Building a Stroke Referral Center in Your Emergency Department:
Protocols and Thrombolysis

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Abstract

The past decade's success with thrombolysis for ischemic stroke has generated intense interest, despite the risk of intracranial hemorrhage. Stroke centers and rapid treatment protocols have become a new focus of emergency medicine, although risk-factor reduction deserves greater emphasis. This article details the development of a stroke center, protocols, and medical-legal issues. A patient case is used to visibly explain how improved outcome can result from reducing a few minutes at every step in the three-hour window to thrombolysis.

Stroke is among the leading causes of death and disability in America. Treatment and lost productivity costs for 2009 are estimated at $70 billion in the U.S., according to the National Stroke Association. Of course, the economics of stroke seem small compared to the social cost.

Following the first successful thrombolytic trials in 1995,[1] the emergency department (ED) aspects of ischemic stroke have become much more interesting. Emergency physicians began to look at stroke care in a different way. In the past, our function had been to make the diagnosis, look for other problems, and then call a consultant. The rest we left to our friends in rehab to treat. Now, the ED has become the focus for stroke care and research.

Although thrombolysis is clearly not yet considered the 'standard of care' for emergency medicine and is used in only a small minority of stroke patients, its success led to the formation of rapid treatment protocols and stroke centers. Time has become the critical issue, and all effort goes to reducing just a few minutes from every step in the pathway to thrombolysis.

Early data on hospitals with JCAHO-certified stroke centers are beginning to show improved patient outcome with reduced complications, length of stay, and cost of care for all types of strokes.[2] The true benefit of a stroke center, however, may result from its focused multidisciplinary care rather than improved technology. This article will detail the planning of an ED stroke team and its function as the key component of a hospital's stroke center.

Prevention: Better Than Intervention

Despite our exuberance for intervention, let's begin with the fact that stroke is the third leading cause of death, and many deaths occur before the ambulance even arrives. So prevention of stroke is at least as important as its treatment.

Despite its efficacy, thrombolysis is at present only potentially useful in about 5-10 % of ischemic strokes. For a variety of reasons patients do not rush to the hospital in time to meet the very narrow three-hour window. So as primary care physicians, for the vast majority of strokes, there is little we can prescribe except 'prevention.' Obviously, if prevention is the only hope that many of our higher risk patients have, then we should put a lot more effort into risk-factor reduction.

Modifiable risk factors include the usual suspects: control of BP, diabetes, cholesterol and weight, smoking and drugs, exercise, diet, and also the need to anticoagulate for atrial fibrillation. Our impressive new therapies should not detract from basic prevention. Success with smoking cessation or blood pressure control is clearly more important than thrombolysis. Yet in emergency medicine we think 'intervention' not 'prevention.' In our society as well, prevention does not receive the money or the media attention it deserves.

We have a lot of work to do in public education about risk-factor reduction and recognizing early symptoms. Perhaps it's not surprising that a majority of the highest risk patients could not name one risk factor, and many could not even name one symptom of a stroke. Multiple studies have shown that even brief educational counseling in the ED is beneficial.

Furthermore, having a stroke or transient ischemic attack (TIA) implies a high risk for subsequent stroke. In past decades having a TIA was almost considered a minor inconvenience that needed follow-up. Now we know that after a TIA, you have a 10% chance of a full stroke in the next three months, and half of these occur within just a few days. The risk exponentially increases with the number of combined risk factors (elderly, diabetes, hypertension, and longer duration TIAs). Platelet inhibitors have proven benefit for a large percent of patients at risk. However, once again, it's public education that is needed for a patient to recognize that a brief TIA may have happened to them and understand its high risk. Likewise, we could possibly thrombolyse ten times as many patients if they came as soon as symptoms appear. With increased public education we do expect more will arrive in time, and we must be ready to help them.

Denying Yourself: A Case Report

The following patient provides a rare, visual example of deterioration during an evolving stroke. It also demonstrates the difficulty in treating a stroke within the three-hour thrombolytic window when a patient denies or ignores early symptoms (Figure 1A Chess Slide).

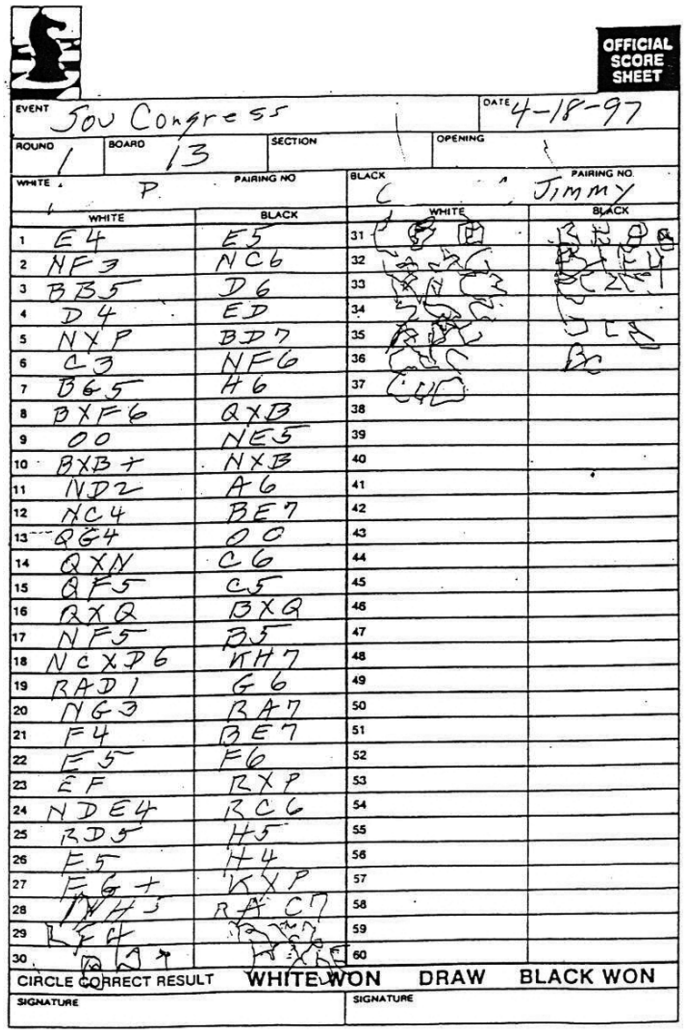

Figure 1A: Patient's own written record of a chess game during an evolving stroke.

An intelligent, previously healthy, 60-year-old man was playing in a local chess competition. When he arrived at the ED, he brought his hand-written record of the chess match, in which you write down each move that you and your opponent make. At the game's beginning each move takes only a few seconds. As the game progresses, more thought is required, and each move may take a few minutes. As seen by the change in writing ability, his stroke began at perhaps the 20th move and progressed with time. He said he had no difficulty in formulating chess strategy and thought his deteriorating ability to write was simply because he was getting tired. When he eventually realized something was wrong and got up from his chair to leave for the ED, he also noticed his leg was not working properly.

At this stage of the chess game each move probably took an average of two to three minutes. Multiplying this by two opponents over 30 moves gives us the first hour of his stroke. In this rare opportunity of regular handwriting samples, we can imagine an increasing number of neurons progressing through

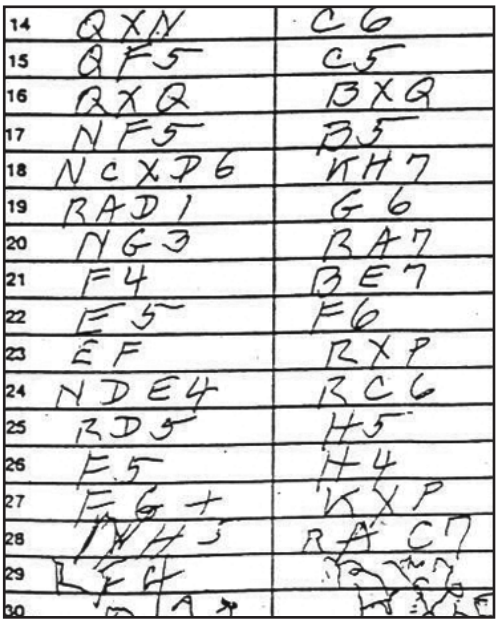

Figure 1B: Shows onset of stroke

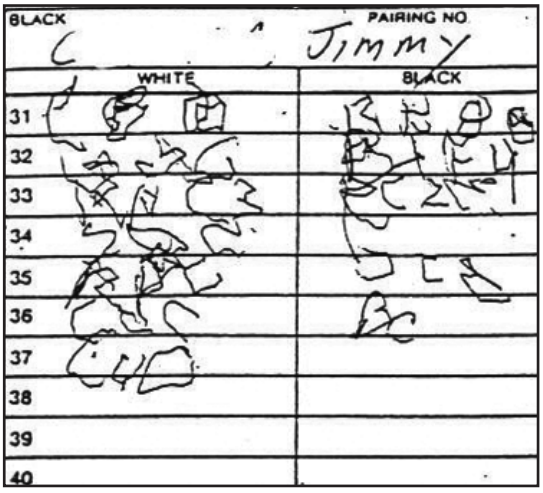

Figure 1C: Further deterioration from stroke

reversible ischemic injury to death. This clearly demonstrates why thrombolysis and the newer clot removal techniques can work. The earliest affected neurons will die, while others in the surrounding ischemic zone are dying but potentially reversible if blood flow can be restored.

This is why strict adherence to a rapid stroke protocol, and regular practice of the protocol, is essential. It can make the difference between a mild versus a debilitating stroke. Until circulation is restored, every minute wasted results in more lost function. This is the time-imperative if they arrive within the therapeutic window. After prevention, it is our next best opportunity to treat strokes. For emergency physicians this is the future of ischemic stroke care.

Stroke in Evolution

Thrombolysis changed the way we treat heart attacks. It has been the cardiac standard of care for so long that we forget how emergency physicians were initially reluctant to use it. The main differences between heart attack and stroke thrombolysis are that the time window is shorter, the complications more frequent, and the diagnosis often harder to make compared with seeing a heart attack on an EKG. The other point to make is how many different hospital departments and people must coordinate to make stroke thrombolysis work.

Currently, there is a lot of controversy about stroke thrombolysis, and 'time will tell' how good it really is.[3-4] The current belief is that for patients fitting strict criteria, it can make a major improvement if given very quickly; i.e., within two hours of symptom onset. Currently, IV stroke thrombolysis must begin within 4.5 hours of symptom onset, and earlier administration clearly gives better results. This time window has recently been expanded from three hours to 4.5 hours,[5] accompanied by even more controversy. Despite the increased time available to treat, however, speed is still essential, and the best outcome will still be from earlier treatment.

It is critical to note that waking up with stroke symptoms present is not the time of onset. For thrombolytic consideration it is the time when the patient was last known to be intact. Replication of the study, which supports the new time-window, is needed before we should feel comfortable advising patients. Until that time, presenting understandable risk/benefit information to the patient and family permits them to make the decision and accept the risk involved (see Medical-Legal Issues below).

Stroke teams and stroke centers are evolving with a goal of rapid and comprehensive therapy. Although only a small percent of strokes are thrombolysed, it has been the impetus for this new era in stroke care, with benefits extending through the full range of emergent, inpatient, and rehab therapy.

Stroke protocols are the foundation of rapid treatment in suspected stroke. Sample protocols developed at our institution (Table 1 – Acute stroke protocol) and by other voluntary organizations are available to adapt to your own ED. 'Guideline' is perhaps a better term to use on your documents than 'protocol' with the understanding that each patient is unique, and any deviation from strict protocols may increase the chance of litigation.

Protocols also help prevent complications that impact stroke outcome. For example, the simple act of leaving a stroke patient lying flat, or allowing them to drink water or take oral medication, can result in fatal aspiration pneumonia. All acute strokes should have head elevation and must be NPO until their swallowing ability has been assessed. If they have any difficulty or if there is cranial nerve involvement, a formal swallowing evaluation is needed. (Bedside evaluation with a small sip of water or an ice chip is often used in the ED; however, it is probably wise to be NPO as the stroke may evolve. Likewise, during their assessment and transport, EMS should also keep patient NPO).

Recent research with CT angiography has helped predict which types of stroke may respond best to thrombolysis. Some interventional centers have success with catheters to remove the blood clot and ultrasound or laser to break it up; others administer a thrombolytic directly in the clotted artery up to six hours after symptom onset.

Induced cerebral hypothermia has recently shown promise in minimizing ischemic injury. There is also intense research into a diverse class of 'neuro-protective agents' including progesterone, which may someday prolong the current 4.5 hour window for IV thrombolysis. In the future, paramedics may administer neuro-protective agents to help injured cells recover enough or to slow cell death long enough to get to an ED with a stroke center, where blood flow can be restored either by thrombolysis or by actual clot removal.

A Stroke Center: If You Build It, They Will Come

A number of initiatives have established a hierarchy of care for stroke that resembles the system for trauma center designation.[2] In its simplest form, written protocols for rapid identification and treatment through an emergency department stroke team are essential. Multiple factors, including administrative support, must be considered in whether your hospital should pursue certification as a JCAHO-designated primary or comprehensive stroke center. Leadership by a neurologist or emergency physician is needed to unite the many hospital departments that are involved. Even without an official designation, all EDs should offer the patient an efficient process for early stroke identification and treatment. Those EDs without 24-hour CT or lab capability should still employ specific stroke guidelines or protocols with triage, including updates at least once a year. Current technology for neurology and radiology diagnosis by internet communication offers the opportunity for larger stroke centers to assist small or rural EDs.

Components for a primary stroke center include: 24-hour availability for rapid neurological consultation, CT interpretation, and lab testing, plus written stroke and thrombolytic protocols with

Table 1: Acute Stroke Protocol

All orders listed will be carried out. Please check appropriate boxes. If an order is not to be carried out, strike a line through the order.

Date:_____ Time:_____ Weight:_____kg
Allergies:_____ED Physician phone #_____
Emergency Department order sheet guidelines for Acute Stroke (timed from patient arrival)

Initial Assessment:
1. Triage: "Code 1" if < 6 hours from symptom onset - call ED physician STAT; "Code 2" if > 6 hours.
2. **Physician or nurse - call "Stroke Team Alert" for "Code 1"**(may be called on EMS advice prior to arrival). 2nd call to neurologist if no response in 10 minutes.
3. Open "Acute Stroke Box" for "Code 1" patient.
4. Initiate monitor, BP cuff every 15 minutes, pulse oximetry, fingerstick glucose (if not done by EMS)
5. 18-20 gauge INT; blood for CBC, BMP, PT/PTT (+/- rapid pregnancy test), liver profile, type and screen, CKMB, troponin
6. EKG if: Chest discomfort, short of breath, dysrythmia, BP>185/110
7. NPO; elevate head 30 degrees; nasal oxygen 2 liter/minute, or to maintain pulse ox >95%
8. ED Physician to confirm: time of onset_____, name of patient's neurologist:_____
9. Physician to consider tPA infusion guidelines with patient/family if appropriate.
10. If BP S>185 or D>110 on two readings and patient is potential tPA candidate, administer:
    ☐ Nitropaste (nitroglycerin) 2 inches, topically **OR**
    ☐ Labetalol (Normodyne) 10mg IV over 2 minutes
11. Rapid transport CT head without contrast, reason: Acute Stroke. Give ED Physician phone number to CT Tech..

PRN Orders:
☐ Dextrose (50%) glucose - 25 ml IV for glucose <70, or 50 ml for glucose <60; and repeat accucheck in 15-30 min
☐ Acetaminophen (Tylenol) 650 mg suppository PRN fever

After return from CT:
12. Total of 3 INT's for "Code 1" (limit IV fluids), elevate head.
13. Obtain EKG, Portable Chest X-ray, U/A (if not already done)
14. Maintain strict bedrest; NPO until swallowing assessment. RN to initiate swallowing assessment and document results (RN may begin with single ice chip, followed by 30 ml water).
15. Foley cath/NG tube *if necessary,* before tPA given (restrict ABG, central line)
16. Physician to perform NIH Stroke Scale
17. Physician to review tPA exclusion list before ordering IV tPA (Activase). Dose per protocol: 0.9 mg/kg, maximum 90 mg. Give 10% bolus over 1 minute, 90% remainder over 1 hour.

After tPA given:
1. Continue BP monitor every 15 minutes, notify if BP>185/110 on 2 readings 5 minutes apart.
2. Monitor status for new headache, level of consciousness, nausea/vomiting, sudden hypertension, bleeding, bruising, DIC
3. If signs of complication, **immediately** stop tPA and notify physician.

Order: ☐ STAT non-contrast CT (reason: bleeding; change in neuro status)
☐ Rainbow blood draw.
☐ Guidelines for hemorrhagic complication.

• *No heparin, warfarin, or aspirin for 24 hours from start of tPA infusion.*

If tPA NOT given: Reason: ☐ Onset > 3 hours ☐ Other:_____
Medications (to be given after swallowing assessment)
☐ Aspirin ☐ 81 mg po now ☐ 325 mg po now
☐ Plavix 300 mg po now (if allergic to aspirin)

BP Management: (For persistent BP S>185 or D>110). *NOTE: most ischemic strokes do not require antihypertensives.*
☐ Labetalol (Normodyne) 10-20 mg IV over 2 minutes. May repeat or double dose in 10-20 minutes to max of 150 mg, or
☐ Labetolol drip at 2-8 mg/min.
☐ For B-blocker contraindication (asthma, cardiac failure or severe cardiac conduction abnormalities):
Enalapril 1.25-2.5 mg IV over 5 minutes OR
☐ Cardene (nicardipine) 5.0 mg/h infusion
☐ If BP not controlled by above medications, titrate Nitroprusside 0.5 - 10.0 mcg/kg/min.

Additional Orders:_____

Physician's Signature:_____

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EMERGENCY DEPARTMENT
ACUTE STROKE/TIA ORDER SET

complication management. Neurosurgical care should be available on-call, or within two hours, if hospital transfer is required. Primary Stroke Centers that admit patients will have a defined "Stroke Unit" with trained staff and monitoring equipment. The stroke team requires a lead physician, which may be an emergency physician, and at least one additional member. A stroke log maintains performance data for quality improvement.

Strong integration and training of emergency medical services (EMS) is also essential. Approximately one-half of all stroke patients arrive by ambulance. EMS stroke assessment screening is reasonably accurate, and their early ED notification for potential thrombolysis provides greater time efficiency. They must also provide precise information on the time of symptom onset obtained from bystanders or family. Trained EMS providers can get the patient an earlier CT exam by drawing labs, performing IVs, EKG, and accucheck while in transport. A cooperative understanding to transport the patient to the most appropriate level of care is still evolving. EMS and staff education as well as public education on prevention and early recognition should be provided at least twice a year, and eight hours of CME is required for physicians and nurses.

Time Lost Is Brain Lost

The "time lost is brain lost" mantra, promulgated by the Brain Attack Coalition, is real. What happens in the pre-hospital and ED phase is the most important to final outcome for all stroke patients. ED guidelines need to incorporate speed and efficiency in their design and also be applicable to patients who are not candidates for thrombolysis, including the 15% of strokes which are hemorrhagic.

A thrombolytic door-to-needle time of < 60 minutes is achievable, but requires cooperation between your stroke team and multiple hospital departments, supported by regular practice drills. Patients who fit thrombolytic criteria and who arrive in time to meet the narrow three-hour time window are infrequent – a few per month at larger hospitals. It is believed that the new 4.5 hour window will significantly increase this number.

As we briefly step though our ED guidelines (Table 1), it is apparent a great deal of preparation is involved for a procedure you do not do very often. But that is the whole point – it has to work right. It can greatly benefit your patient if it is done very efficiently but is high risk even when done correctly. Litigation can happen in both directions: for bleeding complications or for failing to give it to a patient who did fit all the criteria and did arrive in time.

The process begins when either the paramedic or ED triage calls to say they have a recent stroke (< 6 hours); we designate this patient 'code red.' Symptom onset of < 6 hours is used due to initial uncertainty in time of onset and the potential for deterioration in the early phase of a stroke. A stroke page is placed to alert the CT scan technician, lab, and the on-call neurologist. The patient is immediately brought to a room for the usual ABCs, a single IV site, oxygen, glucose check, cardiac rhythm, and blood pressure monitoring. It is absolutely essential that labs must be drawn before the patient goes for the CT scan, so that rapid results are available soon after the scan is complete. An "Acute Stroke Box" containing the items for use prior to CT scanning can help save critical minutes (Table 2 – Acute Stroke Box contents). Non-essential tests, such as the EKG or CXR, should be done after the head CT to save time, unless there is concern for chest pain, arrhythmia, or oxygenation. Quick patient registration is also done at this time.

Table 2: Acute Stroke Box Contents

- 1 Metaclopramide (Reglan) 10 mg
- 1 Labetolol (Normodyne) 100 mg
- 1 nitoglycerin paste and paper
- 3 IV start kits
- 3 saline IV flush
- 1 nasal O2 tubing
- Hemocult slide & developer
- 1 set of lab blood tubes, needles & syringes for IV meds
- Stroke guidelines, consent form, NIH scale & exclusions

Within ten minutes of patient arrival, the ED physician should begin a rapid history and physical, establish a time of symptom onset, and go through the long list of thrombolytic exclusions

Table 3: Potential Exclusions for Thrombolysis in Acute Ischemic Stroke (Note: criteria continue to change; this is a commonly used list.)

Age <18 or >80 years showing a measurable deficit with clear onset < 4.5 hours Potential Exclusions (all must be considered before treatment with TPA)	
- Hemorrhage on CT, or subarachnoid suspicion	- Minor or rapidly improving symptoms, or < 30 min duration
- Aggressive Tx to maintain SBP < 185, DBP < 110	- <14 days from major surgery or trauma
- <3mo post MI, CVA, neurosurgery, sig head trauma	- <21 days from GI or GU hemorrhage
- <7 days from LP or noncompressible arterial puncture	- <6 wk pericarditis, endocarditis
- Hx intracranial bleed, aneurysm, AVM, sig CNS tumor	- Seizure with residual neuro-impairment
- Anticoagulation INR >1.7, Platelets < 100,000	- Pregnancy
- Heparin <48h with elevated PTT	- Glucose < 50
- Known bleeding disorder	- Diabetic hemorrhagic retinopathy

(Table 3). At this point the physician decides if this appears to be a true stroke that can potentially be thrombolysed within three hours and notifies the neurologist. CT scanning begins within 20 minutes of arrival; then the radiologist is immediately called and communicates the results and acceptability for thrombolysis.

Meanwhile, the lab is rapidly doing a CBC, chemistry, and clotting times, that must be known before thrombolysis. The stroke association goal is to have results within 45 minutes, but a 30-minute goal is achievable by partnering with your lab for this infrequent 'Stroke-STAT' (Table 4 – Desired time goals). As the patient returns to the ED, a detailed history and re-examination occur. This would include an initial discussion with the patient or family regarding potential thrombolysis and its risks, making certain the time of symptom onset is accurate, obtaining a CXR, EKG, extra IVs, BP monitoring, and, possibly, preparing t-PA (alteplase). Now the neurologist has either arrived, or in some instances reviewed details with the emergency physician by phone while en route. The final elements should include a formal stroke assessment (such as the NIH stroke scale), a risk/benefit discussion, patient or family consent, and review of stat labs and exclusion criteria. Assuming everything is right and still within the 4.5 hour window, we can give t-PA, and hope.

Table 4: Desired Time Goals for IV Stroke Thrombolysis

	Acceptable Goal	Achievable Ideal
Door to Doctor	<15 min	<10 min
Door to CT Completion	< 25	< 20
Door to CT Interpretation	< 45	< 30
Door to Lab Results	< 45	< 30
Door to Needle	< 60	?

Notice we have coordinated: paramedics, triage, patient registration, ED secretary, nurses, lab, CT, pharmacy, radiologist, neurologist, and the emergency physician – and involved the patient and family in the decision – all hopefully within one hour of their arrival. It is exhausting when done right. Yet contrast this with the intense effort spent on a typical cardiac arrest, where the result is typically dismal.

Post-Thrombolysis Monitoring: Watching and Waiting

Next, we need to closely monitor for potential bleeding and blood pressure complications. The risk of significant bleeding, especially intracranial hemorrhage (ICH), is minimized by adherence to the list of potential exclusion criteria (Table 3). The radiologist also follows exclusion criteria for the CT, which relate to the size and etiology of the acute stroke. The risk of ICH from inadvertent administration of t-PA to 'stroke mimics,' such as migraine, TIA, or psychiatric conversion deficits, appears to be the same as that encountered with MI thrombolysis.

Why is there such a high risk of ICH? Recent studies suggest that sub-clinical petechial hemorrhage may be very common in ischemic stroke. Thrombolysis then promotes bleeding where ischemia has weakened vascular cells. Interestingly, however, about 20% of these bleeds occur at a site distant from the acute stroke, suggesting prior damage from causes such as hypertensive and amyloid angiopathy.

Before, during, and after thrombolysis, BP must be closely monitored, with checks at least every 15 minutes for the first two hours post-thrombolysis. Written treatment guidelines need to be followed for any elevation above 185 systolic or 110 diastolic.

High BP is common during acute stroke, but most will have a spontaneous reduction in their pressure within 90 minutes. In patients who are NOT thrombolytic candidates, pressures as high as 220 systolic and 120 diastolic can be closely observed, unless there is suspicion of additional risk of damage from hypertension (e.g., coronary ischemia, CHF, ARF, dissection, encephalopathy).[6-7] In the past decades we aggressively treated hypertensive patients with ischemic stroke. Now we find that leaving BP relatively high may improve cerebral perfusion (although these recommendations are based on limited data).

Hemorrhagic Complications of Thrombolysis: Immediate Treatment Guidelines

Despite the known risks, many physicians are not prepared to treat hemorrhagic complications with the urgency they require. Although specific reversal agents are available, when a critical hemorrhage happens, you do not have time to begin thinking about treatment options or call a hematologist for advice. Every hospital using thrombolytics (for stroke, heart attack or pulmonary embolism) would benefit from having written guidelines *immediately* available in the ED and ICU/CCU to treat the hemorrhagic complications. This may actually help reduce the reluctance among physicians for stroke thrombolysis.

We developed our own specific "Guidelines for Hemorrhagic Complications of Thrombolysis," which can be copied for your hospital.[8] (Table 5) We keep the table in a visible location with our 'thrombolytic box,' rather than just being attached to a manual with other hospital protocols. The guidelines apply to initial management of thrombolytic-associated bleeding in any body location.

Nurses and physicians must be diligent in watching for early signs of intracranial and other bleeding complications and ready to initiate the guidelines. Based on clinical signs alone, it may be necessary to stop the thrombolytic infusion and begin thawing cryoprecipitate even before an immediate CT is done. Time is the critical issue when you decide to give a thrombolytic, and this same urgency may help limit damage if hemorrhage occurs.

Cryoprecipitate is urgently needed to replace fibrinogen, which is depleted by thrombolysis. Platelets are indicated because pa-

Table 5: Guidelines for Hemorrhagic Complications of Thrombolysis

INDICATED:

- ☐ Stop thrombolytic infusion
- ☐ Draw CBC, INR, PTT, Thrombin Time, Fibrinogen – before & after treatment
- ☐ Rapidly give 10 units of Cryoprecipitate IV
- ☐ Give 1 Platelet pheresis unit (i.e., equivalent to 6 units of Platelets)
- ☐ For recent heparin & low molecular weight heparin, give up to 50 mg Protamine IV
- ☐ Immediate consult with hematologist and neurosurgeon for CNS bleed
- ☐ For CNS bleed - consider seizure prophylaxis (especially for lobar hemorrhage)
  - maintain systolic <180 and mean arterial press <130 mm (or much lower acutely ?)
  - minimize intracranial pressure elevation with gentle intubation techniques

POSSIBLY INDICATED: based on bleed severity and volume status

- ☐ FFP 2 units (or Prothrombin Complex Concentrate) if potential coagulopathy
- ☐ RBC transfusion if anemia (hemostasis improves with higher hematocrit)
  - give 1 unit for Hg 10-11 g, or 2 units for Hg <10 g, over 1 hour each

Source: Rasler, F. Emergency treatment of hemorrhagic complications of thrombolysis. *Ann Emerg Med* 50:485, 2007.

tients at risk for stroke or heart attack commonly use platelet-inhibiting medications. (I think it may eventually be recognized that platelets should be considered in all types of truly life-threatening hemorrhage, medical and traumatic, due to the common use of prescribed and OTC platelet-inhibiting medications.) No recommendation at this time can be made for Activated Factor VII, although theoretically it may offer an option to treat thrombolytic-associated bleeding.

Seizure prophylaxis should be considered for ICH because there is a 10% risk of seizure, usually with an early onset and especially with lobar (subcortical) bleeds. Although it is not clearly recommended in the 2007 AHA/ASA guidelines,[7] I would favor immediate seizure prophylaxis, especially for lobar bleeding. Consider the low risk of a phenytoin load versus the risk of further bleeding during a grand mal seizure (i.e., shaking of the head in an anticoagulated patient who is already bleeding).

Elevated blood pressure following ICH must also be addressed to potentially limit hematoma expansion. Avoid rapid BP reduction and use 30° head elevation in a midline position. Consider sedation and simple analgesic measures, such as relieving a headache or distended bladder, to minimize fluctuations in BP and intracranial pressure. If intubation is performed, the usual measures to minimize its acute effect on intracranial pressure should be used.

Acute treatment goals for BP in thrombolytic-associated ICH have not been established, and each patient should be individualized. Recommendations for treating *spontaneous* ICH (bleeding not caused by thrombolysis), suggest a systolic BP <180 and mean arterial pressure <130 mm.[9] For thrombolytic-associated ICH (and warfarin or heparin-associated ICH), much lower pressures may be appropriate in the acute phase, although no recommendations currently exist. It would seem reasonable to want lower pressure, at least until anticoagulant reversal has begun, and titration with short-acting agents may be preferable. The theory is to balance a reduced BP to limit further bleeding, while maintaining a tamponade effect from cerebral pressure and prevent ischemic levels of cerebral perfusion.

Patient Education . . . "A Teachable Moment"

A growing elderly population ensures that stroke care will continue to be a national priority. Our expertise improves but will always be limited by the patient or family's speed in recognizing stroke symptoms and then calling for help. Even with a heart attack, denial of symptoms can be impressive. Yet unlike a heart attack, ischemic stroke is typically painless and the symptoms easy to ignore or hope they go away, as in our example with the chess player. This is why public education, especially of your high-risk patients, is so important.

Cardiovascular education combined with risk-factor reduction is a difficult challenge that emergency medicine needs to embrace. We all know that many ED visits are the direct result of a lack of prevention. However, the ED remains unused and relatively unstudied as a site for behavioral intervention. Traditionally, we have only been a location for treatment, but we have the potential to effectively address prevention.[10] Yet studies show that emergency physicians are not thorough in informing patients about health risks or in offering treatment advice, even despite an obvious cause of their clinical complaint.

A number of barriers interfere with an ED physician's potential to provide counseling including: a perception of lack of patient interest and the ineffectiveness of advice, a lack of training or physician interest in providing counseling, and a belief that the ED is not an appropriate setting for counseling. In addition, an ED physician's time pressure with multiple patients and lack of reimbursement incentives are recognizable barriers to all physicians.

The dilemma is to quickly convey health information without causing excess anxiety, depression, or guilt in our patients.[11] Positive concepts should be used: "Now is your opportunity to change," rather than "Your years of smoking, obesity, etc., have caused your disease." We need to sensitively engage their fear that "it will get worse if you don't change" and explain why.

Studies on brief counseling in the ED have shown success, and providing written information and follow-up advice increases the likelihood of change. Patient surveys demonstrate a very high level of interest in obtaining health information while waiting in the ED. At least for the few hours they are with us, they are an interested and captive audience for health advice. For many patients the ED is their only source of medical care and prevention.

Our patients are unique, and we ignore this "teachable moment" in our healthcare system. Unlike an office visit, the fear and stress of the ED is a pivotal time when some could be motivated to change the risk behaviors that brought them to us. Concerned by chest pain, stroke symptoms, or difficult breathing, ED patients are often scared and seriously wanting to quit their bad habits. What other event would provide them more motivation? Their desire to change is temporarily maximized by fear, pain, depression, or anxiety coexisting with their acute illness. It is a perfect time to hear a practitioner's warning and get written information on risk factor reduction – and motivate a decision to change while still in the ED.

Medical-Legal Issues Related to Stroke Thrombolysis

No discussion of stroke thrombolysis would be complete without considering its potential for litigation. The major concern is symptomatic intracranial hemorrhage (ICH), which occurs in 6% of stroke patients who receive thrombolysis and carries a 3% risk of death. Higher rates have been found when the exclusion criteria are not strictly followed. These are frightening statistics that the patient and family must consider. With MI thrombolysis in contrast, reperfusion arrhythmias are a greater concern, and the ICH risk is only about 0.5%.

The fear of ICH also causes some hesitation in physicians when it comes to initiating thrombolysis. Although the thrombolytic risk of ICH is higher with stroke thrombolysis, it actually occurs more often with MI thrombolysis, but only because it is used much more frequently for MI. Since it is the standard of care for MI, a consent form is not used. However, for stroke a specific thrombolysis consent form that details the unique risks is advisable.

Litigation can also occur when thrombolytic therapy is not administered to a stroke patient that met the criteria for treatment and arrived within the new 4.5 hour window. Therefore, the reason for deciding not to thrombolyse should be documented. For example, significantly improving stroke symptoms are among the exclusion criteria. Emergency department "protocols" are expected to work efficiently, but perhaps "guidelines" is a better term to use on your documents, because each patient is unique and any deviation from strict protocols may increase the chance of litigation.

The best way to prevent litigation is through careful documentation of informed consent and of your re-examination of the patient before thrombolysis. An honest explanation of the real risk of ICH and death and acknowledgement that the science is still unclear must be conveyed despite the period of time available in the 4.5 hour window. The decision to accept the risk then becomes that of the patient and family. Finally, guidelines for rapidly treating hemorrhagic complications resulting from thrombolysis (Table 5) should be immediately available.

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References

1. The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. Tissue plasminogen activator for acute ischemic stroke**.** NEJM 1995; 333: 1581-1588.
2. Schwamm L, Pancioli A, Acker J, et al. Recommendations for the establishment of stroke systems of care. *Stroke* 2005; 111:1078-1091.
3. Brown D, Barsan W, Lisabeth L, et al. Survey of emergency physicians about recombinant tissue plasminogen activator for acute ischemic stroke. Ann Emerg Med 2005; 46:56-60.
4. Magid D, Asplin B, Wears R. Stroking the data: Re-analysis of the NINDS trial. Ann Emerg Med 2005; 45:385-387.
5. Hacke W, Kaste M, Bluhmki E, et al. Thrombolysis with Alteplase 3 to 4.5 hours after acute ischemic stroke. NEJM 2008:359: 1317-1329.
6. Stead L, Gilmore R, Weaver W, et al. The concept of permissive hypertension for acute ischemic stroke. Ann Emerg Med 2005; 46(3) supp:1-2.
7. Adams H, del Zoppo G, Alberts M, et al. AHA/ASA Guidelines for the early management of patients with ischemic stroke. 2007 update. Stroke 2007; 38:1655-1711.
8. Rasler, F. Emergency treatment of hemorrhagic complications of thrombolysis. Ann Emerg Med 2007; 50:485.
9. Broderick J, Connolly S, Feldman E, et al. AHA/ASA Guidelines for the management of spontaneous intracerebral hemorrhage in adults. 2007 update. Stroke 2007; 38:2001-2023.
10. Irwin, CB. Public health preventive services, surveillance, and screening – The emergency department's potential. Acad Emerg Med 2000; 7:1421-1423.
11. Rasler, F. The Georgia emergency room smoking project. J Med Assoc Georgia 2004; 1:29-31.

Additional information is available at www.stroke-site.org.