NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of endoscopic saphenous vein harvest for coronary artery bypass grafting

Vein grafts can be used in operations to bypass blocked or narrowed arteries to the heart. The veins are usually taken from the leg through long surgical cuts. In endoscopic saphenous vein harvest, the vein is taken from the leg using 'keyhole' surgery.

Introduction

The National Institute for Health and Care Excellence (NICE) has prepared this interventional procedure (IP) overview to help members of the Interventional Procedures Advisory Committee (IPAC) make recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in November 2013 and updated in April 2014.

Procedure name

- Endoscopic saphenous vein harvest for coronary artery bypass grafting

Specialist societies

- Society of Cardiothoracic Surgeons of Great Britain and Ireland
- British Cardiovascular Society.

Description

Indications and current treatment

Coronary artery disease (CAD) refers to hardening and narrowing of the coronary arteries as a result of atherosclerosis. This can cause angina and myocardial infarction and result in heart failure.

One of the treatment options for suitable patients is coronary artery bypass grafting. These coronary artery bypasses are usually made from the patient's own internal mammary artery or greater saphenous vein.

Traditionally, saphenous vein harvest is performed through an incision overlying the length of the saphenous vein using either a single long incision or a number of shorter incisions with skin bridges between them. Complications include wound dehiscence, infection, oedema of the leg and saphenous nerve damage leading to numbness or persistent pain in some patients. Endoscopic saphenous vein harvest aims to reduce these wound complications.

What the procedure involves

Endoscopic saphenous vein harvest is carried out with the patient under general anaesthesia and at the time of cardiac surgery. An endoscope is usually inserted through a short incision near the knee and carbon dioxide may be insufflated into the dissected space within the subcutaneous tissues to facilitate visualisation and removal of the long saphenous vein. The section of vein to be harvested is mobilised circumferentially and tributaries divided. Clips are applied proximally and distally before removing the dissected segment of vein through one of the incisions. The subcutaneous tunnel may be packed with an antibiotic-soaked swab while the bypass grafting is done. This is removed once the heart has been weaned from cardiopulmonary bypass. The small skin incisions are sutured and a compression bandage is applied to the leg to minimise haematoma.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to endoscopic saphenous vein harvest for coronary artery bypass grafting. Searches were conducted of the following databases, covering the period from their commencement to 18 February 2014: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches (see appendix C for details of search strategy). Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The following selection criteria (table 1) were applied to the abstracts identified by the literature search. Where selection criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or a laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising study methodology, unless they reported specific adverse events that were not available in the published literature.
Patient	Patients undergoing coronary artery bypass graft surgery.
Intervention/test	Endoscopic saphenous vein harvest.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the overview

This IP overview is based on 138,602 patients treated by endoscopic vein harvest for coronary artery bypass grafting from 1 systematic review of 44 studies, 2 additional randomised controlled trials, 1 additional non-randomised comparative study, 1 case series and 4 case reports (3 non-randomised comparative studies that were included in the systematic review have also been summarised)[1–12] .

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) have been listed in appendix A.

Table 2 Summary of key efficacy and safety findings on endoscopic saphenous vein harvest for coronary artery bypass grafting

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Sastry P (2013)[1] **Systematic review with meta-analysis** UK, Germany Search date: 2011 Study population: all studies comparing EVH with OVH in CABG **n=269,474**; 51% (n=137,831) EVH versus 49% (n=131,643) open vein harvest (OVH); 19 RCTs, 25 non-randomised comparative studies Mean age: 73 vs 72 years Sex: 30% (82,015/269,474) female Study inclusion criteria: all studies comparing EVH with OVH in CABG, reporting on 11 'outcomes of interest'. Papers combining EVH with other minimally invasive techniques were discarded. Technique: EVH devices/systems included Ethicon EVH kit (Ethicon Endo-Surgery, USA), Endoscopic system (Karl Storz, Germany), Endopath (Ethicon Endo-Surgery, USA), Vasoview (Origin/Guidant and Maquet, USA), Clearglide (Ethicon Endo-Surgery, USA), SaphLITE (Genzyme Surgical Products, USA), VirtuoSaph (Terumo, USA).	Number of patients analysed: **269,474** **Postoperative pain** (12 studies, n=663): Analysis of all studies indicated lower pain scores in the EVH group: SMD= -1.48, 95% CI -2.38 to -0.59, p=0.001 (significant heterogeneity, I^2=98%) RCTs only: SMD=-1.75, 95% CI -3.17 to -0.32, p=0.02 **Vein graft stenosis** (3 studies, n=3229): SRRatio=1.19, 95% CI 1.05 to 1.34, p=0.005, I^2=0 In 2 studies, angiography was done at 3 and 6 months; in the third study, angiograms were reviewed at a median 12.6 months. Neither of the RCTs showed any significant difference between the groups. **Vein graft occlusion** (4 studies, n=4700): SRRatio=1.39, 95% CI 1.11 to 1.75, p=0.004, I^2=55%) suggesting a higher rate in the EVH group. The difference was non-significant when the 2 RCTs were considered separately. **Angina recurrence** (4 studies, n=6401): No significant difference between the groups: SRRatio=1.06, 95% CI 0.49 to 2.25, p=0.81, I^2=53%) RCTs only: SRRatio=0.79, 95% CI 0.15 to 4.18, p=0.78. Follow-up periods: 6 months (2 studies), median 2.6 years, median 17 months after EVH and 37 months after OVH. **Repeat revascularisation** (7 studies, n=21,743): Median follow-up=2.3 years SRRatio=1.16, 95% CI 0.99 to 1.36, p=0.06, I^2=0.02	**Wound infection** (31 studies, n=11,352): less wound infection in the EVH group (SRRisk=0.31, 95% CI 0.23 to 0.42, p<0.0001; I^2=43%) RCTs only: SRRisk=0.26, 95% 0.15 to 0.44, p<0.0001 The device used had no significant influence on effect size. **Postoperative MI (within 30 days)** (12 studies, n=1872): no significant difference between the groups (SRRisk=0.87, 95% CI 0.68 to 1.11, p=0.26, I^2=0) RCTs only: SRRisk=1.34, 95% CI 0.30 to 5.89, p=0.70 The device used had no significant influence on the overall summary effect size. **30-day mortality** (16 studies, n=14,190): lower incidence in EVH group (SRRisk=0.71, 95% CI 0.56 to 0.90, p=0.005) RCTs only: SRRisk=0.75, 95% CI 0.27 to 2.11, p=0.58 The device had no significant influence on the overall summary effect size.	**Study design issues**: • The authors note the likely presence of publication bias with regard to wound infection. **Other issues**: • The authors note that there are very few long-term prospective studies examining clinical and angiographic outcomes after EVH and OVH. They state there is a need for an RCT providing follow-up beyond the vein graft failure peak at 7–10 years after surgery.

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Median follow-up: 2.6 years Conflict of interest/source of funding: none	Insufficient evidence of any difference in the rate of repeat revascularisation between groups. **Mid-term MI** (6 studies, n=12,740): Mean follow-up=26.5 months SRRisk=0.98, 95% CI 0.77 to 1.25, p=0.89, I^2=0 No significant difference in the risk of mid-term MI between groups. **Mid-term mortality** (10 studies, n=252,915): Median follow-up=22.5 months SRRatio=0.90, 95% CI 0.79 to 1.03, p=0.12, I^2=47% Insufficient evidence of a difference in mid-term mortality between the groups.		

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Williams JB (2012)[2] **Non-randomised comparative study (Society of Thoracic Surgeons Adult Cardiac Surgery Database)** USA Recruitment period: 2003–8 Study population: patients undergoing isolated CABG **n=235,394 (122,899 EVH vs 112,495 OVH)** Age: mean 74 years Sex: 31% female Patient selection criteria: patients with primary isolated CABG surgery having at least 1 vein graft. Exclusions included emergent/salvage procedure; prior CABG surgery; radial artery or right internal mammary artery grafting; patients without an internal mammary artery graft. Technique: not reported **Follow-up: median 3 years** Conflict of interest/source of funding: The study was funded by the US Food and Drug Administration. Several authors reported receiving grants from or board membership of various bodies including Eli Lilly, Janssen Pharmaceuticals, Society of Thoracic Surgeons, AstraZeneca, Boehringer-Ingelheim, Daiichi Sankyo.	Number of patients analysed: **235,394 (122,899 vs 112,495)** **Cumulative incidence rate for mortality at median 3 year follow-up:** • EVH=13.2% (12,429/122,899); 95% CI: 13.0 to 13.4 • OVH=13.4% (13,096/112,495); 95% CI: 13.2 to 13.7 Risk-adjusted HR for long-term mortality=1.00 (95% CI 0.97 to 1.04, p>0.99) **Cumulative incidence for composite of death, MI, or revascularisation at median 3 year follow-up:** • EVH=19.5% (18,419/122,899); 95% CI: 19.3 to 19.8 • OVH=19.7% (19,232/112,495); 95% CI: 19.5 to 20.0 Risk-adjusted HR for composite of death, MI or revascularisation=1.00 (95% CI 0.98 to 1.05, p=0.34)	**Unadjusted 30-day rate for wound complication:** • EVH=3.0% (3654/122,899); 95% CI 2.93 to 3.01 • OVH=3.6% (4047/112,495); 95% CI 3.56 to 3.64 Adjusted HR=0.83 (95% CI 0.77 to 0.89, p<0.001)	**Included in Sastry et al., 2013.** **Study design issues**: • Primary outcome measure was all-cause mortality. • The Society of Thoracic Surgeons Adult Cardiac Surgery database files were linked with the Centers for Medicare and Medicaid Services claims database to measure mid-term and long-term outcomes. • Propensity scores were developed to adjust for differences in baseline characteristics between the 2 treatment groups. **Study population issues**: • Baseline patient characteristics were similar between the groups with regard to age, body mass index, prevalence of peripheral vascular disease, active smoking, diabetes mellitus needing insulin, and urgent case status. • The proportion of procedures that were done endoscopically was higher in recent years than earlier years. **Other issues**: • The authors noted that this study could not assess particulars of technique, such as carbon dioxide insufflations, use of

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
			electrocautery, or the experience of the endoscopic harvester. • Any endoscopic procedures that were converted to open surgery were classified as endoscopic.

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Grant SW (2012)[3] **Non-randomised comparative study (3 centres, using data from the Central Cardiac Audit Database)** UK Recruitment period: 2008–10 Study population: patients undergoing isolated CABG **n=4709 (586 EVH vs 4123 OVH)** Age: median 67 years Sex: 14% vs 19% female (p=0.005) Patient selection criteria: not reported. Technique: all 3 centres used the Maquet Vasoview EVH system. **Follow-up: median 22 months** Conflict of interest/source of funding: 1 author has received speaker honoraria and travel grants from Maquet; 1 author has received honoraria and proctorships from Maquet; 1 author has received travel grants from Baxter Healthcare and Edwards Lifesciences.	Number of patients analysed: **2665 propensity matched patients (533 vs 2132)** **Mid-term mortality, MI or repeat revascularisation (primary outcome measure)** There was no difference between the propensity matched EVH and OVH groups with regard to the main outcome measure of mid-term mortality, repeat revascularisation and MI combined (HR 1.15, 95% CI 0.76 to 1.74, p=0.51). Risk factors included age, peripheral vascular disease, dyspnoea, and ejection fraction <50%. **Mid-term mortality** There was no difference in mid-term mortality between the propensity matched groups (HR 1.04, 95% CI 0.65 to 1.66, p=0.88). Risk factors were the same as those identified for the main outcome measure, with the addition of diabetes.	**In-hospital outcomes (in 2665 propensity matched patients):** **Mortality** • EVH=0.9% • OVH=1.1%, p=0.71 **Stroke** • EVH=0.6% • OVH=0.4%, p=0.66 **Dialysis support** • EVH=3.6% • OVH=2.6%, p=0.22 **Reoperation** • EVH=2.8% • OVH=3.1%, p=0.78	**Included in Sastry et al., 2013** **Follow-up issues**: • No patients were lost to follow-up. **Study design issues**: • Retrospective analysis of prospectively collected data. • Consecutive patients. • A propensity score for EVH was developed using multivariable logistic regression and patients who underwent EVH were then matched (1:4) to patients who underwent OVH. • Follow-up data were obtained by combining multiple separate databases, and the main outcome measure rates may be underestimated. **Study population issues**: • Before matching, patients who underwent EVH were more likely to be male and less likely to have had a previous MI, respiratory disease or peripheral vascular disease. After matching, there were no significant differences in patient characteristics between the groups. **Other issues**: • EVH was performed by an experienced surgeon in each centre; OVH was performed by trainee surgeons and surgical assistants.

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Krishnamoorthy B (2012)[4] **RCT** UK Recruitment period: not reported Study population: patients undergoing CABG **n=150** (50 EVH vs 50 bridging technique vs 50 OVH) Age: mean 64 vs 69 vs 68 years (p=0.02) Sex: 10% vs 28% vs 22% female (p=0.025) Patient selection criteria: exclusion criteria included redo CABG, emergency surgery or a contraindication to a technique, including great saphenous vein varicosities, small legs and a superficial great saphenous vein. Technique: EVH was performed using the Vasoview Hemopro® system (Maquet) and carbon dioxide insufflation. Veins were harvested from the thigh (unlike the bridging technique and OVH). For the bridging technique, a small incision was made proximal to the medial malleolus and the vein was exposed and dissected through tunnels with a 5–6 cm gap between incisions. **Follow-up: 6 weeks** Conflict of interest/source of funding: none	Number of patients analysed: **150** **Mean operation duration (min):** • EVH=42 • Bridging=68 • OVH=52, p<0.001 **Mean pain on movement (Likert pain rating scale from 0 [no pain] to 10 [unbearable]) – values have been estimated from graphical presentation:** ***Postoperative day 1*** • EVH=2.25 • Bridging=0.4 • OVH=4.9, p<0.001 for EVH and bridging against OVH ***Postoperative day 5*** • EVH=1.75 • Bridging=0.4 • OVH=3.25, p<0.001 for EVH and bridging against OVH ***Postoperative week 6*** • EVH=0.1 • Bridging=0.2 • OVH=0.9, p<0.001 for OVH vs EVH; p=0.005 for OVH vs bridging By week 6, all 3 groups had similar levels of pain at rest, which were close to 0. Bridging reduced pain compared with EVH during the hospital stay (p=0.01 and 0.004 at rest and movement on day 1; p=0.002 and 0.014 at rest and movement on day 5, respectively) but this benefit was lost after 6 weeks. Patient satisfaction at discharge was greatest in the EVH group followed by bridging and then the OVH group (p<0.001).	**Exudates (none/serous/blood/pus):** • EVH=50/0/0/0 • Bridging=7/0/43/0 • OVH=38/12/0/0 p<0.001 (EVH vs OVH) p<0.001 (EVH vs bridging) p<0.001 (OVH vs bridging) **Erythema (yes/no):** • EVH=35/15 • Bridging=48/1 • OVH=45/5 p=0.012 (EVH vs OVH) p<0.001(EVH vs bridging) p=0.056 (OVH vs bridging) **Bruising (none/bruising/haematoma):** • EVH=26/12/12 • Bridging=40/8/2 • OVH=24/25/1 p=0.204 (EVH vs OVH) p=0.001(EVH vs bridging) p=0.006 (OVH vs bridging) **Infection in hospital:** • EVH=0% (0/50) • Bridging=4% (2/50) • OVH=2% (1/50), p=0.624 **Numbness at 6 weeks:** • EVH=2% (1/49) • Bridging=4% (2/49) • OVH=20% (10/50), p=0.780 **Number of vein repairs (0/1/2):** • EVH=32/17/1 • Bridging=41/9/0 • OVH=50/0/0, p=0.014	**Not included in Sastry et al., 2013 systematic review** **Follow-up issues**: • 2 patients died in hospital (1 in the EVH group and 1 in the bridging group) from causes unrelated to wound infection or MI. • 3 patients assigned to EVH needed a conversion to OVH and were excluded from the study. **Study design issues**: • Computer block randomisation was used to assign patients to treatment groups. The assignment number was concealed in an envelope separately for each patient. **Study population issues**: • There was a significant difference between the groups with regard to age, sex and incidence of peripheral vascular disease (2% vs 39% vs 11%, p<0.001).

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Brat R (2013)[5] **RCT** Czech Republic Recruitment period: 2009–10 Study population: patients undergoing isolated CABG **n=100 (50 EVH vs 50 OVH)** Age: mean 65 years (EVH) Sex: 13% (13/100) female Patient selection criteria: patients with a patent deep vein system, location of the great saphenous vein at least 4 mm under the skin surface, lumen of the vein from 2–5 mm and vein wall thickness <1.5 mm. Technique: in the EVH group the endoscopy was performed by a surgeon with sufficient experience in this harvest method, using the Virtuo-Saph (Terumo) endoscopic vessel harvesting system and carbon dioxide insufflation. Diathermy was used to divide side branches in situ with titanium clips applied before grafting. In the OVH group the graft was harvested by an advanced surgeon using standard open technique with ligating or clipping the side branches. **Follow-up: 1 month** Conflict of interest/source of funding: study was supported by a grant from the Ministry of Health Czech Republic.	Number of patients analysed: **100 (50 vs 50)** There were no conversions to open surgery. **Perioperative characteristics** EVH: 36.9±8.35; 36.2±13.25; 1.3±1.57; 7.6±3.1 OVH: 38.4±11.23; 37.7±20.46; 0.4±0.94; 40.3±12.81 p value: NS; NS; <0.001; <0.001 **Leg wound pain (patient subjective feeling and complaints of pain of any severity)** ***7 days postoperatively*:** • EVH=12% (6/50) • OVH=44% (22/50), p<0.001 ***1 month postoperatively:*** • EVH=0% (0/50) • OVH=8% (4/50), p=NS	***7 days postoperatively*** **Haematoma** • EVH=62% (31/50) • OVH=44% (22/50) **Swelling** • EVH=8% (4/50) • OVH=26% (13/50) **Necrosis** • EVH=0% (0/50) • OVH=2% (1/50) **Dysaesthesia** • EVH=0% (0/50) • OVH=10% (5/50) There were no cases of leg wound dehiscence or infection. ***1 month postoperatively*** **Haematoma** • EVH=2% (1/50) • OVH=0% (0/50) **Leg wound dehiscence** • EVH=2% (1/50) • OVH=8% (4/50) **Swelling** • EVH=2% (1/50) • OVH=4% (2/50) **Leg wound infection** • EVH=0% (0/50) • OVH=2% (1/50) **Dysaesthesia** • EVH=0% (0/50) • OVH=8% (4/50) NB: None of the p values were statistically significant. **Acute endothelial damage seen on histological examination** • EVH=51% (24/47) • OVH=29% (14/49), p<0.001	**Not included in Sastry et al., 2013 systematic review** **Study design issues**: • Method of randomisation not described. • A sample was taken from the distal part of each harvested vein for histological analysis. • P values <0.001 were considered statistically significant. **Study population issues**: • There were no significant differences between the 2 groups with regard to age, sex, left ventricular ejection fraction, angina, body mass index, diabetes or smoking. **Other issues**: • It is not known if the endothelial damage identified on histological analysis would influence the long-term patency of the graft.

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Ad N (2011)[6] **Non-randomised comparative study (multicentre)** USA Recruitment period: 2006–9 Study population: patients undergoing CABG **n=1988 (1734 EVH vs 254 OVH)** Age: mean 64 years Sex: 20% vs 32% female (p<0.001) Patient selection criteria: non-emergent patients presenting for first-time CABG surgery in which the saphenous vein was used in the grafting process. Technique: EVH was done using VasoView (Maquet Cardiovascular LCC). OVH was done using a long, continuous incision. **Follow-up: mean 22 months** Conflict of interest/source of funding: the authors declared no conflicts of interest; an educational grant was received by Maquet for the study.	Number of patients analysed: **1988 (1734 vs 254)** Overall rate for revascularisation, death and MI: • EVH=6% • OVH=7%, p=0.18 There were 17 patients admitted for MI (all in the EVH group). 27 patients from the EVH group underwent a revascularisation procedure. Deaths during late follow-up: • EVH=4% (67/1713) • OVH=7% (17/245), p=0.03 Cox regression for mortality post-discharge did not demonstrate a significant difference in survival after adjustment for covariates, though the OVH group had a tendency towards greater hazard compared with the EVH group (HR=1.65, CI 0.94 to 2.89, p=0.08). Cox regression for all events post-discharge (death, MI or revascularisation) also did not demonstrate a difference in time to first event between the groups (HR=1.04, CI 0.61 to 1.77, p=0.90). Follow-up mortality in propensity matched patients: • EVH=5.9% • OVH=9.2%, p=0.23	**Mortality within 30 days** • EVH=1.5% (26/1734) • OVH=3.9% (10/254), p=0.02 **Prolonged ventilation** • EVH=5.2% • OVH=9.5%, p=0.006 **Reoperation for bleeding** • EVH=2.5% • OVH=2.8%, p=0.79 **Leg infections** • EVH=0.3% • OVH=1.6%, p=0.03 **Readmission within 30 days** • EVH=9.2% • OVH=11%, p=0.36 **Perioperative MI** • EVH=0.1% • OVH=0%, p=1.00 **Perioperative MACE (mortality within 30 days, stroke, reoperation for bleeding, prolonged ventilation and/or readmission within 30 days) – all patients** • EVH=17.8% • OVH=25.2%, p=0.005 *Propensity matched patients (n=239 in each group)* **Mortality within 30 days** • EVH=1.7% • OVH=3.8%, p=0.26 **Readmission within 30 days** • EVH=9.2% • OVH=11.7%, p=0.46 **Perioperative MACE** • EVH=18% • OVH=25.9%, p=0.04	**Included in Sastry et al., 2013** **Study design issues**: • Propensity score matching was done to improve covariate balance across the groups. **Study population issues**: • Retrospective study. • Multiple local databases were used. • Before matching, patients who underwent EVH were more likely to be male; the Society of Thoracic Surgeons predicted risk score for mortality was significantly higher for the OVH group (3% vs 2%, p=0.028) and the proportion of isolated CABG procedures was lower in the OVH group (71% vs 81%, p<0.001). **Other issues**: • All procedures were done by experienced and specially trained practitioners. The same operators harvested the veins in both groups. • Patients were discharged on aspirin unless there was a reason to treat them with Plavix.

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Andreas M (2013)[7] **Non-randomised comparative study** Austria Recruitment period: 2008–11 Study population: patients undergoing CABG with or without concomitant valve procedures **n=885 (262 EVH vs 623 OVH)** Age: mean 69 years Sex: 23% vs 31% female (p=0.012) Patient selection criteria: emergent or rescue procedures were excluded. Technique: EVH was done using Vasoview 6 or Vasoview Hemopro 2 (Maquet Holding GmbH & Co., Germany). **Follow-up: not reported** Conflict of interest/source of funding: none	Number of patients analysed: **885 (262 vs 623)** 1-year mortality • EVH=8.6% • OVH=9.2%, p=NS 2-year mortality • EVH=9.8% • OVH=11.9%, p=NS	**Operative mortality** • EVH=5.3% • OVH=7.1%, p=NS **Minor wound healing complications** • EVH=3.8% • OVH=10.3%, p=0.001 **Severe complications in the leg needing surgical revision** • EVH=1.1% • OVH=2.4%, p=NS After multivariate regression analysis, only female gender remained as a significant risk factor for impaired wound healing and infection (OR=2.4, p=0.001). EVH significantly reduced the risk of wound healing complications (OR=0.4, p=0.008).	**Study design issues**: • Single centre. • Prospective data collection. • The surgeon chose the method of vein harvest, without strict guidelines. **Study population issues**: • Patients receiving EVH were more likely to be male and were taller and heavier than patients in the OVH group. Diabetes was more common (44 vs 35%, p=0.006) and peripheral vascular disease was less common (16 vs 35%, p=0.006) in the EVH group. There were significantly fewer procedures combined with valve surgery in the EVH group than the OVH group (29% vs 36%, p<0.05).

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Lin TY (2003)[8] **Case series** Taiwan Recruitment period: from 2001 (duration unclear) Study population: patients scheduled for off-pump CABG or femoral-popliteal artery bypass grafting surgery. **n=405** Age: 65.5 years (mean) Sex: 69.2% (279/403) male Patient selection criteria: patients excluded if they had prior saphenous vein harvesting for peripheral arterial occlusive disease or CABG surgery. Technique: endoscopic harvesting of saphenous vein using VasoView® (version not reported). CO_2 insufflation up to 15 mmHg and 2 cm incision used. Follow-up: **not reported** Conflict of Interest/source of funding: not reported.	Not reported.	Number of patients analysed: **403** **Severity of CO_2 embolisation** • Nil=82.9% (334/403) • Minimal (<5 bubbles)=13.1% (53/403) • Moderate (dozens of bubbles)=3.5% (14/403) • Massive (numerous bubbles in inferior vena cava, right atrium, right ventricle or pulmonary artery)=0.5% (2/403) • Total CO_2 embolisation=17.1% (69/403) The 2 massive embolisations occurred suddenly and CO2 insufflation was stopped on echocardiographic detection of CO_2 bubbles. Blood pressure, end-tidal CO_2, oxygen saturation and cardiac output all decreased immediately at that time. One patient was successfully rescued with phenylephrine and epinephrine (haemodynamic status rapidly restored). The other patient did not respond to pharmacological intervention and required emergency cardiopulmonary bypass support to complete the CABG surgery. The clinical status of the patients with minimal or moderate CO_2 embolisation was not reported.	**Included in overview for IP407/2** **Follow-up issues:** • 0.5% (2/405) of patients excluded because of conversion to open or bridging harvesting method. • Follow-up was 100% for remaining patients. **Study design issues:** • Single centre. All veins harvested by either surgeon or physician assistant with previous experience (> 50 cases) and trained by the manufacturer. • Study designed specifically to look at incidence of CO_2 embolisation. All patients assessed for embolisation by monitoring the inferior vena cava with TEE probe. The images were recorded and the videotape was assessed by a qualified TEE examiner (anaesthesiologist). If dozens of bubbles noted on imaging, CO_2 insufflation stopped and only restarted after examination of entrance of saphenous vein. **Study population issues:** • Type of operation: 72.5% ([292/403] elective off-pump CABG; 10.4% (42/403) emergency off-pump CABG; 13.2% (53/403) CABG + valve; 1.5% (6/403) CABG

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
			with partial cardiopulmonary bypass and 2.4% (10/403) peripheral arterial occlusive disease.

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Kolli A (2010)[9] Case report – adverse event USA n=1	**Compartment syndrome** A 61-year-old man underwent CABG with EVH. There were no complications during the procedure. On postoperative day 4, the patient complained of left lower extremity tightness, swelling and tenderness. In addition, he had a decreased ability to dorsiflex his left foot and great toe, and had decreased sensation on his left first webspace. Compartment syndrome was diagnosed and a lower extremity fasciotomy was performed to decompress all 4 compartments of the lower leg. By 3 months, the patient had recovered without any neurological sequelae.		
Liliav B (2011)[10] Case report – adverse event USA n=1	**Necrotising fasciitis** A 47-year-old man, with a past medical history significant for systolic congestive heart failure, coronary artery disease, MI, type II diabetes mellitus, hypertension and hypercholesterolaemia, underwent CABG with EVH. Three weeks postoperatively he presented with right lower leg pain, swelling, and redness associated with a low-grade fever. He was initially treated for symptoms and discharged on a second-generation cephalosporin. The patient returned 8 days later complaining of significant worsening of symptoms. Duplex scan revealed superficial thrombophlebitis. Drainage of the wound and intravenous antibiotics were tried without success. Upon surgical exploration of the wound, extensive necrosis was seen subcutaneously and radical debridement was performed. Further treatment included 2 more debridements, intravenous antibiotics followed by oral antibiotics and a split-thickness skin graft.		
Najam O (2011)[11] Case report – adverse event UK n=1	**Scrotal distension** A 77-year-old man, with a positive medical history for nocturnal epilepsy, chronic obstructive pulmonary disease, and a repaired indirect inguinal hernia, underwent CABG with EVH. During the procedure, the patient's scrotum became abnormally enlarged and the harvesting system was immediately removed. After a few minutes, the system was reintroduced and the surgical team noticed the track of the CO_2 infiltrating through the ring into the scrotum. It was decided that the risk of testicular necrosis was considerable and the EVH was converted to the bridging vein harvesting technique. Postoperatively, severe contusion of the left leg was noted along with redness, swelling, pain and serous discharge. Cellulitis was suspected and the patient was treated with antibiotics. Fourteen days postoperatively, swelling decreased and the patient was discharged home.		The authors noted that they have seen 4 more cases of acute swelling of the scrotum with subsequent abandonment of the EVH technique.

Abbreviations used: CABG, coronary artery bypass grafting; CI, confidence interval; CPB, cardiopulmonary bypass; HR, hazard ratio; MI, myocardial infarction; OVH, open vein harvesting, EVH, endoscopic saphenous vein harvesting; MACE, major adverse cardiac events; NS, not significant; OR, odds ratio; SMD, un-standardised mean difference; SRRisk, log-relative risk

Study details	Key efficacy findings	Key safety findings	Comments
Lehmann A (2000)[12] Case report – adverse event Germany n=1	**Pneumoperitoneum** A 62-year-old woman underwent CABG with EVH using CO_2 insufflation. During the procedure the abdomen enlarged significantly, end-expiratory pCO_2 increased from 30 mmHg to 37 mmHg, and peak airway pressure increased from 17 mmHg to 23 mmHg. Mild respiratory acidosis occurred (pH 7.31). There were no significant changes in haemodynamics. No specific therapy was necessary other than an increase in tidal volume to increase ventilation. After the procedure the abdomen was normal and no subcutaneous emphysema was noted; postoperative chest X-ray showed a complete resorption of CO_2; no subcutaneous emphysema or gas below the diaphragm was seen.		

Efficacy

Combined endpoints of survival, myocardial infarction and revascularisation

A systematic review and meta-analysis of 44 studies including 269,474 patients reported no statistically significant difference in mid-term mortality between patients treated by endoscopic saphenous vein harvest (EVH) for coronary artery bypass grafting and patients treated by open saphenous vein harvest (OVH); log-relative risk=0.90, 95% confidence interval (CI) 0.79 to 1.03, p=0.12 (mean follow-up 26.5 months)[1]. A non-randomised comparative study of 235,394 patients treated by EVH or OVH (included in the meta-analysis) reported mortality of 13% in each group (12,429/122,899 and 13,096/112,495 respectively) at median 3-year follow-up[2]. A non-randomised comparative study of 4709 patients treated by EVH or OVH reported that there was no difference between the groups with regard to the main outcome measure of mid-term mortality, repeat revascularisation and myocardial infarction combined (hazard ratio 1.15, 95% CI 0.76 to 1.74, p=0.51) in 2665 propensity matched patients (533 versus 2132)[3]. A non-randomised comparative study of 1988 patients treated by EVH or OVH reported overall rates of revascularisation, death and myocardial infarction of 6% and 7% respectively (p=0.18) with a mean follow-up of 22 months[6].

Vein graft failure

The systematic review of 44 studies reported an increased incidence of vein graft stenosis in the EVH group compared with the OVH group (log-rate ratio 1.19, 95% CI 1.05 to 1.34, p=0.005). In 2 of the studies reporting this outcome, angiography was done at 3 and 6 months; in the third study, angiograms were reviewed at a median of 12.6 months. Neither of the randomised controlled trials included in this analysis showed any statistically significant difference between the groups[1].

Pain

The systematic review and meta-analysis of 44 studies reported reduced postoperative pain in patients treated by EVH compared with patients treated by OVH (unstandardised mean difference -1.48, 95% CI -2.38 to -0.59, p=0.001, I^2=98% [significant heterogeneity]). A similar result was obtained when the analysis was limited to randomised controlled trials only (unstandardised mean difference -1.75, 95% CI -3.17 to -0.32, p=0.02)[1]. Significant heterogeneity was observed in both analyses, partly because of differences in the device system used across studies. A randomised controlled trial of 150 patients treated by EVH, bridging or OVH reported scores for mean pain on movement (range 0–10 with lower scores indicating less pain) of 0.1, 0.2 and 0.9 respectively (p<0.001 for OVH versus EVH; p=0.005 for OVH versus bridging) at 6-week follow-up[4]. A randomised controlled trial of 100 patients treated by EVH or OVH reported leg

wound pain in 12% (6/50) versus 44% (22/50) of patients at 7 days postoperatively (p<0.001) and 0% (0/50) versus 8% (4/50) of patients at 1 month postoperatively (p=not significant)[5].

Patient satisfaction

The randomised controlled trial of 150 patients treated by EVH, bridging or OVH reported that patient satisfaction at discharge was greatest in the EVH group followed by bridging and then the OVH group (p<0.001)[4].

Safety

Mortality within 30 days

The systematic review and meta-analysis of 44 studies reported a lower incidence in 30-day mortality in patients treated by EVH and those treated by OVH (log-relative risk 0.71, 95% CI 0.56 to 0.90, p=0.005)[1]. This difference was no longer statistically significant when only randomised controlled trials were analysed (log-relative risk 0.75, 95% CI 0.27 to 2.11, p=0.58).

In-hospital mortality was 1% after both EVH and OVH in the non-randomised comparative study of 4709 patients (2665 propensity matched patients [533 versus 2132])[3]. Mortality within 30 days occurred in 2% of patients treated by EVH and 4% of patients treated by OVH in the non-randomised comparative study of 1988 patients (478 propensity-matched patients, p=0.26)[6]. Operative mortality was 5% in patients treated by EVH and 7% in patients treated by OVH (p=not significant) in a non-randomised comparative study of 885 patients (262 versus 623)[7].

Infection

Necrotising fasciitis was reported in 1 patient in a case report. The patient developed symptoms 3 weeks after the procedure. Surgical exploration of the wound showed extensive necrosis and radical debridement was performed. Further treatment included 2 more debridements, intravenous antibiotics followed by oral antibiotics, and a split-thickness skin graft[10].

Wound infection was reported in a lower proportion of patients treated by EVH than in patients treated by OVH in the systematic review of 44 studies (log-relative risk 0.31, 95% CI 0.23 to 0.42, p<0.0001, I^2=43%)[1]. A similar result was reported from the analysis of randomised controlled trials only (log-relative risk 0.26, 95% CI 0.15 to 0.44, p<0.0001). Wound complications within 30 days were reported in 3% (3654/122,899) of patients treated by EVH and 4% (4047/112,495) of patients treated by OVH (adjusted hazard ratio=0.83; 95% CI 0.77 to 0.89, p<0.001) in the non-randomised comparative study of 235,394 patients[2]. Wound infection was reported in <1% of patients treated by EVH and 2% of patients treated by OVH in the non-randomised comparative study of 1988 patients (p=0.03)[6]. Minor wound healing complications were

reported in 4% of patients treated by EVH and 10% of patients treated by OVH (p=0.001) in the non-randomised comparative study of 885 patients; severe complications in the leg needing surgical revision were reported in 1% and 2% of patients respectively (p=not significant)[7].

Compartment syndrome

Compartment syndrome was reported in a case report. The patient complained of symptoms on postoperative day 4, including leg tightness, swelling and tenderness. Compartment syndrome was diagnosed and a fasciotomy was performed to decompress all 4 compartments of the lower leg. By 3 months, the patient had recovered without any neurological sequelae[9].

Carbon dioxide embolisation

A case series of 405 patients who had EVH assessed all patients with transoesophageal echocardiography and reported minimal CO_2 embolisation (<5 bubbles) in 13% (53/403), moderate embolisation (dozens of bubbles) in 3% (14/403) and massive embolisation (numerous bubbles in inferior vena cava, right atrium, right ventricle or pulmonary artery) in less than 1% (2/403) (length of follow-up period not reported). Of the 2 patients with massive embolisation, 1 was successfully treated pharmacologically and 1 required emergency cardiopulmonary bypass support to complete the coronary artery bypass grafting (CABG) surgery[8].

CO_2 tracking causing abdominal and scrotal distension

Pneumoperitoneum was reported in 1 patient in a case report[12]. During the procedure the abdomen enlarged significantly. There were no significant changes in haemodynamics and tidal volume was used to increase ventilation. After the procedure the abdomen was normal and no subcutaneous emphysema was noted; postoperative chest X-ray showed a complete resorption of CO_2, and no subcutaneous emphysema or gas below the diaphragm was seen.

Scrotal distension was reported in 1 patient in a case report[11]. The patient had a repaired inguinal hernia. During the EVH procedure, the patient's scrotum became abnormally enlarged and the harvesting system was immediately removed. After a few minutes, the system was reintroduced and the surgical team noticed the track of the CO_2 infiltrating through the ring into the scrotum. It was decided that the risk of testicular necrosis was considerable and the EVH was converted to the bridging vein harvesting technique. Postoperatively, severe contusion of the left leg was noted along with redness, swelling, pain and serous discharge. Cellulitis was suspected and the patient was treated with antibiotics. Fourteen days postoperatively, swelling decreased and the patient was discharged home.

Validity and generalisability of the studies

- Antiplatelet regimens vary between and within studies, which may influence the safety and efficacy outcomes.
- Techniques for vein harvest vary between studies and there are a number of devices available.
- The systematic review noted that there was likely to be publication bias with regard to wound infection[1].
- Three studies specified that they only included patients who were undergoing isolated CABG surgery[2,3,5].
- In one study, EVH was performed by an experienced surgeon in each centre whereas OVH was performed by trainee surgeons and surgical assistants[3]. The experience of the person harvesting the vein may affect the outcome.

Existing assessments of this procedure

The International Society of Minimally Invasive Cardiothoracic Surgery (ISMICS) published a consensus statement on endoscopic vascular harvest in CABG surgery in 2005[13]. The following were recommended:

1. EVH is recommended to reduce wound-related complications when compared with OVH.
2. Based on quality of conduit harvested, either EVH or OVH techniques may be used.
3. Based on major adverse cardiac events and angiographic patency at 6 months, either EVH or OVH techniques may be used.
4. EVH is recommended for vein harvesting to improve patient satisfaction and postoperative pain when compared with OVH in CABG surgery.
5. EVH is recommended for vein harvesting to reduce postoperative length of stay and outpatient wound management resources.

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B gives details of the recommendations made in each piece of guidance listed.

Interventional procedures

- Off-pump coronary artery bypass (OPCAB). NICE interventional procedure guidance 377 (2011). Available from http://guidance.nice.org.uk/IPG377
- Totally endoscopic robotically assisted coronary artery bypass grafting. NICE interventional procedure guidance 128 (2005). Available from http://guidance.nice.org.uk/IPG128
- Intraoperative fluorescence angiography for the evaluation of coronary artery bypass graft patency. NICE interventional procedure guidance 98 (2004). Available from http://guidance.nice.org.uk/IPG98

Medical technology guidance

- The VeriQ system for assessing graft flow during coronary artery bypass graft surgery. NICE medical technology guidance 8 (2011). Available from http://guidance.nice.org.uk/MTG8

Clinical guidelines

- Management of stable angina. NICE clinical guideline 126 (2011, last modified 2012). Available from http://guidance.nice.org.uk/CG126
- Unstable angina and NSTEMI: the early management of unstable angina and non-ST-segment-elevation myocardial infarction. NICE clinical guideline 94 (2010). Available from http://guidance.nice.org.uk/CG94

Specialist advisers' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their specialist society or royal college. The advice received is their individual opinion and does not represent the view of the society.

M Dalrymple-Hay, S Kendall (Society of Cardiothoracic Surgeons of Great Britain and Ireland), S Nair (British Cardiovascular Society)

- Two specialist advisers perform the procedure regularly and 1 has performed it at least once.
- Two specialist advisers consider the procedure to be definitely novel and of uncertain safety and efficacy; 1 considers it to be a minor variation of an existing procedure but with unknown safety.
- The comparator to this procedure would be open saphenous vein harvest.
- A theoretical adverse effect is potential damage to the vein, which might decrease the patency leading to increased major adverse cardiac events (postoperative myocardial infarction [MI], mid-term MI, mid-term mortality [2–

5 years], recurrence of angina and repeat revascularisation) and decreased survival over the long term (<5 years) after coronary artery bypass grafting (CABG).

- One adviser reported harvested vein thrombosis (acute or late) and carbon dioxide embolisation as anecdotal adverse events.
- Adverse events reported in the literature include decreased vein graft patency.
- Key efficacy outcomes include reduced hospital stay, reduced risk of leg wound infections, early mobility, early rehabilitation and return to normal activities after CABG, reduced rate of readmissions, freedom from MI, freedom from reintervention, freedom from perioperative MI and patient satisfaction.
- There are concerns regarding the mid- and long-term vein graft patency.
- One adviser noted that currently there are no major registries of this procedure in progress. Although the Society of Cardiothoracic Surgeons of Great Britain and Northern Ireland planned a prospective registry, this registry is not currently maintained.
- One adviser stated that 20 cases, initially with proctor training, are needed to undertake the procedure safely, and another stated that 30–40 training episodes are required.
- One adviser considers the potential impact of this procedure on the NHS to be major in terms of numbers of patients eligible for treatment and use of resources, 1 adviser considers the potential impact to be moderate and 1 considers it to be minor.

Patient commentators' opinions

NICE's Public Involvement Programme sent 20 questionnaires to 1 NHS trust for distribution to patients who had the procedure (or their carers). NICE received 7 completed questionnaires.

The patient commentators' views on the procedure were consistent with the published evidence and the opinions of the specialist advisers.

Issues for consideration by IPAC

- When this procedure was last considered by the Committee, a large non-randomised comparative study had recently been published (Lopes 2009), which reported significant differences between endoscopic and open harvesting. This contradicted evidence from a meta-analysis (Cheng 2005) and 5 available randomised controlled trials (3 of which were included in the meta-analysis). The Lopes study showed a high incidence of restenosis and occlusion in both groups. Table 2 in this overview summarises a more recent meta-analysis that includes Lopes 2009.
- Ongoing trials:
  - Study to Improve Long Term Vein Graft Patency After Coronary Bypass Surgery by Using a Novel Endoscopic Harvesting Technique (NCT01540422): USA, observational study, estimated enrolment=100, estimated study completion date=June 2014.
  - Long-term Results Following Endoscopic Vein Harvesting in Coronary Artery Bypass Surgery (NCT01480726): Denmark, observational study, estimated enrolment=132, estimated study completion date=December 2012 (Note: the recruitment status of this study is unknown because the information has not been verified recently).
  - ESOS (Endoscopic Saphenous Harvesting With an Open CO2 System) Trial: A Prospective Randomized Trial for Coronary Artery Bypass Grafting (CABG) Surgery (NCT01121341): Italy, RCT, estimated enrolment=200, estimated study completion date=June 2011 (Note: the recruitment status of this study is unknown because the information has not been verified recently).

References

1. Sastry P, Rivinus R, Parker RA et al. (2013) The influence of endoscopic vein harvesting on outcomes after coronary bypass grafting: a meta-analysis of 267 525 patients. European Journal of Cardio-Thoracic Surgery 44: 980–9

2. Williams JB, Peterson ED, Brennan JM et al. (2012) Association between endoscopic vs open vein-graft harvesting and mortality, wound complications, and cardiovascular events in patients undergoing CABG surgery. JAMA 308: 475–84

3. Grant SW, Grayson AD, Zacharias J et al. (2012) What is the impact of endoscopic vein harvesting on clinical outcomes following coronary artery bypass graft surgery? Heart 98: 60–4

4. Krishnamoorthy B, Critchley WR, Glover AT et al. (2012) A randomized study comparing three groups of vein harvesting methods for coronary artery bypass grafting: endoscopic harvest versus standard bridging and open technique. Interactive Cardiovascular and Thoracic Surgery 15: 224–8

5. Brat R, Horacek J, Sieja J (2013) Endoscopic vs open saphenous vein harvest for coronary artery bypass grafting: a leg-related morbidity and histological comparison. Biomedical Papers of the Medical Faculty of Palacky University in Olomouc, Czech Republic 157: 70–4

6. Ad N, Henry L, Hunt S et al. (2011) Endoscopic versus direct vision for saphenous vein graft harvesting in coronary artery bypass surgery. Journal of Cardiovascular Surgery 52: 739–48

7. Andreas M, Wiedemann D, Stasek S et al. (2013) Endoscopic vein harvesting is influenced by patient-related risk factors and may be of specific benefit in female patients. Interactive Cardiovascular & Thoracic Surgery 17: 603–7

8. Lin TY, Chiu KM, Wang MJ et al. (2003) Carbon dioxide embolism during endoscopic saphenous vein harvesting in coronary artery bypass surgery. Journal of Thoracic and Cardiovascular Surgery 126: 2011–15

9. Kolli A, Au JT, Lee DC et al. (2010) Compartment syndrome after endoscopic harvest of the great saphenous vein during coronary artery bypass grafting. Annals of Thoracic Surgery 89: 271–3

10. Liliav B, Yakoub D, Kasabian A (2011) Necrotizing fasciitis following endoscopic harvesting of the greater saphenous vein for coronary artery bypass graft. Journal of the Society of Laparoendoscopic Surgeons 15: 90–5

11. Najam O, Krishnamoorthy B, Kadir I et al. (2011) Scrotal distension after endoscopic harvesting of the saphenous vein in patients with inguinal hernia. Annals of Thoracic Surgery 92: 733–5

12. Lehmann A, Lang J, Weisse U et al. (2000) Pneumoperitoneum secondary to endoscopic harvest of saphenous vein graft. Annals of Thoracic Surgery 69: 1937–8

13. Allen K, Cheng D, Cohn W et al. (2005) Endoscopic Vascular Harvest in Coronary Artery Bypass Grafting Surgery: A Consensus Statement of the International Society of Minimally Invasive Cardiothoracic Surgery (ISMICS) 2005. Innovations: Technology & Techniques in Cardiothoracic & Vascular Surgery 1: 51–60

Appendix A: Additional papers on endoscopic saphenous vein harvest for coronary artery bypass grafting

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (table 2). It is by no means an exhaustive list of potentially relevant studies.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Allen KB, Heimansohn DA, Robison RJ et al. (2003) Influence of endoscopic versus traditional saphenectomy on event-free survival: five-year follow-up of a prospective randomized trial. Heart Surgery Forum 6: E143-E145	RCT n=112 (54 EVH) FU=5 years	5-year event-free survival (freedom from death, myocardial infarction, recurrent angina or congestive heart failure) was similar for the endoscopic and traditional harvest groups (75% vs. 74%, p=0.85).	Results from the same RCT are included in Sastry et al. 2013
Allen KB, Griffith GL, Heimansohn DA et al. (1998) Endoscopic versus traditional saphenous vein harvesting: A prospective, randomized trial. Annals of Thoracic Surgery 66: 26–32	RCT n=112 (54 EVH)	Multiple logistic regression analysis identified only the traditional harvest technique as a risk factor for leg wound complications with no significant interaction between harvest technique and any preoperative risk factor (p≤0.03).	Included in Sastry et al. 2013 meta-analysis
Allen KB, Heimansohn DA, Robison RJ et al. (2000) Risk factors for leg wound complications following endoscopic versus traditional saphenous vein harvesting. The heart surgery forum 3: 325–30	Non randomised comparative study n=919 (276 EVH) FU=6 weeks	Multivariable risk factors for leg wound complications following saphenectomy were traditional harvest technique (OR 7.56, CI 3.8-17.2, p<0.0001), diabetes (OR 2.10, CI 1.4-3.2, p=0.0006) and obesity (OR 1.82, CI 1.2-2.8, p=0.007)	Included in Sastry et al. 2013 meta-analysis
Andreasen JJ, Nekrasas V, and Dethlefsen C. (2008) Endoscopic vs open saphenous vein harvest for coronary artery bypass grafting: a prospective randomized trial. European Journal of Cardio-Thoracic Surgery 34: 384-389	RCT n=132 (66 EVH) FU=30 days	Mean cosmetic score: EVH= 4.5±0.77 OVH=3.8±1.02 (p<0.001) Severe wound complications: EVH=3%, OVH=27%, p<0.001	Included in Sastry et al. 2013 meta-analysis
Athanasiou T, Aziz O, Skapinakis P et al. (2003) Leg wound infection after coronary artery bypass grafting: a meta-analysis comparing minimally invasive versus conventional vein harvesting. Annals of Thoracic Surgery 76:2141-2146.	Meta analysis n=1156 (590 EVH) FU=5–42 days	Significant reduction in wound infection using endoscopic 3% (20/590) compared with conventional 14% (78/566) vein harvest, odds ratio 0.22 (95% CI 0.14 – 0.37) (p < 0.00001).	Only reports on wound infection A more recent meta-analysis is included (Sastry et al. 2013)

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Au WK, Chiu SW, Sun MP et al. (2008) Improved leg wound healing with endoscopic saphenous vein harvest in coronary artery bypass graft surgery: a prospective randomized study in Asian population. Journal of Cardiac Surgery 23: 633-637	RCT n=120 (60 EVH) FU=21 days	Satisfaction score at day 21: EVH=9.9, OVH=5.7, p<0.001 Conversion to open harvest in endoscopic group: 10% (6/60)	Included in Sastry et al. 2013 meta-analysis
Bitondo JM, Daggett WM, Torchiana DF et al. (2002) Endoscopic versus open saphenous vein harvest: A comparison of postoperative wound complications. Annals of Thoracic Surgery 73:523-528.	Non-randomised comparative study n=260 (154 endoscopic) FU=NR	Converted from endoscopic to open technique in 6% (9/154). Any complication: Endoscopic: 7% (9/133) Open: 28% (26/92) p=0.0001	Included in Sastry et al. 2013 meta-analysis
Bonde P, Graham ANJ, MacGowan SW. (2004) Endoscopic vein harvest: Advantages and limitations. Annals of Thoracic Surgery 77:2076-2082.	RCT n=108 (52 EVH) FU=24–37 months	Wound healing was significantly impaired in the open group in comparison with endoscopic group (p<0.01)	Included in Sastry et al. 2013 meta-analysis
Brandt CP, Greene GC, Maggart ML et al. (2013) Endoscopic vein harvest of the lesser saphenous vein in the supine position: A unique approach to an old problem. Interactive Cardiovascular and Thoracic Surgery 16: 1–4	n= 16 FU=not reported	Endoscopic vein harvest of the lesser saphenous vein with the patient in the supine position is safe, effective and affords conduits for a unique subset of patients undergoing coronary artery bypass grafting.	Larger studies are included in table 2.
Brandt CP, Greene GC, Pollard TR et al. (2003) Review of efforts to decrease costly leg wound complications in the medicare population following coronary revascularization. Heart Surgery Forum 6: 258–63	Non randomised comparative study n=3394	Wound rates in the Medicare group were 1% for EVH (n=741) versus 3% for OVH (n=1168), p=0.0163, despite a higher frequency of morbid obesity in the EVH population (p<0.0001)	The main focus of the study was cost comparisons.
Cable DG, Dearani JA, Pfeifer EA et al. (1998) Minimally invasive saphenous vein harvesting: endothelial integrity and early clinical results. Annals of Thoracic Surgery 66:139-143.	Case series n=38 FU=Not reported	Mean operative time was 62.3 minutes, and patients had little incisional pain but mild ecchymosis.	Larger studies are available in table 2 Data from randomised and non-randomised controlled trials is available in table 2 in the original overview

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Cadwallader RA, Walsh SR, Cooper DG et al. (2009) Great saphenous vein harvesting: a systematic review and meta-analysis of open versus endoscopic techniques. Vascular & Endovascular Surgery 43: 561-566	Meta-analysis n=3689	There was a significantly higher rate of infection in the open group compared with the endoscopic group,	A more recent systematic review and meta-analysis is included (Sastry et al. 2013)
Calcaterra D, Salerno TA (2007) Venous gas embolization during endoscopic vein harvesting for coronary artery revascularization: a life-threatening event. Journal of Cardiac Surgery 22: 498-499	Case report n=1	**CO_2 embolisation** Cardiac arrest occurred when CO_2 passed to from the right side of the heart to the left through a patent foramen ovale. CABG subsequently performed uneventfully.	Case report of adverse event already described in table 2.
Carpino PA, Khabbaz KR, Bojar RM et al. (2000) Clinical benefits of endoscopic vein harvesting in patients with risk factors for saphenectomy wound infections undergoing coronary artery bypass grafting. The Journal of thoracic and cardiovascular surgery 119: 69-75	RCT n=132	The use of endoscopic vein harvesting decreases the prevalence of postoperative leg-wound infections in high-risk patients with diabetes and obesity.	Included in Sastry et al. 2013 meta-analysis
Chavanon O, Tremblay I, Delay D et al. (1999) Carbon dioxide embolism during endoscopic saphenectomy for coronary artery bypass surgery. J Thorac.Cardiovasc.Surg. 118:557-558	Case report n=1	**CO_2 embolisation** Respiratory acidosis (pH=7.27, $PaCO_2$=64mmHg) Patient was later discarged without complications.	Case report of adverse event already described in table 2.
Cheng D, Allen K, Cohn W et al. (2005) Endoscopic vascular harvest in coronary artery bypass grafting surgery: a meta-analysis of randomized trials and controlled trials. Innovations 1: 61-74	Meta-analysis n=9462 (36 studies)	Mortality: EVH=1%, OVH=2% (OR 0.71, 95%CI 0.34 to 1.48) Pain at 6 months: EVH=4%, OVH=23% (OR 0.17, 95% CI 0.05 to 0.6) Wound infection: EVH=2%, OVH=8% (OR 0.32, 95% CI 0.20 to 0.53)	A more recent systematic review and meta-analysis is included (Sastry et al. 2013)
Chiu K-M, Chen C-L, Chu S-H et al. (2008) Endoscopic harvest of saphenous vein: A lesson learned from 1,348 cases. Surgical Endoscopy 22:183-187	Case series n=1348 FU=NR	Technical success: 98.6% Wound complications: 61 patients CO2 embolisation: 3 patients required immediate cardiopulmonary bypass	Larger studies in Table 2 Mixed indications for surgery also includes peripheral artery reconstruction and miscellaneous conditions – unclear how many.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Chou NK, Lee ML, Wang SS. (2009) Endoscopic vein harvest in elective off-pump coronary artery bypass grafting. Journal of Zhejiang University Science 748-752	NRCT n=348 (240 endoscopic vs 78 open) FU=1 year	Acute graft failure (perioperative MI): 1 patient in both group (p = 0.3985) Late graft failure at 1 year: 1 patient in open and 3 in endo group (p = 0.9999) Wound complications significantly lower in endoscopic group: 5% vs 19% (p=0.0002)	Larger studies in Table 2
Coppoolse R, Rees W, Krech R et al. (1999) Routine minimal invasive vein harvesting reduces postoperative morbidity in cardiac bypass procedures. Clinical report of 1400 patients. European Journal of Cardio-Thoracic Surgery 16:S61-S66.	Non-randomised comparative study n=600 (300 endoscopic) FU=3 weeks	The procedure was converted from endoscopic to open technique in 9% of patients No significant difference in wound complications between groups.	Included in Sastry et al. 2013 meta-analysis
Crouch JD, O'Hair DP, Keuler JP et al. (1999) Open versus endoscopic saphenous vein harvesting: Wound complications and vein quality. Annals of Thoracic Surgery 68:1513-1516.	Non-randomised comparative study n=568 (180 EVH)	Conversion to open procedure (due to poor vein quality or additional vein required): 7.2% (13/180) Wound complications: EVH=5%, OVH=14%, p<0.001	Included in Sastry et al. 2013 meta-analysis
D'arrigo G, Mauceri G, Mudano M et al. (2007) A new and safe device for minimally invasive saphenous vein harvesting: results after 100 cases. Innovations: Technology & Techniques in Cardiothoracic & Vascular Surgery 2: 205–8	Case series n=130	There were no wound dehiscences, infections, or major hematomas. There was 1 case (0.76%) of superficial hematoma and 3 cases (2.30%) of lymphoceles	Larger studies are included in table 2.
Dacey LJ, Braxton JH Jr, Kramer RS et al. (2011) Long-term outcomes of endoscopic vein harvesting after coronary artery bypass grafting. Circulation 123: 147–53	Non randomised comparative study n=8542	EVH was associated with a significant reduction in long-term mortality (adjusted hazard ratio, 0.74; 95% CI 0.60 to 0.92) but a nonsignificant increased risk of repeat revascularization (adjusted hazard ratio, 1.29; 95% CI 0.96 to 1.74). Similar results were obtained in propensity-stratified analysis	Included in Sastry et al. 2013 meta-analysis

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Davis Z, Jacobs HK, Zhang M, et al. (1998) Endoscopic vein harvest for coronary artery bypass grafting: Technique and outcomes. Journal of Thoracic & Cardiovascular Surgery 116:228-235.	Non randomised comparative study n=138 (110 endoscopic) FU=6 weeks	Leg infection rates did not differ between groups but other leg morbidities were less common in the endoscopic group	Included in Sastry et al. 2013 meta-analysis
Deppe A-C, Liakopoulos OJ, Choi Y-H et al. (2013) Endoscopic vein harvesting for coronary artery bypass grafting: A systematic review with meta-analysis of 27,789 patients. Journal of Surgical Research180: 114–24	Systematic review and meta-analysis n=27,789	The present systematic review underscores the safety of EVH in patients undergoing CABG. EVH reduces leg wound infections without increasing the midterm risk for vein graft failure, MI, or mortality.	A more recent meta-analysis is included (Sastry et al, 2013)
Desai P, Kiani S, Thiruvanthan N et al. (2011) Impact of the learning curve for endoscopic vein harvest on conduit quality and early graft patency. Annals of Thoracic Surgery 91:1385–91	Non randomised comparative study n=85	High-resolution imaging confirmed that technicians inexperienced with EVH are more likely to cause intimal and deep vessel injury to the saphenous vein graft, which increases graft failure risk.	Larger studies are included in table 2.
Felisky CD, Paull DL, Hill ME et al. (2002) Endoscopic greater saphenous vein harvesting reduces the morbidity of coronary artery bypass surgery. American Journal of Surgery 183:576-579.	Non-randomised comparative study n = 720 (340 endoscopic) FU=NR	One or more complication: Endoscopic: 7% Open: 23% p < 0.00001	Included in Sastry et al. 2013 meta-analysis
Folliguet TA, Bret E, Moneta A et al. (1998) Endoscopic saphenous vein harvesting versus 'open' technique. A prospective study. European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery 13: 662–6	RCT n=60 (30 EVH)	Endoscopic saphenous vein harvesting allows improved aesthetic aspect, less postoperative discomfort, with an increased time in harvesting in the beginning.	Included in Sastry et al. 2013 meta-analysis
Hayward TZ, Hey LA, Newman LL et al. (1999) Endoscopic versus open saphenous vein harvest: the effect on postoperative outcomes. The Annals of thoracic surgery 68: 2107-2110	RCT n=100 FU=6 weeks	No significant differences were detected in the primary outcomes: leg infection (p=0.75), incisional pain (p=0.74), physical health (p=0.84), mental health (p=0.47), and postoperative length of stay (p=0.74). However, patient preference for EVH was highly significant (p<0.01).	Included in Sastry et al. 2013 meta-analysis

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Kiaii B, Moon BC, Massel D et al. (2002) A prospective randomized trial of endoscopic versus conventional harvesting of the saphenous vein in coronary artery bypass surgery. Journal of Thoracic & Cardiovascular Surgery 123: 204-212	RCT n=144 (72 EVH) FU=6 to 8 weeks	Overall complication rate was significantly higher in the open group (p = 0.013)	Included in Sastry et al. 2013 meta-analysis
Kiani S, Desai PH, Thirumvalavan N et al. (2012) Endoscopic venous harvesting by inexperienced operators compromises venous graft remodeling. Annals of Thoracic Surgery 93: 11–7	Non-randomised comparative study n=85	Endoscopic vein harvesting by novice harvesters resulted in a greater number of discrete graft injuries and greater expression of tissue-injury genes than EVH done by experienced harvesters.	Larger studies in table 2.
Kirmani BH, Barnard JB, Mourad F et al. (2010) Mid-term outcomes for Endoscopic versus Open Vein Harvest: a case control study. Journal of Cardiothoracic Surgery 5: 44	Non-randomised comparative study n=107	All cause mortality was 2/89 (2%) and 11/182 (6%) in the EVH and OVH groups respectively. This was not significant (p=0.65), even if adjusting for inpatient mortality (p=0.74).	Included in Sastry et al. 2013 meta-analysis
Lai T, Babb Y, Ning Q et al. (2006) The transition from open to endoscopic saphenous vein harvesting and its clinical impact: The Texas Heart Institute experience. Texas Heart Institute Journal 33:316-320	Non-randomised comparative study n=1573 (588 endoscopic) FU= discharge	Leg wound infections: Endoscopic: 0.5% (3/588) Open: 2.7% (27/985) p<0.002	Included in Sastry et al. 2013 meta-analysis
Lopes RD, Hafley GE, Allen KB et al. (2009) Endoscopic versus open vein-graft harvesting in coronary-artery bypass surgery. New England Journal of Medicine 361: 235-244	Non randomised comparative study n=3000 (1753 EVH) FU=3 years	Vein graft failure: • EVH=47% • OVH=38%, p<0.001 Deaths (n): • EVH=128 • OVH=71, p=0.005	Included in Sastry et al. 2013 meta-analysis

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Lutz, CW, Hillman R, Lutter G, et al. (2001) Endoscopic vs. conventional vein harvesting :first results with a new , non-disposable system. Thoracic Cardiovascular Surgery 49:321-327	Non randomised comparative study n=182 (91 EVH) FU=1 month	Wound healing complications were significantly lower in the endoscopic group (3%) than in the open harvest group (15%) (p=0.015)	Larger studies are included in table 2.
Markar SR, Kutty R, Edmonds L et al. (2010) A meta-analysis of minimally invasive versus traditional open vein harvest technique for coronary artery bypass graft surgery. Interactive Cardiovascular and Thoracic Surgery 10: 266–70	Meta-analysis n=4799 (2033 EVH)	There appears to be a trend favouring EVH with regard to reduced pain, haematoma, incision length and infection rates. However, there are significant doubts regarding the long-term patency of grafts harvested endoscopically.	A more recent meta-analysis is included (Sastry et al. 2013)
Morris RJ, Butler MT, Samuels LE. (1998) Minimally invasive saphenous vein harvesting. Annals of Thoracic Surgery 66:1026-1028	Non randomised comparative study n=51 (27 endoscopic) FU=To discharge	The rate of leg oedema was greater in the open surgery group	Included in Sastry et al. 2013 meta-analysis
Ouzounian M, Hassan A, Buth KJ et al. (2010) Impact of endoscopic versus open saphenous vein harvest techniques on outcomes after coronary artery bypass grafting. Annals of Thoracic Surgery 89: 403–8	Non randomised comparative study n=5825 (2004 EVH) FU=median 2.6 years	Endoscopic saphenous vein harvest is associated with a lower rate of leg infection and is not an independent predictor of in-hospital or midterm adverse outcomes.	Included in Sastry et al. 2013 meta-analysis
Perrault LP, Jeanmart H, Bilodeau L et al. (2004) Early quantitative coronary angiography of saphenous vein grafts for coronary artery bypass grafting harvested by means of open versus endoscopic saphenectomy: A prospective randomized trial. Journal of Thoracic and Cardiovascular Surgery 127:1402-1407	RCT n=40 (17 EVH) FU=3 months (mean)	No difference in patency rates (85.2% vs. 84.4%, p = 0.991)	Included in Sastry et al. 2013 meta-analysis

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Puskas JD, Wright CE, Miller PK et al. (1999) A randomized trial of endoscopic versus open saphenous vein harvest in coronary bypass surgery. The Annals of thoracic surgery 68: 1509–12	RCT n=100 (47 EVH)	EVH is a safe, reliable, and cost-neutral method for saphenous vein harvest. The best indication for EVH may be in patients who are at increased risk for wound infection and in those for whom cosmesis is a major concern.	Included in Sastry et al. 2013 meta-analysis
Schurr UP, Lachat ML, Reuthebuch O et al. (2002) Endoscopic saphenous vein harvesting for CABG -- a randomized, prospective trial. The Thoracic and cardiovascular surgeon 50: 160–3	RCT n=140 (80 EVH) FU=3 months	EVH is a safe and efficient technique for CABG. Morbidity was significantly lower, with reduced pain and better cosmetic results. EVH time was significantly longer compared to the traditional harvesting technique.	Included in Sastry et al. 2013 meta-analysis
Simek M, Nemec P, Gwozdziewicz M et al. (2008) Endoscopic versus minimally invasive vein harvesting. Impact on leg-related morbidity in coronary artery bypass surgery: one-year follow-up of a prospective trial. Journal of Cardiovascular Surgery 49: 673-678	Non randomised comparative study n=300 (180 EVH) FU=1 years	Cardiac related mortality at 1 year: Endoscopic: 4.4% (8/180) Minimally invasive: 5.1% (6/120)	Larger studies are included in Table 2.
Tamim M, Al-Sanei A, Bukhari E, Canver C. (2008) Endoscopic saphenous vein harvesting: results of our initial experience.Turkish Journal of Thoracic and Cardiovascular Surgery 16:162-166.	Case series n=32 FU=5 months (mean)	6.3% (2/32) required conversion to open procedure. No wound infections postoperatively.	Larger studies are included in Table 2.
Tennyson C, Young CP, Scarci M. (2010) Is it safe to perform endoscopic vein harvest?. Interactive Cardiovascular & Thoracic Surgery 10: 625–9	Review n=8 papers	EVH reduces the level of postoperative pain and wound complication, with a high-level of patient satisfaction but a sub-analysis of a large RCT has recently called into question the medium- to long-term patency of grafts endoscopically harvested.	A more recent systematic review and meta-analysis is included (Sastry et al. 2013).
Vaidyanathan KR, Sankar MN, Cherian KM (2008) Endoscopic vs conventional vein harvesting: a prospective analysis. Asian Cardiovascular & Thoracic Annals 16: 134–8	Non randomised comparative study n=161 (81 EVH)	The number of cases to reach a plateau on the learning curve for endoscopic vein harvest was 20 for 2 lengths of vein and 35 for 3 lengths of vein.	Larger studies are included in Table 2.

Article	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Waqar-Uddin Z, Purohit M, Blakeman N et al. (2009) A prospective audit of endoscopic vein harvesting for coronary artery bypass surgery. Annals of the Royal College of Surgeons of England 91:426-429.	Case series n=25 FU=NR	12% (3/25) converted to open procedure.	Larger studies are included in table 2.
Wang H, Wu H, Jiang H et al. (2011) Initial experience with endoscopic saphenous vein harvesting for coronary artery bypass grafting in Chinese patients. Heart Surgery Forum 14: E291-E296	RCT n=40	There were no postoperative myocardial infarctions in either group and no deaths or reinterventions in either group during the follow-up period.	Included in Sastry et al. 2013 meta-analysis
Yun KL, Wu Y, Aharonian V et al. (2005) Randomized trial of endoscopic versus open vein harvest for coronary artery bypass grafting: Six-month patency rates. Journal of Thoracic & Cardiovascular Surgery 129: 496-503	RCT n=200 (100 EVH) FU=6 months	There were no significant differences in patency rates at 6 months.	Included in Sastry et al. 2013 meta-analysis
Zenati MA, Shroyer AL, Collins JF et al. (2011) Impact of endoscopic versus open saphenous vein harvest technique on late coronary artery bypass grafting patient outcomes in the ROOBY (Randomized On/Off Bypass) Trial. Journal of Thoracic & Cardiovascular Surgery 141: 338–44	RCT subanalysis n=894 (341 EVH) FU=1 year	For patients with 1-year catheterization follow-up (n=894), the saphenous vein graft patency rate for the endoscopic group was lower than that in the open harvest group (75% vs 85%, $p<0.0001$), and the repeat revascularization rate was significantly higher (7% vs 3%, $p<0.05$).	Included in Sastry et al. 2013 meta-analysis

Appendix B: Related NICE guidance for endoscopic saphenous vein harvest for coronary artery bypass grafting

Guidance	Recommendations
Interventional procedures	**Off-pump coronary artery bypass (OPCAB). NICE interventional procedure guidance 377 (2011).** 1.1 Current evidence on the safety and efficacy of off-pump coronary artery bypass grafting (CABG) is adequate to support the use of this procedure provided that normal arrangements are in place for clinical governance, consent and audit. 1.2 During the consent process, patients should be informed that they will be offered off-pump CABG rather than on-pump surgery, but that on-pump surgery may be a possibility. They should be informed about the uncertainties in relation to longer-term risks of graft occlusion and mortality, as well as the likely advantages of off-pump CABG, including the lower incidence of stroke. 1.3 Patient selection and treatment should be carried out by cardiac surgical teams who are skilled in both off-pump and on-pump surgery. 1.4 NICE encourages clinicians to submit data on patients having off-pump CABG to the UK Central Cardiac Audit Database, with a view to ultimately providing information about longer-term outcomes by linking the database to national statistics records. **Totally endoscopic robotically assisted coronary artery bypass grafting. NICE interventional procedure guidance 128 (2005)** 1.1 Current evidence on the safety and efficacy of totally endoscopic robotically assisted coronary artery bypass grafting does not appear adequate for this procedure to be used without special arrangements for consent and for audit or research. 1.2 Clinicians wishing to undertake totally endoscopic robotically assisted coronary artery bypass grafting should take the following actions. • Inform the clinical governance leads in their Trusts. • Ensure that patients understand the uncertainty about the procedure's safety and efficacy and provide them with

	clear written information. Use of the Institute's information for the public is recommended. • Enter all patients having totally endoscopic robotically assisted coronary artery bypass grafting onto the UK Central Cardiac Audit Database. 1.3 Publication of safety and efficacy outcomes will be useful. The Institute may review the procedure upon publication of further evidence. **Intraoperative fluorescence angiography for the evaluation of coronary artery bypass graft patency. NICE interventional procedure guidance 98 (2004)** 1.1 Current evidence on intraoperative fluorescence angiography suggests that the procedure is safe enough for routine use in the evaluation of coronary artery bypass graft patency. 1.2 There is limited evidence on the diagnostic utility (that is, the extent to which knowledge of its results improves patients' outcomes) of this procedure, and clinicians should therefore audit and review the clinical value of intraoperative fluorescence angiography in all patients having the investigation. The Institute may review the procedure upon publication of further evidence.

Medical technology	**The VeriQ system for assessing graft flow during coronary artery bypass graft surgery. NICE medical technology guidance 8 (2011)** 1.1 The case for adopting the VeriQ system in the NHS for assessing graft flow during coronary artery bypass graft (CABG) surgery is supported by the evidence. The evidence suggests that intra-operative transit time flow measurement is effective in detecting imperfections that may be corrected by graft revision. This may reduce the incidence of graft occlusion and may reduce perioperative morbidity and mortality. 1.2 The VeriQ system is associated with an estimated cost saving of £115 per patient compared with clinical assessment, when it is used routinely for assessing coronary artery bypass grafts during surgery.
Clinical guidelines	**Management of stable angina. NICE clinical guideline 126 (2011, last modified 2012)** ***People with stable angina whose symptoms are not satisfactorily controlled with optimal medical treatment*** 1.5.1 Consider revascularisation (coronary artery bypass graft [CABG] or percutaneous coronary intervention [PCI]) for people with stable angina whose symptoms are not satisfactorily controlled with optimal medical treatment. 1.5.2 Offer coronary angiography to guide treatment strategy for people with stable angina whose symptoms are not satisfactorily controlled with optimal medical treatment. Additional non-invasive or invasive functional testing may be required to evaluate angiographic findings and guide treatment decisions. 1.5.3 Offer CABG to people with stable angina and suitable coronary anatomy when: • their symptoms are not satisfactorily controlled with optimal medical treatment and • revascularisation is considered appropriate and • PCI is not appropriate. 1.5.4 Offer PCI to people with stable angina and suitable coronary anatomy when: • their symptoms are not satisfactorily controlled with optimal medical treatment and • revascularisation is considered appropriate and • CABG is not appropriate. 1.5.5 When either procedure would be appropriate, explain to the person the risks and benefits of PCI and CABG for people with anatomically less complex disease whose symptoms are not satisfactorily controlled with optimal medical treatment. If the person does not express a preference, take account of the evidence that suggests that

	PCI may be the more cost-effective procedure in selecting the course of treatment. 1.5.6 When either procedure would be appropriate, take into account the potential survival advantage of CABG over PCI for people with multivessel disease whose symptoms are not satisfactorily controlled with optimal medical treatment and who: • have diabetes or • are over 65 years or • have anatomically complex three-vessel disease, with or without involvement of the left main stem. 1.5.7 Consider the relative risks and benefits of CABG and PCI for people with stable angina using a systematic approach to assess the severity and complexity of the person's coronary disease, in addition to other relevant clinical factors and comorbidities. 1.5.8 Ensure that there is a regular multidisciplinary team meeting to discuss the risks and benefits of continuing drug treatment or revascularisation strategy (CABG or PCI) for people with stable angina. The team should include cardiac surgeons and interventional cardiologists. Treatment strategy should be discussed for the following people, including but not limited to: • people with left main stem or anatomically complex three-vessel disease • people in whom there is doubt about the best method of revascularisation because of the complexity of the coronary anatomy, the extent of stenting required or other relevant clinical factors and comorbidities. 1.5.9 Ensure people with stable angina receive balanced information and have the opportunity to discuss the benefits, limitations and risks of continuing drug treatment, CABG and PCI to help them make an informed decision about their treatment. When either revascularisation procedure is appropriate, explain to the person: • The main purpose of revascularisation is to improve the symptoms of stable angina. • CABG and PCI are effective in relieving symptoms. • Repeat revascularisation may be necessary after either CABG or PCI and the rate is lower after CABG. • Stroke is uncommon after either CABG or PCI, and the incidence is similar between the two procedures. • There is a potential survival advantage with CABG for some people with multivessel disease. 1.5.10 Inform the person about the practical aspects of CABG and PCI. Include information about: • vein and/or artery harvesting • likely length of hospital stay • recovery time • drug treatment after the procedure.

	Unstable angina and NSTEMI: The early management of unstable angina and non-ST-segment-elevation myocardial infarction. NICE clinical guideline 94 (2010, last modified 2012) ***Percutaneous coronary intervention versus coronary artery bypass grafting*** 1.5.4 When advising patients about the choice of revascularisation strategy (PCI or CABG), take account of coronary angiographic findings, comorbidities, and the benefits and risks of each intervention. 1.5.5 When the role of revascularisation or the revascularisation strategy is unclear, resolve this by discussion involving an interventional cardiologist, cardiac surgeon and other healthcare professionals relevant to the needs of the patient. Discuss the choice of revascularisation strategy with the patient.

Appendix C: Literature search for endoscopic saphenous vein harvest for coronary artery bypass grafting

Databases	Date searched	Version/files
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	18/2/2014	Issue 1 of 12, January 2014
Database of Abstracts of Reviews of Effects – DARE (CRD website)	18/2/2014	Issue 1 of 12, January 2014
HTA database (CRD website)	18/2/2014	Issue 1 of 12, January 2014
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	18/2/2014	Issue 1 of 12, January 2014
MEDLINE (Ovid)	18/2/2014	1946 to February Week 1 2014
MEDLINE In-Process (Ovid)	18/2/2014	February 14, 2014
PubMed	18/2/2014	
EMBASE (Ovid)	18/2/2014	1974 to 2014 Week 07
CINAHL (NLH Search 2.0 or EBSCOhost) (delete if not requested)	18/2/2014	N/A
JournalTOCS	18/2/2014	Endoscopic versus direct vision for saphenous vein graft harvesting in coronary artery bypass surgery.

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

1	Saphenous Vein/ and "Tissue and Organ Harvesting"/
2	((vein* or vascular or vessel) adj3 (harvest* or remov* or retriev*)).tw.
3	"Tissue and Organ Harvesting"/
4	EVH.tw.
5	or/1-4
6	Endoscopy/
7	Endoscopes/

8	endoscop*.tw.
9	percutaneous.tw.
10	6 or 7 or 8 or 9
11	5 and 10
12	Coronary Artery Bypass/
13	((aortocoronary or aorto-coronary or coronary or heart or cardiac) adj3 (bypass* or graft* or transplant* or implant*)).tw.
14	CABG.tw.
15	SVG.tw.
16	or/12-15
17	11 and 16
18	animals/ not humans/
19	17 not 18
20	limit 19 to ed=20100128-20130331
21	limit 19 to ed=20130331-20131023