Rehabilitation after Amputation

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Overview

• US Statistics for Limb Loss
• Vascular Causes
• Traumatic Causes
• Prevention of Limb Loss
• Rehabilitation and Pre-Prosthetic Care Following Surgery
• Conclusion

Limb Loss: US Statistics

185,000 Amputations/year (upper and lower extremity)
• 2009: Hospital Costs: > $8.3 Billion
  • Does not include rehabilitation or prosthetic costs
• 2012: at least 1.9 million people living with limb loss

Limb Loss: US Statistics

• Vascular Disease: 54%
• Trauma: 45%
• Malignancy: <2%
Etiology of Amputation

Limb Loss: US Statistics

Lower Extremity Peripheral Artery Disease (PAD)
- 8 million Americans
- 50% asymptomatic
- Most severe manifestation: severe loss of circulation to a limb resulting in
  - Increased risk of limb loss
  - Increased risk of mortality

Vascular Disease

Limb Loss: Vascular Disease

Peripheral Vascular Disease
- Circulation disorder
  - Blood vessels distant from the heart and brain
- Peripheral Artery Disease
  - Most common
  - Narrowed arteries decrease blood flow to arms and legs

Limb Loss: Peripheral Vascular Disease

Symptoms:
To legs and feet:
- Painful cramping
- Achiness
- Fatigue
- Burning
- Claudication
Limb Loss: Peripheral Artery Disease (PAD)

Risk Factors
- > 50 years of age
- Family history of PAD, heart disease or stroke
- Heart disease or stroke
- Smoking
- Diabetes
- Obesity
- Sedentary Lifestyle
- High cholesterol
- High blood pressure

Limb Loss: Diabetes

Diabetes can result in:
- Impaired circulation in small blood vessels
- Increased risk of peripheral artery disease
- Neuropathy
  - Increases chance of damage to the skin
    → foot ulcers
  These factors increase the risk of amputation

Limb Loss: Diabetes

- 15 x more likely than the general population to undergo amputation
- Leading cause of amputation in lower limb

Limb Loss: Prevention

- 85% of lower extremity amputations are preceded by a foot ulcer
  - Prevention:
    - Teach patients to manage their diabetes and inspect their feet
    - Follow patients closely for evidence of skin breakdown
    - Too difficult for just the primary care MD to do alone → interdisciplinary team care
Interdisciplinary Care: Dysvascular Disease (UK)

Reduction in Diabetic Amputations Over 11 Years in a Defined U.K. Population

Sustained reduction in major amputations in diabetic patients
628 amputations in 461 patients in a defined population over a 20-year period

Interdisciplinary Care: Dysvascular Disease (Sweden)

Limb Loss: US Statistics

Hope for the Future:
- In the US, multiple organizations are publishing evidenced based guideline for the prevention and treatment of those at risk for limb loss to decrease the incidence of amputation.
Limb Loss: US Statistics

Etiology of Amputation

- 45% Trauma

Limb Loss: Traumatic Amputations U.S.

- Mechanism of Injury: blunt trauma
  - Motor vehicle crash: Upper extremity amputations
  - Motorcycle crash, pedestrian vs. auto: Lower extremity amputations
- Males: 76.7%
- Mean age: 36.1
- Most common level: Transtibial (below the knee)

Limb Loss: US Statistics

- Prevalence in 2005: Projected to double by year 2050 (>700,000 to 1,325,000)
- Increase impacted by increase in life expectancy

Limb Loss: Functional Limb Service

Pasquina, et al
- Teamwork
- Critical Specialties
- Peer Support
- Community Reintegration
To provide comprehensive care of patients undergoing amputation, it really takes a village:

Zuckerberg San Francisco General Hospital and Trauma Center

Level I Trauma Center

**Functional Limb Service**

- PM&R
- Orthopaedic Surgeons
- Vascular Surgeons
- Trauma Surgeons
- Plastic Surgeons
- Podiatrists
- Prosthetists
- Physical Therapists
- Occupational Therapists
- Nurses
- Team Coordinator

Nutritionist
- Infectious Disease
- Endocrinologists
- Social Services / Case Managers
- Vocational Rehab Counselor
- Program Facilitator

**Functional Limb Service**

- **Goals:**
  - Prevention
  - Early identification and treatment of at-risk limbs
  - Utilize team input to maximize functional outcomes
  - Provide patients and caregivers with education that will help with decision making and recovery
Limb Loss: Functional Limb Service (FLS)

- Review clinical cases
- Provide inpatient consultation
- Provide outpatient follow up in an interdisciplinary clinic
- Coordinate peer mentor and support groups for patients at risk for limb loss or who have undergone amputation surgery
- Constantly assess the need for service improvements

Before surgery

- Team assessment
  - Surgical considerations
  - Functional considerations
  - Patient Education
  - Informed decisions
  - Guide expectations

Optimizing recovery after surgery
Post Operative Rigid Dressing

**Advantages:**
- Reduction of swelling

**Disadvantages:**
- May not be for residual limbs where wounds need to be closely monitored

Immediate Post-Operative Prosthesis (IPOP)

**Advantages:**
- Reduction of swelling
- Early partial weightbearing (up to 60 lbs)
- Psychological benefit

**Considerations:**
- Requires patients to be compliant with use
- Not optimal for diabetic patients

**Positioning**

*Hip Extension*
Lay on stomach. Lift leg toward back, while keeping knee straight. Lower back should not move.
Positioning

- Keep knee extended while in wheelchair

Serial casting

Positioning

- 10-15 degrees contracture
- Ready for fitting
Wound Care:
- Monitor Closely
- Keep suture line clean and dry

Pre-prosthetic Fit:
- Monitor suture line
- Clean suture line

Post-Operative Care:
- Shrinker sock
  - Reduces swelling and pain
- Limb Guard
  - Protects limb
  - Minimizes risk of contracture

Physical Therapy:
Rehabilitation Should Start as Early as Possible
- PT:
  - Bed mobility
  - Transfers
  - Instruction on ROM, strengthening
  - Pre-gait/Gait activities
- Ideally, should begin pre-amputation

http://www.amputee-coalition.org/resources/after-amputation-surgery/
Occupational Therapy

Rehabilitation Should Start as Early as Possible

OT:
- Bed mobility
- Transfers
- Strengthening
- Activities of Daily Living
- Wheelchair mobility
- Equipment assessment

Transitions from Hospital to Home

- Transferring in/out of wheelchair
- Use of a front wheeled walker
- Household distances
- Navigating stairs
Outpatient Follow Up

- Follow up in outpatient clinic (1-2 weeks after discharge)
- Sutures are removed (3-4 weeks after surgery)
- Massage suture line
- Ongoing shrinker sock use for residual limb shaping

http://www.amputee-coalition.org/resources/after-amputation-surgery/

Volume Changes with Shrinker Sock Use

3 weeks → 8 months
Shape and size of limb directly affects fit of socket

Transitions from Hospital to Home

Surgery → Rehab → Inpatient Rehab → Home → Outpatient Rehab

Assessment of Prosthetic Candidacy + Rehab
Residual limb wound healing and shaping

Prosthetic Candidacy: Can the patient safely and successfully use a prosthesis?

What factors are considered?
- Prior functional status
- Medical comorbidities (other illnesses)
- Cognition
### Prosthetic Candidacy

**Energy Cost of Ambulation**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Increase (%)</th>
<th>MET</th>
</tr>
</thead>
<tbody>
<tr>
<td>No prosthesis, with crutches</td>
<td>50</td>
<td>4.5</td>
</tr>
<tr>
<td>Unilateral BK with prosthesis</td>
<td>9-28</td>
<td>3.3-3.8</td>
</tr>
<tr>
<td>Unilateral AK with prosthesis</td>
<td>60-85</td>
<td>4.2-5.8</td>
</tr>
<tr>
<td>Bilateral BK with prosthesis</td>
<td>41-100</td>
<td>4.2-6.0</td>
</tr>
<tr>
<td>BK plus AK with prosthesis</td>
<td>70</td>
<td>4.7</td>
</tr>
<tr>
<td>Bilateral AK with prosthesis</td>
<td>20-80</td>
<td>3.1-5.8</td>
</tr>
<tr>
<td>Unilateral hip disarticulation with prosthesis</td>
<td>50-55</td>
<td>4.2-5.8</td>
</tr>
<tr>
<td>Hemipelvectomy with prosthesis</td>
<td>125</td>
<td>5.5-7.5</td>
</tr>
</tbody>
</table>

*Normal Gait: 3 METs  
Waters, Perry, et al. 1976*

- Transtibial Amputation: 3.3-3.8 METS (9-28% increase in energy)

- Hemipelvectomy: 6.75 METS (125% increase) = Jogging

- Prosthetic Candidacy: K Levels and Function

<table>
<thead>
<tr>
<th>K-Level</th>
<th>Description</th>
<th>Possible Assemblies</th>
<th>Knee Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>K0</td>
<td>Not eligible for prosthesis</td>
<td>None</td>
<td>Not eligible for prosthesis</td>
</tr>
<tr>
<td>K1</td>
<td>External foot, GACH foot or single axis ankle</td>
<td>Single-axis, single-axis or dynamic-response knee</td>
<td>Single-axis or dynamic-response knee</td>
</tr>
<tr>
<td>K2</td>
<td>Flexible foot and multi-axis ankle</td>
<td>Single-axis or dynamic-response knee</td>
<td>Single-axis or dynamic-response knee</td>
</tr>
<tr>
<td>K3</td>
<td>Partially or fully ambulating with variable cadence or dynamic response</td>
<td>Partially ambulatory or fully ambulatory</td>
<td>Partially ambulatory or fully ambulatory</td>
</tr>
<tr>
<td>K4</td>
<td>Any ambulatory foot system appropriate</td>
<td>Any ambulatory foot system appropriate</td>
<td>Any ambulatory foot system appropriate</td>
</tr>
</tbody>
</table>

- Jogging
Conclusion:

• The number of individuals living with limb loss is increasing
• Prevention of vascular-related limb loss through interdisciplinary care is promising
• Team approach to care is crucial to help patients who have undergone amputation through the process of:
  • Preparing for prosthetic fitting
  • Setting and achieving their functional goals

Thank You