SGUM SSUM

Duplexsonographie Abschlusskurs
23./24. April 2026
Universitätsspital Basel

Venenmapping vor Bypasschirurgie

Dr. med. Kerstin Kotteck
Allgemeine Innere Medizin FMH und Angiologie FMH
SGUM Tutor Modul Gefässe, Abdomen, Basis-Notfall-Sonographie

Venenmapping vor Bypassoperation

Indikation:

- Kardiochirurgie: aorto-koronare Bypässe
- Gefässchirurgie: beispielsweise Bypässe femoro-popliteal, femoro-crural

Venenmapping vor Bypassoperation - Leitlinie

- Femoro-distale Bypässe sollten, wenn möglich, aus autologen Venen (ipsilaterale V. saphana magna) konstruiert werden. *Level of Evidence A*
- Alternativen: V. saphena magna der Gegenseite (jeweils besser als Kunststoffbypass), V. saphena parva, Armvenen
- Venenmapping empfohlen (Vena saphena magna) *Level of Evidence B*

2024 AHA/ACC Guideline on the Management of Patients With Lower Extremity Peripheral Artery Disease

9.2. Conduit for Surgical Revascularization for Femoropopliteal Disease

Recommendation for Conduit for Surgical Revascularization for Femoropopliteal Disease
Referenced studies that support the recommendation are summarized in the Online Data Supplement.

COR	LOE	Recommendation
1	A	1. In patients who are undergoing surgical revascularization for functionally limiting claudication and hemodynamically significant femoropopliteal disease, bypass to the popliteal artery with autogenous vein is recommended in preference to prosthetic graft material.[1–5]

10.2. Revascularization for CLTI

Recommendations for Revascularization for CLTI
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
Revascularization Goals for CLTI		
1	B-R	1. In patients with CLTI, surgical, endovascular, or hybrid revascularization techniques are recommended, when feasible, to minimize tissue loss, heal wounds, relieve pain, and preserve a functional limb.[1–14]
1	C-EO	2. In patients with CLTI, an evaluation for revascularization options by a multispecialty care team is recommended before amputation (Table 15).
Revascularization Strategy for CLTI		
1	A	3. In patients undergoing surgical revascularization for CLTI, bypass to the popliteal or infrapopliteal arteries (ie, tibial, pedal) should be constructed with autogenous vein if available.[14–20]
1	B-R	4. In patients with CLTI due to infrainguinal disease, anatomy, available conduit, patient comorbidities, and patient preferences should be considered in selecting the optimal first revascularization strategy (surgical bypass or endovascular revascularization) (Table 16).[3,13]
1	B-R	5. In patients with CLTI who are candidates for surgical bypass and endovascular revascularization, ultrasound mapping of the great saphenous vein is recommended.[3,13]

2024 AHA/ACC Guideline on the Management of Patients With Lower Extremity Peripheral Artery Disease

Venenmapping vor Bypassoperation - Literatur

Preoperative duplex venous mapping: A comparison of positional techniques in patients with and without atherosclerosis.

John Blebea, MD, William K. Schomaker, RVT, Giora Hod, MD,
Richard J. Fowl, MD, and Richard F. Kempczinski, MD, *Cincinnati, Ohio*

Purpose: Preoperative duplex venous mapping is the preferred modality to measure the diameter of the greater saphenous vein and its suitability as an arterial conduit for infrainguinal bypass. We wanted to determine the optimal mapping technique and maximal venous diameter in patients with and without atherosclerosis.
Methods: Three groups of patients were prospectively studied: younger control subjects (n = 20), preoperative atherosclerotic patients (n = 10), and older control subjects (n = 10). All patients underwent greater saphenous vein duplex mapping in a standardized manner. Maximal internal vein diameters were measured with the subjects in the supine position in bed, in the 20 degree reversed Trendelenburg position, sitting on the edge of the bed, standing, and in the supine position with a high-thigh, low-pressure tourniquet. Measurements were taken just beyond the saphenofemoral junction, in the distal thigh, below the knee, at midcalf, and superior to the medial malleolus.
Results: In younger control subjects an increasingly more erect position resulted in progressively larger measured vein diameters at all levels along the length of the leg. Both patients with atherosclerosis and older control subjects had no such increase in venous diameter with any positional change from the supine position to standing. Patients with atherosclerosis also had significantly smaller measured veins than either younger or older control subjects. A high-thigh tourniquet significantly increased vein diameters in the atherosclerotic group to the size of vein diameters in the older control group, although the absolute size differences were not large.
Conclusions: The optimal position for venous mapping is with the patient in a supine position. If the internal vein diameter is below an acceptable minimum size, a high-thigh tourniquet will maximally distend the vein in patients with atherosclerosis. Vein diameter decreases with age and is less distended in patients with atherosclerosis compared with older patients without atherosclerosis. (J Vasc Surg 1994;20:226-34.)

Table I. Patient demographics

	Younger control subjects	*Patients with atherosclerosis*	*Older control subjects*	*Significance*
Sex				
Men	12	7	6	
Women	8	3	4	NS
Age (yr.)	37 ± 2	63 ± 3	70 ± 2	p < 0.0001 (Younger vs Older) p < 0.0001 (Younger vs Athero)
Race				
White	19	4	9	p < 0.005 (Younger vs Athero)
Black	0	6	1	
Asian	1	0	0	
Weight	159 ± 8	176 ± 16	172 ± 13	NS
Smoking				
Present	0	7	1	p < 0.05 (Younger vs Older)
Past	4	1	5	p < 0.0001 (Younger vs Athero)
Never	16	2	4	–
Pack-years	7 ± 3	44 ± 7	29 ± 3	p < 0.005 (Younger vs Older) p < 0.0001 (Younger vs Athero)

Younger, Younger control subjects; *Older,* older control subjects; *Athero,* patients with atherosclerosis.

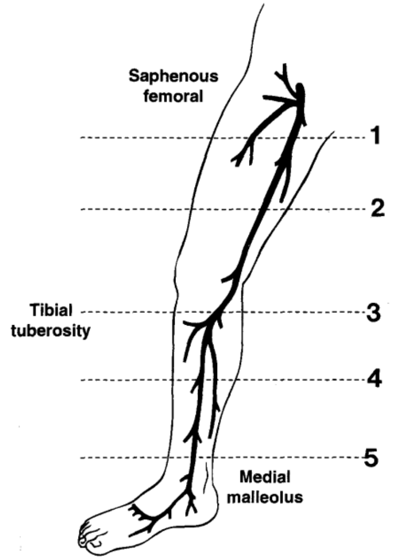


Fig. 1. Sites of greater saphenous vein diameter mapping along leg. *Level 1* is 15 cm distal to saphenofemoral junction; *Level 2* is 20 cm above top of tibial tuberosity; *Level 3* is at top of tibial tuberosity; *Level 4* is 15 cm distal to tibial tuberosity; and *Level 5* is 5 cm above top of medial malleolus.

Position des Patienten bei der Untersuchung:

- 20° reversed Trendelenburg
- sitzend
- stehend
- Tourniquet

Blebea et al. J Vasc Surg 1994

Table II. Vein diameters (in millimeters) in younger control subjects

Position	*Location*				
	Saphenofemoral junction	*Distal thigh*	*Knee*	*Calf*	*Ankle*
Supine	3.5 ± 0.1	3.3 ± 0.1	2.9 ± 0.1	2.5 ± 0.1	2.8 ± 0.1
20 degrees Trendelenburg	4.1 ± 0.1*	3.6 ± 0.1*	3.1 ± 0.1†	2.7 ± 0.1‡	2.9 ± 0.1
Sitting	4.3 ± 0.1*	3.6 ± 0.1§	3.2 ± 0.1*	2.8 ± 0.1§	3.1 ± 0.1‖
Standing	4.3 ± 0.1*	3.7 ± 0.1*	3.2 ± 0.1*	2.7 ± 0.1‡	3.0 ± 0.1
Tourniquet high-thigh	4.7 ± 0.2§	4.1 ± 0.2§	3.4 ± 0.1†	2.9 ± 0.1‡	3.1 ± 0.1

*$p < 0.0001$ versus supine position.
†$p < 0.001$ versus supine position.
‡$p < 0.05$ versus supine position.
§$p < 0.0005$ versus supine position.
‖$p < 0.005$ versus supine position.
Expressed as mm ± SEM. $n = 20$ in the tourniquet groups; $n = 40$ in all other groups.

Signifikante Steigerung des Durchmessers bei der jungen Kontrollgruppe.

Table III. Vein diameters (in millimeters) in patients with atherosclerosis

Position	*Location*				
	Saphenofemoral junction (n)	*Distal thigh (n)*	*Knee (n)*	*Calf (n)*	*Ankle (n)*
Supine	3.1 ± 0.2 (20)	2.9 ± 0.2 (20)	2.6 ± 0.2 (20)	2.5 ± 0.2 (18)	2.9 ± 0.2 (18)
20 degrees Trendelenburg	3.1 ± 0.2 (20)	3.0 ± 0.2 (20)	2.7 ± 0.2 (20)	2.5 ± 0.2 (18)	3.2 ± 0.2* (18)
Sitting	3.2 ± 0.2† (18)	2.9 ± 0.2 (18)	2.7 ± 0.2 (18)	2.6 ± 0.2† (16)	3.1 ± 0.2‡ (16)
Standing	3.1 ± 0.2 (18)	3.0 ± 0.2 (18)	2.7 ± 0.2 (18)	2.7 ± 0.2† (16)	3.2 ± 0.2* (16)
Tourniquet					
High-thigh	3.5 ± 0.2§ (20)	3.1 ± 0.2§ (20)	2.7 ± 0.2† (20)	2.5 ± 0.2 (18)	3.2 ± 0.2‡ (18)
Low-thigh	—	—	2.9 ± 0.2† (18)	2.6 ± 0.2 (18)	3.2 ± 0.2* (18)

*$p < 0.005$ versus supine position.
†$p < 0.05$ versus supine position.
‡$p < 0.01$ versus supine position.
§$p < 0.001$ versus supine position.
Expressed as mm ± SEM.

Keine relevante Steigerung des Durchmessers bei Patienten mit Atherosklerose und bei älteren Patienten.

Table IV. Vein diameters (in millimeters) in older control subjects

Position	*Location*				
	Saphenofemoral junction	*Distal thigh*	*Knee*	*Calf*	*Ankle*
Supine	3.7 ± 0.1	3.3 ± 0.1	2.9 ± 0.1	2.7 ± 0.1	3.0 ± 0.1
20 degrees Trendelenburg	3.7 ± 0.1	3.3 ± 0.1	2.8 ± 0.1	2.6 ± 0.1	3.0 ± 0.1
Sitting	3.8 ± 0.1	3.3 ± 0.1	2.9 ± 0.1	2.5 ± 0.1	3.0 ± 0.1
Standing	3.7 ± 0.1	3.3 ± 0.1	2.8 ± 0.1	2.5 ± 0.1*	3.0 ± 0.1
Tourniquet high-thigh	3.5 ± 0.1	3.3 ± 0.1	2.9 ± 0.1	2.6 ± 0.1	2.8 ± 0.1

*$p < 0.05$ versus supine position.
Expressed as mm ± SEM. $n = 20$ in all groups.

Empfehlung:

- Untersuchung in Rückenlage
- idealer Diameter >3 mm

Blebea et al. J Vasc Surg 1994

INTERACTIVE CARDIOVASCULAR AND THORACIC SURGERY

Interactive CardioVascular and Thoracic Surgery 7 (2008) 188-191

www.icvts.org

Work in progress report - Coronary

Pre-operative long saphenous vein mapping predicts vein anatomy and quality leading to improved post-operative leg morbidity☆

Heyman Luckraz[a,*], Julie Lowe[a], Neil Pugh[b], Ahmed A. Azzu[a]

[a]*Cardiothoracic Unit, Block C5, University Hospital of Wales, Cardiff, CF14 4XW, UK*
[b]*Doppler Ultrasound Department, University Hospital of Wales, Cardiff, CF14 4XW, UK*

Received 4 September 2007; received in revised form 28 November 2007; accepted 26 December 2007

Abstract

Long saphenous vein harvesting for coronary bypass surgery is associated with significant morbidity. Furthermore, vein quality is often variable sometimes requiring incisions in both legs. This prospective randomised control study assessed the usefulness of pre-operative long saphenous vein mapping in terms of conduit quality and location, incision lengths and post-operative morbidity. The long saphenous vein was assessed and mapped pre-operatively ($n=31$) by venous Doppler ultrasound or not ($n=30$). The size and anatomical distribution of the long saphenous vein was well predicted by the ultrasound study (correlation coefficient=0.87). Intra-operatively, the mean length of leg wound incision per vein graft performed was significantly less in the mapped group [16.8 (4.0) vs. 24.1 (10.4) cm, $P=0.005$]. This translated in a shorter operative time for vein harvesting per length of vein graft needed [36 (13) vs. 47 (17) min, $P=0.04$]. Post-operatively there was a tendency to less leg wound complications in the mapped group ($P=0.08$) and earlier hospital discharge (median length of stay 6.5 days vs. 8.0 days, $P=0.05$). Thus, long saphenous vein mapping pre-operatively predicted the size and anatomy of the vein appropriately. This led to a selective leg wound incision and reduced operative time with the benefit of reduced leg complication post-operatively.

Luckraz et al. ICVTS 2008

- Mapping vs. ohne Mapping
- prospektive, randomisierte, kontrollierte Studie
- n = 31 vs. n = 30 (koronarer Bypass)

- weniger Inzisionen für Venenentnahme ($p=0.005$)
- kürzerer Operationszeit für Venenentnahme ($p=0.04$)
- Tendenz zu weniger Wundinfekten ($p=0.08$)
- frühere Entlassung aus dem Spital ($p=0.05$)

Luckraz et al. ICVTS 2008

> Interact Cardiovasc Thorac Surg. 2013 Jun;16(6):886-7. doi: 10.1093/icvts/ivt090. Epub 2013 Mar 7.

Ultrasound mapping of the long saphenous vein in coronary artery bypass graft surgery

Alan Soo [1], Dennis Noel, Simon MacGowan

Affiliations + expand

PMID: 23470614 PMCID: PMC3653490 DOI: 10.1093/icvts/ivt090

Free PMC article

Abstract

Long saphenous vein is the most common conduit utilized for surgical coronary revascularization. Ultrasound-assisted vein assessment is superior to traditional clinical examination of the long saphenous vein in discerning path and suitability for use as a conduit. Preoperative ultrasound mapping of the long saphenous vein is easy and rapidly accomplished allowing optimal surgical site selection, avoiding unnecessary surgical dissection and potential wound complications. We describe the technique of ultrasound mapping of the long saphenous vein and its application to conduit harvest in coronary artery bypass graft (CABG) surgery.

Keywords: Coronary artery bypass graft surgery; Long saphenous vein; Saphenous vein harvest; Vein mapping.

Supplementary Video 1:

Surface mapping of the long saphenous vein.

Figure 1:

Saphenous vein mapping using the ultrasonic probe.

Supplementary Video 2:

Ultrasonic images of the long saphenous vein.

Figure 2:

Location of great saphenous vein identified and marked.

Mapping unmittelbar präoperativ

Technik: Patient in Rückenlage, Beine reverse Trendelenburg, Bein leicht gebeugt und nach aussen rotiert
VSM-Verlauf markiert und Durchmesser bestimmt
Seitenäste, variköse Veränderungen, Duplikaturen markiert
beide Beine untersuchen, auch nach Venenoperationen (residuelle kurze Segmente?)

Soo et al. ICVTS 2012

Observational Study > Interact Cardiovasc Thorac Surg. 2020 Jul 1;31(1):16-19.
doi: 10.1093/icvts/ivaa063.

Predictive value of great saphenous vein mapping prior to endoscopic harvesting in coronary artery bypass surgery

Ferdi Akca [1], Ka Yan Lam [1], Niels Verberkmoes [1], Ignace de Lathauwer [1], Mohamed Soliman-Hamad [1], Bart van Straten [1]

Affiliations + expand

PMID: 32359067 DOI: 10.1093/icvts/ivaa063

753 VSM-Segmente mit einem mittleren Durchmesser von 3.2 +/- 0.7 mm im Ultraschall und 4.7 +/- 0.8 mm nach Entnahme

Abstract

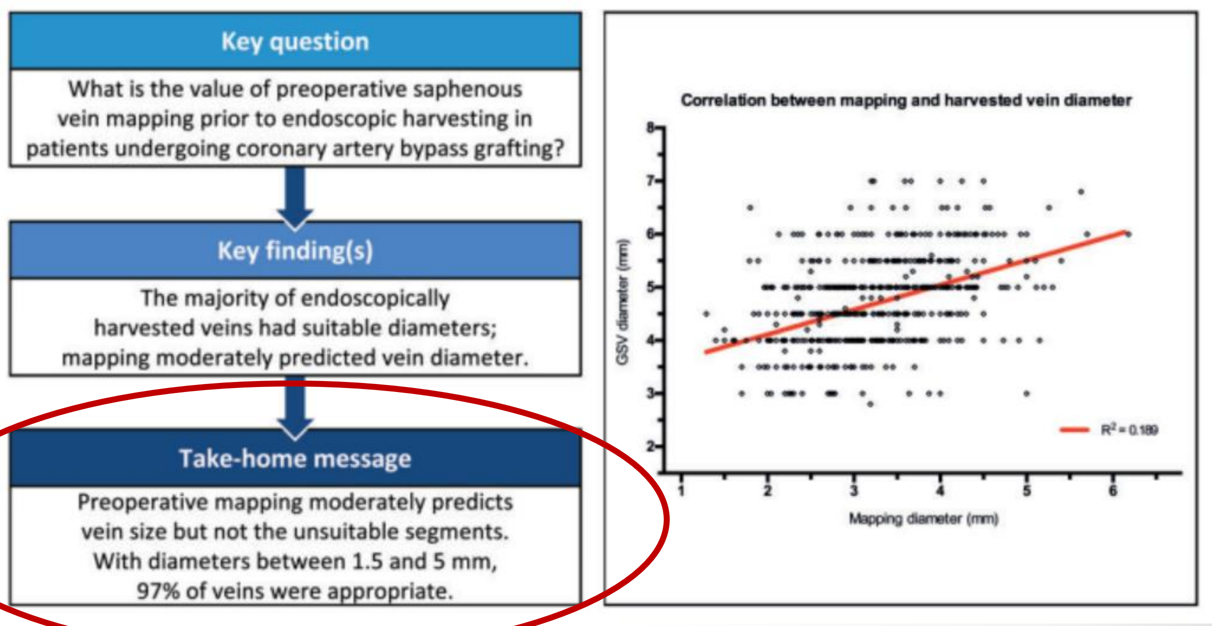
Objectives: The use of endoscopic vein harvesting in patients undergoing coronary artery bypass grafting is increasing, often using bedside mapping. However, data on the predictive value of great saphenous vein (GSV) mapping are scarce. This study assessed whether preoperative mapping could predict final conduit diameter.

Methods: A prospective registry was created that included 251 patients. Saphenous vein mapping was performed prior to endoscopic vein harvesting at 3 predetermined sites. After harvesting and preparing the GSV, the outer diameters were measured. Appropriate graft size was defined as an outer diameter between 3 and 6 mm.

Results: A total of 753 GSV segments were analysed. The average mapping diameter was 3.2 ± 0.7 mm. The harvested GSV had a mean diameter of 4.7 ± 0.8 mm. Mapping diameters were significantly positively correlated with actual GSV diameters (correlation coefficient, 0.47; $P < 0.001$). If the preoperative mapping diameters were between 1.5 and 5 mm, 96.6% of the GSVs had suitable dimensions after endoscopic vein harvesting.

Conclusions: Preoperative bedside mapping moderately predicts final GSV size after endoscopic harvesting but could not detect unsuitable vein segments. However, the majority of endoscopically harvested GSVs had diameters suitable to be used as coronary bypass grafts.

Keywords: Coronary artery bypass grafting; Endoscopic harvesting; Minimally invasive; Preoperative mapping; Saphenous vein.



Empfehlungen für den klinischen Alltag

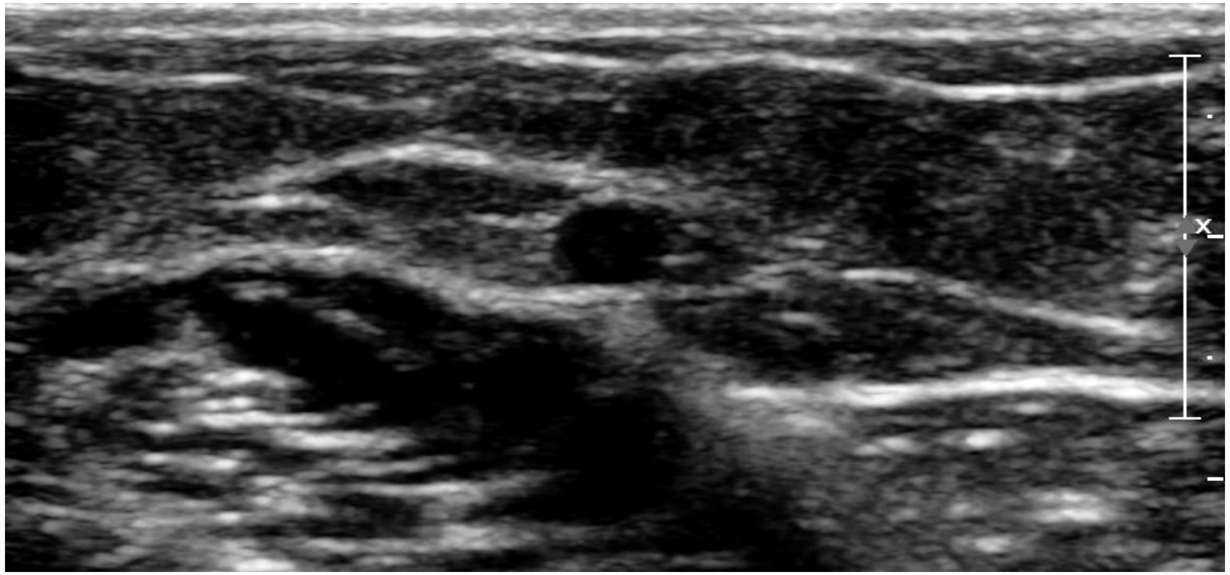
- liegender Patient
- keine Stauung
- angenehme Raumtemperatur

Empfehlungen für den klinischen Alltag

- Untersuchung im Querschnitt – innerer Durchmesser (optimal >3 mm)
- postphlebitische Veränderungen ?
- Varikose ?
- Abstand zur Oberfläche
- Seitenäste
- Duplikaturen
- Untersuchung des tiefen Venensystems (Okklusion, postthrombotische Veränderungen, Anomalien, etc.)

Empfehlungen für den klinischen Alltag

- ipsilaterale V. saphena magna
- kontralaterale V. saphena magna
- V. cephalica beidseits
- ggf. V. saphena parva oder V. basilica in Rücksprache mit Operateur



Take home …

- optimaler Venendurchmesser 3 - 5 mm
- standardisierte Bedingungen für die Untersuchung
- möglichst detaillierte Angaben in den Befund
- Rücksprache mit dem Herz-/Gefässchirurgen

Vielen Dank für die Aufmerksamkeit!