The Price of PAD: Clinical and Economic Consequences of Amputation

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1. Pre-Lecture Questions
   After an amputation for any reason, the probability of dying in the ensuing year is:

   A. <5%
   B. 10%
   C. 15%
   D. >20%
2. Pre-Lecture Questions
Factors associated with improved survival include:

A. Having private insurance vs Medicaid 17%
B. Having a diagnostic angiogram 17%
C. Being Caucasian versus Black or Hispanic 17%
D. Having a peripheral angioplasty or stent 17%
E. Living in Arkansas or Alabama versus Mississippi 17%
F. All of the above 17%
3. Pre-Lecture Questions
The most common cause for amputation is:

A. Diabetes
B. Trauma
C. Cancer
4. Pre-Lecture Questions
The 5 year mortality of critical limb ischemia is higher than:

A. Stroke
B. Heart attack
C. Colorectal Cancer
D. Breast Cancer
E. All of the above
The Price of PAD

• There are nearly 2 million people living with limb loss in the United States.
• Among those living with limb loss, the main causes are vascular disease (54%) – including diabetes and peripheral arterial disease – trauma (45%) and cancer (less than 2%).
• Approximately 185,000 amputations occur in the United States each year.
The Price of PAD

• In 2009, hospital costs associated with amputation totaled more than $8.3 billion.

• African-Americans are up to four times more likely to have an amputation than white Americans.

• Nearly half of the individuals who have an amputation due to vascular disease will die within 5 years. This is higher than the five year mortality rates for breast cancer, colon cancer, and prostate cancer.
The Price of PAD

- Of persons with diabetes who have a lower extremity amputation, up to 55% will require amputation of the second leg within 2-3 years.
Medicare: Geographic Variation in Lower Extremity Amputation for PAD (2000-2008)

Amputation Costs

- **Major lower limb amputation**
  - $40,000-$45,000 first year
  - Rehab doubles cost
- **CMS Medicare 1996**
  - N = 3565 patients underwent amputation; 1 year:
    - 26% required subsequent amputation
    - 33% died
  - Acute and postacute costs: > $4.3 billion annually
- **Minnesota 2005-2008**
  - Median charge per amputation
    - $32,129
  - Cumulative inpatient hospitalization charges
    - $56.5M

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ACS-NSQIP: 30-Day Morbidity and Mortality of Major Amputation for CLI

N = 4250 patients with major amputation from 2005 through 2008

30-day mortality rates from smaller studies
BTK: 4.2%-12%
ATK: 13.5%-17.8%

Survival After Amputation

5-Year Survival: Above Knee vs Below Knee

<table>
<thead>
<tr>
<th>Year</th>
<th>Above Knee (n = 234)</th>
<th>Below Knee (n = 720)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Year</td>
<td>78.2</td>
<td>62.1</td>
</tr>
<tr>
<td>2 Year</td>
<td>67.1</td>
<td>47.7</td>
</tr>
<tr>
<td>5 Year</td>
<td>47.9</td>
<td>31.5</td>
</tr>
</tbody>
</table>

## Nationwide Inpatient Sample: Factors Associated With Amputation

<table>
<thead>
<tr>
<th></th>
<th>Multivariate Odds Ratio</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic Angiogram</td>
<td>0.09</td>
<td>0.09-0.10</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Race (Reference: white)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2.15</td>
<td>1.99-2.32</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Native American</td>
<td>2.00</td>
<td>1.52-2.64</td>
<td>.01</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.60</td>
<td>1.46-1.75</td>
<td>.08</td>
</tr>
</tbody>
</table>

Weighted total of 958,120 discharges for CLI and lower-extremity revascularization or major amputation (2003 through 2007)

# Nationwide Inpatient Sample: Type of Insurance Affects Amputation Rate

<table>
<thead>
<tr>
<th>Primary Payer (Reference: Medicare)</th>
<th>Multivariate Odds Ratio</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Insurance</td>
<td>0.74</td>
<td>0.70-0.78</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Medicaid</td>
<td>1.26</td>
<td>1.17-1.35</td>
<td>&lt; .0001</td>
</tr>
</tbody>
</table>

Weighted total of 958,120 discharges for CLI and lower extremity revascularization or major amputation (2003 through 2007)

“It found that amputation rates for black patients with diabetes and peripheral arterial disease in the rural Southeast can be as high as seven times the rate of other regions. Mississippi showed some of the widest disparities by race. There were 14.2 amputations per 1,000 beneficiaries for black patients in Meridian and 16.1 in Tupelo, compared to 3.8 and 4.7, respectively, for nonblack patients.”
Medicare: Underuse of Revascularization and Angiogram in Year Prior to Major Amputation

N = 20,464 Patients with PAD who underwent major leg amputation (2003-2006)
Nationwide Inpatient Sample: Lower Revascularization Volume Increases Risk of Amputation

Reference: Q4 ≥ 249 lower-extremity revascularization procedures/year

Odds Ratio for Amputation

<table>
<thead>
<tr>
<th>Quartile</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 (0-11/year)</td>
<td>15.16</td>
</tr>
<tr>
<td>Q2 (12-71/year)</td>
<td>2.75</td>
</tr>
<tr>
<td>Q3 (72-248/year)</td>
<td>1.77</td>
</tr>
</tbody>
</table>

$P < .0001$ for all

TASC II: Critical Limb Ischemia

Primary Treatment

- Medical Treatment Only: 25%
- Primary Amputation: 25%
- Revascularization: 50%

CLI = ischemic rest pain, ischemic skin lesions (ulcers/gangrene)

National Trends in Lower-Extremity Interventions

Number of lower-extremity vascular procedures ≈ doubled from 357 to 581

In 2009, the rate per 1000 people with diabetes:

- 3.1 age < 65 years
- 3.5 age 65-74 years
- 3.7 among people aged ≥ 75 years
- 4.5 vs 2.3 age-adjusted rate for blacks vs whites

Revascularization Reduces Amputation

Single Center 12-Year Review
N = 1615 lower extremity vascular procedures

- **Endovascular**
- **Surgery**
- **Amputation**

<table>
<thead>
<tr>
<th>Year</th>
<th>Endovascular (%)</th>
<th>Surgery (%)</th>
<th>Amputation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>0</td>
<td>100</td>
<td>32.3</td>
</tr>
<tr>
<td>2004</td>
<td>32.9</td>
<td>67.1</td>
<td>20</td>
</tr>
<tr>
<td>2010</td>
<td>10.9</td>
<td>89</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Figure 5a–5c. A 59-year-old patient with CLI presented with a severe focal ostial stenosis of the anterior tibial artery (left). A 2.0 mm Diamondback 360° Classic Crown was used to debulk the plaque (center). A channel was cleared, and no adjunct therapy was required.
64 year old with a heavily calcified bifurcation lesion of the distal popliteal artery (take-off of AT and TP trunk) in a patient with Rutherford class 4 rest pain. He was treated with bifurcation CSI Diamondback and PTA using kissing balloons with minimal residual stenosis and no dissection or plaque shift.
75 year old man with a ulcer on his great toe.

Angiogram shows 100% AT and PT.

Revascularization of the AT is performed using Navicross and baby-J Glide wire followed by PTA alone.
Case Presentations

**Angiosomes of the lower extremity**

- Anterior tibial angiosome
- Posterior tibial angiosome
- Peroneal angiosome

- Anterior tibial artery
- Medial plantar branch
- Lateral plantar branch
- Calcaneal branch
- Posterior tibial artery
- Peroneal artery

Medical Illustrator: Beth Halasz ©2014
Case Presentations

Final Result

[Image of a medical scan with text]
Case Presentations

- 68 year old diabetic man presents with this lesion.
- What below the knee vessel are you most concerned about?
Angiosomes of the lower extremity

- Anterior tibial angiosome
- Posterior tibial angiosome
- Peroneal angiosome

Anterior tibial artery
Posterior tibial artery
Medial plantar branch
Lateral plantar branch
Calcaneal branch
Peroneal artery

Medical Illustrator: Beth Halasz
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As predicted, 100% AT and subtotal occlusion of the PT

Could not cross from above due to dissection
Case Presentations
Case Presentations
Diabetes on the Rise

From 1980 through 2010, the percentage of people with diagnosed diabetes increased by 200%. In 2010, 20.7% of people aged 65-74 had diagnosed diabetes vs 1.8% of those < 45 years of age.
Diabetes and Amputation

• Diabetes is responsible for more than half of all lower limb amputations performed in the U.S.

• Each year there are about 88,000 non-injury amputations, 50 - 75% of them due to diabetes.

• About 85% of amputations start with foot ulcers, which develop in about 12% of people with diabetes.
Diabetes and Foot Care

- Check your feet every day.
- Wash your feet every day.
- Keep the skin soft and smooth. Use lotions.
- Smooth corns and calluses gently.
- If you can see, reach, and feel your feet, trim your toenails regularly.
- Wear shoes and socks at all times.
- Protect your feet from hot and cold.
- Keep the blood flowing to your feet.
- Be more active.
- Choose seamless socks that wick moisture away.
- Choose shoes that don’t bind.
PAD Awareness Is Low

N = 2501 ≥ 50 years surveyed for awareness of PAD and other diseases

- PAD: 26%
- ALS: 36%
- Multiple Sclerosis: 42%
- CAD: 67%
- Stroke: 74%

5-Year Mortality for CLI Higher than Common Cancers

- Prostate Cancer: 0.8%
- Breast Cancer: 11%
- AMI: 20%
- PAD: 30%
- Colorectal: 36%
- Stroke: 41%
- Critical Limb Ischemia: 67%

References:

Vascular Screening Recommendations

- **ADA Consensus Panel** recommends ABI Screening for:
  - Patients over the age of 50 years who have diabetes
  - Patients with diabetes younger than 50 years of age who have other PAD risk factors (i.e. smoking, hypertension, hyperlipidemia, diabetes more than 10 years)
- ABI should be repeated in 5 years if normal
- If ABI is abnormal, then patient should be referred

- **TASC II** recommends ABI Screening for:
  - All patients who have exertional leg symptoms
  - All patients between the age of 50-69 and who have a cardiovascular risk factor
  - All patients age greater than 70 years regardless of risk factor status
  - All patients with a Framingham risk score of 10%-20%
Pitfalls of the ABI in Diabetics

• The ankle–brachial index (ABI) is a simple, noninvasive, widely used test that detects peripheral arterial disease (PAD).

• In patients with diabetes, the ABI is notoriously unreliable and this is usually attributed to medial calcinosis, which stiffens the arteries and renders them poorly compressible as well as a tendency to have a greater degree of blockage in BTK vessels.
A System of Care

Patient with a wound

- Wound care
- Podiatry
- Internal Medicine
- Endocrinology

Referrals

Angiogram

Vascular Specialist
Issues

• Growing number of diabetics
  – Education on foot care
  – Early recognition of PAD

• Lack of awareness of PAD and its consequences

• Lack of an organized system of care
Take Home Messages

- Revascularization beneficial
  - Saves limbs, lives
  - Can result in less extensive amputation
- Amputation as last resort
  - Unacceptable without angiogram
  - After revascularization options exhausted
  - Multidisciplinary decision
- Increase awareness of PAD/CLI
  - Patients/family
  - Primary care, podiatrists, endocrinologists...