A prospective audit of endoscopic vein harvesting for coronary artery bypass surgery

ZAKARIYA WAQAR-UDDIN, MANOJ PUROHIT, NADENE BLAKEMAN, JOSEPH ZACHARIAS

Department of Cardiothoracic Surgery, Lancashire Cardiac Centre, Blackpool Victoria Hospital, Blackpool, UK

ABSTRACT

INTRODUCTION: The objectives of this study were to: (i) assess the feasibility of minimally invasive endoscopic harvesting of the long saphenous vein or radial artery for use as conduit during coronary artery bypass surgery in the NHS setting; and (ii) investigate the results of endoscopic vein harvesting with regards to postoperative complications, ability to mobilise, and patient satisfaction.

PATIENTS AND METHODS In this prospective audit, 25 consecutive patients, aged 52–90 years, undergoing either coronary artery bypass grafting alone or together with valve surgery or atrial fibrillation ablation were studied. All data were entered in purpose-designed proforma. Pre-operative risk factors including increasing age, diabetes, peripheral vascular disease, obesity, renal impairment, tobacco consumption and steroid use were documented. Time taken for harvest and conversion to traditional open vein harvest, quality of harvested vein in terms of number of repairs and vein damage were recorded. Postoperatively, we recorded harvest site wound complications, number of days to mobilise and total hospital stay. Pain score and patient satisfaction were also assessed.

RESULTS There was one death due to myocardial infarction; another patient had postoperative cerebrovascular accident. A total of 43 lengths of grafts were harvested, 41 were long saphenous vein and two radial artery. Vein harvest time reduced significantly from a maximum of 94 min to 34 min for two lengths of long saphenous vein. Three patients required conversion from endoscopic vein harvesting to open vein harvest. The only postoperative complication directly related to endoscopic harvesting was bruising along the tunnel created by the passage of the instruments. None of the patients had any wound complication; none required antibiotics or wound debridement. Mean time to mobilise was 3.4 days. All patients who underwent successful endoscopic vein harvesting expressed satisfaction with regards to postoperative pain and cosmetic result.

CONCLUSIONS Competence and ability to harvest conduit in an acceptable time frame are obtainable after a relatively low number of cases. The procedure is associated with a low number of postoperative complications and very high patient satisfaction.

KEYWORDS

Endoscopic vein harvesting – Long saphenous vein – Radial artery

CORRESPONDENCE TO

Joseph Zacharias, Lancashire Cardiac Centre, Blackpool Victoria Hospital, Whinney Heys Road, Blackpool FY3 8NR, UK
E: drjzacharias@gmail.com

Coronary artery bypass grafting (CABG) for the treatment of ischaemic heart disease has been performed for over 40 years.¹ Although arterial conduits, namely the internal mammary and radial artery, are being increasingly utilised, the long saphenous vein remains the staple conduit in the majority of cases. Traditional harvest requires an open technique, which may entail a longitudinal incision from the ankle up to the groin, depending on the number of conduits required. This has been associated with postoperative complications in as many as 25% of cases, ranging from simple wound infection requiring a course of antibiotics to complete wound dehiscence requiring plastic surgical input and skin grafting.¹ These complications delay the postoperative recovery and increase hospital stay and total cost. This

problem often does not resolve at discharge, requiring significant input from general practitioners and district nurses. With the trend towards minimally invasive cardiac surgical procedures, the techniques of endoscopic surgery have been employed to create a system where it is possible to harvest the entire length of the long saphenous vein. The same technology has been also employed in the endoscopic harvest of the radial artery.

Patients and Methods

Twenty-five consecutive patients between 29 October 2007 and 19 January 2008 were studied in this prospective audit. The harvesting system employed was the Guidant Vasoview

Figure 1 The path of the long saphenous vein can be clearly seen on insufflation of carbon dioxide.

6 (Guidant Corporation; 3200 Lakeside Drive, Santa Clara, CA, USA). Patients' legs were circumferentially swabbed with povidone iodine and their feet placed in sterile stockinettes. A 2.5–3-cm incision was made a handbreadth behind the medial margin of the patella on the medial aspect of the knee and blunt dissection was used to identify the long saphenous vein in the subcutaneous tissues. The rigid 7.5-mm endoscope is connected to a Karl Storz video stack system in the operating theatre, placed in the space created by blunt dissection and advanced proximally along the course of the long saphenous vein, creating a tunnel, facilitated by insufflation of carbon dioxide via a side port (Fig. 1).

The vein was circumferentially dissected using a C-ring, which allowed simultaneous identification of side branches. These were interrupted from proximal to distal using an in-built bipolar diathermy knife. At the groin, a small incision was made under endoscopic guidance over the long saphenous vein, which was then extricated, divided, and the proximal stump ligated. The long saphenous vein was retrieved from the knee incision, cannulated, inspected, repaired if needed and used for grafting. The incisions were then closed in the standard fashion, using subcutaneous and subcuticular sutures. Dressings were applied at both sites and the leg was bandaged. Conduit harvest sites were inspected on the first day of discharge from the intensive care unit and on the day of discharge back into the community.

Apart from demographic data, pre-operative risk factors recorded included diabetes, peripheral vascular disease, obesity (defined as body mass index $> 30 \text{ kg/m}^2$), renal failure, steroid use and tobacco consumption (defined as a smoking history of 20 pack years or greater).

Intra-operative details recorded were number of lengths of conduit harvested, time taken for harvest, site harvested and whether conversion to open vein harvest was required. The number of repairs to conduit was also recorded.

Table 1 Surgical procedures undertaken

Procedure	Patients (n)
Coronary artery bypass grafting (CABG)	15
Re-do CABG	1
CABG + valve	8
CABG + atrial fibrillation ablation + excision of clot left atrium	1

In the postoperative period, any harvest site related wound complication and level of pain at conduit harvest site on a standard visual analogue sliding scale of 0–10 (10 being the worst) was recorded. Number of days to mobilise (able to walk to the bathroom and back, as independently documented by the ward physiotherapist) and total hospital stay was also recorded in a purpose-defined proforma.

Patients were interviewed by telephone in the postoperative period to determine their experience.

Results

Of the 25 patients, 12 were female. The mean age was 71.1 years (range, 52–90 years). Mean Euroscore was 5 (range, 1–13), and mean Parsonnet score was 13.2 (range, 3–33). Smoking (48%), obesity (32%), and peripheral vascular disease (12%) were the main pre-operative risk factors of poor wound healing. Table 1 details the surgical procedures undertaken.

A total of 42 lengths of long saphenous vein and two radial arteries were harvested. The average number of grafts was two per patient (range, 1–4). Table 2 shows the details of grafts.

Three patients (12%) required conversion to open vein harvest. In one case, there was difficulty locating the vein; in the second incidence, the incorrect vein was identified; and on the

Table 2 Details of grafts

Conduits		
Long saphenous vein		23
Radial artery		2
Harvest site		
Thigh	One side	20
	Both sides	3
Left forearm		2
Grafts harvested per patient		
One		3
Two		17
Three		2

third occasion, whilst the vein was harvested successfully, it was found to be unsuitable for use when cannulated.

Harvest time reduced significantly with increasing familiarity with the new system as illustrated in Figure 2. Only two vein grafts required repair by 7 '0'-polypropylene suture.

One patient died 4 days' postoperatively in the intensive care unit due to myocardial infarction, unrelated to conduit harvest. Another patient had a cerebrovascular accident on the second postoperative day and, therefore, required longer time to mobilise. The patient who died had undergone successful endoscopic radial artery harvest whereas the patient with the cerebrovascular accident had required conversion to open vein harvest.

Four patients required re-sternotomy for bleeding on the operating day. The conduits were noted to be the source of bleeding in only one case.

Average time to mobilise was 3.4 days (range, 2–7 days). Only two patients required more than 4 days to mobilise due to other co-morbidities.

Postoperative pain was extremely low in the endoscopic group, five patients reporting a score of 0 out of 10, seven a score of 1, five a score of 2, and two a score of 3. The same group rated the pain from their sternotomy site at 5–10, with a mean score of 6. Two patients developed serosanguinous discharge at the knee incision. In the endoscopic group, three patients had no bruising whatsoever at either of the incisions.

Thirteen patients developed bruising at the sites of incision. Five patients developed bruising along the tunnel created by the passage of the endoscopic instruments. Figure 3 illustrates bruising along the passage of the scope 2 days' postoperatively in the third successful case.

There were no other wound complications related to harvest site. Time to discharge ranged from 4–51 days (mean, 9.7 days).

Figure 3 Bruising along the passage of the endoscope at 2 days' postoperatively in the third successful case.

One octogenarian patient remained in hospital for 15 days due to the development of postoperative atrial fibrillation and pleural effusion. A second patient waited for permanent pacemaker implantation and stayed for 22 days. A third patient suffered a perforated duodenal ulcer after return from the intensive care unit. She underwent laparotomy and was discharged 51 days' postoperatively.

The mean time to mobilise (2.8 days versus 4 days) and hospital stay (7.6 days versus 15 days) were much less in those patients who underwent isolated coronary artery surgery, as compared to those who underwent CABG plus a concomitant procedure.

Three patients expressed surprise that they had had a procedure performed on the leg. All 20 who underwent successful endoscopic harvesting expressed pleasure at the lack of pain and good cosmesis.

Discussion

Conduit harvest site complications in bypass surgery are associated with significant morbidity, increased hospital stay and total cost. The endoscopic technique has been developed to prevent these complications and improve patient satisfaction.

This audit was designed to analyse results of this new endoscopic technique in the first 25 patients, in terms of feasibility and postoperative results.

Although one of the first attempts took 94 min, our twenty-third case took only 34 min (over 2.5 times less). Various papers have cited vein procurement time for two lengths of conduit using open vein harvest of 32–64.4 min and using endoscopic

vein harvesting of 27.6–65 min.² The evidence is largely inconclusive on which is the quicker technique. Certainly there is a learning curve to be surmounted in mastering either. In our study, a single operator (a consultant surgeon) performed the conduit harvest. Traditionally, vein harvest has been the job of the most junior member of the surgical team, and with the development of new roles in the NHS, the surgical care practitioner.

Multiple, randomised, controlled trials have found statistically significant benefits with endoscopic vein harvesting, in terms of lower harvest site wound complications and re-interventions while maintaining the quality and short-term results of vein patency.^{2,5} Yun *et al.*,⁴ in a randomised controlled trial, found similar vein patency at 6 months between an open vein harvest and an endoscopic vein harvesting group. A consensus panel of the International Society of Minimally Invasive Cardiac Surgery (ISMICS) agreed that endoscopic vein harvesting is recommended to reduce wound complications when compared with open vein harvest. ISMICS also recommended endoscopic vein harvesting to improve patient satisfaction and postoperative pain, as well as to reduce the length of postoperative stay and out-patient wound management resources. All this is based on Class I evidence. ISMICS has also agreed that there is no difference in the quality of vein harvested using either the open or endoscopic technique, with regards to major adverse cardiac events and angiographic patency at 6 months. This is Class II evidence.⁵

Although not investigated in this audit, the obvious issue of financing endoscopic vein harvesting must be raised. The cost of a pilot of 40 cases for our unit was calculated at £20,000. The cost per case for the isolated vessel harvesting procedure is £556 using the Vasoview system, versus £131 for traditional open vein harvest. However, considering the financial burden of the much greater number of complications associated with open vein harvest, which can range from leg wound infection to complete wound dehiscence requiring plastic surgical input, the total cost per case, using our financial model, is almost £300 less using endoscopic vein harvesting.

We were required to convert to open vein harvest in 12% of cases. In all three cases the patients were obese. In the third open case, two lengths were successfully harvested endoscopically. However, on cannulation of the vessel outside of the leg, only one length was found to be suitable for grafting, hence another length was procured by the open method. One of the drawbacks of endoscopic vein harvesting is that vessel suitability cannot be assessed accurately until the conduit is fully removed.

Although one of the benefits of endoscopic harvesting is earlier mobilisation, there are several other influencing factors amongst cardiac surgical patients. Patients do not mobilise until they have left the intensive care unit. Although the average time spent in the intensive care unit at the Lancashire Cardiac Centre is 1.5 days, in our audit two patients spent 4 days, another spent 7 days and the patient who suffered a cerebrovascular accident spent more than 30 days in the intensive care unit. Even on

the ward, postoperative complications associated with cardiac surgery (such as atrial fibrillation and pleural effusions) limit time to mobilise.

Conclusions

What this audit highlights strongly is the very small incidence and range of wound complications associated with endoscopic vessel harvesting, as well as the minimal pain associated with the procedure. Currently, the incidence of postoperative wound complications associated with open vein harvest in British cardiac surgical centres is 10–24%. The greatest complication we experienced in our audit was bruising along the tunnel created by the passage of the endoscope. Remarkably, even those patients who sustained considerable bruising reported a very low pain score. It should be stated that none of the patients who underwent successful endoscopic vein/radial artery harvesting required a single intervention with regards to the harvest site in the 6 weeks' postoperatively. All were satisfied with regards to both the level of pain as well as cosmetic appearance at the point of discharge.

Although endoscopic vein harvesting will be of obvious benefit in those who are at high risk of wound breakdown, most commonly those who are obese, diabetic or with a long smoking history, we hope that, in time, more than half of our coronary artery surgery will utilise endoscopic vein harvesting, with its enviable lack of complications and superior cosmetic results.

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