Stroke

American Heart Association

American Stroke Association

Evidence-Based Clinical Practice Education in Cerebrovascular Disease
Bart M. Demaerschalk

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://stroke.ahajournals.org/content/35/2/392

Evidence-Based Clinical Practice Education in Cerebrovascular Disease

Bart M. Demaerschalk, MD, MSc, FRCPC

An evidence-to-practice gap exists in stroke. Evidence-based clinical practice (EBCP) education may serve a role in overcoming this gap. EBCP training curricula belong in residency, fellowship, and continuing medical education programs. Examples of successful EBCP curricula already exist, replacing more traditional journal clubs. This brief review emphasizes how EBCP education can be integrated into stroke training and how it fits into the Accreditation Council for Graduate Medical Education core competencies.

Evidence to Practice Gap in Stroke

Although there has been an explosive growth in the design, conduct, and publication of clinical research in cerebrovascular disease, there continues to be an under- and inappropriate utilization of already existing and new evidence at the patient's bedside. Numerous examples of this evidence-to-practice gap in stroke exist. Tissue plasminogen activator is estimated to be used in only 2% of all ischemic stroke patients in North America.[1] Fifty percent of American neurologists continue to use intravenous heparin for acute stroke in the face of evidence of nonefficacy and harm.[2] Fifteen percent of carotid endarterectomies are still performed for inappropriate indications.[3] Adherence to evidence-based secondary stroke prevention strategies is generally low: 53% for antithrombotic therapy, 42% for hyperlipidemia treatment, 40% for use of warfarin in atrial fibrillation, 27% for hypertension control, and 18% for dedicated stroke units.[4] Although the reasons behind the evidence-to-practice gap are multiple, variable, and complex, education in evidence-based cerebrovascular disease is a valuable tool in a global effort to bridge this gap and provide better overall care to stroke patients.

Evidence-Based Clinical Practice

The primary objective of education in evidence-based clinical practice is to provide a physician with the requisite skills to satisfactorily solve real everyday clinical problems throughout a career—the skills of lifelong self-teaching and learning—and to translate those solutions into better care for patients.

The necessary steps are satisfactorily summarized here[5]: (1) Converting a knowledge gap into a focused and readily answerable clinical question; (2) Efficiently searching for, locating, and selecting evidence with which to best answer that question; (3) Critically appraising that evidence for its validity and usefulness in the context of the question; (4) Understanding, in simple explicit quantitative terms (if possible), the magnitude and precision of the results, eg, for a therapeutic intervention or diagnostic test; and (5) Integrating the results of this evidence with one's clinical expertise and a patient's unique biology, values, and circumstances.

EBCP in Stroke Education

Education in cerebrovascular disease is a longitudinal process for any clinician. It may begin in medical school, continues during residency training and fellowship, and should never end during the life of a career. Medical education is practically divided into foreground and background learning.[6] Examples of background learning in stroke are cerebrovascular neuroanatomy, neurophysiology, neuropathology, neuropharmacology, and the core elements of practical history taking and physical examination. Foreground learning involves integrating the background knowledge with new clinical cases, and answering questions concerning diagnosis, therapy, and prognosis. In medical school, more time is spent in background learning, while in later stages of training and in practice, foreground learning dominates. The elements of EBCP in stroke fit more closely in the realm of foreground learning and therefore have a greater role in residency, fellowship, and continuing medical education.

This is an exciting time for education in vascular neurology. The subspecialty of vascular neurology has been approved for certification by the American Board of Medical Specialties, and the Accreditation Council for Graduate Medical Education (ACGME) approved the training requirements for residency training in this field. For accreditation, a training program must require its residents to obtain competencies in 6 areas: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and system-based practice.[7] EBCP education, as described above, satisfies 2 of these 6 competencies: practice-based learning and system-based practice. EBCP education enhances a clinician's ability to investigate and

evaluate his or her own patient care, to appraise and assimilate scientific evidence, and to ultimately improve care. The training also encourages awareness of the larger context and system of health care (eg, health outcomes, health economics).

Converting a Traditional Journal Club Into an EBCP Curriculum

Although the majority of stroke training programs boast a journal club, it is typically a poorly suited vehicle for real training in EBCP. A traditional journal club is suboptimal because it is loosely structured, has no formal curriculum, is not patient or problem based, espouses paper bashing, lacks instruction in EBCP skills, is often poorly facilitated, and does not allow for information storage and dissemination. An evidence-based journal club successfully overcomes these deficiencies by designing and implementing a formal patient- or problem-based curriculum; assembling a team of faculty facilitators skilled in teaching EBCP; incorporating learner-centered and small group instruction; integrating the most valid evidence with expert clinical skills and patient values; and producing, compiling, disseminating, and updating critically appraised topics (CATs).[8]

Examples of EBCP Education in Stroke Neurology Training

At the University of Western Ontario in London, Canada, there is a well-developed and highly successful Evidence Based Neurology curriculum primarily aimed at residents.[9–11] The Cerebrovascular Neurology Fellowship training program, at that university, also developed and implemented an EBCP curriculum.[12] A similar program has been developed at the Mayo Clinic, the MERIT (Mayo Clinic Evidence Based Clinical Practice, Research, Informatics, and Training) Center.[13] These programs teach the principles of EBCP and store what is learned in the form of CATs in electronically accessible CAT banks. Each EBCP session is divided into a preconference, conference, and postconference component.

Example of an EBCP Conference in Action

A clinical vignette and PICO (patient, intervention, comparison intervention, outcome) model question serve as the starting point for a stroke resident or fellow. As an example, the scenario may involve a 70-year-old patient presenting with an acute left hemispheric infarction. The CT scan reveals a left MCA dot sign, according to the interpreting neuroradiologist. The focused, answerable PICO question becomes P: patient presenting with symptoms and signs of an acute anterior circulation ischemic stroke, I: CT scan, C: catheter cerebral angiography, O: presence of an M2 or M3 MCA branch occlusion. The trainee is assisted in the preparatory phase (preconference)

of this EBCP journal club by faculty with expertise in clinical epidemiology, EBCP, informatics and evidence-based medicine search strategies, and in the particular content area (eg, a consultant neuroradiologist or stroke neurologist). The trainees are encouraged to search the biomedical literature databases independently before conferring with a faculty librarian skilled in EBM searching. For this topic, there is no integrative research available (systematic reviews and meta-analyses) and no easy-to-locate pre-appraised EBCP summaries (best evidence[14] and clinical evidence[15]), unfortunately. SUMSearch,[16] an automated evidence search engine, was very helpful in locating 2 relevant articles.[17,18] The best pieces of research are identified from the searches and the articles are distributed to all EBCP journal club attendees. In this case, only 1 of the 2 studies actually compared CT with a recognized reference standard, catheter angiography. The next task is to critically appraise the research, assessing validity. Trainees accomplish this task by asking key questions identified as important on appraisal checklists and scoring systems for articles on a diagnostic topic.[19] Then, if the article is determined to be valid, attention is turned to making sense of the main results. At the 1-hour journal club proper (the conference), the designated trainee begins by describing the scenario, question, and search strategy. This would be followed by a very brief didactic lecture on a directly relevant methodological component or principle, for instance, the use of the terms, sensitivity, specificity, likelihood ratios, Fagan's Likelihood Ratio Nomogram, Kappa, etc. Small group facilitated sessions ensue during which the articles are formally appraised. The methodological strengths and weaknesses are identified and the overall validity is established. Then, in a larger group the results are scrutinized and better understood. Finally, with the assistance of content experts, the usefulness of the results is established and the entire exercise is placed into the context of real clinical practice. In the end (postconference), all of this material is captured and summarized in a very succinct form, a CAT, and placed in a CAT bank on an accessible Web site for all to use. See an example of what a CAT on this particular topic might look like (Figure).

The keys to any successful EBCP education in stroke are (1) committed stroke neurology faculty with the requisite training in research methodology or clinical epidemiology, (2) a curriculum of clinically relevant stroke topics, (3) librarians with expertise in EBM searching and informatics, (4) easy access to large electronic bibliographic databases and pre-appraised EBCP databases, and (5) time to regularly meet at a scheduled EBCP journal club.

It is essential that EBCP principles are incorporated into stroke education programs. ACGME core competencies reflect the necessity of EBCP teaching. An evidence-based journal club is an ideally suited vehicle for introducing this material. Overall, the goal is for practitioners to incorporate these principles into daily practice, to facilitate lifelong learning, and for the care of our stroke patients to be improved.

Example of a Critically Appraised Topic:
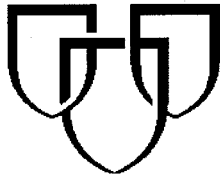
The Presence of a Middle Cerebral Artery (MCA) Dot Sign on Brain Computed Tomography (CT) in Acute Stroke Essentially Rules In the Diagnosis of M2/3 MCA Branch Occlusion.

Clinical Problem: *A 70 year old woman presents to the emergency department within 3 hours of the acute onset of global aphasia and dense right hemiplegia. The acute stroke team is notified and a non-contrast CT scan of her brain is performed. The neuroradiologist detects a left MCA Dot sign.*

Clinical Question: In a patient presenting with symptoms and signs consistent with an acute anterior circulation ischemic stroke, what is the diagnostic performance of the MCA Dot sign on CT in identifying patients with M2/3 MCA branch occlusion?

Search Strategy: Medical Subject Headings [Middle Cerebral Artery Infarction, X-Ray Computed Tomography, Middle Cerebral Artery, Cerebral Angiography] and Text Words [Middle Cerebral Artery Dot Sign, Sylvian Fissure Middle Cerebral Artery Dot Sign, Hyperdense Middle Cerebral Artery Dot Sign] were used on MEDLINE (Ovid) and SUMSearch (PubMed) using saved search strategies and filters for Diagnosis. No systematic reviews/meta-analyses were uncovered. Only one article was found that compared the CT to a reference standard, cerebral angiography. Further searches of Clinical Evidence, Best Evidence, Cochrane, and Bandolier were fruitless.

Evidence: In this diagnostic study, 54 consecutive cases of acute ischemic stroke having had both CT and angiography from a university intra-arterial thrombolysis patient registry were retrospectively evaluated. The CT scans were evaluated for the presence of an MCA dot sign and the angiogram reports documented the site of arterial occlusion. Interrater reliability in identifying the MCA Dot sign was characterized with the kappa statistic. The presence of an MCA Dot sign was compared to the gold standard of an ipsilateral M2 or 3 arterial occlusion at angiography and test characteristics including sensitivity, specificity, and likelihood ratios were presented.

Clinical Bottom Lines:

1. Interrater reliability for the CT interpretation of the presence of an MCA dot sign was 0.76.

2. Sensitivity of an MCA dot sign on CT (compared with catheter angiography) was 38%.

3. Specificity of an MCA dot sign on CT (compared with catheter angiography) was 100%.

4. Likelihood ratio of a positive test result approached infinity.

5. Likelihood ratio of a negative test result was 0.62.

Summary of the Evidence:
Diagnostic Performance of the MCA Dot Sign Compared with Catheter Angiography Confirmation of an M2/M3 MCA Occlusion (n=54)

Table of Results:		
	Sensitivity	38 %
	Specificity	100 %
	Negative Predictive Value	68 %
	Positive Predictive Value	100%
	Likelihood Ratio of a Positive Test	Infinity
	Likelihood Ratio of a Negative Test	0.62

Appraisal Comments:
- The spectrum of patients was highly selective (undergoing intra-arterial thrombolysis) and not representative of a general acute stroke population
- This diagnostic study was retrospective
- The origin of the patient population was well described
- All study patients received the diagnostic test in question, CT brain
- All study patients received the gold standard, catheter angiography
- The CT scans were reviewed independently from the angiography by 2 blinded reviewers and disagreements were settled by a 3rd arbitrator
- Only half of the angiograms were evaluated by more than one reviewer.
- It is not clear if the angiograms were interpreted in a blinded fashion.
- Agreement was reported among evaluators of the CT scans, but not of the angiograms.
- Sensitivities, specificities, and likelihood ratios were reported.
- Investigators did not report on precision (confidence intervals).
- Overall, validity is graded as 1b, a good validating retrospective cohort study

References:	Leary MC, Kidwell CS, Villablanca JP, et al. Validation of Computed Tomographic Middle Cerebral Artery "Dot" Sign, An Angiographic Correlation Study. *Stroke*. 2003;34:2636-2640.
Key Words:	Middle Cerebral Artery Infarction, X-Ray Computed Tomography, Middle Cerebral Artery, Cerebral Angiography, Middle Cerebral Artery Dot Sign, Sylvian Fissure Middle Cerebral Artery Dot Sign, Diagnosis
Appraiser:	Bart M. Demaerschalk, MD, MSc, FRCPC
Appraisal Date:	November 12, 2003
Expiration Date:	November 12, 2005

References

1. Gladstone DJ, Black SE. Update on intravenous tissue plasminogen activator for acute stroke: from clinical trials to clinical practice. *Can Med Assoc J*. 2001;165:311–317.
2. Al-Sadat A, Sunbulli M, Chaturvedi S. Use of intravenous heparin by North American neurologists: do the data matter? *Stroke*. 2002;33:1574–1577.
3. Halm EA, Chassin MR, Tuhrim S, Hollier LH, Popp AJ, Ascher E, et al. Revisiting the appropriateness of carotid endarterectomy. *Stroke*. 2003;34:1464–1472.
4. Holloway RG, Benesch C, Rush S. Stroke prevention: narrowing the evidence-practice gap. *Neurology*. 2000;54:1899–1906.
5. Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB, eds. *Evidence Based Medicine: How to Practice and Teach EBM*. 2nd ed. London, UK: Churchill Livingstone; 2000:2–3.
6. Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB, eds. *Evidence Based Medicine: How to Practice and Teach EBM*. 2nd ed. London, UK: Churchill Livingstone; 2000:15–18.
7. ACGME Outcome Project. General Competencies, Educational Program. Available at www.ACGME.org. Accessed November 14, 2003.
8. Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB, eds. *Evidence Based Medicine: How to Practice and Teach EBM*. 2nd ed. London, UK: Churchill Livingstone; 2000:87–90.
9. Demaerschalk B, Wiebe S. Evaluating the relevance of evidence based medicine in a neurology residency programme. *Can J Neurol Sci*. 1998;25:S79.
10. Wiebe S, Demaerschalk. Progress in clinical neurosciences: evidence based care in the neurosciences. *Can J Neurol Sci*. 2002;29:115–119.
11. University of Western Ontario's Evidence Based Neurology Web site. Available at http://www.uwo.ca/clinns/ebn/. Accessed November 14, 2003.
12. Demaerschalk B, Hachinski V, Wiebe S. Development of a formal evidence-based stroke curriculum in a neurology training program. *Neurology*. 2000;54(suppl 3):A46.
13. Mayo Clinic Scottsdale Evidence Based Clinical Practice, Research, Informatics, and Training (MERIT) Center Web site. Available at http://mcswebpub.mayo.edu/dept/MERIT_Center/CATS.asp. Accessed November 14, 2003.
14. Best Evidence. Available at http://www.acponline.org/catalog/electronic/best_evidence.htm. Accessed November 14, 2003.
15. Clinical Evidence. Available at www.clinicalevidence.com. Accessed November 14, 2003.
16. SUMSearch. Available at http://sumsearch.uthscsa.edu/. Accessed November 14, 2003.
17. Leary MC, Kidwell CS, Villablanca JP, et al. Validation of computed tomographic middle cerebral artery "dot" sign: an angiographic correlation study. *Stroke*. 2003;34:2636–2640.
18. Barber PA, Demchuk AM, Hudon ME, Pexman W, Hill MD, Buchan AM. Hyperdense sylvian fissure MCA "dot" sign: a CT marker of acute ischemia. *Stroke*. 2001;32:84–88.
19. Jaeschke R, Guyatt G, Lijmer J. Diagnostic Tests. In: Guyatt G, Rennie D, eds. *Users' Guides to the Medical Literature: A Manual for Evidence Based Clinical Practice*. Chicago, Ill: AMA Press; 2002:121.