



# THE INTERNET STROKE CENTER

PRESENTATIONS AND DISCUSSIONS ON STROKE MANAGEMENT

---

## The “Golden Hour” of Acute Ischemic Stroke



**Dr. Edward C. Jauch**

Department of Emergency Medicine

University of Cincinnati College of Medicine

Greater Cincinnati / Northern Kentucky Stroke Team

---

### TABLE OF CONTENTS

<b>A Look at Current Stroke Treatment</b>	<b>4</b>
What’s Changed in 2000?	4
What Has Not Changed?	4
Acute Stroke - Where are we Today?	5
Models for the “Golden Hour”	5
Trauma - Example	5
Acute Myocardial Infarction - Example	6
Forces of Change	6
Organized Stroke Care Saves Lives	6
Cost Effectiveness for rt-PA in Acute Ischemic Stroke	7
<b>Treatment Guidelines &amp; Recommendations - Part I</b>	<b>8</b>
NIH National Symposium Recommendations	8
Stroke Chain of Survival & Recovery	8
Dispatch & Delivery: Transport & Management	9
Cincinnati Pre-Hospital Stroke Scale	9
NIH Stroke Scale	9

Preparation	10
American Heart Association Recommendations	10
True Time of Onset	10
Stroke Risk Factors	11
<b>Treatment Guidelines &amp; Recommendations - Part II</b>	<b>12</b>
Early CT Changes in Ischemic Stroke	12
Differential Diagnosis	12
What are the Options?	12
Treatment Based on CT Findings	13
Exclusions to Thrombolytics	13
Pretreatment BP Treatment	13
Treatment Considerations: Who Will Benefit from rt-PA?	14
Factors Associated with Increased Risk of ICH	14
<b>Treatment Guidelines &amp; Recommendations - Part III</b>	<b>15</b>
Symptomatic Hemorrhages by NIH Stroke Scale in NINDS Trial	15
rt-PA Dosing	16
Intra-arterial Thrombolytic Efficacy vs. Time of Delivery	16
Stroke Treatment - Aspirin	16
Stroke Treatment - Heparinoids	16
<b>Post-Treatment Guidelines &amp; Recommendations</b>	<b>17</b>
Post Treatment Care - Antihypertensive Therapy	17
ICH Contingency Plan	17
Management of Seizures	17
Rehabilitation	18
What do you need to treat?	18
<b>Case Study</b>	<b>19</b>

History, Timeline, and Initial CT Findings	19
24 Hour Follow-up	20
<b>References</b>	<b>22</b>

# A Look at Current Stroke Treatment

## What's Changed in 2000?

"EMS systems should implement a prehospital stroke protocol to evaluate and rapidly identify patients who may benefit from fibrinolytic therapy, similar to the protocol for chest pain patients" (Class IIb).

"Patients who may be candidates for fibrinolytic therapy should be transported to hospitals identified as capable of providing acute stroke care, including 24-hours availability of CT scan and interpretation." (Class IIb).

"Stroke presenting with 3 hours should be triaged on an emergent basis with urgency similar to acute ST-elevation myocardial infarction."

### Intravenous fibrinolysis for acute ischemic stroke

- Class I  
IV - t-PA within 3 hours of onset
- Class Indeterminate  
IV - t-PA between 3 and 6 hours of onset

### Intra-arterial fibrinolysis

- Class IIb  
IA prourokinase within 3 to 6 hours after symptom onset

Source: [ASA, Circulation, 2000](#)

## What Has Not Changed?

### Impact of Stroke

- 3rd leading cause of death in the U.S.
- Leading cause of adult disability
- Over 700,000 new stroke cases per year in U.S. with 150,000 stroke deaths per year
- 85% are ischemic
- Less than 25% of eligible thrombolytic candidates receiving therapy

## Acute Stroke - Where are we Today?

Where are we today?

- Public poorly informed
- Response time too slow
- Presentation too late
- Hospitals ill prepared
- Fatalistic

## Models for the “Golden Hour”

Trauma

- Golden hour for intervention
- Centralized trauma center system, certified by the ACS

Acute myocardial infarction

- Similar door-drug/groin benchmarks for reperfusion
- Decentralized system

## Trauma - Example

Stab wound to the abdomen

- Very rapid EMS activation and transport
- Not exactly a difficult diagnosis
- Lots of communication
- Big teams
- Detailed protocols
- “The Golden Hour”
- What is the mortality and morbidity? - Low

## Acute Myocardial Infarction - Example

The paradigm has shifted

- Chest pain - patients know to call 911
- Rapid access to EMS
- Pre-hospital identification and call
- Pre-hospital ECG
- Team, protocols, drugs in the ED
- "Door to Drug" in 30 Minutes
- What is the mortality and morbidity? - Low.

## Forces of Change

- Public expectations
  - Aware of "Draino for the Braino"
  - Nihilistic attitude of stroke changing
- Medical - legal pressures
- Managed care cost concerns
- New treatments of stroke on horizon
- Change in treating physicians' perceptions of "risk"

## Organized Stroke Care Saves Lives

- 21% reduction in early mortality
- 18% reduction in 12 month mortality
- Decreased length of hospital stay
- Decreased need for institutional care

Source: [Jorgenson, Stroke, 1994](#)

## Cost Effectiveness for rt-PA in Acute Ischemic Stroke

	<b>rt-PA</b>	<b>placebo</b>	<b>p value</b>
<b>LOS</b>	10.9	12.4	0.02
<b>Discharge Home</b>	48%	36%	0.002

With rt-PA, considering 1,000 eligible patients:

- Hospitalization costs = \$1.7 million more
- Rehabilitation costs = \$1.4 million less
- Nursing home costs = \$4.8 million less
- 564 quality-adjusted life-years saved

Source: Fagan, Neurology 1998

# Treatment Guidelines & Recommendations - Part I

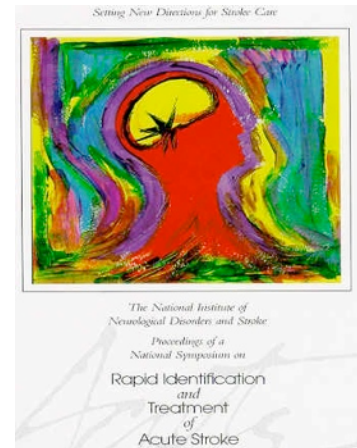
## NIH National Symposium Recommendations

- Door-to-MD: < 10 minutes
- Door-to-Neurologic Expertise: < 15 minutes
- Door-to-CT scan: < 25 minutes
- Door-to-CT Interpretation: < 45 minutes
- Door-to-Drug: (80% compliance) < 60 minutes
- Door-to-Admission: < 3 hours

### Notes:

At this National Symposium, experts developed in-hospital time intervals to allow the stroke patient to be treated and evaluated in a expedient manner. These recommendations include:

- Emergency department arrival to initial physician evaluation: 10 minutes
- Emergency department arrival to Stroke Team Notification: 15 minutes
- Emergency department arrival to CT Scan initiation: 25 minutes
- And they recommended that 80% of eligible stroke patients presenting to the emergency department should be treated with tPA within 60 minutes.



## Stroke Chain of Survival & Recovery

**Detection:** Early recognition

**Dispatch:** Early EMS activation

**Delivery:** Transport & management

**Door:** ED triage

**Data:** ED evaluation & management

**Decision:** Specific therapies

**Drug:** Thrombolytic & future agents

## Dispatch & Delivery: Transport & Management

- ABC's
- Stroke recognition
- Establish time of onset / his
- Perform neurological evaluation
- Check glucose
- Early hospital notification
- Rapid transport

## Cincinnati Pre-Hospital Stroke Scale

### Facial Droop

- Normal: Both sides of face move equally
- Abnormal: One side of face does not move at all

### Arm Drift

- Normal: Both arms move equally or not at all
- Abnormal: One arm drifts compared to the other

### Speech

- Normal: Patient uses correct words without slurring
- Abnormal: Slurred or inappropriate words or mute

## NIH Stroke Scale

<b>Item</b>	<b>Description</b>	<b>Range</b>
1a	Level of Consciousness	0 – 3
1b	LOC Questions	0 – 2
1c	LOC Commands	0 – 2
2	Best Gaze	0 – 2
3	Best Visual	0 – 3
4	Facial Palsy	0 – 3
5	Motor Arm Left	0 – 4
6	Motor Arm Right	0 – 4
7	Motor Leg Left	0 – 4
8	Motor Leg Right	0 – 4
9	Limb Ataxia	0 – 2
10	Sensory	0 – 2
11	Neglect	0 – 2
12	Dysarthria	0 – 2
13	Best Language	0 – 3

## Preparation

Know your stroke team before you need them

- Check glucose
- Two large IV lines
- Oxygen as needed
- Cardiac monitor
- Continuous pulse-ox
- Stat non-contrast CT scan
- ECG
- CXR
- Get rt-PA
  - > Prepare to mix
  - > Have pharmacy alerted
- Discuss options with patient and family
- Contact primary care provider

## American Heart Association Recommendations

Oxygen

- Use to correct hypoxia
- Suggestion that supernormal levels may hurt
  - > one year survival 69% 3L NC vs 73% control

Glucose

- Maintain euglycemia
- Treat glucose > 300 mg/dl with insulin

Source: [Rønning, Stroke 1999](#)

## True Time of Onset

How normal were they?

- What are they like at baseline?
- Who saw them last?
- Clearly no symptoms?

Times of reference

- Television
- The time the basketball game started

## Stroke Risk Factors

### **Modifiable risk factors**

- High blood pressure
- Cigarette smoking
- Transient ischemic attacks
- Heart disease
- Diabetes mellitus
- Hypercoagulopathy
- Carotid stenosis
- Other

### **Non-modifiable risk factors**

- Age
- Gender
- Race
- Prior stroke
- Heredity

# Treatment Guidelines & Recommendations - Part II

## Early CT Changes in Ischemic Stroke

- Loss of insular ribbon
- Loss of gray-white interface
- Loss of sulci
- Acute hypo density
- Mass effect
- Dense MCA sign



## Differential Diagnosis

- Intracerebral hemorrhage
- Hypoglycemia / Hyperglycemia
- Seizure
- Migraine headache
- Hypertensive crisis
- Epidural / Subdural
- Meningitis / Encephalitis / Brain abscess
- Tumor

## What are the Options?

No thrombolytics

- Nothing
- Aspirin
- Heparin

Intravenous rt-PA

Other

- Intra-arterial thrombolytics
- Low dose IV rt-PA followed by IA rt-PA
- Investigation procedure

## Treatment Based on CT Findings

CT Findings	Recommendations
• None	• Treat
• Subtle < 1/3 MCA	• Treat
• Subtle > 1/3 MCA	• Probably treat
• Hypodensity < 1/3 MCA	• Probably treat
• Hypodensity > 1/3 MCA	• Don't treat

## Exclusions to Thrombolytics

- Stroke or head trauma in 3 mos
- Major surgery within 14 days
- Any history of intracranial hemorrhage
- SBP > 185 mm Hg
- DBP > 110 mm Hg
- Rapidly improving or minor symptoms
- Symptoms suggestive of subarachnoid hemorrhage
- Glucose < 50 or > 400 mg/dl
- GI hemorrhage within 21 days
- Urinary tract hemorrhage within 21 days
- Arterial puncture at non-compressible site past 7 days
- Seizures at the onset of stroke
- Patients taking oral anticoagulants
- Heparin within 48 hours AND an elevated PTT
- PT >15 / INR >1.4
- Platelet count <100 X 10/L

"Patients were also excluded if aggressive measures were required to lower the blood pressure to within specified limits"

## Pretreatment BP Treatment

"Gentle" management if thrombolytic candidate:

- SBP > 180 mm Hg
- DBP > 110 mm Hg

Choices:

- Labetalol 10 - 20 mg IV
- Enalapril 1.25 mg IV
- Nitropaste 1" to chest wall

No nipride or nitroglycerin gtts

## Treatment Considerations: Who Will Benefit from rt-PA?

- Patient age and past medical history (diabetes)
- Time from onset
- Blood pressure
- Stroke severity
- Stroke subtype
- CT findings

## Factors Associated with Increased Risk of ICH

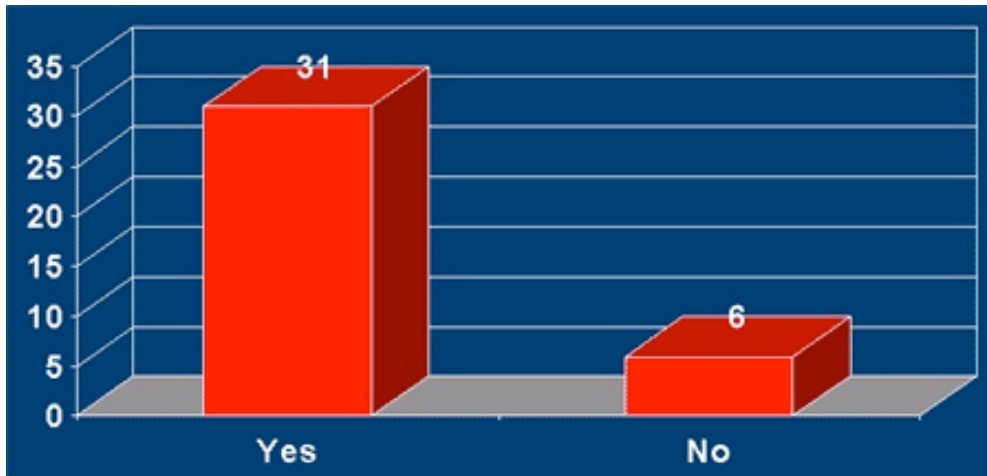
- Treatment initiated > 3 hours
- Increased thrombolytic dose
- Elevated blood pressure
- NIHSS > 20 \*
- Acute hypodensity or mass effect \*

\* Even though increased r/o ICH, still with benefit vs. placebo

## Treatment Guidelines & Recommendations - Part III

### Symptomatic Hemorrhages by NIH Stroke Scale in NINDS Trial

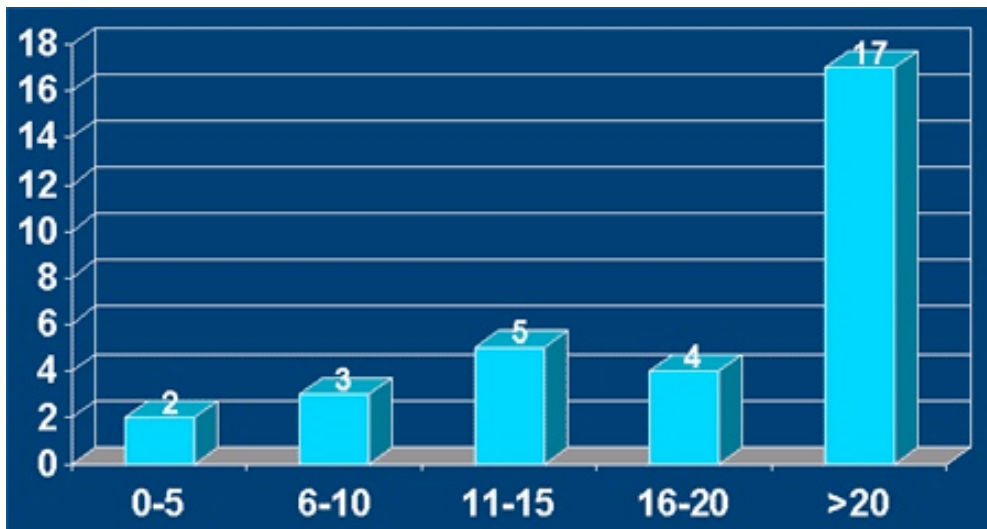
#### Percentage of Patients that Developed Symptomatic Hemorrhages



Edema or Mass Effect Seen on Initial CT

Source: Broderick, Stroke 1997

#### Percentage of rt-PA Patients with Symptomatic ICH



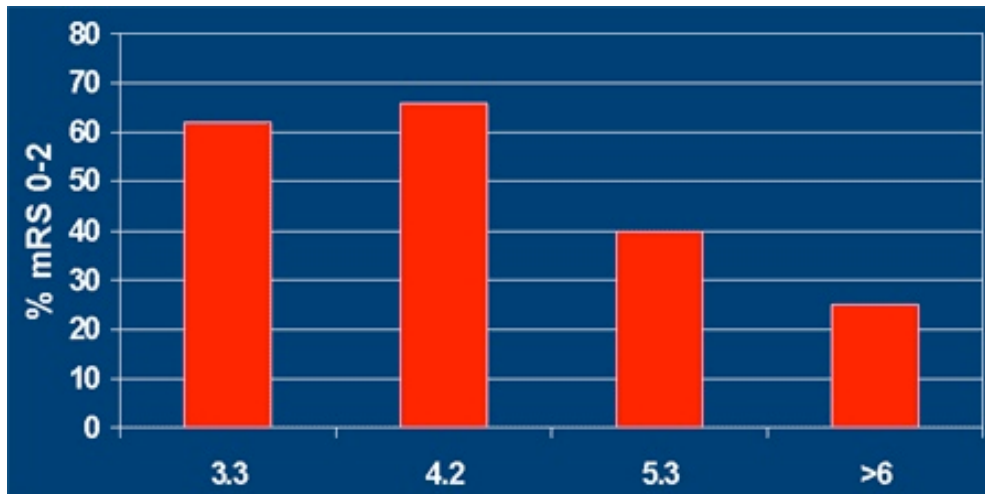
Baseline NIH Stroke Scale Score

Source: Broderick, Stroke 1997

## rt-PA Dosing

- 0.9 mg/kg (max = 90 mg)
- 10% bolus (over 1 minute)
- Remainder as a 1 hour infusion
- Have rt-PA in the Emergency Department

## Intra-arterial Thrombolytic Efficacy vs. Time of Delivery



Time from onset (hours)

Source: Ernst, Stroke, 2000

## Stroke Treatment - Aspirin

- Two important trials:
  - International Stroke Trial (IST)
  - Chinese Acute Stroke Trial (CAST)
- Combined analysis (n=40,090)
- Death / nonfatal strokes reduced 11%
- Don't forget to check swallowing

## Stroke Treatment - Heparinoids

- Two important trials:
  - International Stroke Trial (IST)
  - TOAST (Trial of ORG 10172)
- Decreased recurrent ischemic strokes
- Increased hemorrhagic events
- No net stroke benefit

## Post-Treatment Guidelines & Recommendations

### Post Treatment Care - Antihypertensive Therapy

- |  |   |
|--|---|
| <b>SBP 180 - 230 or<br/>DBP 105-120 mm Hg</b>  | <ul style="list-style-type: none"><li>• Labetalol 10 mg IV, may repeat / double to 150 mg max</li><li>• Labetalol drip 2-8 mg / min</li></ul> |
| <b>SBP &gt; 230 or<br/>DBP 121 - 140 mm Hg</b> | <ul style="list-style-type: none"><li>• Above</li><li>• Sodium nitroprusside</li></ul>  |
| <b>DBP &gt; 140 mm Hg</b>                      | <ul style="list-style-type: none"><li>• Sodium nitroprusside (0.5 ug/kg per minute)</li></ul>   |

May consider enalapril in patients with CHF, asthma, abnormal cardiac conduction  
Check with current guidelines

### ICH Contingency Plan

- Stat CT
- STAT labs  
> (fibrinogen, CBC, PT/PTT)
- Type and screen
- Fresh frozen plasma
- Neurosurgical consult

### Management of Seizures

Prophylactic anticonvulsant medication not recommended

Recurrent seizures require treatment

- Diazepam 5 mg over 2 minutes
- Lorazepam 1-4 mg over 2-10 minutes
- Follow benzodiazepines with longer acting anticonvulsant (phenytoin, phenobarbital, etc.)

### Pneumonia After Stroke

- One third of stroke patients develop a pneumonia within 1 month
- 3rd leading cause of death in the first month
- Estimated cost per event \$10,000 and a 7 day length of stay
- Laryngeal cough reflex cough tests can identify patients at risk.



Source: [Addington, Stroke 1999](#)

## Rehabilitation

Early rehabilitation is key for recovery

Early mobilization also prevents:

- Deep venous thromboses and pulmonary emboli
- Decubitus ulcers
- Contractures
- Malnutrition
- Pneumonias
- UTI

## What do you need to treat?

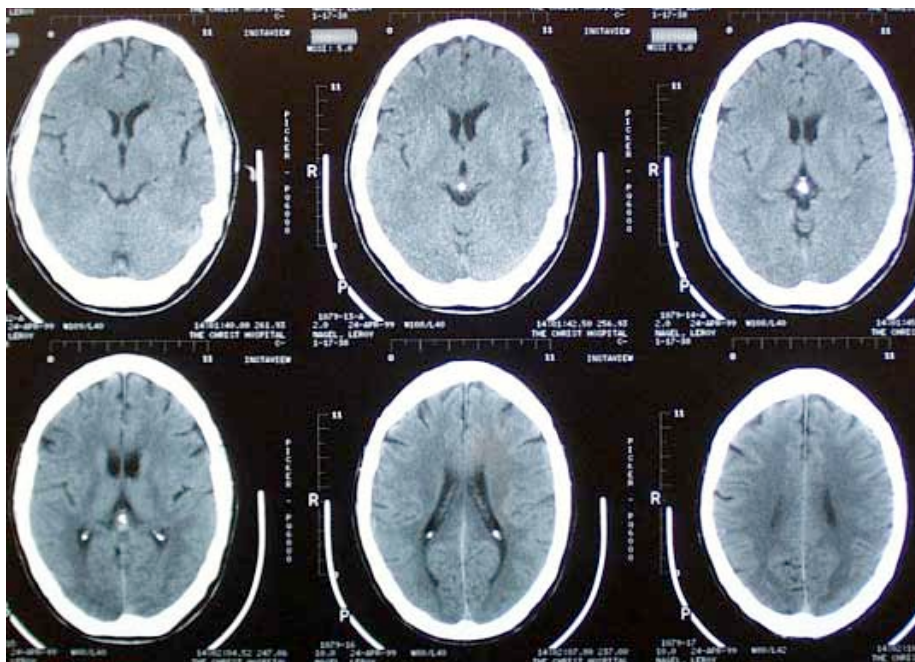
- Preplanning and preparation
- Multidisciplinary approach
- Know the mechanics
- Know the risks
- Coordinated post-treatment care

## Case Study

### History, Timeline, and Initial CT Findings

A 61 year old male, with acute aphasia, right facial droop, and right sided weakness.

- 12:30** Sudden onset while working in yard.
- 12:45** Family calls 911.
- 13:05** Advanced squad evaluates neurologic deficits and glucose.
- 13:15** Squad notifies receiving hospital of possible stroke patient.
- 13:30** ED arrival. Initial evaluation by E.D. physician.
- 13:45** Stroke Team arrives. NIHSS 18.
- 14:00** CT scan performed.
- 14:15** Discuss with family and PMD.
- 14:20** Labs back: gluc 97. BP remains 150/70's.
- 14:20** CT reading back. (See below.) No hemorrhage or early signs of ischemia.



- 14:25** Checklist done. No exclusion criteria met.
- 14:30** Decision time.
- 14:35** IV rt-PA given. 0.9 mg/kg total
- 10% bolus - 9 mg
  - 90% over 1 hr - 81 mg
- 15:45** Patient goes to ICU. Report personally given to ICU staff.
- 15:50** Pathway actions begin (HOB, BP parameters, aspiration precautions).

## 24 Hour Follow-up

A 61 year old male, with acute stroke, treated with rt-PA.

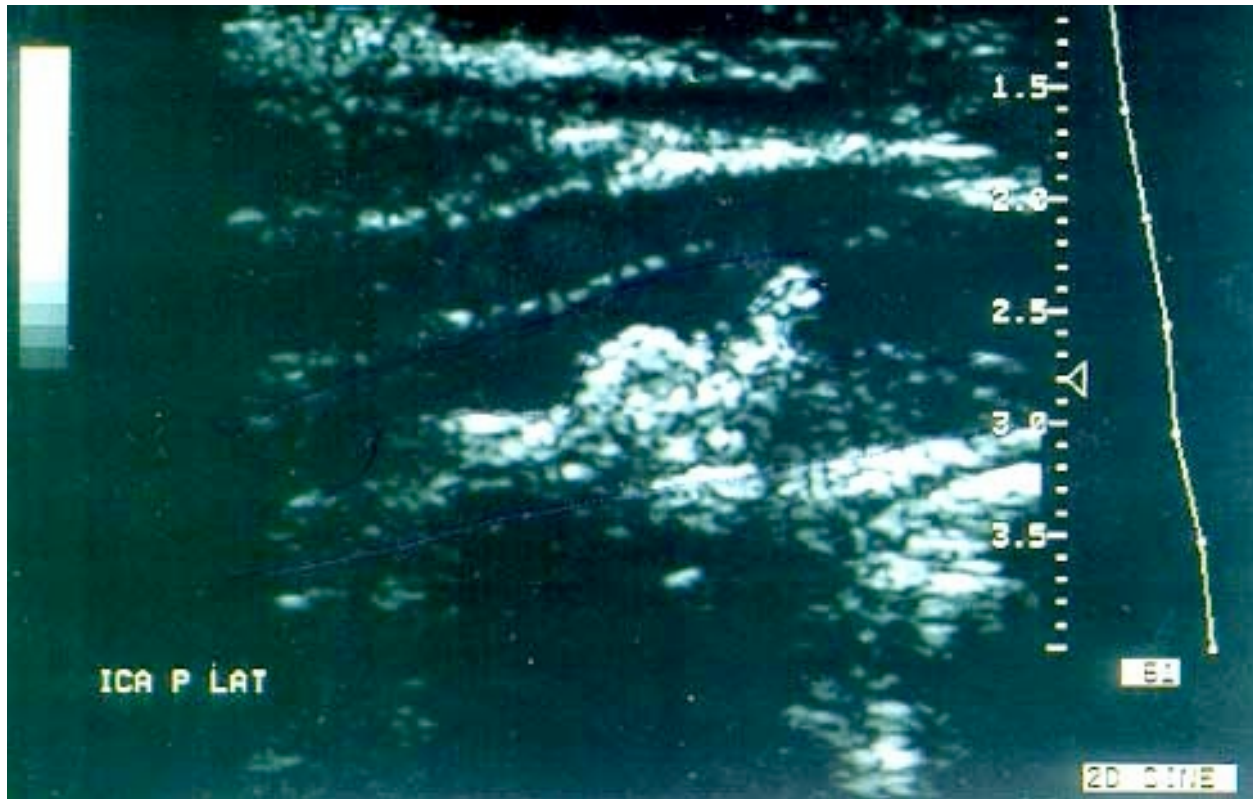
Repeat NIHSS = 3:

- VF intact
- No gaze palsy
- Mild facial palsy
- Mild right arm drift
- Mild dysarthria

Repeat CT shows areas of infarct:



Carotid U/S shows 60-80% stenosis left ICA



- Speech recommends swallowing II diet and daily checks
- Physical therapy pending
- CEA performed day 3
- Patient discharged to home on day 7 near pre-stroke baseline.

## References

Jorgensen HS, Nakayama H, Raaschou HO, Gam J, Olsen TS. "Silent infarction in acute stroke patients. Prevalence, localization, risk factors, and clinical significance: the Copenhagen Stroke Study."

[Stroke 1994 Jan;25\(1\):97-104](#)

Fagan SC, Morgenstern LB, Petitta A, Ward RE, Tilley BC, Marler JR, Levine SR, Broderick JP, Kwiatkowski TG, Frankel M, Brott TG, Walker MD. "Cost-effectiveness of tissue plasminogen activator for acute ischemic stroke." NINDS rt-PA Stroke Study Group.

[Neurology 1998 Apr;50\(4\):883-90](#)

Ronning OM, Guldvog B "Should stroke victims routinely receive supplemental oxygen? A quasi-randomized controlled trial."

[Stroke 1999 Oct;30\(10\):2033-7](#)

Brott T, Broderick J, Kothari R, Barsan W, Tomsick T, Sauerbeck L, Spilker J, Duldner J, Khoury J "Early hemorrhage growth in patients with intracerebral hemorrhage."

[Stroke 1997 Jan;28\(1\):1-5](#)

Ernst R, Pancioli A, Tomsick T, Kissela B, Woo D, Kanter D, Jauch E, Carrozzella J, Spilker J, Broderick J "Combined intravenous and intra-arterial recombinant tissue plasminogen activator in acute ischemic stroke."

[Stroke 2000 Nov;31\(11\):2552-7](#)

Addington WR, Stephens RE, Gilliland KA "Assessing the laryngeal cough reflex and the risk of developing pneumonia after stroke: an interhospital comparison."

[Stroke 1999 Jun;30\(6\):1203-7](#)

Abstracts from all of Dr. Jauch's publications are available at [PubMed](#).