Minimally Invasive Direct Vision versus Conventional Open Saphenous Vein Harvesting

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Background: *Minimally invasive direct vision saphenous vein graft harvesting for coronary artery bypass graft may reduce donor site wound complications compared with conventional open techniques.*
Objective: *This study compared the integrity of saphenous vein grafts harvested by minimally invasive direct vision versus the conventional open technique, and donor site wound complications between groups.*
Material and Method: *The authors included 50 patients from 419 patients undergoing coronary artery bypass grafting from October 2012 to August 2013; 25 received minimally invasive direct vision harvesting. Venous graft integrity was assessed macroscopically by the number of repaired branch avulsions and microscopically by evaluation of percentage of existing endothelial cells using Cluster of Differentiation 31 immunohistochemical stain. Venous integrity and donor wound complications in both groups were compared at the time of operation and 1 month post-coronary artery bypass grafting.*
Results: *Conventional open patients had lower left ventricular ejection fraction, greater number of diabetes mellitus cases, shorter operative time, shorter graft harvesting time, and longer cumulative incision length. The numbers of repaired branch avulsions and microscopic existence of vascular endothelial cell lining were comparable in both groups. First 72-hour pain scores, and overall donor wound complications were similar. However, wound ecchymosis was more prevalent in the minimally invasive group. Thigh vein harvesting was associated with vein graft injury. Venous branch avulsion predicted donor site wound ecchymosis.*
Conclusion: *Integrity of saphenous vein graft harvested by minimally invasive direct vision was comparable with that of conventional open technique. Donor wound complications were similar in both groups and thigh vein harvesting was associated with venous branch avulsion.*

Keywords: *CABG, Venous grafts, Surgery/incisions/exposure/techniques, Complications*

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Coronary artery bypass grafting (CABG) is the most common cardiac surgical procedure performed in adults, and the most commonly used venous conduit for coronary revascularization is the great saphenous vein. Unfortunately, saphenous vein grafts (SVGs) have lower patency rates than arterial grafts[1]. It has been proposed that the SVG harvesting technique may be associated with the rate of graft failure[2].

The standard method of SVG harvesting for CABG is the conventional open (CO) technique, which involves making a long continuous incision. In the last decade, minimally invasive vein harvesting (MIVH) has also been used[3], and has been reported to reduce morbidity and recovery time while preserving the quality of the conduit[4].

MIVH has been shown to reduce the rates of wound infection[5,6] and poor wound healing[7], resulting in less postoperative pain and superior cosmetic results compared with the CO technique. Although the effects of MIVH on patient morbidity from wound-related complications have been extensively investigated, the effects of this procedure on the quality of the harvested conduit are less clear[8].

The major drawbacks of MIVH are the equipment cost and harvesting time, especially with endoscopic techniques[9]. There is also evidence that MIVH may increase the number of SVG branch avulsion that required suture repairs[10,11].

The authors developed a minimally invasive direct vision (MIDV) harvesting technique using multiple skip incisions, standard retractors and instruments for tunneling without additional equipment

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costs. Some previous studies compared CO harvesting with MIDV harvesting using various adapted instruments without assessing the quality of the conduits harvested [12-14]. Black EA et al compared the number of branch avulsion suture repairs between CO harvesting and MIDV harvesting using the SaphLITE system, and found that the mean number of suture repairs was significantly lower in the CO group (2.8 vs. 0.9, *p*-value <0.001)[10].

This study compared the quality of the harvested SVG conduit and donor site wound healing between CO harvesting and MIDV harvesting with standard surgical instruments. The risk factors for SVG injury were evaluated.

Material and Method

Patient population

This study was approved by Siriraj institutional review board, and informed consent for inclusion was obtained from all patients. All patients were treated at the Faculty of Medicine, Siriraj Hospital, Bangkok, Thailand and underwent CABG with or without a concomitant procedure. The inclusion criteria were: age $\geq$18 years, and planned CABG with SVG harvesting. The exclusion criteria were: emergency or redo operation, present of saphenous vein disease such as varicosity or phlebitis, peripheral vascular disease, and scarring or disease of the skin at the harvest site.

Sample size determination

We assessed SVG integrity by the number of branch avulsion suture repairs, and calculated the sample size required to detect a difference between the two harvesting techniques as follows[10].

To test for difference between two independent means, $n_1 = n_2$

$$\frac{n}{\text{group}} = 2\left[\frac{(Z_{\alpha/2} + Z_{\beta})\sigma}{\Delta}\right]^2$$

where α = probability of type I error = 0.01

β = probability of type II error = 0.10

σ = common standard deviation = $[(\sigma_1^2 + \sigma_2^2)/2]^{1/2}$

σ_1 = standard deviation of group 1 (SaphLITE) = 1.8

σ_2 = standard deviation of group 2 (open) = 1.2

Δ = difference in means = $\mu_1 - \mu_2$ = 2.8 - 0.9

n/group = 22

To achieve 90% power with 1% type I error for detecting a difference in the number of branch avulsion suture repairs between the two groups, we calculated that a sample size of 22 patients in each group was needed. Enrollment of 10% more in each group required a total of 25 patients in each group (50 patients in total).

Allocation of interventions

Between October 2012 and August 2013, 193 out of 419 patients who underwent CABG were systemically enrolled. The other 226 patients were excluded because of surgery out of the block enrollment period (n = 152), emergency or redo operation (n = 26), venous disease (n = 26), or peripheral vascular disease (n = 22). Thirty-eight patients withdrew from the study and 105 patients were excluded from the analyses because of multiple vein graft harvesters or harvester apart from the study scope (n = 92), or no available venous sample (n = 13). Of the 50 eligible patients, 25 underwent SVG harvesting using the MIDV technique (MIDV group) and 25 underwent SVG harvesting using the CO technique (CO group). The group allocation was determined by one of the primary surgeons. SVG harvesting was performed by a single harvester in each patient, who was a senior cardiothoracic surgical resident or fellow.

SVG harvesting using the CO technique

Following sterile preparation with sterile plastic draping, the incision is made just anterior to the medial malleolus and is extended along the course of the vein according to the desired length of SVG. The skin and subcutaneous fat are undermined with scissors just superficial to the vein, and the venous branches are ligated with 4-0 silk sutures and divided. Creation of fasciocutaneous flaps and branch avulsions is avoided. The vein is removed and peripheral end was attached to the small adaptor. The vein is flushed with heparinized, balanced saline solution and heparinized blood. Any remaining unsecured branches are ligated with 4-0 silk sutures. Avulsed branches are secured with a double-loop 7-0 polypropylene suture and the vein is placed in the heparinized solution at room temperature until used. The number of branch ligations and branch avulsion suture repairs are counted and recorded.

After adequate hemostasis, the donor wound is closed with 2 to 3 layers of continuous absorbable sutures regardless of systemic heparinization. A small drainage catheter is selectively placed if there is an excessive oozing.

At the end of the operation, a dressing and elastic bandage are applied to the donor wound and the bandage was left overnight. The wound dressing is changed on days 3, 5, and 7 after CABG.

SVG harvesting using the MIDV technique

Sterile preparation is performed as described for the CO technique. The incisions of 2-6 cm in length are made over the vein at 6-10-cm interval, with an effort to minimize the cumulative incision length. Using scissors, Army-Navy retractors, and vein retractors, subcutaneous tunnels are created to bridge the incisions just superficial to the vein. The vein is then harvested as described for the CO technique.

Outcome measurements

The primary outcome was vein graft integrity, which was determined macroscopically by the number of branch avulsion suture repairs and microscopically by cluster of differentiation 31 (CD31) staining. The secondary outcomes were donor site wound complications, cumulative pain score in the first 72 hours, and factors associated with vein graft injury.

Preparation of venous samples for histopathologic examination

Vein grafts were sampled near the distal end and between the grafted segments, to sample the most injured parts. CD31 is a cell adhesion molecule that is found on human vascular endothelial cells[15]. CD31 immunostaining can demonstrate the existence of endothelial cells, which could reflex integrity of the vessels and has been used to study SVG integrity in patients undergoing CABG[16]. Two pieces of 5-10 mm in length samples (one from proximal vein graft and another from distal vein graft) were collected for evaluation after grafting. All samples were fixed in 10% neutral buffered formal in solution and sent to pathology laboratory. The tissue samples were examined by pathologist. Vessel lumina were identified and 3 mm serial cross sectioned, then processed and embedded for paraffin blocks. Sections were cut into 3-μm thick and stained with hematoxyline and eosin for histopathologic examination. Both proximal and distal vein grafts were also performed immunohistochemistry with CD31 antibody (clone JC/70A, 1: 100 dilution) on Ventana XT automated stainer (Ventana Medical Systems, Tucson, AZ, USA). Endothelial lining cells were considered to be immunopositive for CD31 if inner surfaces of the vessel lumina demonstrated unequivocal linear staining. Percentage of endothelial cell denudation was evaluated as <25%, 25-50%, >50-75%, and >75% loss of CD31-positive vascular circumference.

Statistical analysis

Statistical analyses were performed using SPSS™ software version 18.0 (SPSS Inc, Chicago, IL, USA). Continuous variables were compared between groups using the unpaired t-test, and categorical variables were compared using Pearson's χ^2 test, Fisher's exact test, or linear-by-linear association for variables. Relative risk (RR) and 95% confidence intervals (CIs) were calculated using Poisson regression. Continuous data are expressed as the mean $\pm$ standard deviation and categorical data as frequency (%) unless otherwise specified. A *p*-value of <0.05 was considered statistically significant.

Results

Pre-operative patient characteristics (Table 1)

The CO and MIDV groups were similar in terms of mean age (66 vs. 66 years; *p*-value = 0.95), proportion of males (56 vs. 64%; *p*-value = 0.56); and mean body mass index (23 vs. 24 kg/m^2; *p*-value = 0.44). The CO group had a smaller left ventricular ejection fraction (41 vs. 53%; *p*-value $\leq$0.01) and higher proportion of patients with diabetes mellitus (64 vs. 36%; *p*-value = 0.048) than the MIDV group, but the rates of other co-morbidities were similar between groups.

Intra-operative data (Table 2)

There were no significant differences between the CO and MIDV groups in terms of the proportion who underwent associated procedures (20 vs. 36%; *p*-value = 0.21), mean cardiopulmonary bypass time (105 vs. 121 min; *p*-value = 0.14), or mean aortic cross clamp time (72 vs. 86 min; *p*-value = 0.36). However, the CO group had a shorter mean operative time (215 vs. 261 min; *p*-value = 0.01) and shorter mean venous harvesting time (52 vs. 72 min; *p*-value = 0.01) than the MIDV group. The mean number of vein graft segments was 1.8 in the CO group and 1.6 in the MIDV group (*p*-value = 0.16), and the mean cumulative venous graft length was 396 mm in the CO group and 414 mm in the MIDV group (*p*-value = 0.59).

Venous grafts integrity (Table 3 and 4)

Different SVG segments have different risks of injury[17]. The distal SVG segments had greater

Table 1. Pre-operative characteristics of patients

Variable	CO group (n = 25)	MIDV group (n = 25)	*p*-value
Age, years	66.04±10.98	66.24±10.28	0.95
Male	14 (56)	16 (64)	0.56
BMI, kg/m^2	23.53±3.49	24.29±3.30	0.44
Cardiac diagnosis			
TVD	23 (90)	18 (72)	0.14
LM stenosis	5 (20)	6 (24)	0.73
Valvular heart disease	4 (16)	7 (28)	0.31
Aortic disease	0 (0)	3 (12)	0.24
Other diagnosis	2 (8)	3 (12)	1.00
LVEF, %	41.51±15.44	53.01±13.46	<0.01
Creatinine clearance, ml/min	42.09±28.85	48.20±25.79	0.43
Co-morbidities			
DM	16 (64)	9 (36)	0.048
Hypertension	21 (84)	18 (72)	0.31
COPD	1 (4)	2 (8)	1.00
Recent MI (90 days)	4 (16)	8 (32)	0.19
Recent CHF (90 days)	4 (16)	4 (16)	1.00
PAD	1 (4)	0 (0)	1.00
Carotid artery stenosis	1 (4)	4 (16)	0.35
Stroke or TIA	4 (16)	0 (0)	0.11
Smoking status			0.16
Current smoker	1 (4)	2 (8)	
Stopped >8 weeks	4 (16)	8 (32)	
Never smoked	20 (80)	15 (60)	

Data are number of patients (%) or mean ± standard deviation.
BMI = body mass index; CHF = congestive heart failure; CO = conventional open technique; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus; LM = left main coronary artery; LVEF = left ventricular ejection fraction; MI = myocardial infarction; MIDV = minimally invasive direct vision technique; PAD = peripheral artery disease; TIA = transient ischemic attack; TVD = triple vessel disease

biomarker up-regulation, and the SVG samples from between grafted segments were more susceptible to traction injury. There were no significant differences between the CO and MIDV groups in terms of the mean number of venous 2.15 vs. 3.65 branch avulsion suture repairs (0.88 vs. 1.68; *p*-value = 0.28), mean number of suture repairs per unit length/m; *p*-value = 0.32), or percentage of suture repair number to non-avulsed branch (7.91 vs. 8.14%; *p*-value = 0.95). CD-31 immunostaining showed comparable endothelial cell integrity between the two groups (*p*-value = 0.48).

Post-operative pain and donor wound complications (Table 5)

The cumulative post-operative pain score in the first 72 hours was comparable between the two groups (*p*-value = 0.75). Wound complications occurred during the first 30 days in 56% of the CO group and 60% of the MIDV group (*p*-value = 0.77). The most common complication was leg edema, which occurred with similar frequency in the CO and MIDV groups (32 vs. 36%; *p*-value = 0.77). However, wound ecchymosis occurred less frequently in the CO group than in the MIDV group (8 vs. 32%; *p*-value = 0.03).

Risk factors for venous branch avulsion (Table 6)

Analysis of the factors associated with venous branch avulsion was performed for the entire cohort. SVG harvesting from the thigh was strongly associated with vein graft injury (RR: 3.5, 95% CI: 1.3-9.2; *p*-value = 0.01). The presence of branch avulsion suture repair was also associated with donor wound ecchymosis (RR: 4.1, 95% CI: 1.2-14.1; *p*-value = 0.02). However, there was no correlation between macroscopic and microscopic venous integrity (r = 0.16, *p*-value = 0.27).

The cohort was divided into two groups according to the present of thigh vein harvesting. The

Table 2. Intra-operative variables

Variable	CO group (n = 25)	MIDV group (n = 25)	*p*-value
Operation			0.21
Isolated CABG	20 (80)	16 (64)	
CABG and other	5 (20)	9 (36)	
Operative time, min	215±71	261±50	0.01
CPB time, min	105±39	121±34	0.14
Aortic clamp time, min	72±29	86±24	0.06
Harvester			0.36
Fellow	6 (24)	9 (36)	
Resident	19 (76)	16 (64)	
Donor site			
Thigh	9 (36)	16 (64)	0.05
Knee	12 (48)	17 (68)	0.15
Calf	23 (92)	22 (88)	0.64
Harvesting time, minute	52±17	72±31	0.01
Number of incisions	1.60±0.58	4.88±1.54	<0.01
Total incision length, mm	464±98	281±94	<0.01
Total graft length, mm	396±83	414±142	0.59

Data are number of patients (%) or mean ± standard deviation.
CABG = coronary artery bypass grafting; CPB = cardiopulmonary bypass; CO = conventional open technique; MIDV = mini mally invasive direct vision technique; Min = minute

Table 3. Venous side branch avulsion suture repair and venous side branch silk ligation

Variable	CO group (n = 25)	MIDV group (n = 25)	*p*-value
Un-repairable injury	1	0	0.33
No. of side branch avulsions repaired	0.88±1.54	1.68±3.34	0.28
No. repaired/length, time/m	2.15±3.58	3.66±6.61	0.32
No. of side branches ligated.	13.30±5.60	15.90±8.70	0.22
No. repaired/No. ligated, %	7.91±14.79	8.15±13.71	0.95

Data are number of patients or mean ± standard deviation.
CO = conventional open technique; MIDV = minimally invasive direct vision technique; m = meter

group with thigh vein harvesting had a greater number of branch avulsion repairs than another group (2.2±3.3 vs. 0.4±1.0; *p*-value = 0.02). The ratio of avulsed branch repairs to non-avulsed branches was also higher in the group with thigh vein harvesting (0.12±0.16 vs. 0.04±0.10; *p*-value ≤0.01).

Discussion

The MIDV technique was expected to cause more traction injury to SVGs than the CO technique, because of the reduced exposure during MIDV harvesting. We assessed vein graft integrity by the number of venous avulsion suture repairs and the degree of CD-31 immuno staining of the endothelium. The two patient groups had similar findings for these two parameters. Our findings demonstrated comparable macroscopic and microscopic integrity of the SVGs harvested using the two techniques. With similar venous graft length of both groups, the MIDV group had 40% shorter cumulative length of donor wounds and 36% longer harvesting time (approximately 20 minutes). However, the frequency of thigh vein harvesting was higher in the MIDV group than in the CO group. The longer harvesting time may have contributed to the longer operative time, because the aortic cross clamp time and bypass time were not

Table 4. CD31 Immunostaining for endothelial denudation

Endothelial denudation	Score	CO group (n = 25)		MIDV group (n = 25)	
		Proximal	Distal	Proximal	Distal
No denudation	0	6	7	5	5
1-25% denudation	1	8	13	9	11
26-50% denudation	2	7	2	5	6
51-75% denudation	3	0	0	0	1
76-100% denudation	4	4	3	6	2
Mean score		1.52 $\pm$ 1.33	1.16 $\pm$ 1.21	1.72 $\pm$ 1.46	1.36 $\pm$ 1.11
Mean total score		2.68 $\pm$ 2.10		3.08 $\pm$ 1.91	

Data are number of patients or mean $\pm$ standard deviation. The *p*-value = 0.61 for proximal sample mean score between-group comparison. The *p*-value = 0.55 for distal sample mean score between-group comparison. The *p*-value = 0.48 for mean total score between-group comparison.
CO = conventional open technique; MIDV = minimally invasive direct vision group

Table 5. Cumulative pain score in the first 72 hours and donor wound complications during first 30 days

Variable	CO group (n = 25)	MIDV group (n = 25)	*p*-value
Cumulative pain score, first 72 hours	19.32 $\pm$ 16.81	18.04 $\pm$ 10.37	0.75
Wound infection	1 (4)	1 (4)	1.00
Ecchymosis	2 (8)	8 (32)	0.03
Hematoma	0 (0)	1 (4)	1.00
Leg edema	8 (32)	9 (36)	0.77
Edge necrosis	4 (16)	1 (4)	0.35
Drainage	6 (24)	3 (12)	0.46
Any wound complication	14 (56)	15 (60)	0.77

Data are number of patients (%).
CO = conventional open technique; MIDV = minimally invasive direct vision technique

significantly different between the two groups.

Donor wound healing during the first 30 days after surgery was similar in both groups, except wound ecchymosis that was more prevalent in the MIDV group. This finding differs from previously published data[5-7]. This difference may be due to our relatively small sample size and the variations in definitions of wound complications among studies. The association between ecchymosis and lacerated venous branches suggests that ecchymosis resulted from excessive wound traction and/or non-ligated branch bleeding in the wound bed, and wound ecchymosis may therefore be a marker of venous traction injury.

The SVG donor site has infrequently been mentioned in the literature. Our results suggest that the harvesting site is also important, as thigh vein removal was significantly associated with a higher number of venous branch avulsions. This association was independent of the higher venous branch numbers. The higher number of lacerations may be caused by the deeper locations of the thigh veins, resulting in more difficult dissection. In order to minimize branch avulsion repair, our results suggest that thigh may not be the donor site of choice for venous graft harvesting.

The mean number of branch suture repairs tended to be higher in the CO group than in the MIDV group, but this difference was not statistically significant. Comparing with the reference study[10], our relatively small study has a wider distribution, which mayresult in inadequate testing power.

The limitations of this study include its non-

Table 6. Univariate analyses for factors associated with venous branch avulsion

Variable	With avulsion (n = 18)	Without avulsion (n = 32)	*p*-value	Relative risk	95% CI	*p*-value
Preoperative factors						
Age, years	68±8.4	65±11.5	0.34			
Male				1.1	0.5 to 2.2	0.90
BMI, kg/m^2						
TVD				8.8	0.6 to 134.2	0.15
LM stenosis				0.7	0.3 to 2.0	0.52
Valvular heart disease				0.2	0.0 to 1.4	0.11
LVEF, %	50.7±15.5	45.5±15.3	0.26			
Creatinine clearance, ml/min	51.7±30.2	41.5±25.2	0.21			
DM				1.0	0.5 to 2.1	1.00
Hypertension				1.4	0.5 to 4.0	0.52
Recent CHF				0.3	0.1 to 2.0	0.22
PAD				0.7	0.1 to 7.7	0.75
Operative factors						
Associated procedure				0.5	0.2 to 1.5	0.23
Operative time, min	234±67	240±65	0.77			
CPB time, min	103±35	118±38	0.17			
Aortic clamp time, min	70±23	84±28	0.10			
MIDV technique				1.3	0.6 to 2.6	0.56
Resident as harvester				0.7	0.3 to 1.4	0.29
Donor site						
Thigh				3.5	1.3 to 9.2	0.01
Knee				1.5	0.7 to 3.2	0.37
Calf				0.9	0.3 to 2.8	0.84
Harvesting time, min	64±21	61±30	0.74			
Total graft length, mm	440±111	384±114	0.10			

Data are number of patients (%) or mean ± standard deviation
BMI = body mass index; CHF = congestive heart failure; CO = conventional open technique; DM = diabetes mellitus; LM = left main coronary artery; LVEF = left ventricular ejection fraction; MIDV = minimally invasive direct vision technique; PAD = peripheral artery disease; TVD = triple vessel disease

randomized nature and the inability to extrapolate long-term graft patency from the data. However, our results may guide the selection of surgical sites and techniques for SVG harvesting in patients undergoing CABG.

Conclusion

MIDV harvesting with standard instruments and CO harvesting had similar venous graft integrity. The MIDV technique was associated with shorter donor wound length but longer harvesting and operative times. The overall post-operative wound complications were similar in both techniques, but MIDV showed more frequently wound ecchymosis. The thigh vein harvesting was associated with a greater number of venous branch avulsions. Further studies of long-term graft patency are needed.

What is already known on this topic?

It has already been known from previous study that minimally invasive saphenous vein harvesting may reduce donor wound complication.

What this study adds?

Minimally invasive direct vision harvesting with standard instruments and conventional open harvesting has similar saphenous venous graft integrity. Thigh vein harvesting is associated with a greater number of venous branch avulsions.

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Potential conflicts of interest

None.

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การศึกษาเปรียบเทียบการเลาะหลอดเลือดดำซาฟีนัสแบบเปิดแผลเล็กเทียบกับเปิดแผลปกติ

ธีรพงศ์ โตเจริญโชค, รุจิรา เรืองจิระอุไร, สมชาย ศรียศชาติ, ถาวร ทรัพย์ทวีสิน, เกรียงไกร ตันติวงศ์โกสีย์

ภูมิหลัง: *การเลาะหลอดเลือดดำซาฟีนัสในการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจโคโรนารีโดยวิธีเปิดแผลเล็ก อาจลดภาวะแทรกซ้อนของแผลได้เมื่อเปรียบเทียบกับการเลาะโดยวิธีเปิดแผลปกติ*

วัตถุประสงค์: *ศึกษาความสมบูรณ์ของหลอดเลือดดำซาฟีนัสและภาวะแทรกซ้อนของแผลที่เลาะโดยวิธีเปิดแผลเล็ก เปรียบเทียบกับการเลาะโดย วิธีเปิดแผลปกติ*

วัสดุและวิธีการ: *ผู้วิจัยรวบรวมผู้ป่วย 50 รายจาก 419 ราย ที่เข้ารับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจโคโรนารี ระหว่างเดือนตุลาคม พ.ศ. 2555 ถึงเดือนสิงหาคม พ.ศ. 2556 โดย 25 รายได้รับการเลาะหลอดเลือดดำ ซาฟีนัสแบบเปิดแผลเล็ก โดยความสมบูรณ์ของหลอดเลือดดำ ประเมินจากจำนวนการเย็บซ่อมแขนงหลอดเลือดดำที่ฉีกขาด และเปอร์เซ็นต์การคงอยู่ของเซลล์เยื่อบุหลอดเลือดจากการย้อม ซีดี 31 อิมมูโนฮีสโตเคมี ศึกษาเปรียบเทียบความสมบูรณ์ของหลอดเลือดดำและภาวะแทรกซ้อนของแผลหลังผ่าตัดและที่หนึ่งเดือนหลังผ่าตัดจากการเลาะหลอดเลือดทั้งสองวิธี*

ผลการศึกษา: *ผู้ป่วยกลุ่มเปิดแผลปกติมีการบีบตัวของหัวใจห้องล่างซ้ายน้อยกว่า เป็นเบาหวานมากกว่า มีระยะเวลาผ่าตัดสั้นกว่า ระยะเวลาเลาะหลอดเลือดดำสั้นกว่า และมีความยาวรวมบาดแผลมากกว่า จำนวนการเย็บซ่อมแขนงหลอดเลือดดำที่ฉีกขาด และเปอร์เซ็นต์การคงอยู่ของเซลล์เยื่อบุหลอดเลือดจากการย้อม ซีดี 31 อิมมูโนฮีสโตเคมีของสองกลุ่มไม่แตกต่างกัน คะแนนความปวดใน 72 ชั่วโมงแรก และภาวะแทรกซ้อนโดยรวมของแผลไม่แตกต่างกันแต่พบแผลฟกช้ำมากกว่าในกลุ่มเปิดแผลเล็ก นอกจากนี้การเลาะหลอดเลือดดำจากต้นขาสัมพันธ์กับการฉีกขาดของหลอดเลือดและการฉีกขาดของหลอดเลือดสามารถทำนายภาวะแผลฟกช้ำได้*

สรุป: *ความสมบูรณ์ของหลอดเลือดดำซาฟีนัสและภาวะแทรกซ้อนของแผลหลังผ่าตัดจากการเลาะหลอดเลือดทั้งสองวิธีไม่แตกต่างกัน และการเลาะหลอดเลือดดำจากต้นขาสัมพันธ์กับการฉีกขาดของแขนงหลอดเลือดดำ*