Evidence-based Perfusion Practice: It’s not all about the pump

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Objectives: To provide an overview of evidence based perfusion and to describe a framework for making your practice more evidence based.

Introduction:
In March of 2001, the Institute of Medicine report, Crossing the Quality Chasm(1), exposed the gap in the US healthcare system, pointing out the chasm between the way healthcare “is” and the way that healthcare “should be.” The authors reported that scientific knowledge about the best care is not applied systematically or expeditiously to clinical practice. It takes an average of 17 years for new knowledge generated by randomized controlled trials to be incorporated into clinical practices and even then application is highly uneven.” This sobering report describes how one nation’s healthcare system, faced with rapid changes, has fallen short in its ability to translate knowledge into practice and apply new technology safely and appropriately. “We have an extraordinary capacity to deliver the best care in the world, but we repeatedly fail to translate knowledge and capacity into clinical practice.” These findings presents those of us here today with a moral imperative to address this gap problem.


From this definition it is implicit that the external scientific evidence must become integrated and serve as the underpinning of how care is delivered locally to each patient. Jeremy Grimshaw of the Ottawa Health Research Institute described the study of the uptake of research findings as “Implementation Research(2).” Implementation Research focuses on learning how to change the technical aspects of care to a system that is evidence based at the local level. Batalden and colleagues have described a creative model for accelerating improvement that provides a framework at the frontline, the microsystem level, where generalizable scientific evidence (knowledge of what is published in the scientific literature) and particular contexts (knowledge of the local system of care) are synthesized to promote experiential learning (3). This model is well suited in cardiac surgery since the members of a cardiac surgery team are highly interdependent and they work in a complex adaptive system. The integration of clinical expertise involves a team and a myriad of complex interactions with each other and with the patient. No one system of care will work consistent across centers. Evidence based perfusion, is not all about the pump it is about how we redesign our system using two types of knowledge- scientific evidence published in the literature and contextual knowledge about our system. Armed with these two types of knowledge we then have a foundation for designing intelligent tests of change.

What is a Clinical Microsystem?
“A health care clinical microsystem can be defined as a small group of professionals who work together on a regular basis – or as needed - to provide care and the individuals who receive that
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care (who can also be recognized as members of a discrete subpopulation of patients) It has clinical and business aims, linked processes, a shared information environment and produces services and care which can be measured as performance outcomes. These systems evolve over time and are (often) embedded in larger systems/organizations.”


Use of the microsystems concept provides a framework to organize, measure, and improve the delivery of care. Clinics, emergency departments, cardiac catheterization labs, and cardiac surgery teams are examples of clinical Microsystems. Microsystems exist in healthcare organizations regardless of whether they are recognized as such by the professionals that work in the system or the individuals that receive care within the microsystem. Study and improvement of healthcare organizations using the microsystem framework provides a focus of improvement at the point of care. Figure 4.2 depicts how individual microsystems exist within a health organization. The overall quality of the care provided is built on the basis of scientific evidence depicted on the left and quality metrics (or measures) shown on the right. The mesosystem is comprised of departments that provide infrastructure to support the front line Microsystems. The leadership’s role is not to dictate how care will be provided, rather it is to provide support and empower the Microsystems in their journey to continuously improve. Senior leadership’s role is to encourage this culture of engaging the professionals in continuously reflecting on their work and devising tests of change. Leadership should strive to develop a culture where there is a relentless desire by everyone to fulfill duel roles as both; providers of direct care to the patients and as the inventors/initiators of improved processes. The quality of the services provide by the microsystem are closely linked to the relationships and interdependencies of the professionals that comprise the microsystem. Microsystems are complex adaptive systems that may change for the better or for the worse. As professionals in the system begin to understand their interdependencies and develop a common mental model related to the care that they provide, the system will adapt and improve. In other words, when everyone see that it is their job to redesign care and they understand how their success in doing so is based on cooperation the system may adapt and improve at an accelerated rate. Examining the generalizable scientific evidence is a look outward for best practices and the quest for context knowledge is an inward quest, examining the processes and patterns within the microsystem. These two types of knowledge form the foundation for change.

**Generalizable Knowledge**

Generalizable knowledge is usually obtained through basic professional education and is continuously expanding through information presented at conferences like this one, information reported in academic journals and writings. The scientific evidence is expansive in some areas and may be lacking in other areas of practice. Furthermore, the quality of the evidence is variable.
Evidence-based Perfusion Practice: It’s not all about the pump

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Systems for classifying the evidence have been described. One such guideline for classifying evidence has been jointly published by the American College of Cardiology and the American Heart Association. This model for establishing guidelines has been used for establishing many guidelines related to treatment of cardiovascular diseases including; management of patients with unstable angina, management of patients with peripheral vascular diseases, management of patients with acute myocardial infarctions, and management of patients with acute heart failure. Shann and colleagues used this method of classification and guideline development to writing guidelines for CPB related protecting the brain in patients that undergo procedures with CPB. More recently Ferrarias and colleagues have published a joint guideline endorsed by the STS and SCA related to reducing transfusions and coagulation disorders in patients undergoing cardiac surgery. These guidelines attempt to summarize the published literature and provide recommendations to clinicians based on a summary of the published scientific evidence.

Context Knowledge
Generalizable scientific evidence is of little value if it is not applied into the context of clinical care. We can be well versed on the patho-physiology related to a particular aspect of care. For example perfusionists may be well aware of the evidence related to temperature management during CPB. However, knowledge only becomes useful when couple with context knowledge related to how a system performs related to this known best practices. Context knowledge is specific knowledge related to the processes and patterns that occur in the microsystem. Context knowledge may be quantified by measurement of process related variables or outcome related variables. Variables related to processes may be identified to measure adherence to practices that may ultimately improve outcomes. Process related variables are variables that quantify the consistence of microsystem in the delivery of the care that it intends to deliver. A measure of the proportion of patients that receive an antibiotic at the time of induction is an example of a process variable. The proportion of patients that are effectively treated with Beta Blockers prior to surgery is another example of a process variable. Outcome variables are measures of the results of care. Outcome variables may be related to a summary of processes. For example, the rate of mediastinitis is an outcome variable and the rate of mediastinitis may be related to a number of processes including; glycemic control, transfusion rate, timing of antibiotic administration and central line care. Every system is perfectly designed to get the results that it gets (Batalden). Thus, if one wishes to reduce the rate of mediastinitis, improvement efforts should be directed toward measuring processes related to this outcome. The Institute of Healthcare Improvement has proposed the use of “Bundles” as a structured way of improving the processes of care and patient outcomes. Bundles are a small, straightforward, set of practices (generally 3-5) that, when performed collectively and reliably, have been proven to improve patient outcomes. By reporting the adherence to the bundles back to the microsystem the members of the microsystem gain context knowledge about how consistently they are able to deliver the care that they intend to deliver. This context may lead to a multidisciplinary groups generation of strategies to further improve adherence to agreed upon guidelines.

A Regional Approach to EBM: The Northern New England Cardiovascular Disease Study Group
We Used a regional cardiopulmonary bypass (CPB) registry, to compared the practice of CPB at eight northern New England institutions to recently published recommendations (Shann). We examined CPB practice among 3,597 adult patients undergoing isolated coronary artery bypass grafting surgery from January 2004 to June 2005. Registry variables were used to compare regional CPB practice to recommendations on topics of neurologic protection (pH management, avoidance of hyperthermia, minimizing return of pericardial suction blood, aortic assessment, arterial line filtration), maintenance of euglycemia, reduction of hemodilution, and attenuation of the inflammatory response. We report overall regional practice (regional minimum, maximum). All centers used alpha-stat pH management and arterioline filters. Avoidance of hyperthermia (temperature<37°C) was achieved during 23.4% of procedures (regional minimum, 1.5%; maximum, 83.2%). Minimizing return of pericardial suction blood was achieved in 23.7% of cases

Groom-3
Evidence-based Perfusion Practice: It's not all about the pump

Robert C. Groom, MS, CCP

(0.7%, 93.6%). Aortic assessment was performed during 45.7% of procedures (1.3%, 98.9%). Maintenance of euglycemia (<200 mg/dL) was accomplished in 82.7% (57.1%, 97.9%) of cases. Hemodilution (hematocrit <23% on CPB) was lower for men 32.4% (20.6%,52.3%) than women 77.9% (64.7% 88.9%). Men were less likely to receive red blood cell transfusions in the operating room(11.0%; 1.8%, 20.9%) than women (54.6%; 30.1%, 70.6%).In an effort to attenuate the inflammatory response, surfacecoated circuits were used in 83.3% of procedures (8.8%, 100%).During this time, gaps existed between regional CPB practice and recently published recommendations. We continue to prospectively measure CPB practice relating to these recommendations to monitor and improve the care provided to our patients. ( from DioDato CP, Likosky DS, DeFoe GR, Groom RC et al. Cardiopulmonary Bypass Recommendations in Adults:The Northern New England Experience. JECT 2008;40:16-20. (Abstract provided with permission from the Journal of ExtraCorporeal Technology)

A single centers approach to EBM STROBEH Group Strategies to Reduce the Occurrence of Brain Embolism and Hypoperfusion is a multidisciplinary work team at Maine Medical Center comprised of surgeons, perfusionists, anesthesiologists, and an epidemiologist. Since embolization and hypoperfusion of the brain are the most frequently cited mechanism of cognitive injuries for patients undergoing cardiac surgery we developed a two fold strategy to help the team gain both knowledge from the published literature and contextual knowledge about embolism and hypoperfusion in patients treated within their system.

1. Evidence related to brain embolism was systematically reviewed and updated monthly to the team.
2. A monitoring model was developed to capture detailed information related to embolic counts in the inflow and outflow of the heartlung machine and emboli measured in the Right and left middle cerebral arteries. Cerebral RSO2 , patient physiologic parameters, and perfusion parameters were collected every 20 seconds. The monitoring model was used to capture detailed contextual information that would help us understand timing and the extent of a patients exposure to various conditions during CPB. A high definition video camera was used to record the fine processes of the surgical procedure carried out by the surgical team. Embolic activity in middle cerebral arteries was continuously monitored using transcranial Doppler sonography and cerebral and other vital physiological parameters were continuously recorded. The system captured and synchronized the video and physiological data to produce a detailed recording of the timing of emboli and the incidence of brain hypoperfusion. These recordings were used to produce recordings and graphical reports to inform the surgical team and develop strategies to reduce a patients exposure to these precursors to brain injury. Blood samples were also collected immediately before and 48 hours after the procedure for subsequent CNS biomarker analysis. Psychometric testing was performed immediately prior to surgery, prior to hospital discharge, and at three months.

After a period of baseline measurement tests of change were implemented based on the published evidence. Changes included – changing from an empty to a primed venous line (Rodriguez EJCTS 2006, Willcox ATS 1999); use of lowe level of VAVD vacuum (Jone ATS 2002, Willcox ATS 199, Rider JECT 1998); change from a 40 micron arterial filter to a 27 micron arterial filter (Riley JECT 2007), change from a 105 micron filtered venous reservoir to 30 micron reservoir (Myers JECT 2007, De Somers JECT 2007), and change from roller to centrifugal pump (Wheeldon Perf 1990). We also provided feedback to the team during the procedure regarding the occurrence of emboli. These tests of change and redesign initiatives resulted in an 88% reduction in microemboli detected in the outflow of the CPB circuit, and a 76% reduction in microemboli detected in the cerebral arteries. Ultimately changes in the CPB circuit lowered the CPB outflow count presently to below the cerebral microemboli count. Use of this strategy of sharing generalizable evidence and context evidence with our team has helped us to realize a sustained reduction in exposure of patients to emboli.

Summary: Implementing evidence based practices is a moral imperative. It involves systematic review and classification of the literature, measurement of local care, and execution of tests of change. Some view EBM as conforming or cook-book medicine. Actually, EBM is a more scientific approach that involves study, careful measurement, and evaluation. “Insanity: doing the same
Evidence-based Perfusion Practice: It’s not all about the pump

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thing over and over again and expecting different results. Albert Einstein 1879-1955.

"Knowledge is of no value unless you put it into practice." Anton Checkhov 1860-1904

References and Resources


www.clinicalmicrosystem.org


(accessed 8/13/2007)

Registry and Data Forms from the Northern New England Cardiovascular Disease Study Group
http://www.nneedsg.org/study_sum.htm (accessed 1/10/2009) registry forms, last 500 report, published literature,

Healthcare Improvement
http://www.ihi.org/ihi
http://ICEBP.org
http://www.jointcommission.org/