Cerebrovascular Disorders in Elderly

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Syllabus

• Pathophysiologic changes of brain in elderly
• Epidemiology of stroke
• Cerebrovascular types in elderly
  – Ischemic stroke
  – Hemorrhagic stroke
• Management in brief
What happens in brain during aging?
Aging in different organs

Physiological functions in subjects over 65 years of age

- Vital lung capacity
- Cerebral blood flow
- Resting cardiac index
- Liver blood flow
- Glomerular filtration rate
- Renal blood flow
- Maximum breathing capacity
- Maximum oxygen uptake

Relationship between age and selected functional parameters
What happens during aging in brain?

• As a person gets older, changes occur in all parts of the body, including the brain:
  • Certain parts of the brain shrink, especially:
    – Prefrontal cortex (an area at the front of the frontal lobe)
    – Hippocampus
  • Both areas are important to:
    – Learning
    – Memory
    – Planning
    – Complex mental activities.
Healthy Older Adult

Alzheimer’s disease
Brain aging

- Changes in neurons and neurotransmitters affect communication between neurons.
- In certain brain regions, communication between neurons can be reduced because white matter is lost.
- Changes in the brain’s blood vessels occur.
- Blood flow can be reduced because arteries narrow.
Amyloid plaques and NFTs

- In some people, amyloid plaques and tangles develop outside of and inside neurons, respectively, although in much smaller amounts than in AD.
- Damage by free radicals increases.
Aging causes reduced cerebral blood flow

- At one end of this spectrum of changes in cerebral cardiovascular status are the morphological changes in vasculature, manifested as:
  - Large increases in the vascular path due to increased tortuosity of arterioles in the deep white matter
  - Age-associated decrease in capillary number and length → leading to a significant increase (25%) of the intercapillary distance in both the hippocampus and cortex and white matter.
• As a result of such anatomical changes, in the aged brain there is a significant reduction in the cerebral blood flow (CBF), affecting mainly the cortex, and more sparingly the subcortical regions.
Stroke categories

• The stroke can result from:
  – Occlusion of the vessel (ischemia), which can be either:
    • Transient (e.g., the transient ischemic attack, TIA) or
    • Longer duration
  – From the rupture of a vessel → Regional hemorrhage, either within the cortical matter or in the dural cavities.
While the biological and medical consequences of a stroke are significant at any age, the incidence and the severity of a stroke are significantly increased with age.
Age increases severity of stroke

• Several factors are likely contributors to this increased severity of stroke with age:
  – Metabolic decrease in the capacity of neural cells to counteract extreme stressors and/or neurotoxic challenges (decreased metabolic reserve).
Age increases the severity of stroke

• The age-associated changes in the immune function:
  – More intense inflammatory reaction in the first phase of acute ischemia, involving cytokine activation and chemokine expression that lead to an early scar formation and fibrosis.
Age increases severity of stroke

- Aged individuals recover less well from stroke, and rehabilitation aims at improving the physical and cognitive impairments and disabilities of patients with stroke.
Stroke epidemiology
Stroke kills almost 130,000 Americans each year—that’s 1 out of every 19 deaths.

On average, one American dies from stroke every 4 minutes.

Every year, more than 795,000 people in the United States have a stroke.

About 610,000 of these are first or new strokes.
Stroke epidemiology

• About 185,000 strokes—**nearly one of four**—are in people who have had a previous stroke.

• About **87%** of all strokes are ischemic strokes.

• Stroke costs the United States an estimated **$36.5 billion** each year.
  
  – This total includes the cost of health care services, medications to treat stroke, and missed days of work.

• Stroke is a leading cause of serious long-term disability.
Stroke in Iran

• Stroke was reported to be slightly more common in females (range form 51%-53%) in the studies that included all age range.

• However, stroke was more common in young males, age between 15-45, (52%) and in boys (59%).

Stroke in Iran

- Ischaemic stroke: 67.2-68.45% of all stroke
- Primary intracerebral hemorrhage: 23.9-28.4%
- Subarachnoid hemorrhage: 2.9-4.4%

Stroke in Iran

• Hypertension was the most frequent risk factor in both ischaemic stroke (54% of patients) as well as spontaneous brain hemorrhage (70%-73.2% of cases).

• Cardiac causes (54%), mainly rheumatic heart disease (34%) were the most frequent risk factor in young stroke.

Stroke Types
Stroke types

- Occlusive (ischemic)
- Hemorrhagic
# Ischemic subtypes

<table>
<thead>
<tr>
<th>Classification of ischemic stroke</th>
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<tbody>
<tr>
<td>Large-artery atherosclerosis</td>
</tr>
<tr>
<td>Cardioembolism</td>
</tr>
<tr>
<td>Small-vessel occlusion</td>
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<tr>
<td>Stroke of other determined etiology</td>
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<tr>
<td>Stroke of undetermined etiology</td>
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<tr>
<td>- Two or more causes identified</td>
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<tr>
<td>- Negative evaluation</td>
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<tr>
<td>- Incomplete evaluation</td>
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</tbody>
</table>
Large vs. Small stroke
Pathophysiologic ischemic stroke classification

<table>
<thead>
<tr>
<th>Large vessel atherothrombotic stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>More common</strong></td>
</tr>
<tr>
<td>Bifurcation of the common carotid artery</td>
</tr>
<tr>
<td>Siphon portion of the common carotid artery</td>
</tr>
<tr>
<td>Middle cerebral artery stem</td>
</tr>
<tr>
<td>Intracranial vertebral arteries proximal to middle basilar artery</td>
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<tr>
<td>Origin of the vertebral arteries</td>
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<tr>
<td><strong>Less common</strong></td>
</tr>
<tr>
<td>Origin of the common carotid artery</td>
</tr>
<tr>
<td>Posterior cerebral artery stem</td>
</tr>
<tr>
<td>Origin of the major branches of the basilar-vertebral arteries</td>
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<tr>
<td>Origin of the branches of the anterior, middle, and posterior cerebral arteries</td>
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</tbody>
</table>
## Small vessel (lacunar) stroke

### Mechanism
- Lipohyalinotic occlusion
- Less frequently proximal atherothrombotic occlusion

### Most common locations
- Penetrating branches of the anterior, middle, and posterior cerebral and basilar arteries
<table>
<thead>
<tr>
<th>Cardioaortic embolic stroke</th>
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<tbody>
<tr>
<td>Left atrial thrombus</td>
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<tr>
<td>Left ventricular thrombus</td>
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<tr>
<td>Atrial fibrillation and paroxysmal atrial fibrillation</td>
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<tr>
<td>Sustained atrial flutter</td>
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<tr>
<td>Recent myocardial infarction <em>(within one month)</em></td>
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<tr>
<td>Rheumatic mitral or aortic valve disease</td>
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<tr>
<td>Bioprosthetic and mechanical heart valve</td>
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<tr>
<td>Chronic myocardial infarction with ejection fraction &lt;28 percent</td>
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<tr>
<td>Symptomatic heart failure with ejection fraction &lt;30 percent</td>
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<tr>
<td>Dilated cardiomyopathy</td>
</tr>
<tr>
<td>Cardioaortic embolic stroke</td>
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<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>Bacterial endocarditis (exception nonbacterial)</td>
</tr>
<tr>
<td>Atrial myxoma</td>
</tr>
<tr>
<td>Mitral annular calcification</td>
</tr>
<tr>
<td>Patent foramen ovale</td>
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<tr>
<td>Atrial septal aneurysm</td>
</tr>
<tr>
<td>Atrial septal aneurysm with patent foramen ovale</td>
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<tr>
<td>Left ventricular aneurysm without thrombus</td>
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</table>
Brain Hemorrhage

• There are two main subtypes of brain hemorrhage:
  – Intracerebral hemorrhage: refers to bleeding directly into the brain parenchyma.
  – Subarachnoid hemorrhage refers to bleeding into the cerebrospinal fluid within the subarachnoid space that surrounds the brain.
• Bleeding in intracerebral hemorrhage (ICH) is usually derived from arterioles or small arteries.

• The bleeding is directly into the brain, forming a localized hematoma that spreads along white matter pathways.
• The most common causes of ICH are:
  – Hypertension
  – Trauma
  – Bleeding diatheses
  – Amyloid angiopathy
  – Illicit drug use
• ICH destroys brain tissue as it enlarges.
• The pressure created by blood and surrounding brain edema is life-threatening; large hematomas have a high mortality and morbidity.
Subarachnoid hemorrhage — The two major causes of SAH:

- Rupture of arterial aneurysms that lie at the base of the brain
- Bleeding from vascular malformations that lie near the pial surface.
Management
Managing the risk factors

- The management of treatable risk factors that contribute to the development and progression of atherosclerotic cerebrovascular disease is important for reducing the risk of ischemic stroke.
Risk Factors

- Modifiable
- Non-modifiable
Modifiable Risk Factors

- Hypertension
- Diabetes mellitus
- Smoking
- Dyslipidemia
- Atrial fibrillation
Non-modifiable Risk Factors

- Older age: age >80 years
- Ethnicity: Risks: blacks > whites
- Sex, with risk higher at most ages for men compared with women, except for ages 35 to 44 years and >85 years, where women have a similar or higher risk than men.
- Family history and genetic disorders: sickle cell disease or CADASIL.
Risk Factors Augmentation

• The risk of stroke is particularly increased in patients with two or more risk factors, as suggested by calculators.
Life style modification

• Stop tobacco
• Stop Alcohol
• If capable of regular exercise, moderate to vigorous intensity physical exercise for at least 40 minutes most days of the week.
• Mediterranean diet is recommended.
  – Intake of vegetables, fruits, and whole grains.
  – sodium intake to no more than 2400 mg per day.
• Weight reduction for obese patients is potentially beneficial for improved control of blood pressure, blood glucose, and serum lipid levels.
Predicting the risk of stroke in elderly

- The calculators could predict the risk of stroke in future.
- They are derived from Framingham study.
RiskFactorDiff = (Age * 0.0657) + (SysBP * 0.0197) - (SysBP * (HTNMed > 0) * 0.0134) + HTNMed + DM + Cig + CVD + AFib + LVH - 7.5766

RiskDuringPeriod = 100 * (1 - RiskPeriodFactor^e(RiskFactorDiff))
Treating modifiable risk factors

• Currently viable strategies include:
  – Blood pressure reduction
  – Antithrombotic therapy
  – Statin therapy
  – Lifestyle modification
  – Patients with symptomatic carotid disease may benefit from revascularization.
Antiplatelet Therapy

- Nearly all patients with TIA or ischemic stroke of atherosclerotic origin should be treated with an antiplatelet agent.
- The combination of aspirin-extended-release dipyridamole, clopidogrel alone, or aspirin alone are all acceptable options for initial therapy.
Anticoagulation

- Long-term anticoagulation should be considered as prevention for patients with chronic non-valvular AF who have had an ischemic stroke or transient ischemic attack.
Statins

• Who are able to tolerate statins, we suggest high-intensity statin therapy, independent of the baseline LDL-C, to reduce the risk of stroke and cardiovascular events (Grade 2B).
• It is suggested treating with atorvastatin 80 mg/day.
• For patients who are intolerant of high-intensity statin therapy, alternatives are moderate-intensity statin therapy:
  • Atorvastatin 10 to 20 mg daily
  • Simvastatin 20 to 40 mg daily, pravastatin 40 to 80 mg daily, lovastatin 40 mg daily.
Diabetes mellitus

• For patients with diabetes who have had an ischemic stroke or TIA, it is suggested glucose control to near normoglycemic levels.
Conclusion

• Stroke increases in elderly and age is the most important non-modifiable risk factor.
• However, multiple risk factors augment the possibility of stroke.
• Therefore, to overcome the stroke, it is important to modify the modifiable risk factors.
Conclusion

• Do not forget:
  – Prevention is better than cure.

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