

KQ3. 하지 동맥쇄성 질환으로 재개통술을 받은 환자에서 추적검사로 적절한 영상검사는 무엇인가?

출처 문헌번호	문헌정보	연구유형	대상자수	연구결과	Study quality (KCG)	Study quality (original)
22	9. Cao P, Eckstein HH, De Rango P et al. Chapter II: Diagnostic methods. [Review]. Eur J Vasc Endovasc Surg. 42 Suppl 2:S13-32, 2011 Dec.	Review/Other-Dx	N/A	Non-invasive vascular studies can provide crucial information on the presence, location, and severity of critical limb ischaemia (CLI), as well as the initial assessment or treatment planning. Ankle-brachial index with Doppler ultrasound, despite limitations in diabetic and end-stage renal failure patients, is the first-line evaluation of CLI. In this group of patients, toe-brachial index measurement may better establish the diagnosis. Other non-invasive measurements, such as segmental limb pressure, continuous-wave Doppler analysis and pulse volume recording, are of limited accuracy. Transcutaneous oxygen pressure (TcPO ₂) measurement may be of value when rest pain and ulcerations of the foot are present. Duplex ultrasound is the most important non-invasive tool in CLI patients combining haemodynamic evaluation with imaging modality. Computed tomography angiography (CTA) and magnetic resonance angiography (MRA) are the next imaging studies in the algorithm for CLI. Both CTA and MRA have been proven effective in aiding the decision-making of clinicians and accurate planning of intervention. The data acquired with CTA and MRA can be manipulated in a multiplanar and 3D fashion and can offer exquisite detail. CTA results are general equivalent to MRA, and both compare favourably with contrast angiography. The individual use of different imaging modalities depends on local availability, experience, and costs. Contrast angiography represents the gold standard, provides detailed information about arterial anatomy, and is recommended when revascularisation is needed.	2	4
22	10. Hoyer C, Sandermann J, Petersen LJ. The toe-brachial index in the diagnosis of peripheral arterial disease. J Vasc Surg. 2013;58(1):231-238.	Meta-analysis	8 Studies	Eight studies conducted in a normal population were identified, of which only one study used imaging techniques to rule out arterial stenosis. A reference value of 0.71 was estimated as the lowest limit of normal based on the weighted average in studies with preheating of the limbs. A further seven studies showed correlations of the TBI with angiographic findings. The TBI had a sensitivity of 90% to 100% and a specificity of 65% to 100% for the detection of vessel stenosis. Few studies investigated the value of the TBI as a prognostic marker for cardiovascular mortality and morbidity, and no firm conclusions could be made. Studies have, however, shown correlation between the TBI and comorbidities such as kidney disease, diabetes, and microvasculature disease.	1	M
22	11. McCann TE, Scoutt LM, Gunabushanam G. A practical approach to interpreting lower extremity noninvasive physiologic studies. Radiol Clin North Am. 2014;52(6):1343-1357.	Review/Other-Dx	N/A	No results in abstract.	5	4
22	15. van Zitteren M, Vriens PW, Heyligers JM, et al. Self-reported symptoms on questionnaires and anatomic lesions on duplex ultrasound examinations in patients with peripheral arterial disease. J Vasc Surg. 2012;55(4):1025-1034 e1022.	Observational-Dx	701 Patients	Lesions were proximal in 270 (38.5%), distal in 441 (62.9%), and proximal and distal in 94 (13.4%). Patients with proximal lesions were younger (odds ratio [OR], 0.94; P < .0001) and less likely to be obese (OR, 0.34; P < .0001) than those without proximal lesions. Older age (OR, 1.07; P < .0001), male sex (OR, 1.96; P = .003), being without a partner (OR, 2.24; P = .004), and lower anxiety scores (OR, 0.42; P = .003) were associated with distal lesions. Patients with both lesions were more likely to be single (OR, 2.30; P = .010) and less likely to be obese (OR, 0.24; P = .009). No distinguishing leg symptom pattern was observed for patients with proximal lesions. Intermittent claudication was more frequently reported in those with distal lesions (P = .011). Although buttock and thigh pain seemed to be somewhat more present in proximal lesions (P < .01) and calf pain more in distal lesions (P < .001), patients still reported pain at a variety of levels throughout their legs, regardless of the anatomic lesion location.	2	3
22	16. Wong TH, Tay KH, Sebastian MG, Tan SG. Duplex ultrasonography arteriography as first-line investigation for peripheral vascular disease. Singapore Med J. 2013;54(5):271-274.	Review/Other-Dx	110 Patients	During the study period, 113 duplex imaging studies of the lower limb followed by percutaneous transluminal angioplasty were performed at our hospital for peripheral vascular disease. The iliac artery was visualised in 40 images, but could not be visualised in 73 images. There was a potential change in management in three cases due to radiological differences between the duplex images and angiography films.	5	4
22	17. Marti X, Romera A, Vila R, Cairois MA. Role of ultrasound arterial mapping in planning therapeutic options for critical ischemia of lower limbs in diabetic patients. Ann Vasc Surg. 26(8):1071-6, 2012 Nov.	Observational-Dx	244 Patients	Diabetic patients had a significantly higher degree of pathology in all segments, except the common iliac artery. Decisions made after ultrasound mapping matched the final surgical decision 90% and 94% of the time in diabetic patients and nondiabetic patients, respectively. Decisions made on the basis of ultrasound arterial mapping matched decisions made on the basis of arteriography in 86.3%.	2	3
22	18. Sultan S, Tawfik W, Hynes N. Ten-year technical and clinical outcomes in TransAtlantic Inter-Society Consensus II infrainguinal C/D lesions using duplex ultrasound arterial mapping as the sole imaging modality for critical lower limb ischemia. J Vasc Surg. 57(4):1038-45, 2013 Apr.	Observational-Tx	4783	From 2002 to 2012, a total of 4783 patients with peripheral arterial disease were referred, of whom 622 critical limb ischemia patients underwent revascularization for TASC C and D lesions (EvR: n [423; BS: n [199]. Seventy four percent of EvR and 82% of BS were performed for TASC D (P = .218). The DUAM showed sensitivity of 97% and specificity of 98% in identifying lesions requiring intervention. Of the 520 procedures performed with DUAM alone, there was no difference regarding the number of procedures performed for occlusive or de novo lesions (EvR: 65% and 71%; BS: 87% and 78%; P = .056). Immediate clinical improvement to the Rutherford category #3 was 96% for EvR and 97% for BS (P = 1.78). Hemodynamic success was 79% for EvR and 77% for BS (P = .72). Six-year freedom from binary restenosis was 71.6% for EvR and 67.4% for BS (P = .724). Six-year freedom from target lesion revascularization was 81.1% for EvR and 70.3% for BS (P = .3571). Six-year sustained clinical improver was 79.5% for EvR and 66.7% for BS (P = .294). Six-year amputation-free survival was 77.2% for EvR and 74.6% for BS (P = .837). There was a significant difference in risk of major adverse clinical events between EvR and BS (51% vs 70%; P[.034]. Only 16.4% of patients required magnetic resonance angiography, which tended to overestimate lesions with 84% agreement with intraoperative findings. Six-year binary restenosis was 71% for DUAM procedures compared with 55% for magnetic resonance angiography procedures (P = .001), which was solely based on the prospective modality.	2	2
22	19. Mustapha JA, Saab F, Diaz-Sandoval L, et al. Comparison between angiographic and arterial duplex ultrasound assessment of tibial arteries in patients with peripheral arterial disease: on behalf of the Joint Endovascular and Non-Invasive Assessment of Limb Perfusion (JENALI) Group. J Invasive Cardiol. 2013;25(11):606-611.	Observational-Dx	49 Patients	Average age of patients was 69.8 years. A total of 846 segments were assessed by both angiography and ultrasound. We found that 648 segments (76.6%) were deemed to be patent by angiography compared to 723 (85.5%) by ultrasound. Critical limb ischemia (CLI; Rutherford score ≥ 4) was described in 26 patients (53%). Average JENALI score for the right lower extremity was 7.0 by angiogram vs 7.7 by ultrasound. The average JENALI score of the left leg was 6.7 by angiogram vs 7.7 by ultrasound. A total of 94 lower extremities were assigned a JENALI score. Ultrasound was accurate in detecting tibial artery patency or occlusion in 80% of segments. The overall sensitivity/specificity of ultrasound detecting tibial artery patency was calculated at 93% and 40% (P<.05), respectively. Detection of patency via ultrasound was highest for the anterior tibial artery and the lowest for the peroneal artery. The angiographic and ultrasound JENALI scores better correlated with vessel patency (higher scores) than the lower angiographic and ultrasound JENALI scores.	2	2
22	21. Arvela E, Dick F. Surveillance after distal revascularization for critical limb ischaemia. Scand J Surg. 2012;101(2):119-124.	Review/Other-Tx	N/A	No results in abstract.	5	4
22	22. Troutman DA, Madden NJ, Dougherty MJ, Calligaro KD. Duplex ultrasound diagnosis of failing stent grafts placed for occlusive disease. J Vasc Surg. 60(6):1580-4, 2014 Dec.	Observational-Tx	79 Patients	We retrospectively classified the following factors as "abnormal DU findings:" focal PSVs >300 cm/s, uniform PSVs <50 cm/s throughout the graft, and a Vr >3.0. Fifteen of 20 patients with one or more of these abnormal DU findings underwent prophylactic intervention (n[5) or occluded without intervention (n[7) whereas only two of 72 with normal DU findings occluded (P = .0001). Excluding the eight patients who underwent prophylactic intervention, seven of 12 patients with abnormal DU findings occluded without intervention vs two of 72 with normal DU findings (P = .0001).	2	3
22	23. Shrikhande GV, Graham AR, Aparajita R, et al. Determining criteria for predicting stenosis with ultrasound duplex after endovascular intervention in infrainguinal lesions. Ann Vasc Surg. 2011;25(4):454-460.	Observational-Dx	143 Patients	Repeat angiograms were performed on 345 lesions in 143 patients, and 254 lesions in 103 patients had a corresponding duplex ultrasound. Indications for the initial interventions were claudication (n[462, 43.4%), rest pain (n[23, 16.1%), and tissue loss (n[58, 40.5%). A total of 178 superficial femoral artery (SFA) lesions, 59 popliteal lesions, and 17 tibial lesions were identified by surveillance duplex in 103 patients. In all, 70.5% of the intervened vessels that were studied were non-stented and the remaining 29.5% were stented. A total of 65% of the patients had diabetes. On determining correlations for peak systolic velocity (PSV) as measured by duplex ultrasound with degree of angiographic stenosis, strong correlation coefficients for SFA disease (R ² ¼ 0.84) and popliteal disease (R ² ¼ 0.88) were found. However, poor correlation was found in patients with tibial disease. When analyzing the lesions on the basis of Vr <2.0, 11 of 86 (12.8%) had >70% angiographic stenosis. In lesions with ratios from 2 to 2.5, 12 of 13 (92.3%) had >70% angiographic stenosis and in lesions with ratios >2.5, 69 of 75 (92.0%) had >70% angiographic stenosis. ROC curve analysis showed that to detect 70% stenosis in the SFA, a PSV >204 cm/sec had a sensitivity of 97.6% and specificity of 94.7%. To detect 70% stenosis in the overall femoropopliteal region, a PSV >223 cm/sec had a sensitivity of 94.1% and specificity of 95.2%.	2	3
22	24. Humphries MD, Pevco WC, Laird JR, Yeo KK, Hedayati N, Dawson DL. Early duplex scanning after infrainguinal endovascular therapy. J Vasc Surg. 53(2):353-8, 2011 Feb.	Review/Other-Dx	113 patients	There were 122 infrainguinal interventions for CLI in 113 patients (53% male; mean age 71 years). Risk factors included diabetes: 61%; renal failure: 20%; and smoking (within 1 year): 40%. Duplex US was performed within 30 days of the index procedure in 90 cases. Fifty patients had an abnormal early duplex and 40 patients had a normal duplex. In patients with a normal duplex US the amputation rate was 5% vs 20% in the group with an abnormal duplex (P=.04). Primary patency was 56% in the normal duplex group and 46% in the abnormal duplex group (P=.18). Early duplex US was able to identify a residual stenosis not seen on completion angiography in 56% of cases. Duplex scanning detects residual stenosis missed with conventional angiography after infrainguinal interventions. An abnormal duplex US in the first 30 days after an intervention is associated with an increased risk of amputation. This suggests a possible role for intraoperative duplex US, as well as routine postprocedure duplex US, close clinical follow-up, and consideration of reintervention for residual abnormalities in patients treated for CLI.	5	4

22	25. Wilson YG, Davies AH, Currie IC, et al. The value of pre-discharge Duplex scanning in infrainguinal graft surveillance. <i>Eur J Vasc Endovasc Surg.</i> 1995;10(2):237-242.	Review/Other-Dx	123 patients	46 abnormalities (37% detection rate) were identified on scans within 1 week. In all cases, on-table completion studies with either arteriography and/or flow measurements had failed to identify the anomalies subsequently detected by Duplex. At 1 week, 6 grafts had occluded, 27 had a focal peak mean velocity increase (mean V2/V1 ratio: 2.6; range 1.5-4.3), 4 had low flow velocities, 4 had arteriovenous fistulae, 1 contained mobile thrombus, 2 had retained cusps and 2 had hamstring entrapment. Of 40 patient, but compromised grafts, 18 warranted immediate investigation. Of the 27 patients with velocity disturbances or Duplex, 25 were simply observed but 8 have since required intervention for definitive stenoses at these sites which, in retrospect, were evident within the first postoperative week.	5	4
22	26. Jones DW, Graham A, Connolly PH, Schneider DB, Meltzer AJ. Restenosis and symptom recurrence after endovascular therapy for claudication: does duplex ultrasound correlate with recurrent claudication? <i>Vascular.</i> 23(1):47-54, 2015 Feb.	Observational-Tx	71 Patients	We analyzed 183 follow-up visits following treatment in 88 limbs (femoropopliteal (56%) or iliac (44%) arteries). After femoropopliteal intervention, median systolic velocity ratio was higher in patients with symptom recurrence (2.99 symptomatic vs. 1.69 asymptomatic; p<0.001). Elevated systolic velocity ratio or occlusion correlated with symptom recurrence (area under receiver operator characteristic curve>0.82 [95% CI 0.74-0.83]), and systolic velocity ratio>2.5 was 71% sensitive and 72% specific for symptom recurrence.	2	2
22	27. Fontcuberta J, Flores A, Orgaz A, et al. Reliability of preoperative duplex scanning in designing a therapeutic strategy for chronic lower limb ischemia. <i>Am J Vasc Surg.</i> 2009; 23(5):577-582.	Observational-Dx	335 consecutive patients	Agreement between both plans were as follows: 80%, 82.7% and 59% in the examinations of the iliac arteries, femoropopliteal or tibial arteries, respectively. The operation plan was more frequently modified due to a duplex scanning failure in procedures involving the distal vessels (10/44 [22.7%], P<0.01). In conclusion, duplex scanning evaluation of patients with occlusive arterial disease of the lower limbs permit the design of both a medical and a surgical or endovascular treatment plan with a high level of agreement with the findings obtained during the revascularization procedure.	2	3
22	29. Owen AR, Roditi GH. Peripheral arterial disease: the evolving role of non-invasive imaging. <i>Postgrad Med J.</i> 2011;87(1025):189-198.	Review/Other-Dx	N/A	No results in abstract.	5	4
22	30. Ouwendijk R, de Vries M, Stijnen T, et al. Multicenter randomized controlled trial of the costs and effects of noninvasive diagnostic imaging in patients with peripheral arterial disease: the DIPAD trial. <i>AJR.</i> 2008;190(5):1349-1357.	Experimental-Tx	514 patients randomized to MRA (n=258), DSA (n=177), CTA (n=79)	With adjustment for potentially predictive baseline variables, the learning curve, and hospital setting, a significantly higher confidence and less additional imaging were found for MRA and CTA compared with duplex US. No statistically significant differences were found in improvement in functional patient outcome and quality of life among the groups. The total costs were significantly higher for MRA and duplex US than for CTA. The results suggest that both CTA and MRA are clinically more useful than duplex US and that CTA leads to cost savings compared with both MRA and duplex US in the initial imaging evaluation of PAD.	1	1
22	31. Fotiadis N, Kyriakides C, Bent C, Vorvolakos T, Matson M. 64-section CT angiography in patients with critical limb ischaemia and severe claudication: comparison with digital subtractive angiography. <i>Clin Radiol.</i> 66(10):945-52, 2011 Oct.	Observational-Dx	41 consecutive patients	For arterial segments with haemodynamically significant disease (stenosis >=50%), the overall sensitivity, specificity, and accuracy of MDCT in patients with severe claudication and CLI was 99% (95% CI: 98-100%), 98% (95% CI: 97-100%) and 98% (95% CI: 97-99%), respectively. The PPV was 97% and the NPV was 99%. MDCT angiography is a useful tool in the assessment of patients with severe claudication and CLI and can be reliably used to grade disease severity and plan treatment.	2	2
22	32. Jens S, Koelemay MJ, Reekers JA, Bipat S. Diagnostic performance of computed tomography angiography and contrast-enhanced magnetic resonance angiography in patients with critical limb ischaemia and intermittent claudication: systematic review and meta-analysis. <i>Eur Radiol</i> 2013;23:3104-14.	Meta-analysis	12 CTA, 30 CE-MRA studies, 673 and 1,404 participants respectively	Out of 5,693 articles, 12 CTA and 30 CE-MRA studies were included, respectively evaluating 673 and 1,404 participants. Summary estimates of sensitivity and specificity were respectively 96% (95% CI, 93-98%) and 95% (95% CI, 92-97%) for CTA, and 93% (95% CI, 91-95%) and 94% (95% CI, 93-96%) for CE-MRA. Regression analysis showed that the prevalence of CLI in individual studies was not an independent predictor of sensitivity and specificity for either technique. Methodological quality of studies was moderate to good.	1	M
22	34. Ouwendijk R, Kock MC, van Dijk LC, van Sambeek MR, Stijnen T, Hunink MG. Vessel wall calcifications at multi-detector row CT angiography in patients with peripheral arterial disease: effect on clinical utility and clinical predictors. <i>Radiology.</i> 2006;241(2):603-608.	Observational-Dx	145 patients	The number of calcified segments was a significant predictor of the need for additional imaging (P=.001) and of the confidence scores (P<.001). The number of calcified segments discriminated between patients who required additional imaging after CTA and those who did not (area under the receiver operating characteristic curve, 0.66; 95% CI: 0.54, 0.77). Age, diabetes mellitus, and cardiac disease were significant predictors of the number of calcified segments in both the univariable and multivariable analyses (P<.05).	5	4
22	40. Healy DA, Boyle EM, Clarke Moloney M, et al. Contrast-enhanced magnetic resonance angiography in diabetic patients with infra-genicular peripheral arterial disease: systematic review. <i>Int J Surg.</i> 2013;11(3):228-232.	Meta-analysis	3 articles (83 Patients)	Only three studies (83 patients) provided data regarding the infragenicular vessels. The pooled sensitivity of MRA was 86% while the pooled specificity of MRA was 93%.	1	M
22	43. Kinner S, Quick HH, Maderwald S, Hunold P, Barkhausen J, Vogt FM. Triple-TWIST MRA: high spatial and temporal resolution MR angiography of the entire peripheral vascular system using a time-resolved 4D MRA technique. <i>Eur Radiol.</i> 2013;23(1):298-306.	Observational-Dx	10 Patients	Three-station TR-MRA proved feasible and was comparable with DSA in 282 vessel segments, with underestimation grade of stenosis in four segments and overestimation in four segments, respectively. In 32/38 patients no venous overlay was noted; in six patients there was mild venous overlay. Image quality was rated excellent or good in most cases.	3	3
22	44. Knobloch G, Gielen M, Lauff MT, et al. ECG-gated quiescent-interval single-shot MR angiography of the lower extremities: initial experience at 3 T. <i>Clin Radiol.</i> 2014;69(5):485-491.	Observational-Dx	25 Patients	QISS-MRA and CE-MRA of all patients were considered for analysis, resulting in 807 evaluated vessel segments for each MRA technique. Readers 1 and 2 rated image quality of QISS-MRA as diagnostic in 97.3% and 97% of the vessel segments, respectively. CE-MRA was rated diagnostic in all vessel segments. Image quality of the proximal vessel segments, including the infrarenal aorta, iliac arteries, and common femoral artery, was significantly lower on QISS-MRA compared to CE-MRA [image quality score across readers: 2 (1,3) versus 1 (1,1) p < 0.001]. In the more distal vessel segments, image quality of QISS-MRA was excellent and showed no significant difference compared to CE-MRA [image quality score across readers: 1 (1,1) versus 1 (1,1) p = 0.036]. Diagnostic performance of QISS-MRA was as follows (across readers): sensitivity: 87.5% (95% CI: 80.2-92.4%); specificity: 96.1% (95% CI: 93.6-97.6%); diagnostic accuracy: 94.9% (95% CI: 92.6-96.5%).	1	1
22	48. Link J, Steffens JC, Brossmann J, Graessner J, Hackethal S, Heller M. Iliofemoral arterial occlusive disease: contrast-enhanced MR angiography for preinterventional evaluation and follow-up after stent placement. <i>Radiology.</i> 1999; 212(2):371-377.	Observational-Dx	67 patients (41 stented segments)	24 occlusions were correctly diagnosed with CE-MRA. Of the 59 stenoses, 36 were >50% and 23 were =50%. Sensitivity and specificity for the detection of stenoses >50% were 100% and 83%, respectively. Patency of the different stents was determined correctly with CE-MRA. Some stents caused signal intensity dropout, which made MR evaluation of stents difficult. Generally, these signal intensity artifacts were most severe in stainless steel stents and mild in some nitinol stents.	2	2
22	50. Ersoy H, Rybicki FJ. Biochemical safety profiles of gadolinium-based extracellular contrast agents and nephrogenic systemic fibrosis. <i>J Magn Reson Imaging.</i> 2007;26(5):1190-1197.	Review/Other-Dx	N/A	Gadolinium-based paramagnetic contrast agents are relatively safe when used in clinically recommended doses. However, with the rapidly expanding body of literature linking Gadolinium-based paramagnetic contrast agents and NSF, awareness of the potential side effects and adverse reactions from Gadolinium is now an important requirement for practicing radiologists. In addition to the ongoing accumulation and analyses of clinical NSF data, it is also essential for the practicing radiologist to understand the biochemical characteristics of the extracellular Gadolinium-chelates.	5	4
22	64. Egglin TK, O'Moore PV, Feinstein AR, Waltman AC. Complications of peripheral arteriography: a new system to identify patients at increased risk. <i>J Vasc Surg.</i> 1995;22(6):787-794.	Observational-Dx	549 consecutive patients	Rate of major complications 2.9%. Patients studied for claudication or limb threatening ischemia had intermediate risk (2.0%). Previous reports overestimated the risk of arteriography for trauma or aneurysm but underestimated the risk for patients with other common conditions.	5	4
22	65. Lin JS, Olson CM, Johnson ES, Whitlock EP. The ankle-brachial index for peripheral artery disease screening and cardiovascular disease prediction among asymptomatic adults: a systematic evidence review for the U.S. Preventive Services Task Force. <i>Ann Intern Med.</i> 2013;159(5):333-341.	Meta-analysis	418 full-text articles	One large meta-analysis (n = 43,919) showed that the ABI could reclassify 10-year risk for coronary artery disease (CAD), but it did not report measures of appropriate reclassification (the net reclassification improvement [NRI]). Four heterogeneous risk prediction studies showed that the magnitude of the NRI was probably small when the ABI was added to the FRS to predict CAD or CVD events. Of 2 treatment trials meeting inclusion criteria, 1 large trial (n = 3,350) showed that low-dose aspirin did not prevent CVD event in persons with a screen-detected low ABI but may have increased the risk for major bleeding events.	1	M
22	66. Hartmann A, Gehring A, Vällbrächt C, et al. Noninvasive methods in the early detection of restenosis after percutaneous transluminal angioplasty in peripheral arteries. <i>Cardiology.</i> 1994; 84(1):25-32.	Observational-Dx	56 patients (59 lesions)	Noninvasive follow-up after PTA in peripheral arteries requires exercise testing with delimitation of ankle arm index or segmental arterial pulse oscillography for the early detection of restenosis. The resting ABI and clinical history are not accurate in follow-up. However, because of reduced specificity, repeat CT is necessary for accurate evaluation.	3	3
22	67. Eslahpazir BA, Allemang MT, Lakin RO, et al. Pulse volume recording does not enhance segmental pressure readings for peripheral arterial disease stratification. <i>Ann Vasc Surg.</i> 2014;28(1):18-27.	Observational-Dx	76 Patients	Interobserver variance for all modalities was high, except for SP. When surveying for any stenosis (<50% and >50%), sensitivity (range 25e75%) was lower than specificity (range 50e84%) for all modalities. When surveying for critical stenosis only (<50%), sensitivity (range 27e54%) was also lower than specificity (range 68e92%). Accuracy for detecting any stenosis with SP+DW was significantly higher than with PVR alone (86 ± 7% vs. 56 ± 12%, P ¼ 0.017). There was a significant reduction in accuracy when including incompressible readings within the SP-only analysis compared with exclusion of incompressible vessels (P ¼ 0.006). However, the effect of vessel incompressibility on accuracy was removed with the addition of DW (P ¼ 0.17) to the protocol.	2	2
22	68. Bandyk DF, Cato RF, Towne JB. A low flow velocity predicts failure of femoropopliteal and femorotibial bypass grafts. <i>Surgery.</i> 1985;98(4):799-809.	Review/Other-Dx	42 femorotibial, 24 femoropopliteal, 3 femoropopliteal (isolated segment) in situ saphenous vein bypasses	At operation peak systolic flow velocity was greater (p less than 0.01) in femoropopliteal grafts (90 +/- 22 cm/sec) compared with femorotibial grafts (68 +/- 19 cm/sec) and isolated segment femoropopliteal (58 +/- 16 cm/sec) grafts. Diastolic forward flow, indicative of low outflow resistance, was present in all successful grafts at operation and in the immediate postoperative period, but decreased thereafter. Early graft occlusion was associated with a low peak systolic flow velocity (<40 cm/sec) and absent diastolic forward flow. Postoperative decrease in PSV to <45 cm/sec identified grafts with impending failure due to intrinsic graft lesions or progression of atherosclerosis. A low blood flow velocity threatens graft patency and should prompt an angiographic evaluation to identify correctable graft lesions or an outflow tract suitable for sequential grafting for the purpose of augmenting flow velocity.	5	4

22	69. Scall ST, Beck AW, Nolan BW, et al. Completion duplex ultrasound predicts early graft thrombosis after crural bypass in patients with critical limb ischemia. <i>J Vasc Surg.</i> 54(4):1006-10, 2011 Oct.	Observational-Dx	116 Patients	Primary, primary-assisted, and secondary patency for all crural bypasses were 62%, 66%, and 70% at 1 year, respectively. When stratified by tertiles of distal graft EDV (0 - <5 cm/s, 5-15 cm/s, >15 cm/s), 1-year primary patency rates were 32%, 64%, and 84% (P = .001). Low (0 - <5 cm/s) distal graft EDV (hazard ratio [HR], 3.3 confidence interval [CI], 1.74-6.41; P < .001), poor-quality conduit (HR, 2.5; CI, 1.19-5.21; P = .015), age <70 (HR, 2.08; CI, 1.06-4.00; P = .031), and lack of statin use (HR, 2.04; CI, 1.04-4.00; P = .038) were independent predictors of graft failure. While the modified Rutherford score correlated with distal graft EDV (P = .05), it was not an independent predictor of patency (P = .58). Predictors of low EDV (<5 cm/s) included single-vessel runoff (odds ratio [OR], 3.33; CI, 1.14-9.71; P = .027), poor conduit (OR, 2.94; CI, 1.16-7.41; P = 0.024), and diabetes (OR, 2.86; CI, 1.14-7.21; P = .025).	3	3
22	70. Carter A, Murphy MO, Halka AT, et al. The natural history of stenoses within lower limb arterial bypass grafts using a graft surveillance program. <i>Ann Vasc Surg.</i> 2007;21(6):695-703.	Observational-Dx	212 infrainguinal lower limb grafts in 197 patients	During the program, 21.6% of grafts occluded. Overall, 16% of grafts underwent a salvage procedure, 40.5% of which were carried out at the 6-month time point. There were 56.6% of occlusions preceded by a stenotic lesion. Primary occlusions accounted for 95.9% in the prosthetic group and 66.5% in the femorocrural group. As a group, vein grafts were more likely to develop a progressive stenosis prior to occlusion, with 58.3% in this group predated by a stenotic lesion. Fewer than 75% of stenoses were common and had a variable natural history, with over 40% resolving or failing to progress. Throughout the study period, 56.2% of grafts remained stenosis-free.	3	3
22	71. Calligaro KD, Doerr K, McAfee-Bennett S, Krug R, Raviola CA, Dougherty MJ. Should duplex ultrasonography be performed for surveillance of femoropopliteal and femorotibial arterial prosthetic bypasses? <i>Ann Vasc Surg.</i> 2001;15(5):520-524.	Observational-Dx	89 infrainguinal grafts in 66 patients	The results support the routine use of Duplex US as a part of a graft surveillance protocol for femorotibial, but not femoropopliteal, prosthetic grafts.	3	3
22	73. Adam DJ, Gillies TE, Kelman J, Allan PL, Chalmers RT. Vascular surgical society of great britain and ireland: duplex surveillance does not enhance infrainguinal prosthetic bypass graft patency. <i>Br J Surg.</i> 1999;86(5):705.	Observational-Dx	220 grafts (141 above-knee popliteal, 69 below-knee popliteal, 10 tibial)	During the first study interval, an 'abnormal' scan was reported in 66/220 grafts. For clinical reasons (no further reconstruction feasible), no intervention was undertaken in 56 patients. Of these, 34 grafts occluded and 17 amputations were performed. An intervention to maintain patency in 10 patients. In 154 patients with 'normal' scans, 53 grafts occluded and 21 amputations were performed. During the second study interval, 20 grafts occluded and 12 amputations were performed. In 6 patients, an attempt was made to re-establish patency and this was successful in two. Kaplan-Meier 36-month primary and secondary patency rates were 48% and 51% respectively for the group that underwent duplex surveillance and 58% and 60% for the group that was followed without duplex imaging.	5	4
22	74. Davies AH, Hawdon AJ, Sydes MR, Thompson SG. Is duplex surveillance of value after leg vein bypass grafting? Principal results of the Vein Graft Surveillance Randomised Trial (VGSRT). <i>Circulation.</i> 2005;112(13):1985-1991.	Experimental-Dx	594 patients	The clinical and duplex surveillance groups had similar amputation rates (7% for each group) and vascular mortality rates (3% vs 4%) over 18 months. More patients in the clinical group had vein graft stenosis at 18 months (19% vs 12%, P=0.04), but primary patency, primary assisted patency, and secondary patency rates, respectively, were similar in the clinical group (69%, 76%, and 80%) and the duplex group (67%, 76%, and 79%). There were no apparent differences in health-related quality of life, but the average health service costs incurred by the duplex surveillance program were greater by 495 pound sterling (95% CI: 83 pound sterling to 807 pound sterling) per patient.	1	1
22	75. Hobbs SD, Pinkney T, Sykes TC, Fox AD, Houghton AD. Patency of infrainguinal vein grafts—effect of intraoperative Doppler assessment and a graft surveillance program. <i>J Vasc Surg.</i> 2009;49(6):1452-1458.	Observational-Dx	468 infrainguinal bypass procedures	Overall primary and primary-assisted graft patency was 81% and 83% at 6 weeks and 42% and 64% at 3 years. Grafts failing by 6 weeks had significantly lower flow (130.5 mL/min vs 150.5 mL/min, P=0.09) and higher resistance (0.67 peripheral resistance units vs 0.57 peripheral resistance units, P=0.04) than those remaining patent. However, OpDop measured flow and resistance was a poor predictor of graft failure in individual cases (area under the receiver operating characteristic curve, 0.57). While there was no statistical difference in primary 18-month patency rates between grafts undergoing surveillance and those undergoing clinical follow up (55% vs 76%, P=.133), primary-assisted 18-month patency rates were significantly higher in the surveillance group (83% vs 77%, P=.042).	2	3
22	76. Ferris BL, Mills JL, Sr., Hughes DJ, Durran T, Knox R. Is early postoperative duplex scan surveillance of leg bypass grafts clinically important? <i>J Vasc Surg.</i> 2003;37(3):495-500.	Review/Other-Dx	224 bypass grafts placed in 204 patients	Early scans were abnormal (PSV, >200 cm/sec) in 58 grafts (26%). 6 grafts of the 58 (10.3%; 2.7%) with an early abnormal duplex scan and unrepaired defects occluded during the follow-up period. 30 grafts were revised on the basis of the initial early scan; 23 of these revisions were performed for critical or rapidly progressive lesions in the first 3 postoperative months. 7 lesions progressed more slowly and were repaired at a mean of 8 months after surgery. Interestingly, 22 flow abnormalities (37%) resolved or stabilized despite a PSV of more than 300 cm/sec in six cases (27%). Clear duplex scan evidence of regression progression of these early flow abnormalities occurred within 3 months in 51/58 cases (88%). A total of 68 grafts (30%) were revised during the entire study period; 30 of these (44%) were on the basis of the early abnormal scan.	5	4
22	77. Bosma J, Montauban van Swijndregt AD, Vahl AC, Wisselink W. The utility of contrast enhanced MR angiography as a first stage diagnostic modality for treatment planning in lower extremity arterial occlusive disease. <i>Acta Chir Belg.</i> 111(2):73-7, 2011 Mar-Apr.	Observational-Dx	128 Patients	In 28 extremities (15%) ce-MRA was found inconclusive and additional imaging was performed. In the remaining patients (85% of the extremities (n = 154), treatment was initiated as planned. However, in 19 (11%) of these patients, the treatment plan was altered. In 7 of them, procedural findings did not correspond with those at the time of ce-MRA, including 6 patients (3%) with a falsely diagnosed stenosis or occlusion, in total, 52 patients received non-operative treatment (34%), 65 an endovascular procedure (36%), 49 open surgical reconstruction (27%) and 6 a combined treatment.	2	3
198	389. Jongasma H, Bekken JA, van Buchem F, et al. Secondary interventions in patients with autologous infrainguinal bypass grafts strongly improve patency rates. <i>J Vasc Surg.</i> 2016;63:385-90.	observational	69	A total of 69 infrainguinal bypasses at risk in 69 patients were identified and treated with PTA. Technical success was achieved in 91%. The median follow-up was 17 months (range, 1-58 months). During follow-up, 30 bypasses (43%) remained free of significant stenosis or bypass occlusion, 29 bypasses (42%) developed recurrent stenosis, and 10 bypasses (14%) occluded. Rates of primary assisted, and secondary patency at 1 year were 84%, and 86%. Five (7%) major amputations were performed, all after bypass occlusion.	5	
198	390. Carter A, Murphy MO, Halka AT, et al. The natural history of stenoses within lower limb arterial bypass grafts using a graft surveillance program. <i>Ann Vasc Surg.</i> 2007;21:695-703.	observational	197	During the program, 21.6% of grafts occluded. Overall, 16% of grafts underwent a salvage procedure, 40.5% of which were carried out at the 6-month time point. There were 56.6% of occlusions preceded by a stenotic lesion. Primary occlusions accounted for 95.9% in the prosthetic group and 66.5% in the femorocrural group. As a group, vein grafts were more likely to develop a progressive stenosis prior to occlusion, with 58.3% in this group predated by a stenotic lesion. Fewer than 75% of stenoses were common and had a variable natural history, with over 40% resolving or failing to progress. Throughout the study period, 56.2% of grafts remained stenosis-free. Stenoses were more common at the proximal anastomosis in the vein graft cohort. There were low rates of significant stenoses within the prosthetic group. These lesions were more likely to occur at the distal anastomosis but were poor predictors of occlusion. Statin use postoperatively was protective against the development of significant stenosis and occlusions, particularly in the above-knee grafts (p = 0.03). Surprisingly, preoperative smoking status was predictive of neither occlusion nor development of significant stenosis. The presence of diabetes was not predictive of poor outcome.	5	
198	391. Ihlberg L, Luther M, Albäck A, et al. Does a completely accomplished duplex-based surveillance prevent vein-graft failure? <i>Eur J Vasc Endovasc Surg.</i> 1999;18:395-400.	experimental	362	one hundred and eighty-three grafts were enrolled to the ABI group and 179 to the DD group. The primary assisted patency, secondary patency and limb salvage rates were 67%, 74%, 85% for the ABI group and 67%, 73%, 81% for the DD group. Ninety grafts in the ABI group and 57 in the DD group had surveillance that completely adhered to the protocol. The outcome was also similar for these groups at one year (77%, 87%, 94% and 77%, 83%, 93% respectively), although grafts were revised more frequently in the DD group.	1	
198	392. Westerband A, Mills JL, Kistler S, et al. Prospective validation of threshold criteria for intervention in infrainguinal vein grafts undergoing duplex surveillance. <i>Ann Vasc Surg.</i> 1997;11:44-8.	observational	101 grafts	Fifty-one grafts had normal serial CFDS and ABI; none subsequently occluded or required revision. Stenosis was detected by CFDS in 43 grafts (PSV > 180 cm/sec, Vr > 1.5). Within this subgroup, 54% of grafts subsequently required revision (20/43) or occluded (3/43). All grafts in this subgroup with stenoses progressed to PSV > 300 or Vr > 3.5 prior to revision or occlusion. Ten lesions (23%) regressed spontaneously without intervention (mean PSV 252 cm/sec, mean Vr 3.2); 10 lesions (23%) are stable, non-progressive, and remain under surveillance. Two grafts were abnormal by LVC; one was successfully revised, the other occluded prior to intervention. Five grafts had normal CFDS and ABI decrease > 0.15. Four were revised (three inflow lesions, one outflow lesion) and one occluded (mild lesion by CFDS). Only five graft occlusions occurred in the entire series: three grafts met HVC and occluded prior to intervention; one developed an ABI drop of 0.4 due to graft stenosis missed by CFDS and uncovered following thrombolysis, and the other graft met LVC and occluded prior to intervention. Infrainguinal vein grafts with normal serial CFDS and ABI are at minimal risk of spontaneous graft occlusion. When CFDS is abnormal (PSV > 180 cm/sec, Vr > 1.5), over 50% of grafts will ultimately require revision or progress to occlusion. Grafts with such lesions can be safely monitored by CFDS until progression to lesions meeting HVC occurs with minimal risk of graft occlusion. A decrease in ABI > 0.15 with normal CFDS mandates arteriography to identify inflow and outflow lesions or a missed graft stenosis	5	

198	393. Lundell A, Lindblad B, Bergqvist D, et al. Femoropopliteal-crural graft patency is improved by an intensive surveillance program: a prospective randomized study. <i>J Vasc Surg.</i> 1995;21:26-33.	experimental	156	Assisted primary cumulative vein graft patency in the intensive group (n = 56) compared with that in the routine surveillance group (n = 50) after 3 years was 78% versus 53% (chi square analysis, 4.51; one degree of freedom; p < 0.05). Secondary patency was 82% versus 56% (chi square analysis, 5.62; one degree of freedom; p < 0.05). Assisted primary cumulative e-polytetrafluoroethylene and composite graft patency after 1 year in the intensive group (n = 23) compared with that of the routine surveillance group (n = 20) was 57% vs 50% (chi square analysis, 2.17; one degree of freedom; p > 0.1). Secondary patency was 67% vs 54% (chi square analysis, 1.85; one degree of freedom; p > 0.1). Revisions were made on 14 patent and 10 thrombosed grafts in the intensive group and on four patent and 15 thrombosed grafts in the routine surveillance group. All except eight were made during the first postoperative year.	1
198	394. Mills JL, Harris EJ, Taylor LM, et al. The importance of routine surveillance of distal bypass grafts with duplex scanning: a study of 379 reversed vein grafts. <i>J Vasc Surg.</i> 1990;12:379-86.	observational	379 grafts	An average of 3.2 postoperative duplex graft flow velocity (GFV) measurements per graft was obtained during a mean follow-up interval of 21 1/2 months. Only 2.1% of 280 grafts with GFV measurements greater than 45 cm/sec failed within 6 months of a normal surveillance examination. GFV measurements less than 45 cm/sec in 99 grafts led to arteriography in 75 grafts, identifying 50 stenotic lesions in 48 bypasses (12.6% of series). Inflow lesions were present in 5%, outflow stenoses in 2%, and intrinsic graft stenoses in only 6% of bypasses. Only 29% of grafts identified as failing by duplex scan were associated with a reduction in ankle-brachial index of greater than 0.15. Secondary reconstructions were performed in 48 grafts based on detection of a reduced GFV measurement; all such reconstructions are patent after a mean follow-up of 5 months.	5
198	395. Bandyk DF, Cato RF, Towne JB. A low flow velocity predicts failure of femoropopliteal and femorotibial bypass grafts. <i>Surgery.</i> 1985;98:799-809.	observational	42 FT, 24 FP, 3 FP(isolate d seg) bypass	At operation peak systolic flow velocity was greater (p less than 0.01) in femoropopliteal grafts (90 +/- 22 cm/sec) compared with femorotibial grafts (68 +/- 19 cm/sec) and isolated segment femoropopliteal (58 +/- 16 cm/sec) grafts. Diastolic forward flow, indicative of low outflow resistance, was present in all successful grafts at operation and in the immediate postoperative period, but decreased thereafter. Early graft occlusion was associated with a low peak systolic flow velocity (less than 40 cm/sec) and absent diastolic forward flow. Postoperative decrease in peak systolic velocity to less than 45 cm/sec identified grafts with impending failure due to intrinsic graft lesions or progression of atherosclerosis.	5
198	396. Davies AH, Hawdon AJ, Sydes MR, et al. Is duplex surveillance of value after leg vein bypass grafting? Principal results of the Vein Graft Surveillance Randomised Trial (VGST). <i>Circulation.</i> 2005;112:1985-91.	experimental	594	The clinical and duplex surveillance groups had similar amputation rates (7% for each group) and vascular mortality rates (3% versus 4%) over 18 months. More patients in the clinical group had vein graft stenosis at 18 months (19% versus 12%, P=0.04), but primary patency, primary assisted patency, and secondary patency rates, respectively, were similar in the clinical group (69%, 76%, and 80%) and the duplex group (67%, 76%, and 79%). There were no apparent differences in health-related quality of life, but the average health service costs incurred by the duplex surveillance program were greater by 495 pound sterling (95% CI 83 pound sterling to 807 pound sterling) per patient.	1
198	397. Back MR, Novotny M, Roth SM, et al. Utility of duplex surveillance following iliac artery angioplasty and primary stenting. <i>J Endovasc Ther.</i> 2001;8:629-37.	observational	67	During intermediate-term follow-up ranging to 36 months (mean 12), life table primary, assisted primary, and secondary patency rates for the treated iliac systems were 78%, 90%, and 98%, respectively, at 18 months. Assisted primary iliac system patency at 18 months was significantly worse in the 20 (24%) limbs having an outflow bypass done with or prior to iliac stenting (83% versus 100% without bypass, p = 0.01). Indirect clinical indicators found 17 (20%) suspected failing iliac systems, in which duplex imaging correctly identified 5 of 6 recurrent iliac stenoses and facilitated secondary endovascular intervention. Three (4%) stent occlusions occurred in the treated iliac systems despite surveillance.	5
198	398. Baril DT, Marone LK. Duplex evaluation following femoropopliteal angioplasty and stenting: criteria and utility of surveillance. <i>Vasc Endovascular Surg.</i> 2012;46:353-7.	observational	330 limbs	-	5
198	399. Troutman DA, Madden NJ, Dougherty MJ, et al. Duplex ultrasound diagnosis of failing stent grafts placed for occlusive disease. <i>J Vasc Surg.</i> 2014;60:1580-4.	observational	79	We retrospectively classified the following factors as "abnormal DU findings:" focal PSVs >300 cm/s, uniform PSVs <50 cm/s throughout the graft, and a Vr >3.0. Fifteen of 20 patients with one or more of these abnormal DU findings underwent prophylactic intervention (n = 8) or occluded without intervention (n = 7), whereas only two of 72 with normal DU findings occluded (P = .0001). Excluding the eight patients who underwent prophylactic intervention, seven of 12 patients with abnormal DU findings occluded without intervention vs two of 72 with normal DU findings (P = .0001).	5
198	401. Brumberg RS, Back MR, Armstrong PA, et al. The relative importance of graft surveillance and warfarin therapy in infrainguinal prosthetic bypass failure. <i>J Vasc Surg.</i> 2007;46:1160-6.	observational	121	Three-year primary, assisted, and secondary patency rates were 39%, 43%, and 59%, respectively, for all bypasses, with no difference noted between above-knee and BK grafts (P = .5). At 3 years, freedom from limb loss was 75%, and patient survival was only 70% with no adverse effect on survival imparted by amputation. Sixty-nine total adverse events occurred as a result of thrombotic occlusion (n = 51), duplex scan-detected stenosis (n = 13), or graft infection (n = 5). Forty-nine percent of all initial graft occlusions eventually led to amputation. Twenty-three grafts (27% of 86 patients) in patients maintained on chronic warfarin were subtherapeutic at the time of occlusion. Use of a distal anastomotic adjunct with BK bypasses reduced graft thrombosis (35% with vs 60% without) but did not impart a significant patency advantage (P = .07). Multivariate analysis revealed low graft flow (midgraft velocity < or =45 cm/s; odds ratio [OR], 6.1; 95% confidence interval [CI], 1.9-19.2), use of warfarin (OR, 8.4; 95% CI, 2.1-34.5), and therapeutic warfarin (OR, 24.6; 95% CI, 5.7-106) to be independently predictive for bypass patency. Graft patency was maintained in 89% of grafts remaining therapeutic on warfarin compared with only 55% of subtherapeutic or nonanticoagulated grafts (P < .001). Low-flow grafts (n = 61) occluded more frequently than higher-flow grafts (46% vs 13%; P < .001). Therapeutic warfarin augmented the patency of low-flow (P < .001) but not high-flow (P = .15) grafts.	5
198	402. Calligaro KD, Doerr K, McAfee-Bennett S, et al. Should duplex ultrasonography be performed for surveillance of femoropopliteal and femorotibial arterial prosthetic bypasses? <i>Ann Vasc Surg.</i> 2001;15:520-4.	observational	66	DU was considered to have correctly diagnosed a failing graft if a stenosis > 75% the luminal diameter of the graft, at an anastomosis, or in an inflow/outflow artery was confirmed by operative or arteriographic findings or if the graft thrombosed after an abnormal DU but before intervention.	5
198	403. Stone PA, Armstrong PA, Bandyk DF, et al. Duplex ultrasound criteria for femorofemoral bypass revision. <i>J Vasc Surg.</i> 2006;44:496-502.	observational	108	During a mean 40-month follow-up (range, 2 to 120 months), 31 bypasses (29%) were revised: 19 duplex-detected stenosis involving the inflow iliac artery (n = 15) or anastomotic stenosis (n = 4), or both, 11 for graft thrombosis, and 1 for graft infection. Abnormal inflow iliac (PSV >300 cm/s) hemodynamics or a mid-graft PSV <60 cm/s was measured in eight of 11 grafts before thrombosis. Mean time to revision was 30 +/- 17 months. The primary graft patency at 1, 3, and 5 years was 86%, 78%, and 62%, respectively. Correction of duplex-detected stenosis resulted in assisted-primary patency of 95% at 1 year and 88% at 3 and 5 years (P < .0001, log-rank). Secondary graft patency was 98% at 1 year and 93% at 3 and 5 years.	5
36	10. Collins R, Cranny G, Burch J, Aguiar-Ibáñez R, Craig D, Wright K, et al. A systematic review of duplex ultrasound, magnetic resonance angiography and computed tomography angiography for the diagnosis and assessment of symptomatic, lower limb peripheral arterial disease. <i>Health Technol Assess</i> 2007;11:iii-iv, xi-xiii, 1-184	review	-	A total of 113 studies met the inclusion criteria (including six economic evaluations). For the detection of stenosis greater than 50% in the whole leg, contrast-enhanced (CE) MRA (14 studies) had the highest diagnostic accuracy, with sensitivity ranging from 92 to 99.5% and specificity from 64 to 99%. Two-dimensional (2D) time-of-flight (TOF) MRA (11 studies) was less accurate, with sensitivity ranging from 79 to 94% and specificity from 74 to 92%. 2D phase-contrast (PC) MRA (one study) had a sensitivity of 98% and specificity of 74%. CTA (seven studies) also appeared slightly inferior to CE MRA, with a sensitivity ranging from 89 to 99% and specificity from 83 to 97%, but better than DUS (28 studies), which had a sensitivity ranging from 80 to 98% and specificity from 89 to 99%. There was some indication that CE MRA and DUS were more accurate for detecting stenoses/occlusions above the knee than below the knee or in the pedal artery. The four studies of patient attitudes strongly suggested that patients preferred CE MRA to CA. CA was considered the most uncomfortable test, followed by CE MRA, with CTA being the least uncomfortable. Half of the patients (from a sample who did not suffer from claustrophobia and had no metallic implants) expressed no preference between undergoing TOF MRA or DUS; most of those who did express a preference favoured TOF MRA. In the 55 studies identified for adverse events, MRA was associated with the highest reported proportion. However, the most severe adverse events were more common in patients undergoing CA; although these were rare for both tests. The economic evaluation showed DUS dominated the other alternatives when the whole leg was assessed, by presenting higher effectiveness at a lower cost per quality-adjusted life-year (QALY; i.e. 13,646 pounds per QALY). When the assessment was limited to a section of the leg, either above the knee or below the knee, 2D TOF MRA was the most cost-effective preoperative diagnostic strategy. The incremental cost per QALY for below-the-knee comparisons was equal to 37,024 pounds when 2D TOF MRA was compared with DUS. For above-the-knee comparisons, 2D TOF MRA presented the lowest cost and slightly lower effectiveness compared with CE MRA, with a cost per QALY equal to 13,442 pounds.	1

36	11. Pinto F, Lencioni R, Napoli V, Petrucci R, Vignali C, Armillotta N, et al. Peripheral ischemic occlusive arterial disease: comparison of color Doppler sonography and angiography. <i>J Ultrasound Med</i> 1996;15:697-704; quiz 705-706	observational	334	Overall, color Doppler sonography revealed diagnostic agreement with angiography in 668 of 714 lesions (93.5%), including 343 of 369 (92.9%) nonsignificant stenoses, 279 of 297 (93.9%) significant stenoses, and 46 of 48 (95.8%) occlusions. Overestimation occurred in 26 of 369 (7%) nonsignificant stenoses and 3 of 297 (1%) significant stenoses. Underestimation was observed in 15 of 297 (5%) significant stenoses and in 2 of 48 (4.2%) occlusions. Peak systolic velocity ratio correlated better ($P < 0.01$) than peak systolic velocity with diameter reduction percentage as assessed at angiography.	2
36	12. Moneta GL, Yeager RA, Lee RW, Porter JM. Noninvasive localization of arterial occlusive disease: a comparison of segmental Doppler pressures and arterial duplex mapping. <i>J Vasc Surg</i> 1993;17:578-582	observational	79	Rates of sensitivity and specificity of arterial duplex mapping for identifying a high-grade stenosis at the three arterial levels were 88% and 97%, 95% and 100%, and 78% and 99%, respectively. Those for segmental Doppler pressures were 59% and 86%, 73% and 80%, and 48% and 53%, respectively. There was complete agreement between arterial duplex mapping and angiography in 82% of the limbs studied and between segmental pressures and angiography in 34% of the limbs ($p < 0.0001$). The presence of diabetes, kidney failure, or previous vascular surgery in the limb studied did not affect the accuracy of either test.	3
36	13. Rieker O, Düber C, Schmiedt W, von Zitzewitz H, Schweden F, Thelen M. Prospective comparison of CT angiography of the legs with intraarterial digital subtraction angiography. <i>AJR Am J Roentgenol</i> 1996;166:269-276	observational	50	The sensitivities of CTA were 100% for the diagnosis of femoral artery occlusion, 100% for the detection of popliteal artery (including tibial-peroneal arterial trunk) occlusion, and 94% for the detection of tibial artery occlusion. The specificities were 100%, 99%, and 98%, respectively. When maximum-intensity-projection images were interpreted without axial scans, sensitivities were 98%, 85%, and 92% and specificities were 100%, 99%, and 97%, respectively. For the accurate grading of high-grade (75-99%) stenoses of the superficial femoral artery and the popliteal artery (including tibial-peroneal arterial trunk), the sensitivities of CTA were 88% and 73% and the specificities were 94% and 100%, respectively. When maximum-intensity-projection images alone were used, the sensitivities for the correct grading of high-grade stenoses were 58% and 36% and the specificities were 99% and 100%, respectively.	3
36	14. Rubin GD, Schmidt AJ, Logan LJ, Sofilos MC. Multi-detector row CT angiography of lower extremity arterial inflow and runoff: initial experience. <i>Radiology</i> 2001;221:146-158	observational	24	A mean scanning time of 66 seconds was required to cover a mean of 1,233 mm, resulting in a mean of 908 transverse reconstructions. All 504 arterial segments were depicted and analyzable. Mean arterial attenuation ranged from 253 HU in the midabdominal aorta to 357 HU in the popliteal artery and 253 HU in the dorsalis pedis or posterior tibial artery measured inferior to the tibiotalar joint. Maximum mean venous enhancement (99 HU) was observed in the saphenous vein at the ankle, with all other venous stations measuring less than 74 HU.	3
36	15. Met R, Bipat S, Legemate DA, Reekers JA, Koelemay MJ. Diagnostic performance of computed tomography angiography in peripheral arterial disease: a systematic review and meta-analysis. <i>JAMA</i> 2009;301:415-424	metaanalysis	957	Of 909 studies identified, 20 (2.2%) met the inclusion criteria. These 20 studies had a median sample size of 33 (range, 16-279) and included 957 patients, predominantly with intermittent claudication (68%). Methodological quality was moderate. Overall, the sensitivity of CTA for detecting more than 50% stenosis or occlusion was 95% (95% confidence interval [CI], 92%-97%) and specificity was 96% (95% CI, 93%-97%). Computed tomography angiography correctly identified occlusions in 94% of segments, the presence of more than 50% stenosis in 87% of segments, and absence of significant stenosis in 96% of segments. Overstaging occurred in 8% of segments and understaging in 15%.	1
36	16. Khilnani NM, Winchester PA, Prince MR, Vidan E, Trost DW, Bush HL Jr, et al. Peripheral vascular disease: combined 3D bolus chase and dynamic 2D MR angiography compared with x-ray angiography for treatment planning. <i>Radiology</i> 2002;224:63-74	observational	30	The three readers selected identical segments for inflow at MR angiography and x-ray angiography in 32, 32, and 35 of the 35 limbs evaluated (mean percentages of agreement [95% CI]: 91% [77%, 98%], 91% [77%, 98%], and 95% [90%, 100%], respectively). The readers selected identical segments for outflow in 32, 32, and 34 of the 35 limbs evaluated (mean percentages of agreement [95% CI]: 91% [77%, 98%], 91% [77%, 98%], and 97% [85%, 100%], respectively).	2
36	17. Kreitner KF, Kalden P, Neufang A, Düber C, Krummenauer F, Küstner E, et al. Diabetes and peripheral arterial occlusive disease: prospective comparison of contrast-enhanced three-dimensional MR angiography with conventional digital subtraction angiography. <i>AJR Am J Roentgenol</i> 2000;174:171-179	observational	24	MR angiography was significantly better than DSA in revealing peripheral runoff vessels ($p < 0.001$). In nine (38%) of the 24 patients, MR angiography showed patent pedal vessels suitable for distal bypass grafting that were not revealed by DSA. Because of the results of MR angiography, treatment plans changed in seven of the nine patients in whom patent vessels were subsequently used as target vessels for distal pedal bypass grafts.	2
36	18. Bertschinger K, Cassina PC, Debatin JF, Ruehm SG. Surveillance of peripheral arterial bypass grafts with three-dimensional MR angiography: comparison with digital subtraction angiography. <i>AJR Am J Roentgenol</i> 2001;176:215-220	observational	39	Sensitivity and specificity values for MR angiography regarding the assessment of grafts were 100% for 87 evaluable segments for which digital subtraction angiography correlation was available: stenosis ($n = 10$), occlusions ($n = 9$), ectasia or aneurysms ($n = 8$). Six segments could not be assessed because of the presence of intravascular stents or metallic clips.	3
36	19. Dorenbeck U, Seitz J, Volk M, Strotzer M, Lenhart M, Feuerbach S, et al. Evaluation of arterial bypass grafts of the pelvic and lower extremities with gadolinium-enhanced magnetic resonance angiography: comparison with digital subtraction angiography. <i>Invest Radiol</i> 2002;37:60-64	observational	15	Using both techniques, 70 of 75 evaluated locations (93.3%) were classified identically. This included six stenoses $< 50\%$ and six stenoses $> 50\%$, respectively. Four of five overestimations of stenoses were scaled in DSA as stenoses type 1. One stenosis was categorized as type 3 in DSA. Sensitivity for CE MRA for detecting stenoses $\geq 25\%$ was 100% and the specificity 90%. Interobserver agreement for all evaluations was 0.77 (Spearman rank correlation test).	3