From DTN to DTG: Strategies to Improve Timeliness of Care in Acute Stroke Patients

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Disclosures
- Genentech – Speakers Bureau
- Medtronic – Speakers Bureau

The Problem
- Stroke is the 5th leading cause of death
- Approximately 690,000 people will experience a stroke in the US annually
- IV Alteplase (tPA) is the only FDA approved drug for acute stroke treatment
  - 0-3 Hour Window: Class I, Level of Evidence A
  - 3-4.5 Hour Window: Class I, Level of Evidence B
- Endovascular treatment for acute stroke
  - Now considered standard of care, in addition to IV Alteplase
  - Class I, Level of Evidence A
- Fuster treatment = better outcomes

About Swedish
- 350 bed, Acute Care Hospital
- Located in Englewood, Colorado
- Joint Commission Certified Comprehensive Stroke Center
- >1250 Stroke Patients Annually
- First in the Rocky Mountain Region
- Level 1 Trauma Center
First things first:

Where did we get started and how did we improve our DTN times?

This is Our Story:
IV Alteplase Cases at Swedish

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
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</thead>
<tbody>
<tr>
<td>2006</td>
<td>40</td>
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<tr>
<td>2007</td>
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<td>2012</td>
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<td>2013</td>
<td>75</td>
</tr>
<tr>
<td>2014</td>
<td>55</td>
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This is Our Story:
Median Door to Needle Time at Swedish

<table>
<thead>
<tr>
<th>Year</th>
<th>Time (min)</th>
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<td>2007</td>
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<tr>
<td>2008</td>
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<td>2013</td>
<td>32</td>
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<tr>
<td>2014</td>
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Making the Case for Faster DTN Times

Five Domains
of Early IV Alteplase Administration

- Communication and teamwork
- Process
- Organizational culture
- Performance monitoring and feedback
- Overcoming barriers
Making the Case for Faster DTN Times

Fonarrow et al (2011) found that "every 15-minute reduction in door-to-needle time was associated with a 5% lower odds of mortality."

EMS Involvement
Hospital Pre-notification
Preorder of Test
No-Delay CT Interpretation
Premixing of Alteplase
Delivery of Alteplase on the CT Table
CT Relocated to ER
CT Priority and CT Transfer
Rapid Neurologic Evaluation
Pre-Acquisition of History
Point of Care INR
Reduced Imaging

Making the Case for Even Faster DTN Times

Target Stroke Findings

- Target: Stroke
  - Launch in January 2010
  - Goal: Increased the proportion of stroke patients treated with a DTN time < or ≥ to 60 minutes
  - 71,169 Stroke Patients Treated with IV Alteplase
    - From 1,030 GWTG-Stroke participating hospitals
    - 27,319 patients were from 2003-2009 (Pre-intervention)
    - 43,850 patients were from 2010-2013

Five Domains of Early IV Alteplase Administration at Swedish

- Communication and Teamwork
  - Formal meetings and document development
  - Electronic and in-person discussion of new process with stakeholders
- Process
  - Standards of practice guidelines
- Organizational Culture
  - Supportive of stroke program and process change
- Performance Monitoring and Feedback
  - Sharing success with the team
  - Data tracking and evaluation
- Overcoming Barriers
  - Working with many department to achieve goals

How did we achieve such low median door to needle times?

Lean Concept

- Value from customers perspective
- Identify the value steps for the process
- Eliminate non-value added steps
- Make the flow uninterrupted
- Continue to rework until state of perfection is achieved
What is Waste? The Patient Perspective

- Health care is filled with waste
- Very linear process
- Remove any step that does not improve patient care or outcome
- With acute ischemic stroke any delay in IV Alteplase is waste

2002 Process For IV Alteplase Treatment For Acute Ischemic Stroke

- Patient Has a Stroke
- May or May Not Call 911
- EMS Arrival
- Check Patient and Glucose On Scene
- EMS Transport to Hospital Often "Non Emergency"
- Enter Room
- Transfer to ED bed
- RN Takes Report
- Registration
- ED Doc Sees Sometime Later
- Put in Line for CT
- Sent to CT
- Often Wait for CT result
- Patient returns from CT
- CT Read by Radiologist
- CT Report Reviewed by ED doc
- ED Doc Pages Neurologist
- Neurologist Calls Back
- History Reviewed
- Decision to Administer Drug
- Patient Weight Obtained
- Pharmacy Called
- Drug Mixed
- Drug Delivered to Bedside
- Drug Administered?

Swedish Stroke Program History

- Program began in 2003
- Very linear process
- Initial goal was to simply treat the acute stroke patient within the 3-Hour window

2004 Stroke Program Initial Steps "Stroke Alert" Process

- Modeled after successful Cardiac Alert program
- We learned that pre-arrival notification from EMS was key to improving process times
- Partnership and education with area EMS agencies
- First hospital in Colorado to recognize "stroke alert"
- 70% of first 100 Stroke Alerts were having a Stroke or TIA

Swedish Stroke Program Next Steps 2006

- Initial stroke program not consistently staffed by Stroke Neurologists
- 24/7 Emergency Neurology coverage with dedicated stroke physicians 2007
  - Neuro Hospitalists

2006 – 2010 Building A Referral Network

- Continued to fine tune our process
- Large Increases in Stroke Cases
- Focused on outreach and building a larger referral network
- However DTN times for our own EMS patients plateaued
How does a patient get to CT?

2013: We Eliminate Waste

- Process of EMS patients moving into an ED room and transferring to an ED bed is inherently wasteful
- Simply moving onto the ED stretcher and onto the ED monitor takes time
- Rooms differ in proximity to CT scan

2013 CT Direct Protocol Development

- Patient moved to CT on EMS stretcher
- ED Leadership Driven Process
  - Fully Supported by Stroke Team
  - Stakeholder buy-in obtained
  - EMS
  - Physicians
  - Nurses
  - ED Techs
- Trial period initially
- Evaluation
- Process change

Stroke Launch Pad

- Entering the ED room is waste
- We created a Stroke Launch Pad
- Directly between EMS entrance and CT
- Identified position of Neurologist and ED physician
- Script what part of exam are needed prior to CT scan
- Adjacent to registration printer

Door to Stroke Launch Pad

44 feet

Stroke Launch Pad to CT

120 feet
2014 Door-to-Needle Task Force

- DTN meeting early 2014
- ED medical director
- Stroke medical director
- Stroke coordinators
- Pharmacists
- Discuss IV Alteplase admin in CT
- Dedicated pump for IV Alteplase administration
- Keep at launch pad
- For IV Alteplase only
- Call for IV Alteplase to be mixed prior to transport to CT

- Use ED weigh bed at launch pad when available
- IV pump to accompany launch pad cart to CT
- Back-up IV pump in CT
- Alteplase dosing chart in CT
- Start date: April 1, 2014

What About Safety? Alteplase Time-Out and Other Safety Issues

- Requirements to give Alteplase in CT
  - Neurologist present
  - RN, MD both must be comfortable with the plan to treat in CT
- If not, return to ED room

Getting Leaner 2014: Focus on the IV Alteplase

- Pre mix Alteplase prior to CT?
- Pharmacy goal to improve their 10 minute process for preparing Alteplase
- Where should drug be given?
- Alteplase on CT table instead of after the patient returns to the ED
- Plan: administer Alteplase immediately after the CT head, prior to CTA
Mock Stroke Alert the Morning of “Go-Live”

- **0800 Mock Stroke Alert**
  - Participants
    - “Patient”
    - AirLife ground transport team
    - Neurologist
    - Stroke Coordinator
    - ED Physician/Nurse/Tech
    - CT Techs
    - Pharmacy
  - **Process**
    - Used bed scale
    - Took approx. 1.5 minutes
    - Called for Alteplase at Launch Pad
    - To CT
    - Waited in hallway for approx. 2-3 minutes
    - Alteplase arrived at approx. 12 min
    - Alteplase timeout performed
    - Mock DTN 14 minutes

Performance Feedback

**Subject: Door to Needle Success - September**

We treated our first patient with our DTN task force protocol on 10/24/2016 with a DTN time of 12 minutes! This is now our fastest time. Diagnosis is suspected left subcortical ischemic stroke. We still hopefully change to lower this weekend.

Thank you to everyone who participated:

- ED to Launch Pad: 3 minutes
- ED to CT: 5 minutes
- CT to first slice of the CT: 12 minutes
- First slice to needle: 3 minutes
- Door to needle: 12 minutes

What are the risks of getting too lean?

- Missing a contraindication for IV Alteplase?
  - Near miss case solidified need for time-out process
- Will faster treatment lead to better outcomes?
  - Report monthly at stroke council meetings
- Will symptomatic hemorrhages increase?
  - Not at present time
- Wasting of Alteplase
  - Watch number of returns/not used
  - Discuss each case in neuro peer review

Switching gears slightly:

Focus on faster endovascular treatment times

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Radiology Imaging Associates
Denver, Colorado
SNIS Guidelines Time Metrics

- Door to CT: < 30 minutes
- Door to groin puncture: < 60 minutes
- Puncture to Recanalization: < 90 minutes

Objective

To describe the steps taken to improve time metrics for patients receiving intra-arterial therapy (IAT), and compare metrics before and after implementation of process improvements.

Patient Selection for ELVO (Emergent Large Vessel Occlusion)

- Imaging based patient selection
  - CT, CTA, +/- CTP
- Time from last known normal
  - This is not used for patient selection
- NIHSS
  - No lower NIHSS threshold

Improvements in Care

On June 1, 2013, the neuro-interventional team instituted a series of process improvements to streamline care for emergent large vessel occlusion (ELVO) patients:

- The INR team meets the patient in the CT scanner 24/7
  - Neuro-IR physician, anesthesiologist, nurse, 2 technologists
- Standardized thrombectomy procedure
  - Wheeled stroke cart with all thrombectomy devices
- Stroke tray with all additional items needed to perform the thrombectomy
- Conscious sedation for all stroke patients
- No shaving the groin or placing a foley catheter
- Increased biplane room capacity
  - 4 biplane rooms
Thrombectomy Procedure

- 11 cm, 9 French sheath
- 90 cm Neuron Max guide sheath
- ACE-64, 3 Max, 0.016” Fathom wire
- Advance wire through clot
- Advance 3 Max into proximal clot
- Advance ACE-64 into proximal clot
- Remove wire
- Remove 3 Max under suction with a syringe
- Suck for 2 minutes, if no flow after 2 minutes, pull back slowly
- 3 aspiration attempts

Methods

We compared the following time metrics for ELVO patients that received IAT

Before 1/1/12 - 5/31/13 and After 6/1/13 - 12/31/15

Process improvements using univariate analysis:

- Door to CT decision
- CT decision to groin puncture
- Groin puncture to Recanalization

Data are presented as Median (Interquartile Range) and Mean (Standard Deviation).
Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre- Implementation n=113</th>
<th>Post- Implementation n=267</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (range)</td>
<td>69 (34 – 92)</td>
<td>70 (19 - 94)</td>
<td>0.88</td>
</tr>
<tr>
<td>Female</td>
<td>68 (60.2%)</td>
<td>134 (50.2%)</td>
<td>0.07</td>
</tr>
<tr>
<td>Race (White)</td>
<td>92 (81.4%)</td>
<td>204 (76.4%)</td>
<td>0.48</td>
</tr>
<tr>
<td>Arrival NIHSS, mean (SD)</td>
<td>16.7 (6.3)</td>
<td>17.6 (7.2)</td>
<td>0.27</td>
</tr>
<tr>
<td>Symptom onset to facility arrival, Minutes, median (range)</td>
<td>218 (4 – 1060)</td>
<td>200 (0 - 1524)</td>
<td>0.11</td>
</tr>
<tr>
<td>Transferred in</td>
<td>90 (79.6%)</td>
<td>188 (70.4%)</td>
<td>0.08</td>
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</table>

SD, Standard deviation

Door to CT decision

CT to Puncture

Puncture to Recanalization
Conclusions

Our initiatives allowed us to refine our process of care, resulting in a significant reduction of time between:
- Patient arrival and imaging
- Imaging and IV Alteplase
- Imaging and femoral artery access
- Groin puncture to recanalization.

Current Acute Endovascular Metrics

Door to Groin
37 min (median)

Door to Recanalization
74 min (median)
Endovascular Patient Selection

- Time from symptom onset... is meaningless
  - Like a bell shaped curve, the percentile of patients eligible for thrombectomy will diminish over time
  - On the flip side, early presenting patients may be ineligible
- Core infarct volume
- Identify LVO (large vessel occlusion)
- Collaterals?
  - Indirect measurement of infarct core
  - May reflect to slope of core infarct growth
  - Poor collaterals = rapid growth of core infarct

Time Metrics

- Efficient throughput
  - Onset to arrival
  - EMS/airlife
    - Stroke alert called by EMS
  - LAMS (LA motor scale)
  - ER to imaging
    - Launchpad concept – bypass the ER, go right to imaging
    - Imaging to groin puncture
    - ESCAPE trial metric – 60 minutes
  - Groin puncture to recanalization
    - ESCAPE trial metric – 30 minutes

Technology

- Thrombectomy devices
  - Groin puncture – recanalization < 30 minutes
  - TICI 2B/3 : > 90%
  - No ENT (embolization to a new territory)
  - Low symptomatic hemorrhage rate

  Direct aspiration with large I.D. catheter is the best choice

References