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AHC Media

Stroke Recovery — Issues for the Emergency Physician

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Initially, this topic appears to have little to do with the practice of emergency medicine. After all, emergency physicians are trained to rapidly recognize an acute stroke, expedite the initial assessment (primarily rapid head CT scanning and specialty consultation), and, when indicated, administer fibrinolytic reperfusion therapy. Knowledge and skills for issues present during the recovery from stroke do not seem germane for emergency practice. However, emergency medicine practice is not all acute events; we see plenty of patients with chronic illness, including stroke patients with persistent impairment. While perhaps not as exciting as "lyzing" an acute stroke patient, knowledge about the recovery period and rehabilitative therapy that can reduce disability enables us to better understand our patients and improve the referrals we can make to help these patients. I trained in the pre-CT and fibrinolytic era; strokes were considered permanent, and whatever recovery was due to natural processes and not improved by therapy. After reading this article, you, too, will learn that therapy is beneficial, and that the damage is not always permanent.

—J. Stephan Stapczynski, MD, Editor

Stroke Recovery

Most stroke survivors are left with significant neurological impairments and other sequelae, such as spasticity and pain. According to the their ability to perform daily activities, approximately 40% of stroke patients are left with moderate functional impairment and 15%-30% with severe disability.[1] Stroke rehabilitation aims to reverse these impairments to the extent possible, maximize functionality through the use of compensatory approaches, prevent complications, and manage comorbidities. This article will review the principles of rehabilitation, current practices, and evidence supporting various aspects of stroke rehabilitation.

Role of the Emergency Physician

With millions of stroke survivors in the United States, emergency physicians often provide care to these individuals and, thus, need to be able to identify common post-stroke rehabilitation issues. Post-stroke depression can occur at any time after stroke, and it is important that this be recognized as a treatable and reversible condition, rather than a "natural" consequence of disability after stroke. Detecting contracture and/or spasticity is important so that referral can be made to a rehabilitation program. Noting the stroke survivor's mobility, ability to perform activities of daily living (ADL), and any deterioration in functional status is critical to making timely referrals to rehabilitation services. When these issues are identified in the emergency department, the debilitating consequences can be mitigated by referral to appropriate specialists for further evaluation and management.

Executive Summary

- In stroke patients, both acute and during recovery, use a bedside dysphagia screening tool to identify patients at risk for aspiration pneumonia and to guide dietary orders.
- In the stroke-recovery patient, ask about current rehabilitative services, and, whn possible, use care managers to facilitate follow up for patients not receiving treatment.
- Ask about symptoms of depression, and when such symptoms are found, utilize mental-health resources for further evaluation and care.
- Utilize social workers to assess the current living situation and identify stressors on the family.

Rehabilitation

Functional improvement in the post-stroke patient is accomplished through a combination of neurological recovery and adoption of compensatory techniques and equipment. Neurologic recovery seeks to directly reduce impairment via neural recovery using cerebral plasticity to overcome neuronal loss. Compensatory techniques improve function by enhancing remaining physical and cognitive abilities and strategies. Both recovery and compensation are crucial concepts in rehabilitation and key therapeutic approaches; specific interventions are chosen to address patient goals and efficiently deploy the available rehabilitation resources.[2]

During the past century, a significant amount of research has been conducted to further elucidate how best to provide comprehensive stroke rehabilitation. Currently, it is comprised of several key components, including assessment, goal setting, treatment of functional and psychosocial impairments, and prevention of complications. Patients are reassessed at regular intervals to evaluate progress, and treatment plans are adjusted accordingly. Ideally, rehabilitation begins immediately following stroke and often becomes a long-term element in the lives of these patients. Assessment and treatment should begin in the setting of acute hospitalization, and depending on the needs of the individual, continued rehabilitation may transition to the appropriate inpatient or outpatient setting.

National and international guidelines have been developed to provide resources for health care providers with evidence-based practices, such as the American Heart Association (AHA) Guidelines in 2005 and the National Institute for Health and Care Excellence (NICE) Guidelines in 2013.[3,4] AHA guidelines incorporate the U.S. Preventive Services Task Force (USPSTF) grading system for level of evidence and are referenced in this article where applicable.[5] (*See Table 1.*) AHA rehabilitation guidelines currently are being updated, with release anticipated in 2014. Adherence to stroke rehabilitation guidelines is associated with improved patient functional outcomes.[6]

In an effort by The Joint Commission and the AHA, certification has been developed using current guidelines and established standards of care to identify Primary Stroke Centers and, more recently, Comprehensive Stroke Centers. The rehabilitation requirements for Primary Stroke Center certification include the ability to assess for rehabilitation needs and refer for appropriate post-acute care. Comprehensive Stroke Centers also must have a rehabilitation service led by a physician with expertise in neuro-rehabilitation, and the service must include therapists, nurses, and social workers with an expertise in addressing the rehabilitation needs of stroke patients.[7,8] Complete guidelines can be found on The Joint Commission's website.[7]

Services and Settings

A coordinated, multidisciplinary rehabilitation evaluation and treatment during the early post-stroke period is associated with improved clinical outcomes[9,10] (*USPSTF Level A*[1]). The multidisciplinary team typically consists of physicians, physical therapists, occupational therapists, speech therapists, recreational therapists, nurses, social workers, and psychologists who work closely with patients and their family members or caregivers to achieve rehabilitation goals. If these rehabilitation services are not available in the acute hospital, then patients with moderate or severe impairment should be referred to a facility with these services (*USPSTF Level I*[1]).

Stroke patients should be assessed for rehabilitation needs, and rehabilitation should commence during the acute hospitalization. Upon discharge, rehabilitation (if required) may continue in either the inpatient, home, or outpatient setting. For patients who require inpatient rehabilitation prior to returning home, the two main options are acute inpatient rehabilitation (often referred to as inpatient rehabilitation facilities, or IRFs) or subacute inpatient rehabilitation (also known as skilled nursing facilities). IRFs typically provide three or more hours of therapy per day, with subacute rehabilitation facilities providing a lesser (and more variable) amount. For patients who can be managed safely at home, rehabilitation may continue either through homecare services or in an outpatient rehabilitation program. Choice of rehabilitation setting depends on the patient's care needs, the team's assessment, goals of care, available resources, and patient's ability and willingness to participate in and tolerate a therapeutic exercise program (*USPSTF Level I*[1]).

Timing and Intensity

Initiation of rehabilitation during the acute hospitalization should occur once the patient is medically stable and safe to participate in therapy. Evidence supports early mobilization to prevent complications, such as venous thrombosis and contractures, and to begin the assessment and treatment process[3] (*USPSTF Level C*[1]). Early mobilization is currently being studied in A Very Early Rehabilitation Trial (AVERT), a single-blind, multicenter, randomized, controlled trial. Results from phase 2 of this trial have shown that mobilization within 24 hours of stroke and at regular intervals is safe, is feasible, expedites return to unassisted ambulation, and is independently associated with long-term improved functional outcomes.[11,12]

There is wide acceptance of the hypothesis that a higher intensity of therapy is more beneficial than a lower intensity;[2,4,9,13-15] however, there is insufficient evidence to make specific recommendations regarding the optimal level of intensity of rehabilitation services (*USPSTF Level B*[1]). Ultimately, determining intensity level as well as duration of therapy is often greatly impacted by the mental and physical tolerance of the patient to participate in therapy, and therefore, programs must be individualized based on the multidisciplinary team's assessment and plan of care.[16]

Motor Rehabilitation

Many stroke patients suffer from muscle weakness and impaired motor control, with resultant functional deficits. Multiple therapeutic methods have been developed to aid stroke patients with improving motor function. These methods typically involve repeated practice of movements as a foundation, and vary greatly from simple task-specific training to more complex methods, using virtual reality or advanced robotics. Additional therapeutic options have emerged recently and are still currently being studied, including pharmacotherapy to facilitate plasticity and the use of non-invasive brain stimulation. (*See Figure 1.*) These novel therapies are likely to serve an adjunctive role to conventional physical and occupational therapy.

Conventional stroke rehabilitation includes repetitive task training; however, effects of specific interventions may generalize poorly to related tasks, and emphasis should be placed on task- or context-specific training, which may be referred to as meaningful task-specific training.[17,18] This type of therapeutic exercise has been found to be effective in improving upper and lower extremity motor function.[18]

Constraint-induced movement therapy (CIMT) is another type of repetitive task training, involving forced use of the affected limb by "constraining" use of the non-paretic limb. A randomized trial found benefit in upper limb use after CIMT training.[19] The durability of this benefit is unknown, however, and additional research is required to define optimal dosing and timing of CIMT.[20,21,22]

In mirror therapy, a mirror is placed in the patient's midsagittal plane while performing bilateral exercises, providing the patient with the visual illusion of successfully moving the affected limb. As analyzed in a Cochrane systematic review, mirror therapy was shown to improve upper extremity motor function, ADLs, and pain; however, data are limited.[23,24] Mirror therapy may be used as an adjunct to conventional therapy.[24]

More than half of stroke patients are unable to walk independently during the acute phase of recovery and may benefit from intensive gait training, which can significantly improve gait function.[25,26] Gait training may include assisted ambulation, treadmill training, and body-weight-supported treadmill training (BWSTT).[27,26] There would be an inclination to believe that BWSTT would enable the impaired stroke patient to spend a longer time during each episode of gait training, thus leading to enhanced muscle strength recovery and improved outcome for independent gait. However, more equipment does not lead to better outcome. A recent large, multicenter, randomized trial comparing BWSTT to a home exercise program with physical therapy found no incremental benefit for BWSTT on walking speed, motor recovery, balance, and functional status, with patients participating in the home exercise program experiencing fewer falls.[28] The key is likely the concept of therapist-led gait training and not the specific technique.

Functional electrical stimulation (FES) involves stimulating specific muscle groups to cause a muscle

Table 1: USPSTF Recommendation Grading System[5]

A: A strong recommendation that the intervention is always indicated and acceptable.
B: A recommendation that the intervention may be useful/effective.
C: A recommendation that the intervention may be considered.
D: A recommendation that the procedure may be considered not useful/effective or may be harmful.
I: Insufficient evidence to recommend for or against — the clinician must use clinical judgment.

Figure 1: Transcranial Magnetic Stimulation

This technique is used both as a tool for investigating brain physiology during stroke recovery and also as a potential therapy to enhance motor recovery.
Photo courtesy of Dr. Joel Stein.

Table 2: General Principles of Bedside Dysphagia Screening: Positive Results

- History: prior history of difficult swallowing, family reports difficulty swallowing
- Patient's level of alertness: somnolent, difficult to maintain arousal or alertness;
- Motor speech and/or voice abnormalities: wet, gurgly voice quality, slurred speech;
- Ability to handle oral secretions: drooling or pooling of saliva, coughing or choking on saliva
- Watching the patient drink small amounts of water, increasing from 5 to 10 mL: cough, throat clear, wet voice, or decline in SpO_2 < 2% after each water trial

contraction. The concept is to reduce muscle atrophy after a stroke. Studies indicate that FES may lead to a short-term increase in motor strength and reduction in impairment severity, but without evidence of improved function.[29,30,31] FES is currently recommended for use in ankle, knee, or wrist motor impairment, shoulder subluxation, and for gait training (*USPSTF Level B*[1]).

Foot drop is a common problem in stroke patients that contributes to impaired gait. Foot drop is commonly treated using the traditional ankle-foot orthosis (AFO). Several FES devices have been designed to provide stimulation of the muscles of the anterior shin so as to reduce foot drop and aid in ambulation, including the Bioness L300 (Bioness Inc., Valencia, CA) and the Walk Aide (Innovative Neurotronics Inc., Austin, TX).

In a comparison of one FES (the Bioness L300) with a traditional ankle-foot orthosis (AFO), both the FES and AFO with physical therapy training significantly improved gait speed and functional outcomes, with no significant difference between groups.[32] Both approaches achieve equivalent outcomes.

Electrical signals also can be detected in the muscle using surface electromyographic electrodes and translated into visual or auditory signals to provide biofeedback during therapeutic exercises.[33,34] The benefits of this therapy remain unproven.

Robots have been used in stroke rehabilitation to provide reliable, reproducible, high-intensity exercise therapy.[35,36,37] A 2012 Cochrane review found that patients who received robot-assisted arm training were more likely to improve arm function and activities of daily living, but not muscle strength.[17] Overall, data regarding efficacy of robot-assisted rehabilitation are limited and its cost-effectiveness may pose a barrier to implementation.[36,38] Other systems, including computer games and virtual reality, have been studied as stand-alone therapies to provide guidance and a motivating environment, as well as in combination with robot-assisted therapy.[39] Although some benefit has been demonstrated, further research is needed to optimize these treatments and determine their clinical utility and cost-effectiveness.

Multiple drugs have been studied as potential facilitators of motor recovery. The Fluoxetine for Motor Recovery in Acute Ischemic Stroke (FLAME) study found that patients with moderate-to-severe motor deficits experienced enhanced motor recovery with combined fluoxetine and physical therapy after three months.[40] However, larger studies are needed before fluoxetine can be routinely recommended for this indication.

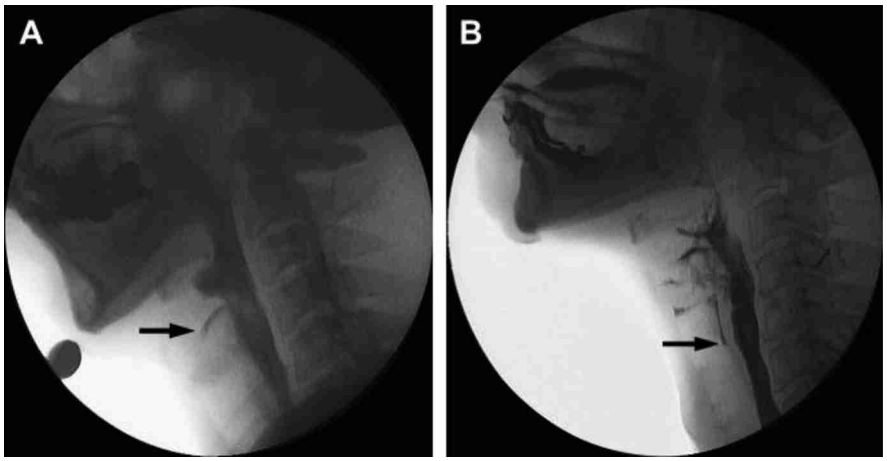
Non-invasive cortical stimulation is currently being studied to assess its impact on motor recovery.[41,42] The two main types of non-invasive cortical stimulation are repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS).[16] In rTMS, electric current is induced in the underlying cortex using pulses of high-intensity magnetic fields. Depending on the stimulation parameters, rTMS can either augment or inhibit cortical excitability. In tDCS, surface electrodes on the scalp deliver direct current that can similarly modulate excitatory or inhibitory effects on the underlying cortex. In a 2012 meta-analysis, Hsu et al found that rTMS had a positive effect on motor recovery, especially for those with subcortical stroke.[43] Non-invasive cortical stimulation is generally safe and well tolerated and is a potentially useful future therapeutic option when paired with exercise therapy.[16] Cortical stimulation therapy is not routinely available in stroke rehabilitation programs.

Approximately one-third of stroke patients develop muscle spasticity, which may further impair motor function and quality of life. However, treatment of spasticity is not necessary unless it causes impaired function, pain, deforming contractures, or limits skin hygiene. Treatment options include stretching and range-of-motion exercises, bracing, oral medications, and intramuscular injections. The most frequently used oral medications include baclofen, tizanidine, benzodiazepines, and dantrolene.[1] If possible, use of benzodiazepines should be avoided during the stroke recovery period because of possible deleterious effects on recovery[44] (*USPSTF Level D*[1]). Intramuscular injection is most commonly performed with botulinum toxins and less commonly with phenol or ethanol, and should be considered for disabling or painful spasticity, particularly if localized (*USPSTF Level B*[1]). Occasionally, patients may require more invasive treatments, such as intrathecal baclofen (ITB) or surgical correction of contractures.

Speech and Language Rehabilitation

Disorders of communication, which may occur in as many as 40% of stroke patients, most commonly include aphasia, dysarthria, or apraxia. Aphasia results from damage to the regions of the central nervous

Figure 2: Modified Barium Swallow (MBS) Study



Static images from MBS studies show laryngeal penetration (A) and aspiration of barium into the trachea (B)

Reprinted with permission. Matsuo K, Palmer JB. Anatomy and physiology of feeding and swallowing: Normal and abnormal. *Phys Med Rehabil Clin N Am* 2008;19:691-707, vii.

system that affect language reception, expression, or both. Apraxia is caused by impairment in the patient's ability to plan and organize commands for muscle movement. Dysarthria results from neuromuscular damage, causing impairment in muscle movement and subsequent alterations in speech production.

Speech and language rehabilitation involves careful assessment of the patient's abilities and deficits, as many patients suffer from a complex combination of these communication disorders. Therapy includes working on the affected system (e.g., phonation, articulation, prosody, etc.), along with use of compensatory strategies and potential use of augmentative or alternative communication devices.[1] Patient and caregiver education is a critical component of speech therapy. Currently, no guidelines exist for use of specific therapeutic modalities in speech and language therapy. Nonetheless, treatment can aid in recovery and prevent ineffective or inappropriate compensatory behaviors[45] (*USPSTF Level A, B*[1]).

Several novel therapeutic approaches are currently being investigated, including constraint-induced aphasia therapy, in which use of compensatory strategies (such as communicating using gestures) is not permitted; use of non-invasive brain stimulation; and use of medications, such as memantine, an NMDA receptor antagonist.[46]

Dysphagia

Dysphagia is seen in approximately 45% of hospitalized stroke patients; therefore, early assessment is critically important due to the risk of aspiration.[1] Bedside dysphagia screening assessment should be performed before initiating oral intake for all stroke patients (*USPSTF Level B*[1]) (*see Table 2*). Such screening tests can be done in the emergency department.[47-49] An abnormal dysphagia screening test indicates the risk for aspiration and may facilitate the diagnosis of aspiration pneumonia in post-stroke patients. If the bedside screening assessment is abnormal, then a complete bedside swallow evaluation is warranted (*USPSTF Level I*[1]). Additional measures, including modified barium swallow studies (*see Figure 2*) and flexible endoscopic evaluation of swallowing and sensory testing, also may be necessary in evaluating patients at high risk for aspiration.

Treatment of dysphagia includes use of dietary texture modification, compensatory strategies, exercises, and postural advice.[4,50,51] In some cases, a feeding tube may be needed temporarily or long term to support a patient's nutrition. Malnutrition affects approximately 30% of stroke patients during the first week of hospitalization, and nutritional status should be carefully monitored and appropriate supplementation provided when necessary.[1]

Cognitive Rehabilitation

Cognitive deficits are very common after stroke, may be quite complex, and may affect multiple aspects of cognition such as attention, executive function, memory, and insight. Screening for alterations in cognition is important, as sustained cognitive deficits may result in poor outcomes. These deficits may impact a patient's ability to perform therapeutic exercise, and may affect one's ability to recognize one's own impairments, known as anosognosia. When possible, sedating medication that may exacerbate cognitive difficulties, such as benzodiazepines, neuroleptics, barbiturates, and anticonvulsants, should be avoided. Severe cognitive impairments may pose significant obstacles in community and home reintegration.

Spatial neglect and visual deficits may result from damage to the non-dominant parietal lobe or to various areas of the visual system. Use of prisms, education, functional training, compensatory strategies, and sensory stimulation may be employed in the treatment of spatial neglect or visual deficits.[4,52-54]

Psychological

Psychological disorders after stroke, including depression and fatigue, are very common and under-diagnosed, and can have a negative impact on rehabilitation. Signs or symptoms of depression warrant assessment by a mental health specialist and frequently require treatment. (*See Table 3.*) Standard antidepressant therapeutic modalities, including psychotherapy and psychopharmacologic treatment (e.g., selective serotonin reuptake inhibitors, such as fluoxetine),[4] have been found effective for post-stroke depression.[55]

Emotion lability or uncontrolled emotions should be differentiated

Table 3: Symptoms of Depression

- Feeling sad or empty most of the time
- Feeling worthless or helpless
- Feelings of guilt
- Loss of interest or pleasure in ordinary activities
- Fatigue of feeling slowed down
- Sudden trouble sleeping or excessive sleeping
- Sudden loss of appetite
- Unable able concentrate or make decisions yourself
- Excessive crying

from depressive symptoms. Patients who laugh or cry at inappropriate times, or have an exaggerated response to situations may have pseudobulbar affect (PBA), defined as a pathologically lowered threshold for either laughter, crying, or both. Patients may have episodes of laughter and/or crying without an apparent motivating stimulus. PBA patients may laugh or cry suddenly and without apparent reason, or they may have an exaggerated response in excess to their previous behavior. For example, a funny circumstance may provoke overwhelming laughter, or a sad stimulus may provoke pathologically exaggerated weeping instead of a sigh.

Psychosocial Issues

Rehabilitation not only should assess and treat motor, sensory, and cognitive deficits, but also should address issues of social support and caregiver stress early and at regular intervals. Living with disability after stroke is a lifelong challenge, and adequate support from family and caregivers is critical to successful outcomes. During an emergency department stay, social workers can be used to assess the current living situation and identify issues within the family.

Conclusion

Stroke is one of the most common causes of acquired disability. Despite enhanced recognition and aggressive promotion of reperfusion therapy to reduce the degree of neurologic damage, a large number of patients sustain significant functional impairment. Stroke rehabilitation is evolving to better meet the needs of stroke survivors. Novel techniques and technology are being developed and studied with the ultimate goal of improving patient function and quality of life.

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CME Questions

1. Which of the following is true regarding neurological recovery after stroke?
   A. It is a typical part of the post-stroke course.
   B. It is frequently incomplete.
   C. It is influenced by sensorimotor activities.
   D. It frequently needs to be combined with compensatory training to achieve functional goals.
   E. All of the above are true.

2. Which of the following is true regarding post-stroke depression?
   A. It is uncommon, affecting less than 20% of stroke survivors.
   B. It does not respond to conventional antidepressant therapies.
   C. It is a normal reaction to the losses associated with stroke and doesn't require treatment.
   D. It responds well in most cases to SSRIs and other pharmacotherapies.
   E. It does not impact functional recovery.

3. A bedside dysphagia screening assessment should be performed before initiating oral intake for all stroke patients.
   A. true
   B. false

4. All of the following are used to treat spasticity in stroke survivors *except*:
   A. range-of-motion exercises
   B. desensitization therapy
   C. tizanidine
   D. botulinum toxin intramuscular injections

5. When can rehabilitation assessment and treatment begin after stroke in a medically stable patient?
   A. within 24 hours
   B. within 72 hours
   C. within 1 week
   D. within 2 weeks

6. What is the key characteristic of pseudobulbar affect?
   A. flat affect
   B. inappropriate or exaggerate laughing and/or crying
   C. easily annoyed with inappropriate anger
   D. exaggerated feeling of worry, fear, and irritability

7. Cognitive defects after a stroke are common.
   A. true
   B. false

8. Which statement regarding post-stroke motor rehabilitation is true?
   A. Body-weight-supported treadmill training is superior to home exercise program with physical therapy, and is the preferred technique to recover independent gait.
   B. Functional electrical stimulation is a better technique to treat foot drop than the traditional ankle-foot orthosis.
   C. Fluoxetine can enhance recovery by three months when combined with physician therapy.
   D. Non-invasive cortical stimulation does not have a positive effect.

9. What percentage of stroke patient experience problems in communication?
   A. 10%
   B. 40%
   C. 60%
   D. 80%

10. Constraint-induced movement therapy and mirror therapy are beneficial for which of the following?
   A. upper limb motor recovery
   B. gait training
   C. lower limb motor recovery
   D. balance training

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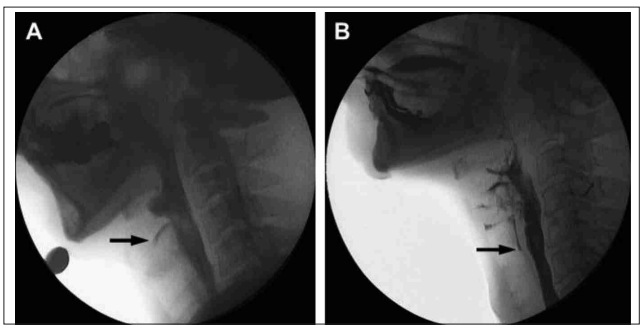
Practical, Evidence-Based Reviews in Emergency Care

Stroke Recovery — Issues for the Emergency Physician

Modified Barium Swallow (MBS) Study



Static images from MBS studies show laryngeal penetration (A) and aspiration of barium into the trachea (B)
Reprinted with permission. Matsuo K, Palmer JB. Anatomy and physiology of feeding and swallowing: Normal and abnormal. *Phys Med Rehabil Clin N Am* 2008;19:691-707, vii.

USPSTF Recommendation Grading System

A: A strong recommendation that the intervention is always indicated and acceptable.
B: A recommendation that the intervention may be useful/effective.
C: A recommendation that the intervention may be considered.
D: A recommendation that the procedure may be considered not useful/effective or may be harmful.
I: Insufficient evidence to recommend for or against — the clinician must use clinical judgment.

Transcranial Magnetic Stimulation

This technique is used both as a tool for investigating brain physiology during stroke recovery and also as a potential therapy to enhance motor recovery.
Photo courtesy of Dr. Joel Stein.

General Principles of Bedside Dysphagia Screening: Positive Results

- History: prior history of difficult swallowing, family reports difficulty swallowing
- Patient's level of alertness: somnolent, difficult to maintain arousal or alertness;
- Motor speech and/or voice abnormalities: wet, gurgly voice quality, slurred speech;
- Ability to handle oral secretions: drooling or pooling of saliva, coughing or choking on saliva
- Watching the patient drink small amounts of water, increasing from 5 to 10 mL: cough, throat clear, wet voice, or decline in SpO_2 < 2% after each water trial

Symptoms of Depression

- Feeling sad or empty most of the time
- Feeling worthless or helpless
- Feelings of guilt
- Loss of interest or pleasure in ordinary activities
- Fatigue of feeling slowed down
- Sudden trouble sleeping or excessive sleeping
- Sudden loss of appetite
- Unable able concentrate or make decisions yourself
- Excessive crying

Supplement to *Emergency Medicine Reports*, November 17, 2013: "Stroke Recovery — Issues for the Emergency Physician." *Authors:* **Ethan Rand, MD**, Resident Physician, Department of Rehabilitation Medicine, New York Presbyterian Hospital, New York, NY; and **Joel Stein, MD**, Professor and Chief, Division of Rehabilitation Medicine, Weill Cornell Medical College, Cornell University, New York, NY.