Vascular Disease

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Vascular Disease

The Setting

Aging population

Obesity/diabetes (1%/yr increase!)

Continued smoking

Rapidly decreasing cardiac mortality

US Population Demographic

- Aging population
- Obesity/diabetes (1%/yr increase!)
- Continued smoking
- Rapidly decreasing cardiac mortality
Vascular Disease

Topics

Abdominal Aortic Aneurysm

Peripheral Arterial Disease
- Intermittent Claudication
- Critical Limb Ischemia

Chronic Venous Disease
Aortic Aneurysms

Bulging or dilatation of aorta
Aortic Aneurysms

Epidemiology

Disease of older people

- AAA: 1% prevalence age >50

Male predominance

Usual cardiovascular risk factors, especially smoking

13th leading cause of death in the US

50,000 ruptured AAA annually
Aortic Aneurysms
Natural History of an Aortic Aneurysm
Patient perspective

“Don’t lift more than 10 lbs”
“Don’t cough”
“Don’t bend over”
“Don’t drive a car”
“Don’t have sex”
“Don’t walk”
“Stay close to a hospital”
The Reality of an Aortic Aneurysm

Aortic aneurysm is a condition with a well defined risk to life and available successful treatment, when appropriate.

Much like many other chronic conditions.

Aortic aneurysms almost never cause symptoms.

Role of treatment entirely prophylactic – prevention of premature death.

Even large aortic aneurysms don’t always rupture.
### Natural History of AAA

<table>
<thead>
<tr>
<th>Diameter (cm)</th>
<th>Rupture rate/year</th>
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<tbody>
<tr>
<td>&lt; 4.0</td>
<td>Zero</td>
</tr>
<tr>
<td>4 – 5.9</td>
<td>0.5 – 5 %</td>
</tr>
<tr>
<td>5 – 5.9</td>
<td>3 – 15 %</td>
</tr>
<tr>
<td>6 – 6.9</td>
<td>10 – 20 %</td>
</tr>
<tr>
<td>7 – 7.9</td>
<td>20 – 40 %</td>
</tr>
<tr>
<td>&gt; 8.0</td>
<td>30 – 50 %</td>
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</tbody>
</table>
AAA Screening

Everyone agrees:
-Males > 65 with history of smoking *

More controversial:
-Any male > 65 yo
-Pt’s with family h/o AAA
-Females with multiple risk factors i.e. brother with AAA **

* US Preventative Services Task Force
** SVS/SVMB
Open Repair of Aortic Aneurysm
What You Get from Open AAA Repair

In the hands of a board certified vascular surgeon a high likelihood (>95 to 97%) chance of survival and initial cure.

A low likelihood of long term complication (1 to 2% per year).

A real risk of incisional hernia or bulging (10 to 25%).

Freedom from multiple rechecks for endoleaks, migration, AAA expansion, kinking/thrombosis and associated radiation exposure.
Endovascular Repair of Aortic Aneurysm
What You Get from EVAR

A shorter hospital stay and recovery time

A residual aneurysm with a real rupture risk (up to 1% per year)

A re-intervention rate of about 10% per year

Inconvenience and dangers of repetitive long-term imaging, re-intervention and radiation exposure
Repair of AAA
Dream Trial

Survival

Re-intervention

NEJM, 2005
Repair of AAA
EVAR 1

Aneurysm Related and All Cause Mortality

Complications and Re-intervention

Lancet, 2005
Functional Outcome of Open AAA Repair

OHSU Study

154 open AAA pts

100% ambulatory and living independently preoperatively

> 90% driving preoperatively

> 90% shopping preoperatively

JVS 2001
Functional Outcome of Open AAA Repair

OHSU study

11% went to a skilled nursing facility – 9% still there at last follow-up (mean 34 m)

33% had decreased shopping/driving

12% were non-ambulatory

64% had “full recovery” at mean of 3.9 m postop

36% not “fully recovered” at mean of 34 m post op
Tertiary referral center

Poor functional outcome associated with increased preoperative risk (age, CHF, renal insufficiency)

Unclear how much of the decline was dependent or independent of the AAA operation
Functional Outcome of Open AAA Repair

UK Small AAA trial - Functional Outcome

Post surgery subjects had better mental health subscores

Observation subjects had better physical health subscores

Overall scores no different

UKSAT participants, Lancet 1998
48 open vs 34 endovascular repairs were compared prospectively.

No significant preop differences (SF – 36)

6 months post op both groups showed declines in physical function and vitality.

**NO DIFFERENCE** in open vs endovasc

Lloyd et al, Br J Surg, 2000
Functional Outcome of AAA Repair

Functional Outcome – Open Repair

Prospective study of 454 preoperative patients (SF – 36)

AAA pt scores comparable to total hip pts, lung cancer pts

Post op AAA pts showed significant decline in SF – 36 scores; maximal at 6 wks, back to preop levels by 6 months, maintained at 12 months

Mangione et al, J Gen Intern Med 1997
UK Small AAA trial - Functional Outcome

UK small aneurysm trial confirmed recovery from initial postoperative SF – 36 decline by 6 months

No overall difference in surgery vs. observation groups at 12 months

UKSAT participants, Lancet 1998
QoL Following AAA Repair

Open (n=196) vs Endovascular (n = 92) Repair

SF-36: Increased Physical and Mental Health for First 3 Months with EVAR

Differences Decreased with Time

No Significant Differences After 3 Months

QoL Following AAA Repair

Open vs Endovascular Repair

141 Open Repairs

153 Endovascular Repairs

Functional Outcomes (<6 vs >6 months)
-ambulation, independent living, employment status

Better with EVAR < 6 months; NO Differences after 6 months

J Endovasc Ther 2003; 10: 2-9
Aortic Aneurysm

Chronic, asymptomatic but potentially fatal disease of older patients.

Patient knowledge of their aneurysm adversely affects quality of life but no lifestyle modifications are required.

Quality of life is decreased following repair but is back to baseline by 6 to 12 months.
Peripheral Arterial Disease
Lower Extremity Atherosclerosis

40% have atypical leg symptoms

50% are asymptomatic

10% have classic intermittent claudication
Peripheral Arterial Disease

Therapeutic Paradox: Invasive Treatment Best For:

Old patients

Need minimal improvement

Limited life expectancy
Peripheral Arterial Disease

Therapeutic Paradox: Invasive Treatment Worst For:

Young patients

Need for better performance

Longer life expectancy

Prefer “less invasive” therapy
Intermittent Claudication

Comparing Physical Health for Chronically ill U.S. Adults

- Congestive Heart Failure
- Chronic Lung Disease
- Intermittent Claudication
- Average Adult
- Average Well Adult

Physical Component Summary (PCS)

Intermittent Claudication

Short Version

Intermittent claudication is frequently over treated – invasive therapy rarely required

Many patients improve with stop smoking/exercise

Most important issue is treatment of systemic atherosclerosis
Intermittent Claudication

Weighted Mean Prevalence
Intermittent Claudication

Classic Claudication

Asymptomatic at rest

Exercise induced leg pain

“Reproducible”

Varying severity
Intermittent Claudication
Intermittent Claudication
Five-Year Outcome

At least another 300 people with asymptomatic PAOD

100 patients presenting to doctor with claudication

Another 100 patients with claudication will not present to a doctor

local outcome in leg

75 stabilise or improve claudication

25 will deteriorate

5 will require an intervention and 2 will require a major amputation

systemic outcome

5 to 10 non-fatal CV events in 5 years

30 will die within 5 years

55 to 60 will be alive without new CV event in 5 years

16 cardiac
4 cerebral
3 other vascular
7 non-vascular
Intermittent Claudication
Risk Factors for Progression of Arterial Disease

- Male gender (cf female)
- Age (per 10 years)
- Diabetes
- Smoking
- Hypertension
- Hypercholesterolaemia
- Fibrinogen
- Alcohol
- Hyperhomocysteinaemia
Intermittent Claudication
Survival Compared to Controls

![Graph showing survival rates over follow-up years for controls and intermittent claudication (IC). The graph illustrates a decreasing trend in survival with increasing follow-up time.]
Intermittent Claudication
Mortality Risk Factors

Male gender (cf female)
Age (per 10 years)
ABPI (<0.5 to >0.8)
Diabetes
Smoking
Hypertension
CAD
Intermittent Claudication
Causes of Death

- Non-vascular (25%)
- Cerebral (11%)
- Other vascular (9%)
- Cardiac (55%)

Patients with IC

- Non-vascular (48%)
- Cerebral (4%)
- Other vascular (12%)
- Cardiac (36%)

General population >40 years
Intermittent Claudication

Patients have shorten life expectancy.

Walking ability is decreased and roughly parallels the ankle brachial index.

Generally pain free at rest.

Walking induced pain is real but rapidly resolves with rest and does not have adverse health consequences.
Critical Limb Ischemia
Critical Limb Ischemia

Not All “Ischemia” is Arterial!
Critical Limb Ischemia

Not all “ischemic” feet are the same!
Critical Limb Ischemia

The Principal Problem: CLI Knowledge Base

Very few prospective studies

Almost all clinical trials are non-operative Rx (topical/systemic meds vs. placebo)

No prospective studies of revascularization vs. non-operative Rx

No prospective studies of revascularization vs. amputation
Critical Limb Ischemia

Definition of CLI

Ischemic rest pain, ulcer, gangrene

$\text{ABI} < 0.40$ (TBI $< 0.30$ for incompressible vessels)

Group of patients with high risk of amputation without revascularization
Critical Limb Ischemia

Problems with CLI Definition

84 y o with Type II diabetes, an ABI of 0.40 and occasional rest pain for 1 year

43 y o with Type I diabetes, ESRD, gangrene of forefoot and an ABI 0.70

Which is more likely to require amputation?
Critical Limb Ischemia

Problems with CLI Definition

30% to 40% of placebo – treated patients in CLI treatment trials never require amputation (at least for the duration of the trial)

Definition of CLI is clearly too inclusive!
Critical Limb Ischemia

The Ultimate Definition of CLI

Best Marker of CLI

Only Available in Retrospect
Nearly all recognize potential for limb loss

Almost none recognize associated short-term mortality
Critical Limb Ischemia

ABI and 5-Year Survival

5-Year Survival

ABI
Critical Limb Ischemia

CLI Treatment – The Good News

The past 40 years have been spent figuring out techniques to permit treatment of lesions

Undeniable and remarkable improvement in lesion-oriented results

Angiography, instruments, training, graft surveillance, etc all are important
Critical Limb Ischemia

Most centers now report 99% ability to treat

Bypass Graft assisted primary patency approximately 70% @ 5 yrs

Limb salvage > 80% @ 5 yrs

Evolving Endovascular Options
Critical Limb Ischemia

CLI: Patient Oriented Treatment Questions

Does successful revascularization restore/maintain function?

Does successful revascularization improve quality of life?

What is successful revascularization anyway?
Critical Limb Ischemia

Restoration/Maintenance of Function

Does Revascularization get people out of the nursing home?

Does Revascularization take away the ability to walk?

Does Revascularization put people into nursing homes?
Critical Limb Ischemia

OHSU Study

513 pts had functional status assessed pre-op and 6 mo post surgical bypass for CLI

Ambulatory Status

Living Status

Combination of Ambulatory and Living Status
Critical Limb Ischemia

OHSU Study

Pre-morbidity, 91% were ambulatory and 88% were living independently

6 months post-op, 14% were dead, 80% were ambulatory, 76% were living independently
### Ambulation and Living Status

<table>
<thead>
<tr>
<th>Living Situation</th>
<th>Pre-op Status</th>
<th>6 mo Post-op Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent</td>
<td>98.6%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Dependent</td>
<td>4%</td>
<td>96%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambulation</th>
<th>Independent</th>
<th>Dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulatory</td>
<td>97.1%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Non-ambulatory</td>
<td>20.7%</td>
<td>79.3%</td>
</tr>
</tbody>
</table>
Changes in Ambulation and Living Status

- Nonamb-amb: 21%
- Nonind-Indep: 4%
- Amb-Amb: 97%
- Indep-Indep: 99%

Percentages indicate the proportion of changes in ambulation and living status.
Critical Limb Ischemia

Six Months After Bypass for CLI

Does bypass surgery restore ambulation? – 20% chance

Does bypass surgery get you out of a nursing home? – 4% chance

Does bypass surgery take away the ability to walk? – 3% chance

Does bypass surgery put you in a nursing home? – 1.4% chance
Critical Limb Ischemia

What is Important to Patients?

Symptom Relief

Wound Healing

Freedom from Recurrence

Freedom from Repeat Surgery

Long-term Functional Status
Critical Limb Ischemia

Ideal Result

Cure of Ischemia

Prompt Wound Healing

Rapid Return to Pre-morbid Functional Status

Freedom from Recurrence

Freedom from Repeat Surgery
133 Patients

Infrainguinal Bypass for Critical Limb Ischemia

>2 Years of Follow-up
Critical Limb Ischemia

Study Parameters

Time to Complete Wound Healing

Recurrence of Ischemia

Repeat Operations
Critical Limb Ischemia

Demographics

Mean Age: 66 Years

56% Male, 44% Female

Mean Post Operative Follow-up: 42 Months
Critical Limb Ischemia

Indications

- Ulcer/Gangrene, 66%
- Acute Ischemia, 5%
- Rest Pain, 29%
Critical Limb Ischemia

Procedure Performed

- Fem-tib, 44%
- Fem-pop, 41%
- Fem-pedal, 5%
- Pop-tib, 6%
- Pop-pedal, 4%
Critical Limb Ischemia
5 Year Life Table Analysis

- Assisted primary patency: 77%
- Limb salvage: 87%
- Survival: 49%
Critical Limb Ischemia

Ambulatory and Living Status
(mean follow up 42 months)

- 88% living independently preoperatively
- 92% ambulatory preoperatively
- 86% living independently at last follow up or death
- 67% ambulatory at last follow up or death
- 64% living independently and ambulatory at last follow up or death
- 58% ambulatory and living independently at last follow up or death
Ancillary Operations

61 patients (54%) required repeat operations

Mean of 1.6 repeat operations per patient
## Critical Limb Ischemia
### Wound Healing

<table>
<thead>
<tr>
<th>Wound type</th>
<th>Mean healing time (mos)</th>
<th>Median healing time (mos)</th>
<th>Range (mos)</th>
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</thead>
<tbody>
<tr>
<td>Operative</td>
<td>1.9</td>
<td>1.3</td>
<td>0.4-10</td>
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<tr>
<td>Ischemic</td>
<td>5.2</td>
<td>3.4</td>
<td>0.4-48</td>
</tr>
<tr>
<td>All wounds</td>
<td>4.2</td>
<td>2.2</td>
<td>0.4-48</td>
</tr>
</tbody>
</table>

- Healing rate: 78%
- Not healed at last follow up: 4%
- Not healed at death: 18%
Critical Limb Ischemia

96 Patients with less than ideal results

Operative death or complications only – 8%

Longterm – 92%

Decrease in functional status – 28 pts.

Wound complications 27 pts.

Repeat Surgery 28 pts.
Critical Limb Ischemia
How Often Are Ideal Results Achieved?

- Less than Ideal, 86%
- Ideal Result, 14%
Prospective Multi-Center Study of Quality of Life Before and After Lower Extremity Vein Bypass in 1404 Patients with Critical Limb Ischemia

Critical Limb Ischemia

Prevent III Trial

1404 patients enrolled

83 North American centers

Largest randomized trial in patients with critical limb ischemia
Prevent III Trial

Qol Assessment

At Baseline, 3 and 12 Months

Global and Domain Specific Qol Scores

Effect of Patient and Procedure Variables on Qol

Effect of Graft Related Events (revision, stenosis, amputation) on Qol
Vascular Quality of Life Questionnaire

VascuQol

25 Questions

5 Domains (pain, symptoms, activities, social, emotional)

7 Point Response Scale

Overall and Domain Specific Scores

1 = Worst Qol, 7 = Best Possible Qol
Prevent III Trial

Selected Patient Characteristics

Age: 69 ± 12 years
64% Male
64% Diabetes
12 % Dialysis
28% Previous Infrainguinal Bypass
Prevent III Trial

Indication for Operation

- Rest Pain: 36%
- Ulcer: 25%
- Gangrene: 39%
Prevent III Trial

Distal Anastomosis: 1404 Vein Grafts

- Popliteal Artery: 30%
- Tibial Artery: 13%
- Pedal Artery: 13%

55%
Prevent III Trial

Perioperative (30 Day) Complications

Death: 2.7%

Graft Occlusion: 5.2%

Major Amputation: 1.8%

Major Morbidity: 17.6%

Major Wound Complication: 5%
Prevent III Trial

Global QoL Scores: Baseline, 3 and 12 Months

- Baseline: 2.8 ± 1.1
- 3 Months: 4.7 ± 1.4
- 12 Months: 5.1 ± 1.4

P < 0.0001
## Prevent III Trial
### 3 Month Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
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<tbody>
<tr>
<td><strong>Adverse Effect on QoL</strong></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Ulceration</td>
<td>0.013</td>
</tr>
<tr>
<td>Popliteal inflow</td>
<td>0.0001</td>
</tr>
<tr>
<td>Recurrent symptoms</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Favorable Effect on QoL</strong></td>
<td></td>
</tr>
<tr>
<td>Age &lt;65</td>
<td>0.06</td>
</tr>
<tr>
<td>Rest pain</td>
<td>0.010</td>
</tr>
<tr>
<td>Com femoral inflow</td>
<td>0.005</td>
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<tr>
<td>Primary healing</td>
<td>0.039</td>
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</table>
## Prevent III Trial

### 12 Month Analysis

<table>
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<th>p-value</th>
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<tbody>
<tr>
<td>Recurrent Symptoms</td>
<td>0.023</td>
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</tbody>
</table>

### Adverse Effect on QoL

### Favorable Effect on QoL

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt;65</td>
<td>0.06</td>
</tr>
</tbody>
</table>
Prevent III Trial

Effect of Graft Related Event on Qol

Effect of Graft Related Event on Qol Score

- 3 Months
- 12 Months

No Graft Event

Graft Event

Qol Score

- 4
- 4.2
- 4.4
- 4.6
- 4.8
- 5
- 5.2
- 5.4

(p = 0.004)

(p = 0.0002)
<table>
<thead>
<tr>
<th>Author</th>
<th>n</th>
<th>QOL</th>
<th>F/U</th>
<th>Results</th>
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<tbody>
<tr>
<td>Johnson (1997)</td>
<td>150</td>
<td>Mult.</td>
<td>12</td>
<td>Improved (multiple domains)</td>
</tr>
<tr>
<td>Chetter (1998)</td>
<td>55</td>
<td>SF36</td>
<td>12</td>
<td>Improved (multiple domains)</td>
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<tr>
<td>Klevsgard (2001)</td>
<td>62</td>
<td>NHP</td>
<td>12</td>
<td>Improved (pain, sleep, mobility)</td>
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<tr>
<td>Kalbaugh (2004)</td>
<td>105</td>
<td>SF36</td>
<td>6</td>
<td>Improved (multiple domains)</td>
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<tr>
<td>Wann-Hanson (2005)</td>
<td>62</td>
<td>NHP</td>
<td>12</td>
<td>Improved (pain, sleep)</td>
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<tr>
<td>Bradbury (2005)</td>
<td>195</td>
<td>EQOL/SF36</td>
<td>12</td>
<td>Improved (multiple domains)</td>
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<tr>
<td>Engelhardt (2006)</td>
<td>86</td>
<td>SF36</td>
<td>6</td>
<td>Improved (all domains)</td>
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<tr>
<td>PREVENT III (2006)</td>
<td>732</td>
<td>VascuQOL</td>
<td>12</td>
<td>Improved (all domains)</td>
</tr>
</tbody>
</table>
Critical Limb Ischemia

CLI patients have markedly reduced survival.

Results indicate CLI treatment for most patients is lifelong.

Patients can be improved but palliation/maintenance rather than “cure” is the rule.

Disease process and its treatment resemble treatment of malignancy.
Chronic Venous Disease
Chronic Venous Disease

Primary venous disease
- More common than secondary venous disease
- Primary management is compression therapy
- Improvement in QoL with surgery, sclerotherapy, etc

Secondary venous disease
- Follows venous thrombosis
- Primary management is compression therapy
- Interventions more controversial
Chronic Venous Disease

Symptoms of CVI

- Pain
- Aching
- Burning / Itching
- Heavy Feeling
Chronic Venous Disease

Signs

Edema
Hyperpigmentation
Ulceration
Chronic Venous Disease

Primary goal is to minimize swelling

Elastic stockings for chronic management

Periodic leg elevation for chronic management

Various bandages for acute management of ulceration
Chronic Venous Disease

Varicose Veins

Generally Result from Primary Venous Insufficiency

May or May Not Be Associated With Saphenous Insufficiency

Not an Important Part of The Post Thrombotic Syndrome
Chronic Venous Disease

CVD After DVT

85% Have Abnormal Tests of Venous Function

50% – 60% Have Some Symptom of CVI

50% Have Some Sign of CVI

15% - 30% Develop Hyperpigmentation

3% - 5% Develop Ulceration
Chronic Venous Disease
Possible Correlates With CVI Post DVT

Thrombus Location, Propagation, Recurrence, and Resolution

Reflux: Development, Location, Severity

Residual Obstruction
# Chronic Venous Disease

## Risk factors for DVT

<table>
<thead>
<tr>
<th>Hospitalized Patients</th>
<th>Previous DVT</th>
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</thead>
<tbody>
<tr>
<td>Age over 40</td>
<td>Chronic medical illness</td>
</tr>
<tr>
<td>Extensive Surgery</td>
<td>-cardiac disease</td>
</tr>
<tr>
<td>Surgery for malignant disease</td>
<td>-pulmonary disease</td>
</tr>
<tr>
<td>Major orthopedic procedures</td>
<td>-recent stroke</td>
</tr>
<tr>
<td>Postoperative sepsis</td>
<td>Obesity</td>
</tr>
<tr>
<td>Bed rest &gt; 4 days</td>
<td>Varicose veins</td>
</tr>
<tr>
<td></td>
<td>Trauma</td>
</tr>
</tbody>
</table>
### Chronic Venous Disease

#### Hazard Ratios for Development of CVI

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hazard Ratio</th>
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<tbody>
<tr>
<td>Popliteal Vein Thrombi</td>
<td>1.2</td>
</tr>
<tr>
<td>Occlusive Thrombi</td>
<td>0.8</td>
</tr>
<tr>
<td>Extent of Thrombosis</td>
<td>1.1</td>
</tr>
<tr>
<td>Recurrent DVT</td>
<td>6.4</td>
</tr>
</tbody>
</table>
Chronic Venous Disease
Cumulative Incidence of PTS
Chronic Venous Disease

For patients with varicose veins, no edema and superficial venous insufficiency, symptoms can generally be controlled with elastic compression stockings.

For patients with venous insufficiency and edema, elastic stockings, avoidance of prolonged standing and periodic leg elevation will control symptoms.

For patients with venous ulcer, tight bandages and strict leg elevation are required for healing of the venous ulcer.
Questions?

Columbia River, Oregon