REVIEW ARTICLE

Quality assurance and improvement: the Pediatric Regional Anesthesia Network

David M. Polaner[1], Lynn D. Martin[2] & the PRAN Investigators*

1 Department of Anesthesiology, Children's Hospital Colorado, University of Colorado School of Medicine, Aurora, CO, USA
2 Department of Anesthesiology & Pain Medicine, Seattle Children's Hospital, University of Washington School of Medicine, Seattle, WA, USA

Summary

Quality assurance and improvement (QA/QI) is a critical activity in medicine. The use of large-scale collaborative databases is increasingly essential to obtain enough reports with which to establish standards of practice and define the incidence of complications and risk/benefit ratios for rare events. Such projects can enhance local QA/QI endeavors by enabling institutions to obtain benchmark data against which to compare their performance and can be used for prospective analyses of inter-institutional differences to determine 'best practice'. The pediatric regional anesthesia network (PRAN) is such a project. The first data cohort is currently being analyzed and offers insight into how such data can be used to detect trends in adverse events and improve care.

Quality assurance and improvement (QA/QI) is a critical activity in medicine. In the United States, QA/QI activities are mandated by the Centers for Medicare and Medicaid Services (CMS), The Joint Commission (formerly JCAHO) and by most, if not all, hospital bylaws. In most departments, QA/QI functions are met by relying on the extemporaneous reports of adverse events by individual practitioners. While these reports are valuable tools and can, especially if coupled with root cause analyses, teach a department a lot about systems issues that contribute to complications, they are insufficient for us to learn more globally about what the real or relative risks are of performing a particular procedure or how ones department stands compared with national or international standards. Thus, it is imperative that large-scale data be generated and continually updated to learn what the current standards are and how individual departments rank against their peers. Only with such measurements and benchmarks can a department know where it stands and if it is improving.

Three large-scale studies have looked prospectively at the incidence of complications in pediatric regional anesthesia. The French Language Society of Pediatric Anesthesiologists (ADARPEF) has performed two prospective studies reporting very large aggregated data on regional blocks contributed from 47 institutions over two time epochs of 1 year each, the first in 1996 and second in 2010 (1,2). These studies provide the most accurate and complete data to date on blocks of all types in infants and children. In 2008, 21 centers in Great Britain and Ireland reported a prospective detailed audit of epidural anesthetics in children (3). Although all three articles provide invaluable information about the incidence of complications related to regional anesthetics in children, to date there are no similar data from North America, and no system that, in addition to its research function, is organized to provide longitudinal data to individual departments that can be used to benchmark performance.

The pediatric regional anesthesia network (PRAN) was established as an ongoing project to accrue data

on practice patterns, safety, complications, and risks associated with regional anesthetics in children. The purpose of the Network is twofold. First, it is organized as a research consortium to collect audited prospective data and develop a data warehouse that can be mined for future investigations. In addition to the projects currently in process, a research committee of the Network is organized to propose and/or approve future research projects using the PRAN data. Second, the PRAN website is set up to permit the lead investigator from each participating center to have continuous access to their own institution's data – that is, to serve as a local data repository. This enables the calculation of local complication rates and practice patterns. Each center also has access to the current aggregate numbers from the entire network, which enables them to benchmark local performance against the Network norms. The structure of the database also will permit both prospective and retrospective comparisons to develop 'best practices' by looking at anonymous de-identified comparisons between institutions. It is known from the UK and two French studies that serious complications are rare in pediatric regional anesthesia; thus, the accumulation of very large numbers of cases through a multicenter database has the best chance of discovering small differences in practice that may result in better outcomes or lower risk. The UK investigators demonstrated this very well when their biannual status reports detected that a single center had a higher infection rate than the others in the study, thus enabling that center to change their practice and reduce their rate to that of the rest of the centers (3).

PRAN was organized in 2006 and began with the participation of six pilot sites; it now includes 12 centers (Table 1). All are academic institutions, but there is a mixture of large and small hospitals and of free-standing children's hospitals and pediatric anesthesia divisions of general medical centers. De-identified data on every block performed by anesthesia staff members at each center are collected locally and entered into a secure server hosted by Axio Research, LLC (Seattle, WA, USA) over the Internet using an interface that was designed in partnership with Axio. All study centers obtain approval from their local human studies review board to participate in PRAN, and because there are no changes in care and all data uploaded to the database are de-identified, waivers for both consent and HIPPA (Healthcare Information Privacy and Portability Act) authorization have been granted. Since the initiation of the project in April 2007, data on over 26 000 regional anesthetics have been entered. The detailed data include demographics, type of block, drugs and dosages administered, patient state at the time of the block (awake, sedated, or anesthetized), the use of localizing and imaging techniques, and detailed information on early and late complications. The first report of detailed results from PRAN is currently in review for publication; much of these data have been presented in abstract form over the past several years (4–8).

Because one of the primary goals of the PRAN is to determine complication rates and estimate risk, it is important to know the denominator (that is, the total number of blocks performed at each participating center) with precision, in addition to ensuring the accuracy of the block information and the details of any complications. An auditing system was designed that reviewed and confirmed the accuracy of the data content that was uploaded to the server and also required each center to review the records from every anesthetic performed at their institution to detect and recover any cases that might have been missed. Any missing cases that were discovered were then entered, so there is great likelihood that 100% of all blocks were recorded. Every record with a reported complication is reviewed for accuracy, and 10% of all cases from each center that are entered into the database are randomly audited for accuracy as well. Thus, the investigators have a high degree of confidence in the accuracy of the data. We believe that the increasing use of electronic anesthesia record keeping systems may be able to automate and simplify this task in the near future. PRAN is already looking at the potential for automated capture of data from several electronic anesthesia information systems; although such software will not eliminate the necessity of auditing, it may speed and ease the collection of raw data.

Quality assurance and improvement issues have become apparent in our analysis of the first data

Table 1 PRAN participating centers

Seattle Children's Hospital (Seattle, WA)*
The Children's Hospital, Denver (Aurora, CO)*
Dartmouth Hitchcock Medical Center (Hanover, NH)*
Children's Memorial Hospital (Chicago, IL)*
Lucile Packard Children's Hospital of Stanford (Palo Alto, CA)*
Children's Medical Center (Dallas, TX)
Columbia University (New York City, NY)
The Cleveland Clinic (Cleveland, OH)
University of Texas, Houston (Houston, TX)
Children's Hospital, Boston (Boston, MA)
University of New Mexico (Albuquerque, NM)
Texas Children's (Houston, TX)
Oregon Health Sciences University (Portland, OR)

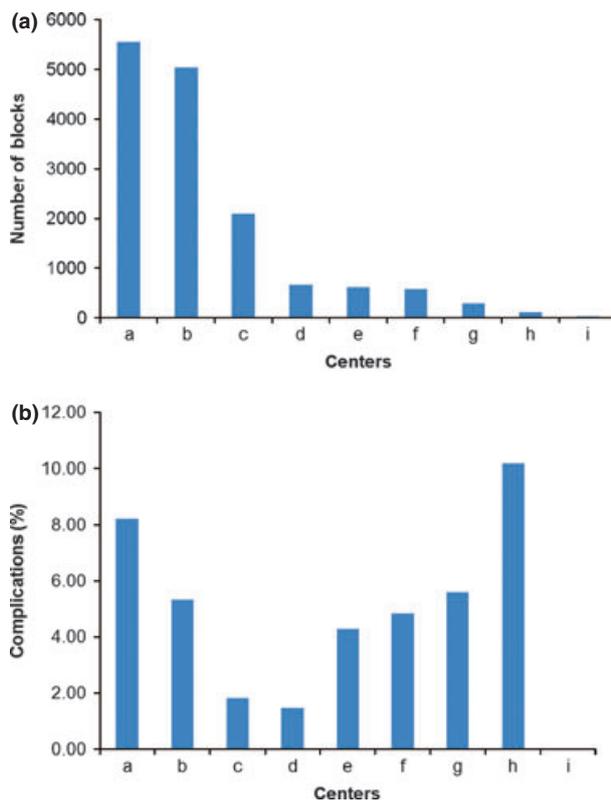Pilot centers are denoted with an asterisk.

cohort (April 1, 2007–August 1, 2010) and provide an opportunity to test interventions and changes in methods. Review of the incidence of complications with catheter (continuous) blocks revealed that the most frequent complications reported regardless of block type were problems with the catheter inadvertent withdrawal, kinking, or other technical malfunction (Table 2). In most cases, this was significant enough to require the block to be aborted and a different analgesic modality substituted. The incidence of catheter complications ranged from 4.9% of neuraxial blocks, representing 17.9% of all complications in this group, to 12.6% in lower extremity blocks, representing 40.7% of all complications in that group. This is an extremely high rate of blocks that are otherwise functioning but fail due solely to technical problems with

the catheter. Obviously, there are several types of continuous blocks that were infrequently reported; thus, those numbers may be of questionable significance. Nonetheless, the commonly performed continuous blocks do show similarly high frequencies of catheter complications and are reported in large numbers. These data highlight the urgent need to develop improved methods of catheter fixation. The organization of the PRAN can enable different methods to be tested and compared prospectively. This is just one example of a QA/QI project that is made possible by the PRAN.

The nature of the PRAN database also can permit the comparison of practices between centers. Figure 1 shows the differences in complication rates between the nine centers contributing data to this first time

Table 2 Block complications

Block	Total	Complications	Complication rate (%)	Catheter problems	Catheter problem rate (of total blocks) (%)	Catheter problem rate (of complications) (%)
Neuraxial	2905	788	27.13	141	4.9	17.9
Upper extremity	25	10	40.00	3	12.0	30.0
Lower extremity	541	167	30.87	68	12.6	40.7
Other	23	3	13.04	1	4.3	33.3
Totals	3494	968	27.70	213	6.1	22.0
Neuraxial type						
Caudal – sacral	270	43	15.93	4	1.5	9.3
Caudal – lumbar	256	45	17.58	6	2.3	13.3
Caudal – thoracic	191	52	27.23	6	3.1	11.5
Lumbar	1501	368	24.52	71	4.7	19.3
Thoracic	684	279	40.79	54	7.9	19.4
Totals	2902	787	27.12	141	4.9	17.9
Upper extremity type						
Intrascalene/parascalene	8	6	75.00	2	25.0	33.3
Supraclavicular	7	2	28.57			
Infraclavicular	8	1	12.50			
Axillary						
Other	1	1	100.00	1	100.0	100.0
Totals	24	10	41.67	3	12.5	30.0
Lower extremity type						
Lumbar plexus	180	66	36.67	26	14.4	39.4
Fascia iliaca						
Femoral	168	45	26.79	21	12.5	46.7
Sciatic	149	44	29.53	19	12.8	43.2
Popliteal fossa	33	8	24.24	2	6.1	25.0
Other	8	4	50.00			
Totals	538	167	31.04	68	12.6	40.7
Other block type						
Intercostal	1		0.00			
Ilioinguinal						
Rectus sheath						
Paravertebral	3	1	33.33			
Other	10	2	20.00	1	10.0	50.0
Totals	14	3	21.43	1	7.1	33.3

Figure 1 (a) Total number of blocks reported from each PRAN Center. (b) Total complications (%) from each PRAN Center. Note that the definition of complications includes failed blocks and technical complications such as catheter problems (see text).

epoch of our data analysis. Note that center 'i' had only recently joined the Network and thus had contributed a very small number of cases, so comparison of its complication rate is not reliable. The highly granular nature of the PRAN data will permit much more detailed examination of these complications between centers and thus permit exploration of differences in practice that may result in higher or lower rates of any particular complication, including changing trends over time. This, of course, highlights the ultimate value of QA/QI projects: the identification of best practices that result in decreased risk and complications to our patients.

There are significant challenges to maintaining a multicentre network like PRAN, which are common to any large collaborative QA/QI initiative. The current lack of extramural funding mandates that participating centers provide yearly fees to partly offset the cost of developing and maintaining the database. Substantial local resources are necessary to input data and perform auditing. A lack of such local resources led to the withdrawal of one of the original centers during the pilot phase of the study and of an additional center last year. Depending upon the size of a department, we estimate it takes approximately a 25% full time effort by a trained assistant to perform these tasks on a weekly basis. Additionally, management by a local principal investigator is necessary to make judgements and answer questions regarding nomenclature and classification, verify audit results, and provide oversight of the entire site's project.

Long-term goals of PRAN are not limited to the on-going collection of data and production of updated risk and complication information. The availability of these large-scale data will permit the investigators to initiate prospective randomized controlled trials focused on questions generated and powered by PRAN data. New research questions can be developed by any participating investigator and submitted to the research and publications committee, which is charged with the vetting of new projects and controlling access to the database for research and QA/QI questions. The use of networks like PRAN will undoubtedly become critical tools for data driven improvement of practice whenever one wishes to ask quantitative questions about rare or uncommon events. As the demands build for evidenced-based practices, it will be increasingly necessary to use collaborative networks to amass adequate and accurate numbers to generate statistically and clinically valid data for quality improvement.

The PRAN continues to recruit new centers in the US and internationally that are interested in committing to a rigorous program of data collection for research and QA/QI on regional anesthesia in infants and children. Interested readers may contact the authors at david.polaner@ucdenver.edu or the project manager at Axio Research, LLC at christiew@axioresearch.com.

Conflict of interest

No conflicts of interest declared.

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Appendix 1

List of PRAN Investigators as of June 2011

Name	PRAN Center
Adrian Bosenberg	Seattle Children's
Kyun Kee Chung	Children's Hospital, Boston
Joseph Cravero	Dartmouth Hitchcock Medical Center
Sean Flack	Seattle Children's
Nancy Glass	Texas Children's
Ranu Jain	University of Texas, Houston
Helga Komen Usljebrka	University Hospital Rijeka
Elliot Krane	Lucile Packard Children's Hospital of Stanford University
Nicholas Lam	University of New Mexico
Sara Lozano	Children's Hospital Cleveland Clinic
Lynn Martin	Seattle Children's
Maria Matuszczak	University of Texas, Houston
Kim Nguyen	Texas Children's
Susumu Ohkawa	Morgan Stanley Children's Hospital at Columbia University
Jorge Pinenda	Doernbecker Children's Hospital/ Oregon Health Sciences University
David Polaner	The Children's Hospital, Denver
Robert Power	Texas Children's
Navil Sethna	Children's Hospital, Boston
Carmen Simion	Children's Memorial Hospital, Chicago
Santhanam Suresh	Children's Memorial Hospital, Chicago
Peter Szmuk	Children's Medical Center Dallas
Andreas Taenzer	Dartmouth Hitchcock Medical Center
Polina Voronov	Children's Memorial Hospital, Chicago
Christie Wolf	Axio Research LLC