

COMPARISON OF SINGLE AND DOUBLE LAYERED SAPHENECTOMY WOUND CLOSURE TECHNIQUES IN CORONARY ARTERY BYPASS GRAFT SURGERY (CABG) USING ASEPSIS WOUND SCORE

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Contribution

FP conceived the idea. RT planned the study. AK drafted the manuscript. All the author contributed significantly in manuscript submission.

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ABSTRACT

Objective: To compare the mean ASEPSIS wound scores in single-layer versus double-layer closure of below-knee saphenectomy wound at 5th postoperative day in coronary artery bypass graft surgery patients.

Methodology: This randomized controlled trial was conducted at Department of Cardiac Surgery, Dow University of Health Sciences and Civil Hospital Karachi from January to June 2017. Patients of either gender with age of 50-60 years having multi-vessel coronary artery disease undergoing elective, isolated CABG with ejection fraction greater than 40% and controlled diabetes and hypertension for more than 5 years were included in the study. Patients were randomly assigned to two groups (Single layer closure and Double layer closure). Wounds were examined and scored (using ASEPSIS scoring system) by consultant on 5th postoperative day.

Results: A total of 80 patients were included in the study. Patients were divided in two groups (S= Single layer closure and D= Double layer closure) having 40 patients each. The mean age was 54.9 ± 3.31 years. About 77.5% of patients were males. Mean ASEPSIS score in group S was 3.10 ± 1.02 while in group D was 5.68 ± 1.30 ($p < 0.05$).

Conclusion: Compared with double-layer, single-layered technique has lower mean ASEPSIS score in saphenectomy wounds of CABG surgery patients and hence is more suitable modality of saphenectomy wound closure.

Key Words: Saphenectomy, wound closure, coronary artery bypass graft surgery (CABG).

INTRODUCTION

Coronary artery bypass graft (CABG) surgery is the gold standard for the treatment for coronary artery disease.¹⁻³ The great saphenous vein is the most commonly used conduit.⁴ It may be harvested from either the ankle (below-knee) or the thigh (above-knee), with the preference of below-knee approach since it is associated with lower wound infection rates as compared to the above-knee technique.⁵

Wound infection is an important concern after saphenous vein harvest in CABG surgery and increases the hospital length of stay, hospital costs and reduces the quality of life.⁶ With the below-knee approach the incidence of wound infection is 11%.⁷ There are two methods of saphenectomy wound closure; Single layer and double layer techniques. Conflicting results have been demonstrated in the literature with both these techniques. Traditionally, double-layer technique has been utilized in the approximation of saphenous vein harvest wound. The rationale behind this strategy is the elimination of dead space, which in turn, prevents hematoma formation and exudates.^{5,8} Proponents of this conventional double layered wound closure technique demonstrated significantly lower wound infection rates (i.e. 1.7%).⁹ On the contrary, opponents of double layered-closure of saphenectomy highlighted substantial skin edge necrosis with resultant wound infection and favored single-layered closure technique.¹⁰ A study demonstrated that mean ASEPSIS wound infection score was reduced from 9.467 ± 5.32 in double-layer closure to 4.038 ± 8.93 with single-layer closure after saphenous vein harvest ($p=0.001$).¹¹

Therefore, our study was designed to compare the mean ASEPSIS wound scores in the single-layer versus double-layer closure of below-knee saphenectomy wound in CABG surgery patients. This evidence based evaluation of the two methods will be helpful in establishment of suitable modality of saphenectomy wound closure.

METHODOLOGY

We conducted a randomized controlled trial at the Department of Cardiac Surgery, Dow University of Health Sciences and Civil Hospital Karachi. The duration of the study was six-months from January to June 2017.

The sample size was calculated by using Sisa home-sample size calculator using 80% power of test and 95% confidence interval. Non probability consecutive sampling technique was utilized.

Patients of either gender with age of 50-60 years having multi-vessel coronary artery disease undergoing elective, isolated CABG with ejection fraction greater than 40% and controlled diabetes and hypertension for more than 5 years

were included in the study. Similarly patients with lower limb varicosities, deep leg vein thrombosis, previous lower leg surgery (knee joint, fracture fixation), peripheral vascular disease, re-do CABG surgery, in whom above knee saphenous vein harvesting was required, with co-morbidities (end stage renal disease on dialysis and congestive cardiac failure with pedal edema) and morbid obesity with body mass index $> 34 \text{ kg/m}^2$ were excluded.

Informed consent was taken from all patients who underwent CABG surgery. The patients were randomly assigned into two groups (S= Single layer closure and D= double layer closure). Once admitted, detailed history, physical examination and relevant investigations were carried out.

Invasive and non-invasive monitoring was done in operation theatre and 1gm of intravenous Ceftriaxone at the time of induction of anesthesia was given and continued postoperatively at 12-hourly interval for 5-days. Below-knee saphenous vein was harvested by using longitudinal incision starting 3cm superior and anterior to medial malleolus extending up to the upper border of patella. The great saphenous vein was exposed and care was taken to prevent flap formation. After harvesting the saphenous vein hemostasis was done. Then wounds of group S patients were closed by subcuticular skin sutures using 3/0 vicryl (rapide) over suction drain (single-layer closure). Double-layer closure was carried out in group D patients with approximation of subcutaneous fat tissue followed by skin (subcuticular suture using 3/0 vicryl) without suction drainage. The leg incisions were closed before reversal of anticoagulation. CABG was performed on-pump with moderate hypothermia (30°C) and with antegrade cold cardioplegia. Saphenous vein harvest and wound closure were done by a consultant cardiac surgeon. After wound closure, sterile dressing was applied and leg wrapped with elastic crepe bandage for 48 hours in both groups. Drain was removed after 48. Wounds were examined and scored using ASEPSIS scoring system by a consultant on 5th postoperative day (Table 1).

a. Scored for 5 of the first 7 days only.

The software program SPSS for Windows (version 17) was utilized for statistical analyses. Frequencies and percentages were used to summarize categorical variables like gender distribution, coronary vessel disease and co-morbidities. Mean \pm standard deviation (SD) were computed for numerical variables like age distribution and wound scoring. Unpaired student t-test was applied to compare the mean ASEPSIS wound scores in both groups. The p-value of less than 0.05 was taken as significant. Stratification of data was done for age, gender, co-morbidities and coronary vessel disease.

Table 1: Asepsis Scoring¹⁹

CRITERION	POINTS
No Additional treatment	0
Additional treatment	
• Antibiotics for wound infection	10
• Drainage of pus under local anesthesia	5
• Debridement of wound under general anesthesia	10
Serous discharge	Daily 0-5
Erythema	Daily 0-5
Purulent exudate	Daily 0-10
Separation of deep tissues	Daily 0-10
Isolation of bacteria from the wound	10
Stay as in-patient prolonged over 14 days as result of wound infection	5

RESULTS

About 80 patients who underwent CABG were selected. The age range of patients was between 50 to 60 years with mean age of 54.9 ± 3.31 years. Mean ages in two groups (S and D) were 55.28 ± 3.30 and 54.58 ± 3.32 years respectively

(Table 2). Out of 80 patients, 62 (77.5%) were males and 18 (22.5%) were females. Fifty nine (73.8%) patients had 3 vessel disease and 21 (26.3%) had 2 vessel disease. About 46 (73.75%) patients had comorbidities with diabetes mellitus (DM) in 29 (36.3%) patients and hypertension (HTN) in 30(37.5%) patients (Figure 1 and 2).

Table 2: Age Distribution in Study Population (n=80)

Age of patients (years)	Group S (Single layer closure)		Group D (Double layer closure)		Total	
	(n = 40)	%	(n = 40)	%	(n = 80)	%
50-55	20	50	23	57.5	43	53.8
56-60	20	50	17	42.5	37	46.3

Figure 1: Comorbidities in Study Population (n=80)

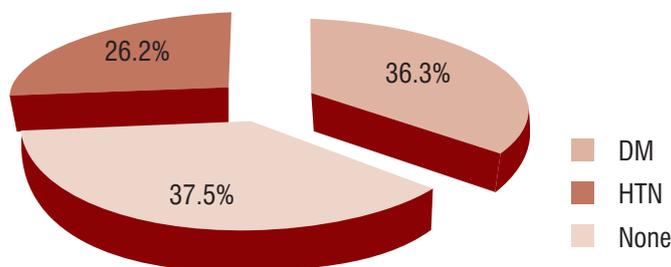
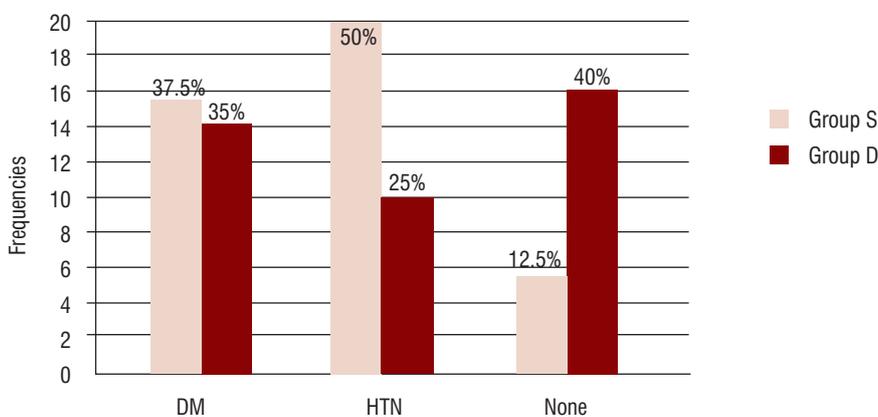


Figure 2: Comorbids Distribution in Groups S and D (n=80)



Wound characteristics are shown in table 3. Mean ASEPSIS score on the 5th postoperative day in coronary artery bypass graft surgery patients was 3.10 ± 1.02 in group S and 5.68 ± 1.30 in group D (Table 4). In group S the ASEPSIS wound score was significantly lower than group D (p < 0.05). Stratification with regards to age, gender, number of diseased coronary vessels and comorbidities are shown in table 5. In the 50 to 55 year age group the mean ASEPSIS score for Group S was 3.80 ± 1.61 and Group D was 4.01 ± 2.29, (p > 0.05). In the 56 to 60 year age group the mean ASEPSIS score for Group S was 3.40 ± 2.06 and Group D was 6.41 ± 1.18, with the difference being significant (p < 0.05). In male patients the mean ASEPSIS score in Group S was 3.93 ± 1.91 and Group D was 4.43 ± 2.35 (p > 0.05). In female patients the mean ASEPSIS score in Group S was 4.00 ± 1.31 and Group D was 7.00 ± 1.24 (p < 0.05). In patients with two vessel disease the mean ASEPSIS score in

Group S was 3.78 ± 2.15 and Group D was 4.27 ± 3.12 (>0.05). In patients with three vessel disease the mean ASEPSIS score in Group S was 2.39 ± 1.21 and Group D was 5.19 ± 1.34 (p < 0.05). In patients with diabetes mellitus the mean ASEPSIS score in Group S was 4.53 ± 1.12 and Group D was 7.36 ± 1.59 (p < 0.05). In patients with hypertension the mean ASEPSIS score in Group S was 3.01 ± 1.32 and Group D was 5.96 ± 1.45 (p < 0.05). In patients with no comorbidities the mean ASEPSIS score in Group S was 4.20 ± 2.31 and Group D was 3.89 ± 2.07 (p > 0.05).

In patients with hypertension the mean ASEPSIS score in Group S was 3.01 ± 1.32 and Group D was 5.96 ± 1.45 (p < 0.05). In patients with no comorbidities the mean ASEPSIS score in Group S was 4.20 ± 2.31 and Group D was 3.89 ± 2.07 (p > 0.05).

Table 3: ASEPSIS Wound Scoring

Wound Characteristics	0	<20%	20 -39%	40 -59%	60 -79%	>80%
Serous discharge	0	1	2	3	4	5
Erythema	0	1	2	3	4	5
Purulent exudates	0	2	4	6	8	10
Separation of deep tissues	0	2	4	6	8	10

Serous and purulent exudates
 <20% = Discharge from less than 1/5th (less than 20%) area of wound length
 20-39% = Discharge from >1/5th but < 2/5th (i.e. 20-39%) area of wound length
 40-59% = Discharge from >2/5th but < 3/5th (i.e. 40-59%) area of wound length
 60-79% = Discharge from >3/5th but < 4/5th (i.e. 60-79%) area of wound length
 >80% = Discharge from >4/5th (i.e. >80%) area of wound length/ complete disruption of wound

Table 4: Mean Asepsis Score in Two Groups (n=80)

	Group S (Single layer closure) (n=40)	Group D (Double layer closure) (n=40)
Mean painscores ± SD	3.10 ± 1.02	5.68 ± 1.30

p-value < 0.05

Table 5: Stratification of Mean ASEPSIS Scores of Study Population (n=80)

Technique of saphenectomy wound closure	Age (years)		Gender		Number of Diseased Coronary Arteries		Comorbidities		
	50-55	56-60	Male	Female	2 VD	3 VD	DM	HTN	None
Group S	3.80 ± 1.61	3.40 ± 2.06	3.93 ± 1.91	4.00 ± 1.31	3.78 ± 2.15	2.39 ± 1.21	4.53 ± 1.12	3.01 ± 1.32	4.20 ± 2.31
Group D	4.01 ± 2.29	6.41 ± 1.18	4.43 ± 2.35	7.00 ± 1.24	4.27 ± 3.12	5.19 ± 1.34	7.36 ± 1.59	5.96 ± 1.45	3.89 ± 2.07
p - value	>0.05	< 0.05	>0.05	< 0.05	>0.05	< 0.05	< 0.05	< 0.05	> 0.05

Group S=Single layer closure; Group D=Double layer closure; VD: Vessel disease; DM: Diabetes mellitus, HTN: Hypertension.

DISCUSSION

CABG utilizing the saphenous vein graft, has dramatically changed the management of patients with ischemic heart disease. Use of bilateral internal mammary and radial arteries as conduits for coronary artery bypass grafting is increasing, but the saphenous vein is still often used.⁷ Several minimally invasive vein harvesting techniques including endoscopic vein harvesting (EVH) have been developed. Conventional open vein harvesting (OVH) from the lower leg is still in routine use.

Advanced age, female gender, body mass index (BMI), diabetes mellitus, renal failure, smoking, peripheral vascular disease (PVD) and chronic obstructive pulmonary disorder are common risk factors reported for the development of surgical site infections¹²⁻¹⁵. The duration of surgery and cardiopulmonary bypass (CPB), as well as different vein-harvesting techniques have also been shown to affect the incidence of surgical site infections.¹⁶ Different mechanisms have been suggested to be involved in the pathogenesis of wound infections, such as a reduced amount of oxygen and its affinity to haemoglobin, low oxygen tension and reduced oxygen delivery at the capillary level, compromised drainage of wound haematoma and duration of wound exposition during vein harvesting. Another mechanism suggested is the technique of wound closure that has a significant impact on the morbidity in terms of wound infection.

The great saphenous vein (GSV) is the most commonly used graft in CABG patients. "Surgical site infections following vein harvesting still represent a significant postoperative problem with substantial economic costs.¹⁷ In order to reduce the occurrence of wound infection after saphenectomy, various closure techniques have been described in literature.¹⁸ The most common among them are the single-layer and double-layer closure techniques but the wound infection rate after both closure techniques are still a subject of debate.⁹⁻¹¹ Postoperative saphenectomy wound infection is the cause of increase hospital stay, hospital cost and reduced quality of life. Leg wound infections following saphenous vein harvesting have been reported in 2–20% of patients after CABG.^{6,16}

One of the most widely recognized wound scoring system is the ASEPSIS scoring system.¹⁹ This enables surgical wound healing to be graded according to specific criteria, usually giving a numerical value, thereby providing a more objective assessment of the wound. The ASEPSIS scoring system was devised to assess wounds following cardiothoracic surgery and can be used to categorize the severity of infection. Wounds are given a score depending on the extent of any wound healing complications such as serous exudate, erythema, purulent discharge and separation of deep tissues. In addition, points are awarded for specific criteria such as positive swab results and prescription of antibiotics. Scoring is meant to take place in five of the first seven days

postoperatively. Two studies have examined and used the ASEPSIS system and highlight its benefits in providing more objective detailed information on wound healing.¹⁹⁻²¹

In spite of preference of below-knee approach; the reported incidence of wound infection in this technique is 11%.⁷ This is attributable to wound closure methods: single-layer and double-layer techniques. The effectiveness of these wound closure techniques have varied and occasionally conflicting results have been demonstrated in literature. Traditionally, double-layer technique has been utilized in the approximation of saphenous vein harvesting. The rationale behind this strategy is the elimination of dead space, which in turn, prevents hematoma formation and exudates.⁸ Proponents of the double layered wound closure technique demonstrated significantly lower wound infection rates (i.e. 1.7%).⁹ On the contrary, opponents of the double layered-closure of saphenectomy highlighted substantial skin edge necrosis with resultant wound infection and favored single-layered closure technique.¹⁰ Siddiqui et al reported that mean \pm SD) ASEPSIS wound infection scores were reduced from 9.467 ± 5.32 in double-layer closure to 4.038 ± 8.93 with single-layer closure after saphenous vein harvesting ($p=0.001$).¹¹ In our study mean \pm SD ASEPSIS wound infection scores were reduced from 5.68 ± 1.30 in double-layer closure to 3.10 ± 1.02 with single layer closure after saphenous vein harvest ($p < 0.05$).

Another study compared seventy eight consecutive patients undergoing CABG, prospectively randomized to have their leg wound closed by either a single-layer technique with a suction drain or multiple layers. They observed ASEPSIS scores significantly lower ($p < 0.001$) in those patients closed with a single layer (Mean \pm SD = 4.38 ± 6.34) than those with multiple layers (Mean \pm SD = 8.24 ± 6.8). They concluded that the single-layer leg wound closure over a suction drain is superior to the traditional multiple-layer closure.²²

Several other techniques of saphenectomy wound closure are under trial like the use of skin staplers and triclosan coated sutures. Another study that compared skin clips versus suture technique reported that better outcomes were achieved in cases of closure with subcuticular technique which was first described by Halstead in 1890.^{23,24}

Angelini et al in their prospective randomized trial in CABG patients examined three methods of leg wound skin closure in 113 patients: continuous vertical mattress, continuous subcuticular closure, and metal clips.²⁴ They found that wound discharge, inflammation and infection were significantly less with subcuticular closure. Thus, they recommended standard use of subcuticular techniques for skin closure after saphenous vein harvesting. Their study correlates well with our study.

It has been reported that increasing age has a weak positive correlation with ASEPSIS scores ($r = 0.24$; $p = 0.04$).²² In

our study the ASEPSIS score increased with age in Group D. Moreover, in the 56 to 60 year age group the mean Asepsis score for Group S was lower than Group D with the difference being significant, while in the 50 to 55 year age group the difference in the mean ASEPSIS score between the two groups was not significant.

We found that in female patients the mean Asepsis score was significantly lower in Group S as compared to Group D, where as in male patients the mean Asepsis score was not significantly different between Group S and D. Previously, it has also been shown that in CABG patients females were associated with higher incidence of wound infections).²⁵ Our study showed that in patients with two vessel coronary artery disease the mean Asepsis score was not significantly different between group S and D, while in patients with three vessel disease the mean Asepsis score in Group S was significantly lower than Group D. Diabetes, was demonstrated to be an independent predictor of surgical wound infection.²⁶ We also found that in patients with co-morbidities (diabetes mellitus, hypertension) the ASEPSIS score was significantly lower in group S compared to group D, while the ASEPSIS score was not significantly different in patients without co-morbidities.

If wound complications develop the surgical outcome is suboptimal which leads to prolonged hospital stay and increases the hospital cost. It is therefore important that proper surgical technique to improve wound healing are explored and used. Utilizing a saphenectomy wound closure technique with low ASEPSIS score will lead to quality improvement and decrease hospital length of stay and costs.

CONCLUSION

This study concluded that closure with single-layer has lower mean ASEPSIS scores than double-layered technique in CABG surgery patients proving it a better technique for wound closure.

REFERENCES

1. Parvizi R, Safaei N, Salmasi SH, Mahmoudian R. Assessment of the hospital results in coronary artery bypass graft with and without cardiopulmonary bypass. *Rawal Med J* 2007;32(2):139-41.
2. Serruys PW, Morice MC, Kappetein AP, Colombo A, Holmes DR, Mack MJ, et al. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. *N Engl J Med* 2009;360(10):961-72.
3. Tsuneyoshi H, Komiya T, Kadota K, Shimamoto T, Sakai J, Hiraoka T, et al. Coronary artery bypass surgery is superior to second generation drug-eluting stents in three-vessel coronary artery disease: a propensity score matched analysis. *Eur J Cardiothorac Surg* 2017;52(3):462-8.
4. Au WK, Chiu SW, Sun MP, Lam KT, Lin MF, Chui WH, et al. Improved leg wound healing with endoscopic saphenous vein harvest in coronary artery bypass graft surgery: a prospective randomized study in Asian population. *J Card Surg* 2008;23(6):633-7.
5. Akowuah E, Shrivastava V, Ponniah A, Jamnadas B, Chilton G, Cooper G. Above-knee vein harvest for coronary revascularization increases ASEPSIS score. *Asian Cardiovasc Thorac Ann* 2006;14(1):57-9.
6. Stenvik M, Tiomsland O, Lien S, Gunnes S, Kirkeby-Garstad I, Astudillo R. Effect of subcutaneous suture line and surgical technique on wound infection after saphenectomy in coronary artery bypass grafting: a prospective randomised study. *Scand Cardiovasc J* 2006;40(4):234-7.
7. Andreasen JJ, Nekrasas V, Dethlefsen C. Endoscopic vs open saphenous vein harvest for coronary artery bypass grafting: a prospective randomized trial. *Eur J Cardiothorac Surg* 2008;34(2):384-9.
8. Llyod JD, Margue MJ 3rd, Kacprowicz RF. Closure techniques. *Emerg Med Clin North Am.* 2007;25(1):73-81.
9. Wang S, Tang H, Wilkinson V, Lukat T, Gelfand ET, Koshal A, et al. Saphenous vein harvest with saphLITE system versus conventional technique: a prospective, randomized study. *Ann Thorac Surg* 2005;79(6):2018-23.
10. el Gamel A, Dude J, Perks J, Shaw R. Should we stitch the subcutaneous fat layer following saphenous vein excision for coronary revascularization? *Eur J Cardiothorac Surg* 1994;8(3):162-4.
11. Siddiqi MS, Al Sabti H, Mukaddirov M, Sharma AK. Prospective comparative study of single-layer versus double-layer closure of leg wounds after long saphenous vein harvest in coronary artery bypass graft operations. *J Thorac Dis* 2011;3(3):171-6.
12. Harrington G, Russo P, Spelman D, Borrell S, Watson K, Barr W, et al. Surgical-site infection rates and risk factor analysis in coronary artery bypass graft surgery. *Infect Control Hosp Epidemiol* 2004;25(6):472-6.
13. Sharif-Kashani B, Shahabi P, Mandegar MH, Saliminejad L, Bikdeli B, Behzadnia N, et al. Smoking and wound complications after coronary artery bypass grafting. *J Surg Res* 2016;200(2):743-8.
14. Charlesworth DC, Likosky DS, Marrin CA, Maloney CT, Quinton HB, Morton JR, et al. Development and validation of a prediction model for strokes after coronary artery bypass grafting. *Ann Thorac Surg* 2003;76(2):436-43.

15. East SA, Lorenz RA, Armbrecht ES. A retrospective review of leg wound complications after coronary artery bypass surgery. *AORN J* 2013;98(4):401-12.
16. Swenne CL, Lindholm C, Borowiec J, Carlsson M. Surgical-site infections within 60 days of coronary artery by-pass graft surgery. *J Hosp Infect* 2004;57(1):14-24.
17. Fry DE. The economic costs of surgical site infection. *Surg Infect (Larchmt)* 2002;3Suppl 1:537-43.
18. Risness I, Abdelnoor M, Lundblad R, Baksaas ST, Svennevig JL. Leg wound closure after saphenous vein harvesting in patients undergoing coronary artery bypass grafting: a prospective randomized study comparing intracutaneous, transcutaneous and zipper techniques. *Scand Cardiovasc J* 2002;36(6):378-82.
19. Wilson AP, Treasure T, Sturridge MF, Grüneberg RN. A scoring method (ASEPSIS) for postoperative wound infections for use in clinical trials of antibiotic prophylaxis. *Lancet* 1986;1(8476):311-3.
20. Hall JC, Hall JL. Evaluation of a wound scoring method for patients undergoing cardiac surgery. *J Hosp Infect* 1996;33(2):139-44.
21. Byrne DJ, Lynch W, Napier A, Davey P, Malek M, Cuschieri A. Wound infection rates: the importance of definition and post-discharge wound surveillance. *J Hosp Infect* 1994;26(1):37-43.
22. Zafar M, John A, Khan Z, Allen SM, Marchbank AJ, Lewis CT, et al. Single-layer versus multiple-layer closure of leg wounds after long saphenous vein harvest: a prospective randomized trial. *Ann Thorac Surg* 2005;80(6):2162-5.
23. Chughtai T, Chen LQ, Salasidis G, Nguyen D, Tchervenkov C, Morin JF. Clips versus suture technique: is there a difference? *Can J Cardiol* 2000;16(11):1403-7.
24. Angelini GD, Butchart EG, Armistead SH, Breckenridge IM. Comparative study of leg wound skin closure in coronary artery bypass graft operations. *Thorax* 1984;39(2):942-5.
25. Al-Alao BS, Parissis H, McGovern E, Tolan M, Young VK. Gender influence in isolated coronary artery bypass graft surgery: a propensity match score analysis of early outcomes. *Thorac Cardiovasc Surg* 2012;60(7):417-24.
26. Spelman DW, Russo P, Harrington G, Davis BB, Rabinov M, Smith JA, et al. Risk factors for surgical wound infection and bacteraemia following coronary artery bypass surgery. *Aust NZ J Surg* 2000;70(1):47-51.