Best Evidence Topic

A review of the best method of leg wound closure following open harvesting of the long saphenous vein for coronary artery bypass grafting

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ABSTRACT

Uncertainty exists around the optimal method of leg wound closure following open long saphenous vein harvesting in adults undergoing coronary artery bypass graft surgery (CABG). Such is evident from the variety observed in the closure approach utilised. Consequently, a best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was ‘following open long saphenous vein harvesting in adults undergoing CABG, is single-layer leg wound closure superior to multiple-layer closure in terms of post-operative complications encountered?’ Altogether 382 papers on Ovid Embase and Ovid Medline, 301 papers on PubMed and 11 papers on the Cochrane database were found using the reported search. From the screened articles, 6 represented the best evidence to answer the clinical question. The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes and results of these papers are tabulated. We conclude that the best method of leg closure following open saphenous vein harvesting for CABG is single-layer cutaneous closure. The use of a suction drain to eliminate the dead space should be considered on a case-to-case basis by the lead operating surgeon with the patient’s characteristics and their own expertise in mind.

1. Introduction

Leg wound complications following coronary artery bypass graft surgery (CABG) are a major cause for morbidity requiring further invasive interventions [1]; a large-scale study by Paletta et al. reported an average lower extremity complication rate of 4.1% which conforms with the range observed in other literature findings [1–4]. As such, it is important to study every surgical aspect to identify methods of minimising the complication rate where possible in addition to making economic and time savings. Endoscopic vein harvesting of the long saphenous vein (LSV) is gaining popularity over the open approach owing to its lower complication rate [5]; however, several centres continue to use the open technique due to factors such as the harvest time, learning curve and cost. In this study, we have focused on the open technique. Traditionally, when employing the open approach to harvesting the LSV as a conduit for CABG, a double-layer closure technique is used where the subcutaneous tissue is closed first followed by cutaneous closure. Here, we review the best evidence available to determine whether the multiple-layer approach should be replaced by a single-layer cutaneous closure. This best evidence topic was constructed according to a structured protocol; this is fully described by the International Journal of Surgery [6].

2. Clinical scenario

A 74-year-old patient with a background of type 1 diabetes mellitus initially presented to the chest pain clinic with angina. Further investigations were carried out including percutaneous angiography which revealed severe triple vessel disease of the coronary arteries. Echocardiography found no valvular pathology and a left ventricular ejection fraction of 30–35%. The case was discussed at the multidisciplinary meeting and CABG was recommended. You discuss the choice of conduit with the patient. The patient who is of a surgical background enquires further about the outcomes encountered when using a single-layer leg wound closure compared with multiple-layer closure. Unsure of the best closure technique, you resolve to check the literature for evidence.
3. Three-part question

In [adults undergoing coronary artery bypass graft surgery], which method of leg wound closure following open long saphenous vein harvesting [single-layer versus multiple-layer closure] is superior in terms of [length of admission and post-operative complications] encountered?

4. Search strategy

The search strategy outlined below was utilised and where possible the results were limited to English articles, Persian articles and human studies. In addition, the reference lists of the screened articles were reviewed.

Medline 1946 to May 2021 and Embase 1974 to May 2021 using the OVID interface:

[(single layer) OR (single-layer) OR (double layer) OR (double-layer) OR (multiple layer) OR (multi layer) OR (multi-layer) OR (unilayer) OR (uni-layer) OR (bilayer) OR (bi-layer) OR (closure)] AND [(bypass) OR (cardiac surgery) OR (cardiothoracic) OR (cardiac)] AND [Saphenous]

Medline using the PubMed interface:

[(single layer) OR (single-layer) OR (double layer) OR (double-layer) OR (multiple layer) OR (multi layer) OR (multi-layer) OR (unilayer) OR (uni-layer) OR (bilayer) OR (bi-layer) OR (closure)] AND [(bypass) OR (cardiac surgery) OR (cardiothoracic) OR (cardiac)] AND [Saphenous]

Cochrane Database:

Saphenous vein, layer

5. Search outcome

382 papers on Ovid Embase and Ovid Medline, 301 papers on PubMed and 11 papers on the Cochrane database were found using the reported search and screened. From these, 6 papers were identified that provided the best evidence to answer the question determining the optimal leg wound closure technique following open LSV harvesting in adults undergoing CABG. These are presented in Appendix 1. An example of the screening and eligibility assessment process for the search results obtained from the Ovid interface is detailed in Fig. 1.

6. Results

The results of this article are tabulated in Appendix 1 which contains a review of the most relevant and highest quality evidence available assessing the best method of leg wound closure after harvesting the LSV for CABG. This table is structured according to the guidance by the International Journal of Surgery [6] highlighting key results, statistical analysis and study limitations.

7. Discussion

In 2011, a randomised controlled trial by Siddiqi et al. compared single-layer closure of the leg over a suction drain (with drain removal after 48 hours) against double-layer closure following extraction of the LSV for CABG [7]. The harvesting of the vein was performed by a single surgeon and the patients were followed up until two weeks after discharge. The ASEPSIS score was used to assess the wound in this study; this scoring method was first described in a study published in the Lancet by Wilson et al. on cardiac surgery patients [8] and has been shown to be a reliable method of wound assessment [9]. The ASEPSIS score allocates points for the following: need for Additional treatment, Serous discharge, Erythema, Purulent exudate, Separation of deep tissues, Isolation of bacteria, and the duration of inpatient Stay. In the study by Siddiqi et al. the mean ASEPSIS score of both single- and double-layer groups were within the satisfactory healing category; however, a statistically significant lower ASEPSIS score was observed in the single-layer group compared with the double-layer group. Furthermore, a smaller percentage of complications were encountered in the single-layer group. Consequently, it was concluded that single-layer closure of the leg wound should be the method of choice.

Tiryakioglu et al. conducted a randomised controlled trial in 2010...
comparing single-layer closure with double-layer closure following saphenectomy for CABG [10]. Several aspects of the leg wound were assessed up to 2 months post-operatively. There were no statistically significant differences between the two groups in terms of the demographics, operative time, number of grafts and hospitalisation period. Whilst it was found that up to the point of 1 week post-discharge, the incidence of haematoma was higher in the single-layer group, this was not statistically significant. On the other hand, the single-layer group demonstrated a statistically significant lower incidence of infection, oedema, numbness and number of legs with associated complaints. As such, it was reasonably concluded that single-layer closure should be the favoured method.

In 2006, a randomised controlled trial by Stenvik et al. investigated single-layer leg wound closure against double-layer closure and further investigated the impact of the operating practitioner harvesting the vein (rotational surgical residents against one dedicated experienced physical assistant) [11]. Whilst a lower incidence of infection was observed in the single-layer group, this was not statistically significant. Of note is the fact that there was a significant lower infection rate in the group operated on by one dedicated physical assistant when compared to the group operated on by surgical residents. In terms of closure technique, similar findings were reported in a study by Teebken et al. who observed no significant difference between the two closure methods when considering haematoma formation, length of hospital stay, infection and wound dehiscence; this article by Teebken et al. has not been tabulated in the present study because it is not available in English [12].

Zafar et al. conducted a randomised controlled trial in 2005 to compare single-layer leg closure over a suction drain (with drain removal after 24 hours) against double-layer closure following saphenectomy for CABG [13]. The legs were reviewed every 48 hours until discharge and at 6 weeks in the outpatient clinic. The randomisation method of minimisation and the statistical analysis are clearly defined. The ASEPSIS score, used to assess the wound in this study, suggested that the use of a fat suture is not necessary and as such its use should be discontinued.

The discussions of this study are limited by the weaknesses of the included articles which are highlighted in the comments section of the table in Appendix 1. For instance, it is important to note that the inconsistency in wound healing descriptors makes comparisons between studies more challenging. The ASEPSIS scoring system has been validated as a reproducible method to quantify wound healing and is recommended for future studies in this field.

8. Clinical bottom line

Taking into account the above discussed articles representing the best evidence topics available, it is evident that the best method of leg wound closure following LSV harvesting for CABG is single-layer cutaneous closure. Some of the discussed studies combined single-layer closure with the use of a suction drain; as such, the use of a suction drain to eliminate the dead space should be considered on a case-to-case basis by the lead operating surgeon with the patient’s characteristics and their own expertise in mind.

Ethical approval

Not required.

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Author contribution

- Mr. Pedram Panahi, MBBS, MRes (Distinction), PGCert (Clinical Education), MRCS: Generated research proposal, conducted literature search, data collection, data entry into table and manuscript write up.
- Dr. Ali Adeb Ilyas, MBChB, BAO: Reviewed literature search methodology, data collection and data entry into table.
- Mr. Clinton Lloyd, MBChB, FRCS (CTh): Reviewed research proposal and manuscript.
- Mr. Adrian Marchbank, BSc, MBBS, FRCS (CTh, McCormack Medal): Reviewed research proposal and manuscript.
Consent
Not required.

Registration of research studies
Not required.

Guarantor
Pedram Panahi

Declaration of competing interest
None to declare.

Appendix 1. Best evidence articles

| Article | Author, date, journal, country and study type | Patient group | Outcomes | Key results | Comments |
|---------|-----------------------------------------------|---------------|----------|-------------|----------|
| Prospective comparative study of single-layer versus Double-layer closure of leg wounds after long saphenous vein harvest in coronary artery bypass graft operations [7] | Siddiqi et al. (2011) n = 77 | - Single layer (SL) = 52 - Double layer (DL) = 25 | Length of incision | - SL = Median (52 cm) and mean (52.6 cm) - DL = Median (54 cm) and mean (58.5 cm) - Mean ASEPSIS score in all patients - 4.038 in SL and 9.467 in DL - p < 0.001 - Mean ASEPSIS score in diabetics - 3.69 in SL and 13.2 in DL - Reported as statistically significant, though level of significance not mentioned. - Infective wound characteristic - observed in 0% of the SL and 3.33% of the DL group - Statistical significance not measured. | Randomisation method not delineated, but method of statistical analysis clearly defined. Non-significant discrepancy was observed in the gender of patients (58 male and 19 female patients), method of closure (52 by SL and 25 by DL), and proportion of diabetics (61.53% of SL subgroup and 41.6% of DL subgroup). Statistically significant discrepancy was observed in the proportion of those with renal failure (7.6% of SL subgroup and 33.3% of DL subgroup - p = 0.012). The above discussed discrepancies may be a source of selection bias in this study. NB. a lower ASEPSIS score indicates better healing. |
| | | | Infection | - Proportion of SL group affected - Serous discharge (28.8%), inflammation (23.07%) and oedema (23.07%). - Proportion of DL group affected - Serous discharge (46.6%), inflammation (46.6%) and oedema (53.3%). | |
| | Journal of Thoracic Disease, Oman, Prospective randomised trial (Level 1b) | Oedema/erythema/haematoma/seroma | | | |
| | | | Length of admission | - SL = 10.67 days - DL = 11 days - Proportion of SL group affected by pain (44.2%). - Proportion of DL group affected by pain (73.33%). The difference is specified as statistically significant, but the exact p value not mentioned. | |
| | | | Other | | |
| Unilayer closure of saphenous vein incision lines is better than bilayer closure [10] | Osman Tiryakioglu et al. (2010) n = 79 (Total recruited number was reduced from 82 following exclusion of 3 patients due to inpatient mortality). - Single layer (SL) = 41 - Double layer (DL) = 38 | | Length of incision | - SL = 40 ± 5.5 cm (Median) - DL = 43 ± 6 cm (Median) Difference not statistically significant. - Findings up to 1 week post discharge - SL (4.8%) and DL (21%) - p = 0.033 - Findings at 2nd post-operative month - SL (0%) and DL (5.2%) - p = 0.05 Oedema | Randomisation method not defined, but method of statistical analysis clearly delineated. No declaration of conflict of interest. No statistically significant difference in the demographics of the two groups. Further, no differences in operative time, number of grafts or hospitalisation period. To assess oedema, a measuring tape mounted on a fixed surface (continued on next page) |
Effect of subcutaneous suture line and surgical technique on wound infection after saphenectomy in coronary artery bypass grafting: A prospective randomised study [11]

Stenvik et al. (2006)

n = 239 (Total recruited number was reduced from 243 following exclusion of 4 patients from group A). This sample was constituted from two subgroups:

Group A (Test group, total = 119) were all operated on by one physical assistant and the patients randomised to either single layer (SL = 59 patients) or double layer (DL = 60 patients).

Group B (Control group, total = 120) were all operated on by rotational surgical residents.

Scandinavian Cardiovascular Journal, Norway, Prospective randomised trial (Level 1b)

| Article | Author, date, journal, country and study type (Level of Evidence) | Patient group | Outcomes | Key results | Comments |
|---------|-------------------------------------------------------------------|---------------|----------|-------------|----------|
| The Open Cardiovascular Medicine Journal, Turkey, Prospective randomised trial (Level 1b) | Oedema/erythema/haematoma/seroma | - Findings up to 1 week post discharge - SL (7%) and DL (26%) - p = 0.023
- Findings at 2nd post-operative month - SL (2.4%) and DL (15.7%) - p = 0.04
- Findings up to 1 week post discharge - SL (14%) and DL (5.2%) - NS
- Findings at 2nd post-operative month - SL (0%) and DL (0%) - NS
- Haematoma incidence findings were not statistically significant (NS).
- SL = 7.3 ± 3 days
- DL = 8 ± 2 days
- Difference is not statistically significant. | Haematoma
- Findings up to 1 week post discharge - SL (14%) and DL (5.2%) - NS
- Findings at 2nd post-operative month - SL (0%) and DL (0%) - NS
- Haematoma incidence findings were not statistically significant (NS).
- SL = 7.3 ± 3 days
- DL = 8 ± 2 days
- Difference is not statistically significant. | (the Leg-O-meter) was used which has been found to be > 97% reliable in a study by Berard et al. [17]. However, there is risk of bias due to the fact that there is no mention of who undertook the measurement using a Leg-O-meter. Haematoma/infection was assessed by clinical examination. It is reported that the patients' medical history was used to evaluate pain and numbness which is subjective, and therefore introduces risk of confirmation bias; additionally, it is not explained whether the medical history was obtained directly from the patient or indirectly from their medical notes. |

Other Pain
- Findings up to 1 week post discharge - SL (4.8%) and DL (31.5%) - p = 0.002
- Findings at 2nd post-operative month - SL (2.4%) and DL (10.4%) - NS
- Number of patients with leg complaints
- Findings up to 1 week post discharge - SL (14%) and DL (21%) - NS
- Findings at 2nd post-operative month - SL (2.4%) and DL (15.7%) - p = 0.04

Randomisation method not defined. However, the statistical analysis method is clearly delineated. No declaration of conflict of interest. The reasoning behind removal of 4 patients from group A is clearly accounted for (1 death and 3 conversions to off pump surgery). Some of the patients were followed up via a telephone call introducing risk of recall bias.
| Article | Author, date, journal, country and study type (Level of Evidence) | Patient group | Outcomes | Key results | Comments |
|---------|---------------------------------------------------------------|---------------|----------|-------------|----------|
| Single-layer versus multiple-layer closure of leg wounds after long saphenous vein harvest: a prospective randomized trial [13] | Zafar et al. (2005) | Group 1 - n = 78 - Single layer over a suction drain (SL) – 44 - Double layer (DL) – 34 | Length of incision | - SL = 51.2 cm (Mean) - DL = 48.7 cm (Mean) Difference not statistically significant (p = 0.49). | Minimisation was used to allow for a method of randomisation which accounts for the imbalance between patients. The statistical analysis method is clearly delineated. No declaration of conflict of interest. |
| | | NB. From the 78 patients recruited, 8 patients had the long saphenous harvested from both legs and therefore 86 legs were studied. | Infection | ASEPSSIS Wound score (Mean) - SL = 4.38 - DL = 8.24 p = 0.001 | Discrepancy in the gender of patients was present (67 male and 11 female patients), but diabetics were equally distributed amongst the two groups. The above discussed discrepancies may be a source of selection bias in this study. NB. a lower ASEPSSIS score indicates better healing. |
| Should we stitch the subcutaneous fat layer following saphenous vein excision for coronary revascularization? [16] | El Gamel et al. (1994) | Group 1 - n = 100 [Below knee saphenectomy of both legs of the same patient with one leg randomly assigned to no fat suture (1A–100 wounds) and the contralateral leg of the same patient to fat suturing (1B–100 wounds). As a result of both legs of every patient being used, group 1 had a total of 200 leg wounds]. Group 2 - n = 200 [Above knee/high saphenectomy with random allocation to either no fat suture (2A–100 wounds) or a fat suture (2B–100 wounds)]. | Length of incision | Not assessed. | Randomisation method not defined. However, the statistical analysis method is clearly delineated. No declaration of conflict of interest. Group 2 had 200 patients compared with group 1 which had 100 patients in total. Group 1 displayed gender disparity with 91 male and 9 female patients. There was also a gender disparity in group 2 where 30% of the participants were female. Further, discrepancy was also displayed in other demographic domains (though no statistical analysis carried out): - Peripheral vascular disease - Group 1 (29%) compared with group 2 (27%). - Diabetes - Group 1(16.5%) compared with group 2 (39%). The above discussed discrepancies may be a source of selection bias in this study. Group 2 participant number is mismatched with the breakdown; the total is indicated as 100, yet the breakdown shows that there are 69 male and 30 female patients adding up to a total of 99 with no account of/explanation for the inconsistency. Further, the recruitment of one group of patients from the UK and the other group from the USA introduces risk of sampling bias. |
| European Journal of Cardio-Thoracic Surgery, United Kingdom and United States of America, Prospective randomised trial (Level 1b) | | | Infection | - Group 1A (No fat suture) - 1/200 wounds were complicated with infection. - Group 1B (Fat sutured) - 1/200 wounds were complicated with infection. - Group 2A (No fat suture) - 2/200 wounds were complicated with infection. - Group 2B (Fat sutured) - 2/200 wounds were complicated with infection. Statistical significance not assessed, though note that the incidence is the same in both subgroups. | |
| | | | Oedema/erythema/haematoma/seroma Length of admission | Oedema - SL = 9.1%. - DL = 82.4% p < 0.001 | Not assessed. | |
| | | | Other Antibiotic requirement | - SL = 18.2% - DL = 25.7% | |
| | | | Other Wound complication rate | | |
| | | | Length of hospital stay | | |
| | | | Wound complication rate | | |
| | | | Other Antibiotic requirement | | |
| | | | Other Wound complication rate | | |

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Appendix 1. Best evidence articles (p = level of significance; NS = Not statistically significant).

| Article | Patient group | Outcomes | Key results | Comments |
|---------|---------------|----------|-------------|----------|
| A comparison of single-layer versus multi-layer closure of the leg wound following long saphenous vein harvest for coronary artery bypass graft surgery: a prospective randomised controlled trial | Nouraei et al. (2010) | n = 80 - Single layer and Haemovac (SL) = 40 - Multiple layer (ML) = 40 | Findings at day 2 post-operatively: Higher incidence of haematoma in the ML group: SL (2.5%) vs ML (45%) - p < 0.001 | It is mentioned that simple randomisation was utilized, though there is no further elaboration on this; the method of double blinding is explained. Further, the statistical analysis method is clearly delineated. No declaration of conflict of interest. Over 70-year olds, diabetics, BMI >30 and urgent cases excluded. No mention of how surgical site infection was managed. Apart from the abstract, the article is in Persian which was translated by Pedram Panahi (First author) for inclusion in the table. |
| Journal of Mazandaran University of Medical Sciences, Iran, Prospective randomised trial (Level 1b) | | Findings at day 14 post-operatively: - Seroma discharge: SL vs ML - p = 0.009 | |
| | | Findings at day 21 post-operatively: In the multiple-layer closure group, there was a higher incidence of: - Ecchymosis (37.5% of SL vs 67.5% of ML - p = 0.007) - Haematoma (2.5% of SL vs 47.5% of ML - p = 0.000) - Seroma discharge (22.5% of SL vs 47.5% of ML - p = 0.018) - Infection (12.5% of SL vs 27.5% of ML - p = 0.000) - Skin necrosis (2.5% of SL vs 17.5% of ML - p = 0.018) - Pain (35% of SL vs 77.5% of ML - p = 0.000). - Saphenous nerve paraesthesia (17.5% of SL vs 32.5% of ML - p = 0.019/NS) | |

Length of admission
Other
Not assessed.
No further assessment.

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