

Stroke Therapies

Introduction:

Stroke is considered to be a vascular disease with devastating neurologic consequences. It is the third most common cause of death among our aging population. It is also the leading cause of disability in industrialized countries. Stroke is defined as a sudden neurologic deficit due to central nervous ischemia or hemorrhage.⁷ Ischemic stroke accounts for 75% of all strokes⁷ and is caused by focal vessel occlusion leading to cessation of oxygen and glucose supply to the brain with subsequent breakdown of the metabolic processes in the affected territory. Hemorrhagic stroke involves bleeding within the brain damaging adjacent brain tissue. The focus of this discussion is on ischemic stroke and on the basic problems presented with stroke, current treatments and prevention, and future technologies. The information presented below was derived from the references listed at the end of this monograph.

The Problem:

Although there are two traditional stroke categories as mentioned above, ischemic and hemorrhagic, there are still several sub-categories and underlying conditions. It is necessary to understand the underlying conditions of these subtypes for the purpose of therapeutic treatment.

One of the most common causes of ischemic stroke is large artery atherosclerosis. This occurs when there is a moderate to severe stenosis of the major vessels leading to the brain. Another cause of stroke is cardioembolism which is directly associated with the heart and related to atrial fibrillation or a mechanical heart valve. A third subtype is small-vessel occlusion. This stroke usually occurs with no clinical signs of cortical involvement and is commonly related to patients with diabetes mellitus or hypertension, sometimes both. Finally, there are strokes due to nonatherosclerotic conditions and no identifiable causes at all.

Current Technologies:

To this day, stroke represents a major therapeutic challenge however effective treatment is possible and is currently in developmental stages. Antithrombotic drugs and anticoagulants are key players in stroke prevention. Although there is no scientific evidence that these medications such as warfarin, heparin, and aspirin reduce the risk of stroke, they do reduce the risk of myocardial infarction.

Carotid endarterectomy may be the most effective and currently most studied treatment for stroke and stroke prevention. Carotid artery stents and balloon dilatation have increasingly become more common in treatment of stroke. These particular endovascular procedures can often cause arterial injury and embolism of plaque material to the brain due to catheter insertion, site infection and hematoma, and carotid sinus trauma. These complications create a need to develop a standard for angioplasty and stenting of carotid artery stenosis in order to assure the safety of patients. The first carotid artery stent system developed by Guidant Corporation was recently approved by the Food & Drug Administration in August 2004. This system is designed to be used in patients showing symptoms of stroke, or patients with more than 80% blockage. Additional devices are currently under investigation to evaluate the long term efficacy, safety and indications for this type of procedure.

An additional treatment for stroke is thrombolytic therapy with intravenous tissue plasminogen activator or t-PA. Thus far, this has been known to be the most consistent of stroke therapies. Outcomes have shown dramatic results when t-PA was given to patients within the first 3 hours after a stroke. Many studies with t-PA have proven significant benefits and dramatically greater results if given to patients within the first 90 minutes after stroke onset.

New Technologies:

New technologies and treatments are under investigation studying many different theories and approaches to stroke treatment and prevention. Clinical trials are being performed studying the use of ultrasound and t-PA. They are studying the efficacy of continuous transcranial Doppler ultrasound in monitoring the middle cerebral artery to facilitate recanalization of the artery and, thereby, improving outcomes in patients with middle cerebral artery occlusions.³ Results from the studies have shown that all patients had complete recanalization or at least dramatic clinical recovery within 2 hours of administration of t-PA. An underlying issue is that transcranial Doppler ultrasound is technically difficult and should be performed by only highly trained operators.

Additional methods of treatment currently under clinical investigation include infusion catheters for acute embolic stroke management. One device is an ultrasound enhanced micro-catheter developed to dissolve blood clots in the brain with the use of thrombolytic agents. The hypothesis behind using the infusion catheter is that sonography can potentially accelerate thrombolysis and improve clinical outcomes. This technique is early in clinical studies and more trials are warranted to evaluate the efficacy and safety of this treatment.

Other studies suggest that mild hypothermia can have neuroprotective effects in various neurological injuries. Clinical studies support, in some cases, a neurogenic rise in temperature often 4-12 hours after an acute stroke. This is most likely due to hypothalamic disturbance. Morbidity and mortality can often be associated with raise in temperature supporting the theory that maintaining a patient's temperature is valuable during the neurologic episode. Therapeutic hypothermia has had very positive results in animal studies and clinical trials to support these theories are currently underway.

Conclusion:

Regardless of the treatment or current studies evaluating the many different new therapeutic approaches, it is apparent that stroke represents an imminent medical challenge to our increasingly aging society. As science continues to improve longevity, stroke poses a serious risk to future generations by its debilitating effects and its costs to an aging population. These new technologies must continue to advance in order to avoid this neurological disease from becoming the leader in morbidity and mortality worldwide.

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