718.
22. Horlocker TT, Wedel DJ, Rowlingson JC, et al. Regional anesthesia in the patient receiving antithrombotic or thrombolytic therapy: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (Third Edition). *Reg Anesth Pain Med*. 2010;35:64–101.
23. Ehrenfeld JM, Agarwal AK, Henneman JP, Sandberg WS. Estimating the incidence of suspected epidural hematoma and the hidden imaging cost of epidural catheterization: a retrospective review of 43,200 cases. *Reg Anesth Pain Med*. 2013;38:409–414.
24. Bateman BT, Mhyre JM, Ehrenfeld J, et al. The risk and outcomes of epidural hematomas after perioperative and obstetric epidural catheterization: a report from the Multicenter Perioperative Outcomes Group Research Consortium. *Anesth Analg*. 2013;116:1380–1385.
25. Sites BD, Taenzer AH, Herrick MD, et al. Incidence of local anesthetic systemic toxicity and postoperative neurologic symptoms associated with 12,668 ultrasound-guided nerve blocks: an analysis from a prospective clinical registry. *Reg Anesth Pain Med*. 2012;37:478–482.
26. Nseir S, Pronnier P, Soubrier S, et al. Fatal streptococcal necrotizing fasciitis as a complication of axillary brachial plexus block. *Br J Anaesth*. 2004;92:427–429.
27. Johnston G, Ekert L, Pally E. Surgical site signing and "time out": issues of compliance or complacency. *J Bone Joint Surg Am*. 2009;91:2577–2780.
28. van Klei WA, Hoff RG, van Aarnhem EE, et al. Effects of the introduction of the WHO "Surgical Safety Checklist" on in-hospital mortality: a cohort study. *Ann Surg*. 2012;255:44–49.
29. Hudson ME, Chelly JE, Williams JP. Wrong site blocks: 10 year experience in a large multihospital health care system. ASRA Abstracts, May 2013. Available at: http://www.asra.com/display_spring_2013.php?id=22. Accessed December 9, 2013.